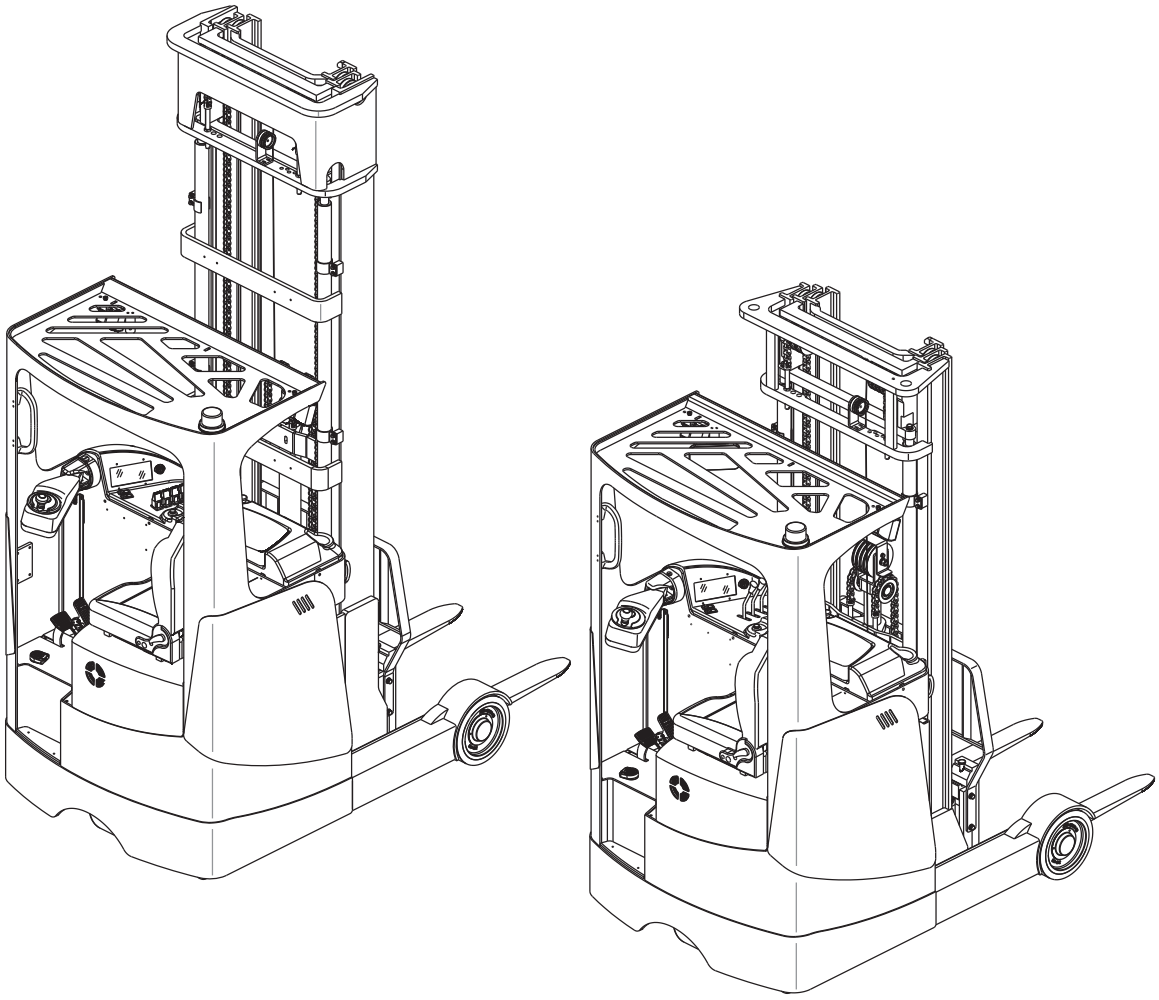
Service Manual

CQD16/20RVF/RV
CQD16NRVF/NRV
Electric Reach Truck



CE CERTIFICATE

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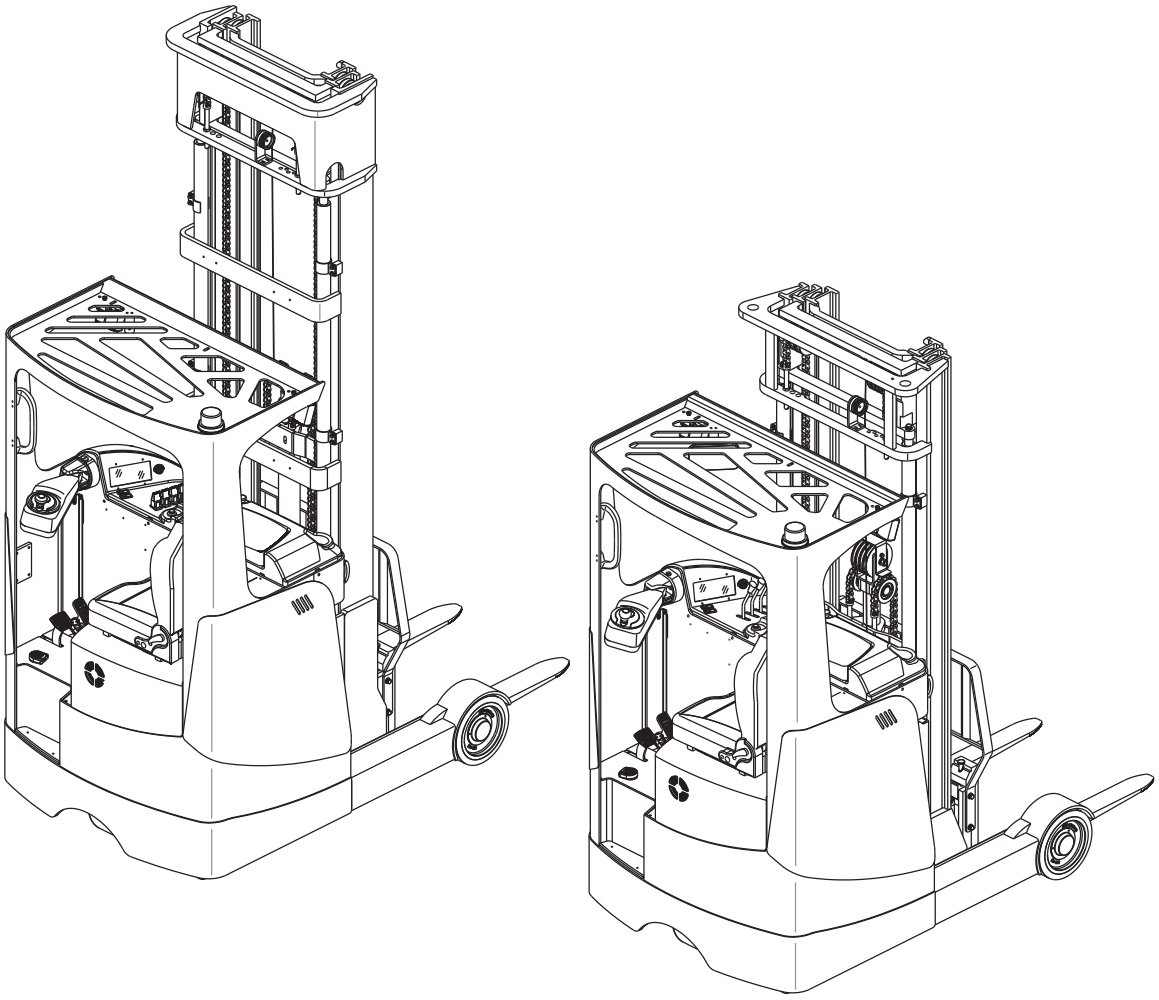

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Release Date	Version No.	Changes (Serial number)
2016-07-07	SM-3316 07.16	New Version

* 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
CQD16RV	1,600 kg Capacity, Full Height Series, Medium Configuration
CQD16NRV	1,600 kg Capacity, Full Height Series, Medium Configuration, Narrow Body
CQD16RVF	1,600 kg Capacity, Full Height Series, Premium Configuration
CQD16NRVF	1,600 kg Capacity, Full Height Series, Premium Configuration, Narrow Body
CQD20RV	2,000 kg Capacity, Full Height Series, Medium Configuration
CQD20RVF	2,000 kg Capacity, Full Height Series, Premium Configuration

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.

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Tel: 400-0550-205

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REV. SM-3316 07.16

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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

1

LET'S GROW TOGETHER!

NOTE:

1.1 After-sales Service Platform

Claims/Replacement Parts Service Platform:

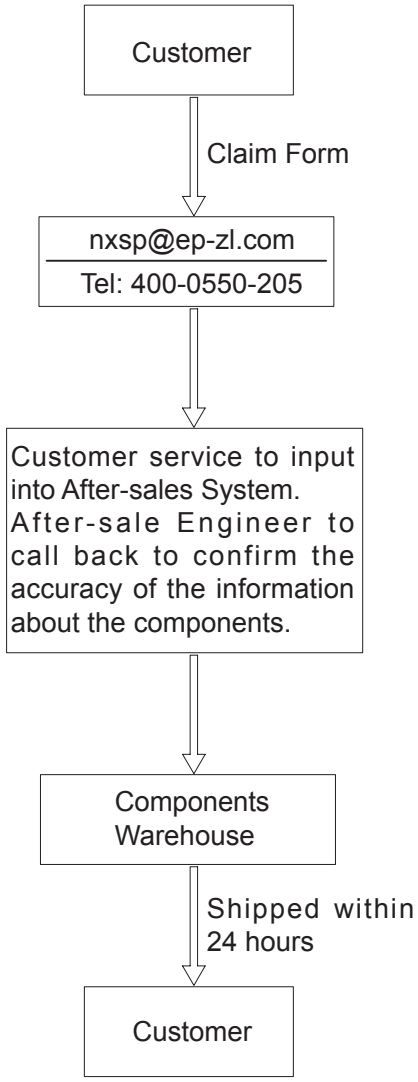

Figure 50004-1

After-sales Maintenance Service Platform:

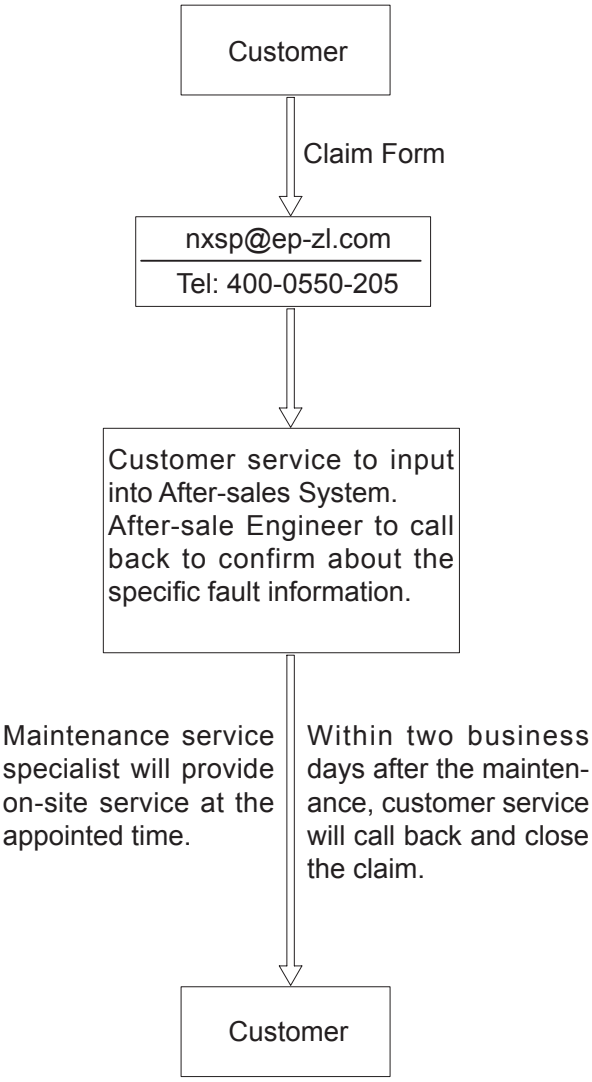

Figure 50005-1

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

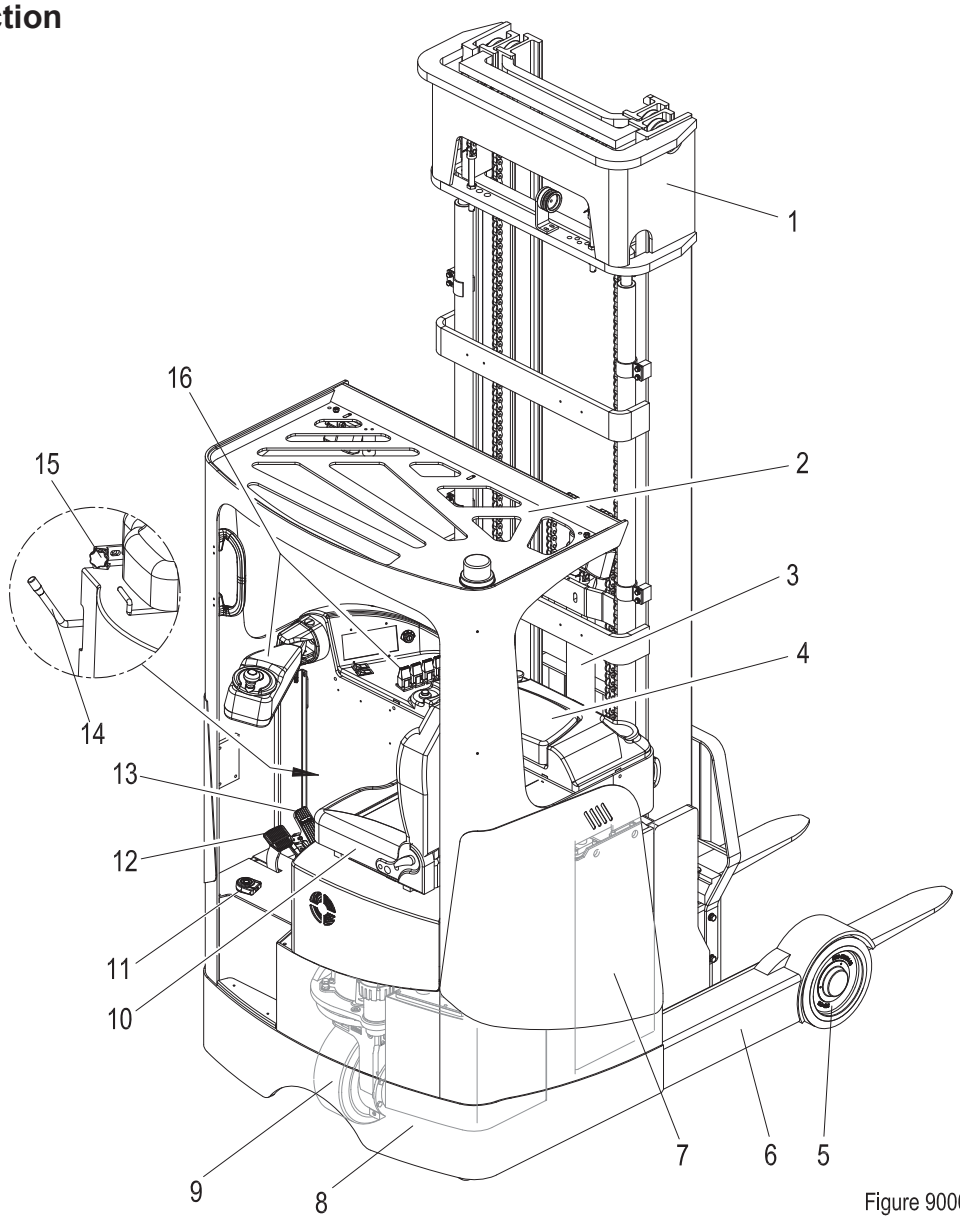

Figure 90001

No.	Name
1	Lift Mast
2	Overhead Guard
3	Free Lift Cylinder
4	Controller
5	Load Wheel
6	Reach Outrigger
7	Battery
8	Tank

No.	Name
9	Drive Wheel
10	Seat
11	Foot Switch
12	Brake Pedal
13	Accelerator Pedal
14	Battery Slider Unlocking Lever
15	Star-shaped Handle
16	Control Panel

This series are electric reach trucks. Its important structure is as shown in Figure 90001.

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.*

The truck is driven forward or backward by AC motor. The lifting and lowering of mast can also drive the truck, while the travel speed will be limited.

The Electric Power Steering has greatly met the demand for high mobility of the truck.

The truck is equipped with foot switch, only by pressing the switch can the truck be operated, which has greatly reduced the possibility of misuse by the operator.

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	8#~24# One Set
3	Phillips Screwdriver	2# One Piece
4	Slotted Screwdriver	2# One Piece
5	Sockets and Knobs	One Set
6	Circlip Pliers	One for holes and one for shaft
7	Hammer	One Piece
8	Spreader, Crane	One Pair
9	Cylinder Wrenches	For removal and installation of cylinders
10	Diagonal Pliers	One Piece
11	Cylinder Pliers	One Piece
12	Grease Gun	One Piece
13	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

INFORMATION & SPECIFICATIONS

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2. MAINTENANCE

2

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
150	At least once per 60 days
250	At least once per 90 days
500	At least once every 6 months
1000	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**	**150**	**250**	**500**	**1000**
Functions and Control					
Check the functions of the operation switches and display	A				
Check alarm system functions	A				
Check foot switch functions	A				
Check the emergency switch functions	A				
Check the cables for damage and if the terminals are secure		A			
Check the electronic limit functions	A				
Check and tighten the controllers and contactors					A
Check height display functions	A				
Check fault information records and operating hours				A	
Power Supply & Drive System					
Check the battery cables for damage and replace if necessary				A	
Check the battery charge connector				A	
Check if the cable connections between battery monomers are secure, apply some grease to electrodes if necessary				A	
Check electrolyte fluid level				A	
Check electrolyte density				A	
Check battery temperature				A	
Check battery locking mechanism				A	
Check and tighten motor mounting bolts					A
Check the connections of motor connectors					A
Check the position of various bearings for noise					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**	**150**	**250**	**500**	**1000**
Power Supply & Drive System					
Check transmission oil level				A	
Clean or replace the gear oil	Replace after 100 hours of early operation. Then replace once every 2000 hours				
Check the gearbox for abnormal noise or leaks				A	
Check and lubricate the bearings between drive motor and gearbox		A / L			
Check and lubricate steering large ring gear		A / L			
Check the drive wheel and load wheel for worn or damage	A				
Check the wheel bearings and fixation					A
Check the fixation of drive mounting base					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 and clean oil tank air filter				A	
Replace the oil tank air filter and filter					A
Check the relief pressure					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**	**150**	**250**	**500**	**1000**
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
Check the braking functions of brake	A				
Check the brake fluid level				A	
Check the brake pump and piping connections for leaks				A	
Check the release of brake pedal is normal				A	
Check the installation and connection of brake					A
Check the braking distance of brake					A
Mast System					
Check the mast for damages					A
Clean and lubricate the rolling surface of lift mast column with grease		A / L			
Check and lubricate mast rollers			A / L		
Check the fixation of lift mast				A	
Check the tubing on mast for connections and leaks			A		
Check the side shifter functions	A				
Check the connections of bolts and nuts			A		
Check and lubricate the chains			A / L		
Check the lifting chains and chain guides for wear, adjust and grease				A	
Check the fork carriages for wear and damage				A	

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**	**150**	**250**	**500**	**1000**
Mast System					
Visual inspection of rollers, sliders and stoppers				A	
Check the lifting and lowering speed					A
Other					
Check if the signs are clear and complete				A	
Check the chassis for cracks or damages					A
Check the engine hood and lubricate the hinges				A / L	
Lubricate the forward tilting guides and rollers				A / L	
Check the fixation of battery and battery tray				A	
Check the forward tilting safety blocks				A	
Check the seat fixation and adjustment functions					A
Check the seat belt and functions	A				
Check the overhead guard and cabin					A
Checking covering parts for damages					A
Check the casters for wear and cracks				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.

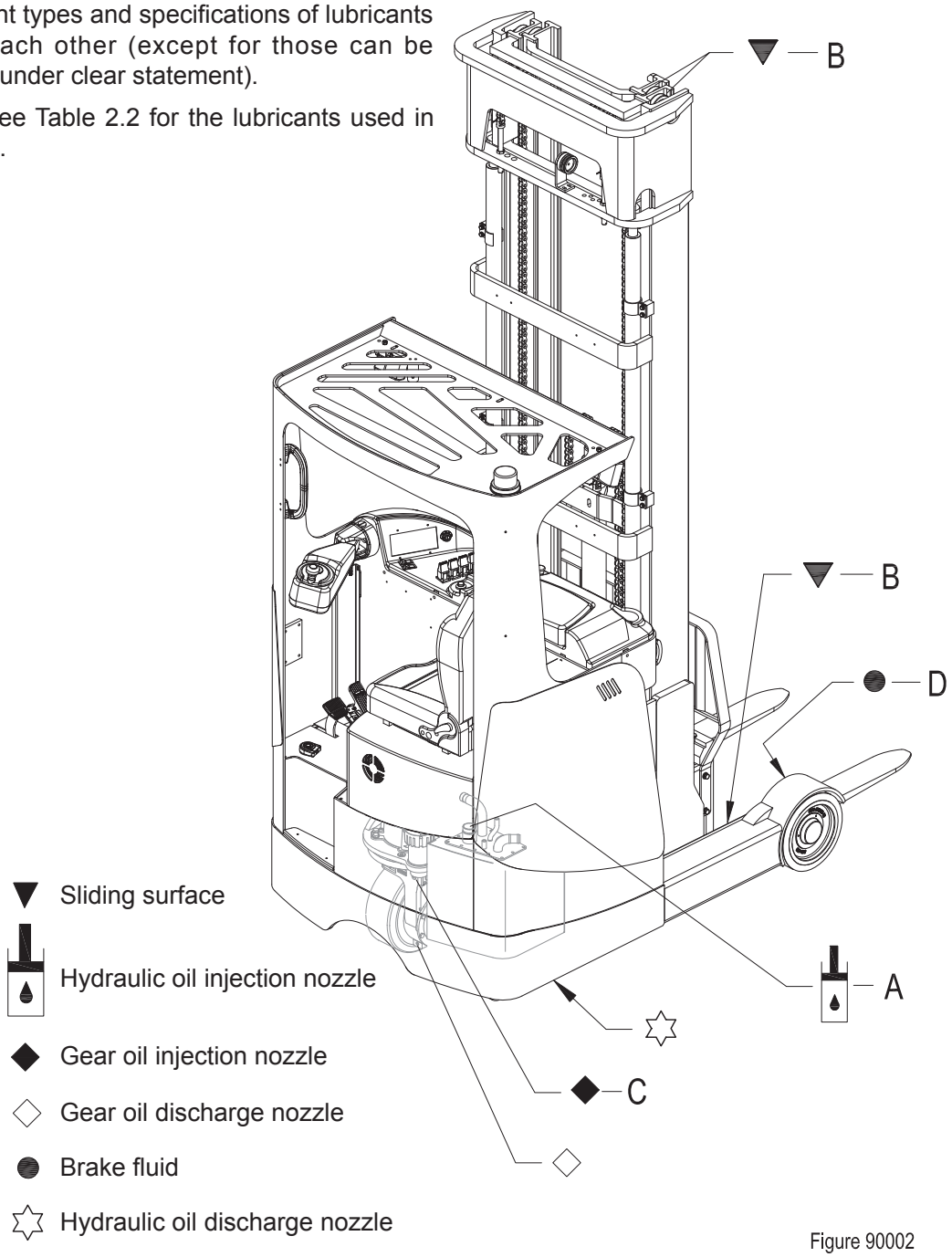


Figure 90002

Table 2.2 Lubricants				
Code	**Type**	**Specification**	**Amount**	**Position**
A	Anti-wear hydraulic oil	L-HM46	See Table 2.3	Hydraulic System
	Low temperature anti-wear hydraulic oil (cold storage)	L-HV32		
B	Multi-purpose grease	Polylub GA352P	Appropriate amount	Sliding surface (See Table 2.4)
C	Heavy duty gear oil	80W-90 GL-5	3.3L (Align with oiling port)	Gearbox
D	Brake fluid	ZSM207DOT3	After the gas within the system is completely discharged, add to 2/3 of the oil cup	Brakes

Table 2.3 Application Amount of Hydraulic Oil - 1		
Mast Series	**Lifting height (mm)**	**Amount (L)**
2-stage Mast	2700	11.2
	3000	12.0
	3300	12.7
	3640	13.6
	4000	14.6
	4300	15.4
	4520	16.0
	5000	17.2
	5480	18.5
	6000	20.0

Table 2.3 Application Amount of Hydraulic Oil - 2		
Mast Series	**Lifting height (mm)**	**Amount (L)**
3-stage Mast	4050	17.1
	4500	18.5
	5000	20.2
	5500	21.8
	6000	23.4
	6500	25.0
	7000	26.7
	7500	28.3
	8000	29.9
	8500	31.5
	9000	33.1
	9500	34.7
	10000	36.4
	10500	38.0
	11000	39.6

Table 2.4 Sliding Surface Lubrication Table	
Code	**Position**
L1	Steering gear
L2	Engine hood hinges
L3	Caster
L4	Load Wheel
L5	Forward tilting guides and rollers
L6	Chains
L7	Steel channel and rollers
L8	Side shifter

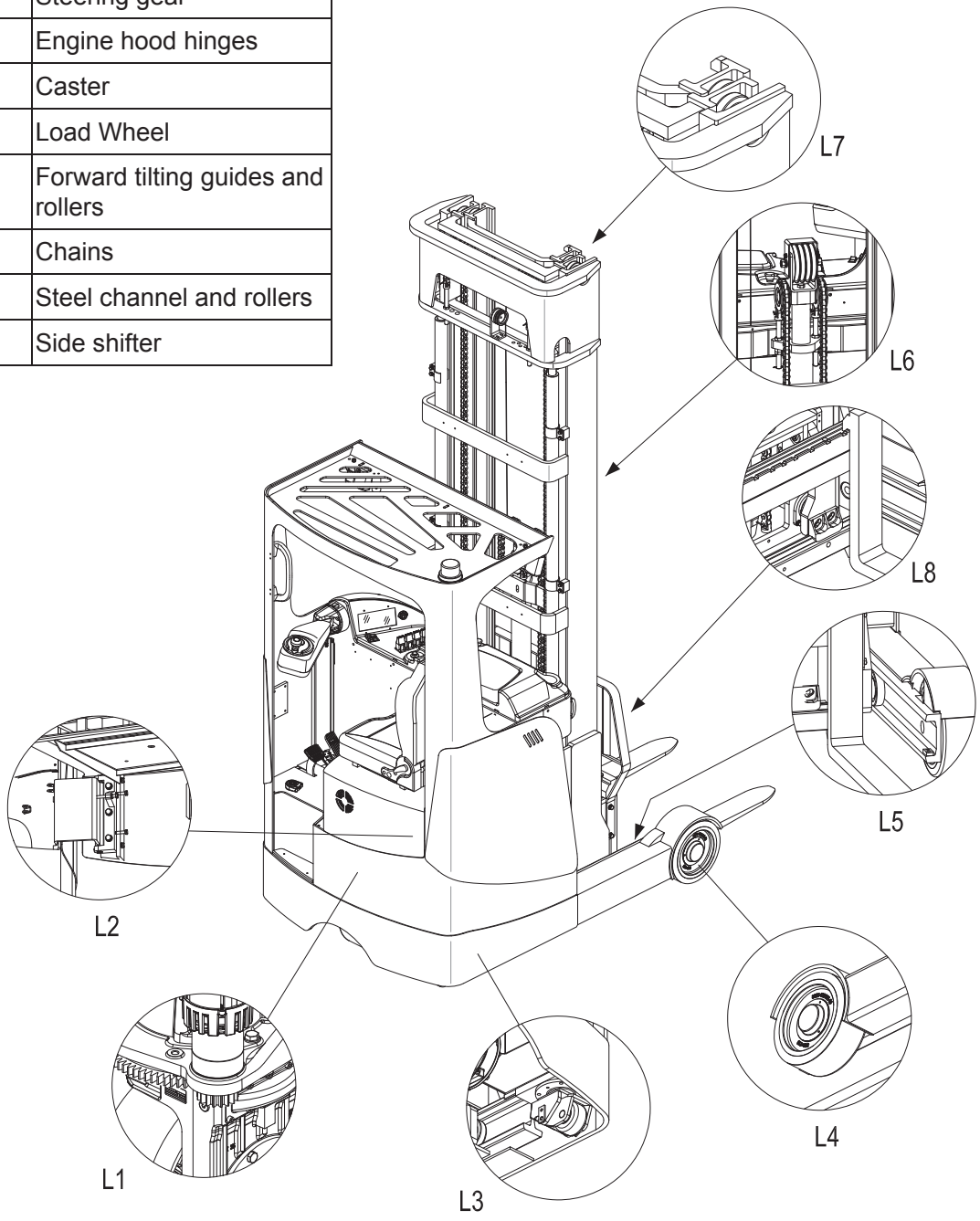


Figure 90003

2

3. STRUCTURE & FUNCTIONS

3

NOTE:

3.1 Structure & Functions

3.1.1 Travel Switch

Location: on front cover of control panel;

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.

3.1.2 Emergency Stop Switch

Location: on front cover of control panel;

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.

3.1.3 Key Switch

Location: on front cover of control panel;

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.

3.1.4 Horn Button

Location: on front cover of control panel;

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.

3.1.5 Control Switch (RVF/NRVF)

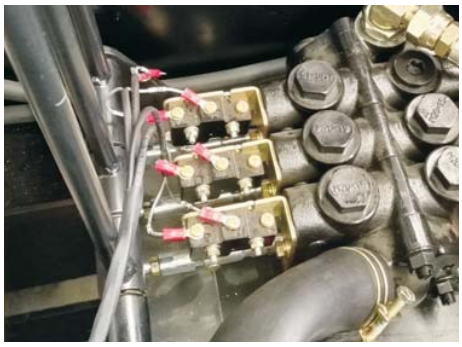
Location: on front cover of control panel;

Function: to provide the controller with lift - lower, forward - retract, tilt forward - tilt backward, shift left - shift right and other signal inputs;

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

Note: Unserviceable.

3.1.6 Control Switch (RV/NRV)



Location: at the end of operating lever;

Function: to provide the controller with lift - lower, forward - retract, tilt forward - tilt backward, shift left - shift right and other signal inputs;

Description: the control switch is normally-open;

Note: Unserviceable.

3.1.7 Instrument

Location: on front cover of control panel;

Function: to display the battery power, working hours, travel speed and other basic information, as well as fault code, and so on;

Description: 48V operating voltage, SICOS controller;

Note: Unserviceable.

3.1.8 Horn

Location: under the front cover of control panel;

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

Description: 48V operating voltage;

Note: Unserviceable.

3.1.9 Fan

Location: at side of engine hood panel;

Function: for cooling of drive systems and pump motor;

Description: 48V operating voltage;

Note: Unserviceable.

3.1.10 Accelerator Pedal

Location: on foot switch cover;

Function: to provide acceleration signal for the travel of truck;

Description: 48V operating voltage;

Note: Unserviceable.

3.1.11 Brake Pedal

Location: on foot switch cover;

Function:to brake the truck under emergencies;

Description: N/A;

Note: Unserviceable.

3.1.12 Foot Switch

Location: on foot switch cover;

Function: when the foot switch is not pressed, you cannot operate the truck;

Description: 48V operating voltage;

Note: Unserviceable.

3.1.13 Warning Light

Location: above the overhead guard;

Function: to warn the surrounding personnel that the truck is powered on, please keep clear of it;

Description: 12V operating voltage;

Note: Unserviceable.

3.1.14 Headlight

Location: below the overhead guard;

Function: to provide lighting for operator;

Description: 12V operating voltage;

Note: Unserviceable.

3.1.15 Rocker Switch

Location: on front cover of control panel;

Function:to control the on and off of headlight and warning light;

Description: rocker switch is normally-open;

Note: Unserviceable.

3.1.16 Stepper Motor

Location: below the steering wheel;

Function: to provide steering input signals to the steering controller;

Description: 5V operating voltage;

Note: Unserviceable.

3.1.17 AC2 Controller(TranceController)

Location: electrical mounting plate;

Function: to control the speed of drive motor through the signal input by the accelerator;

Description: 48V operating voltage, to control the drive motor circuit;

Note: Unserviceable.

AC2 Drive Controller

3.1.18 AC2 Controller (Pump Controller)

Location: electrical mounting plate;

Function: to control the speed of pump motor through the signal input by the control switch;

Description: 48V operating voltage, to control the pump motor circuit;

Note: Unserviceable.

AC2 Pump Controller

3.1.19 EPS-AC0 Controller

Location: electrical mounting plate;

Function: to control the rotating direction of steering motor through signal input by stepper motor;

Description: 48V operating voltage, to control the steering motor;

Note: Unserviceable.

EPS-AC0 Controller

3.1.20 DC-DC Converter

Location: electrical mounting plate;

Function: to provide 12V voltage for headlight and warning lights;

Description: 48V to 12V DC transformer;

Note: Unserviceable.

DC-DC Converter

3.1.21 Main Contactor

Location: electrical mounting plate;

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

Description: to provide power loads through controller under the circumstances that the controller is failure-free;

Note: Unserviceable.

Main Contactor

3.1.22 Solenoid Valve Controller (RVF/NRVF)

Location: electrical mounting plate;

Function: to control the oil passage within multi-way solenoid valve through the signal input by the control switch;

Description: 48V operating voltage, to control solenoid valve;

Note: Unserviceable.

Solenoid Valve Controller

3.1.23 Multi-way Solenoid Valve (RVF/NRVF)

Location: below the battery compartment;

Function: to implement connection and disconnection of oil passage;

Description: solenoid valve control;

Note: Unserviceable.

3.1.24 Multi-way Manual Valve (RV/NRV)

Location: under the front cover of control panel;

Function: connection and disconnection of oil passage;

Description: manual valve control;

Note: Unserviceable.

3.1.25 Pump Motor

Location: right side of the drive motor;

Function: to provide power for gear pump for lifting of carriage;

Description: upon receiving the signal input by control switch, AC2 pump controller to control the power transmission of pump motor;

Note: Unserviceable.

Pump Motor

3.1.26 Gear Pump

Location: left side of the pump motor;

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

Description: N/A;

Note: Unserviceable.

Gear Pump

3

4. CHASSIS SYSTEM

4

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.

- 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.

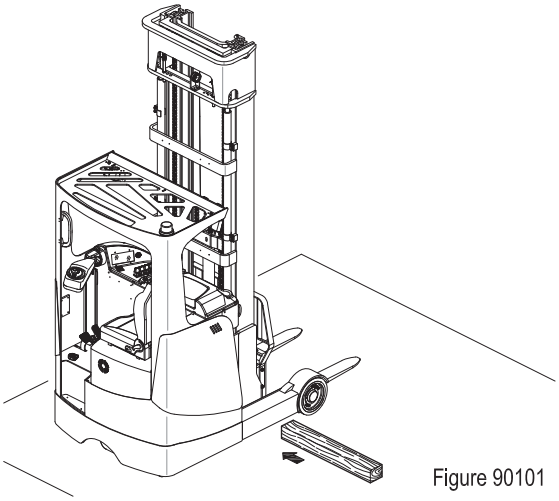


Figure 90101

(see Figure 90102)

- Unscrew the three screws (1) in dust cover (2) and remove the dust cover;
- Unscrew the round nut (3) on the axle, then remove lock washer (4), load wheel (6) and oil seal (9) in order;
- Remove the bearing (7) and bearing (8) of load wheel (6) with hammer and jacking equipment.
- Unscrew four screws (5) and remove the brake drum from load wheel (6).

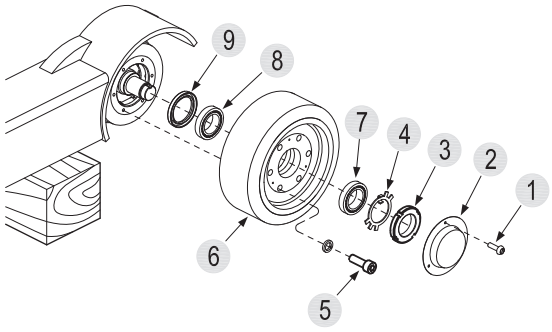


Figure 90102

Installation and Commissioning

- Install according to the reverse order of removal;
- After tightening the round nut (3), unscrew the nut for 1/4 turn and lock it with lock washer;
- Turn the wheel to see if it is rotating smoothly, and if there is blocking or not;
- Put the dust cover (2) back and fix it with three screws (1);
- 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 Caster

4.2.1 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 300mm, to prevent the hazards to the maintenance personnel working under the vehicle for caster removal and installation.

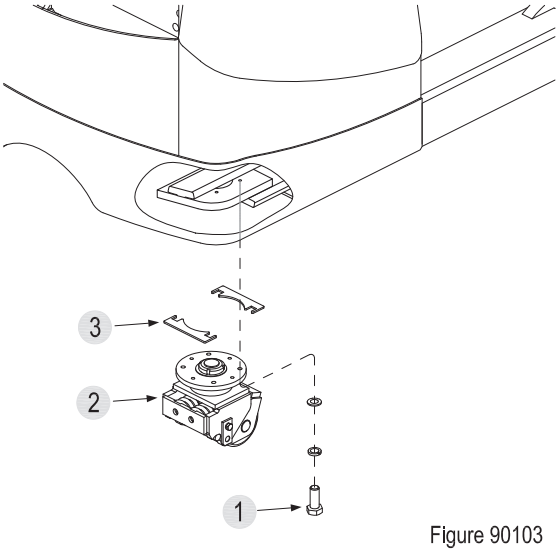


Figure 90103

- Unscrew four screws (1), then remove the caster (2) and adjustment shim (3).

Installation

- Install according to the reverse order of removal;

Adjustment

- Park the truck with replacement completed on level ground to see if the casters and drive wheel can both be in contact with the ground;
- When the truck is running, check if the three wheels are functioning properly.

CAUTION

After long time of use, the drive wheel will wear and tear to certain level, at this time, adjust the height of caster (2) through increasing or decreasing the number of adjustment shims (2) to make the two casters and drive wheel to be in close contact with the ground.

Upon maintenance or replacement for parts of the caster, please refer to Figure 30107 for removal and installation.

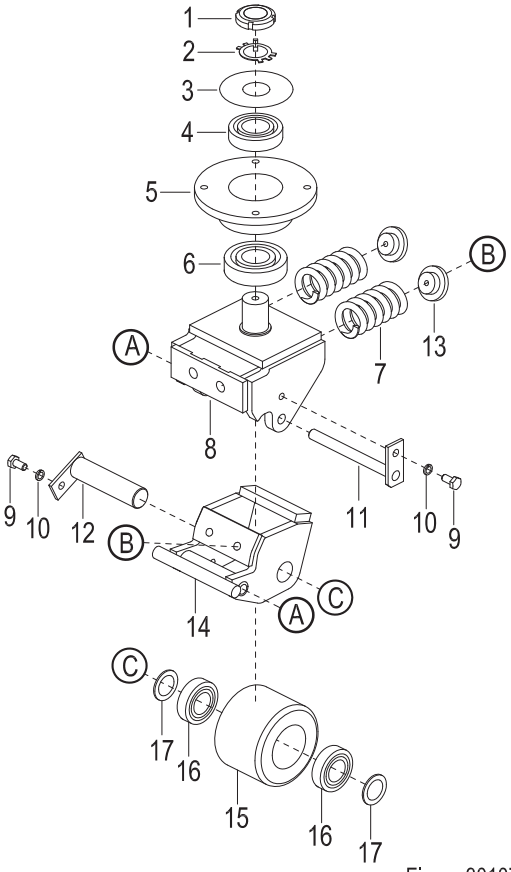


Figure 30107

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.

4.3 Brake Pedal

4.3.1 Removal and Installation

Removal

- Unscrew the four screws used to fix the pedal and remove the pedal;
- Remove the three tubings (12, 13 & 14) on brake master cylinder (2);
- Unscrew the three bolts (7) with wrench and remove the service brake assembly from the chassis;
- Unscrew the two nuts (5) and bolts (1), remove the cotter pin (4) on the pin shaft (3), then remove the brake master cylinder (2);
- Unscrew one nut (8) and one bolt (9), remove the spring (10), then remove the brake pedal (11).

Installation

- Install according to the reverse order of removal;

CAUTION

After replacing the brake master cylinder or tubings, the air within the entire brake pipeline must be discharged;

Air Discharge / Adding Brake Fluid

- Unscrew the star-shaped handle on engine hood and open the engine hood;
- Fill the oil cup (6) with brake fluid;
- Press the brake pedal (11) repeatedly until the stepping pressure becomes heavy;
- Open the vent on brake cylinder of drum brake, press the brake pedal pressure to the bottom, discharge the residual air from the vent through high level of brake fluid;
- When there is flow of fluid running out of the vent, it indicates that the air discharge is completed, release the brake pedal and close the vent;

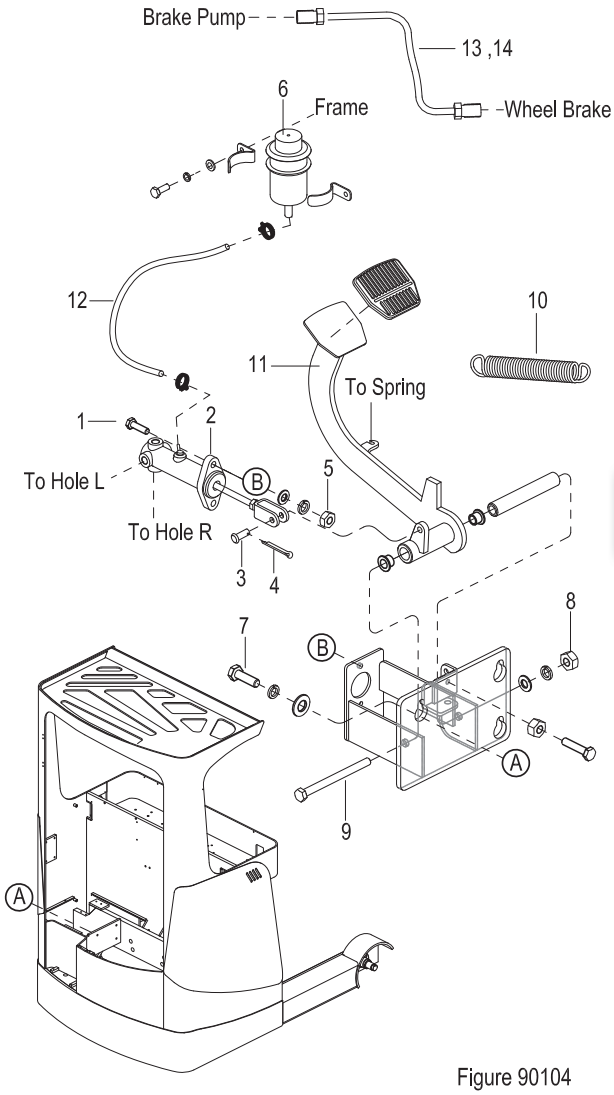


Figure 90104

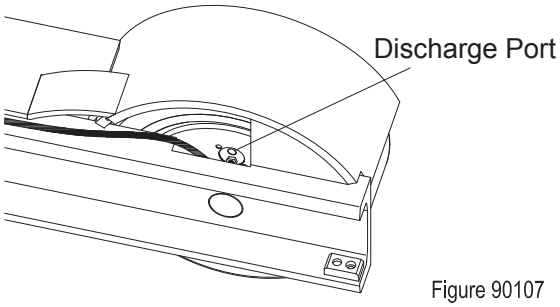


Figure 90107

CAUTION

During the entire process of operation, there must always be brake fluid in the oil cup.

- Add brake fluid into the oil cup until it fills 2/3 of the cup. Please apply as specified (see Section 2.2.3 for specifications).

4.3.2 Faults and Causes

1	Fault	Brake performance weakened or failure
	Cause	a. Insufficient brake fluid; b. Brake master cylinder blocked; c. Brake pipeline leaks.

4.4 Seat

4.4.1 Removal and Installation

Removal

- Unscrew the star-shaped handle on engine hood and open the engine hood;
- Unscrew four nuts (1) and bolts (2), remove the seat (4) from the engine hood (3).

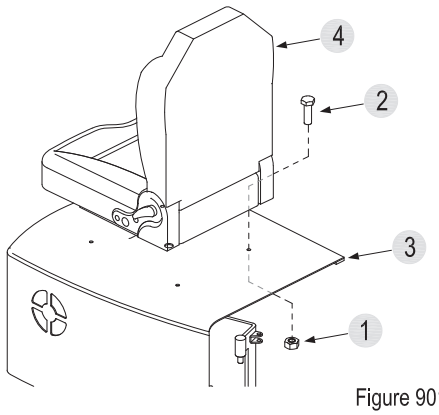


Figure 90105

Installation

- Install according to the reverse order of removal;

Adjustment

- The seat height can be adjusted via star-shaped handwheel under the seat;
- The seat back angle can be adjusted via the handle on the left of the seat.

4.5 Brakes

4.5.1 Removal and Installation

Removal

- Remove the load wheel; (see Section 4.1.1)
- Unscrew the four screws (1), loosen the connection between the brake (2) and the chassis;
- Remove the rigid pipe (3) attached to the brake cylinder and remove the brake (2).

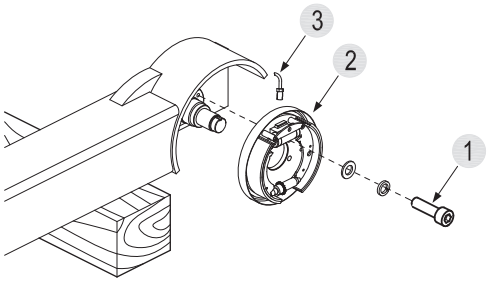


Figure 90106

Upon maintenance or replacement for parts of the brakes, please refer to Figure 90109 for removal and installation.

Installation

- Install according to the reverse order of removal;

Adjustment

- Toggle the toothed flange on the lash adjuster with slotted screwdriver through the opening on brake bottom plate, such operation can change the length of the adjuster, thus playing the role of adjustment.

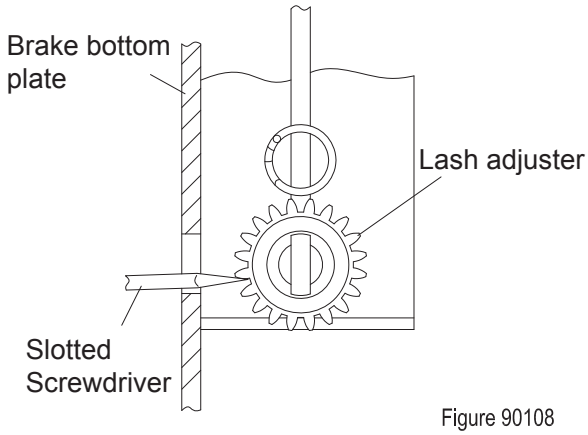


Figure 90108

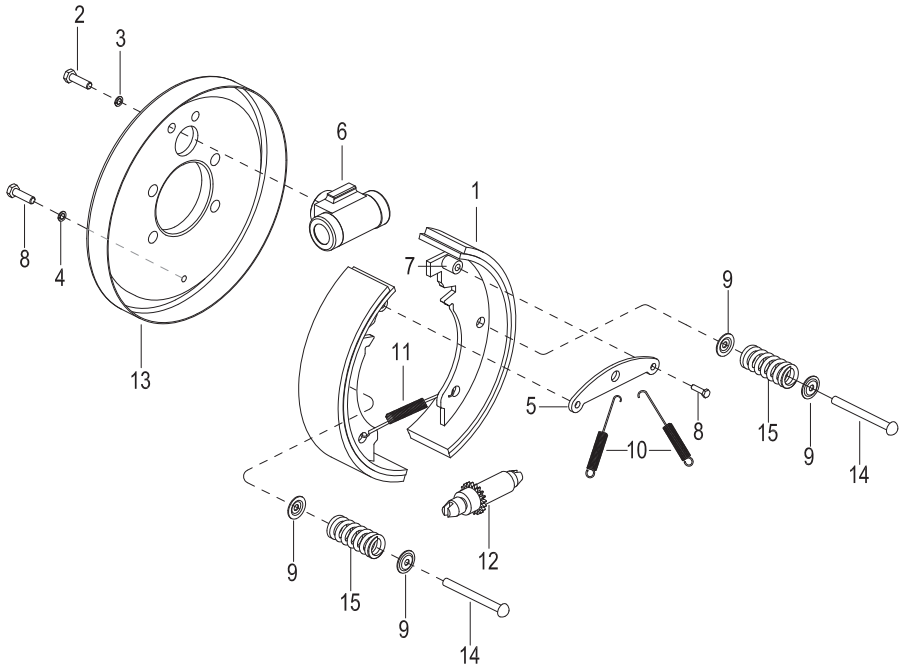


Figure 90109

Air Discharge / Adding Brake Fluid

- Unscrew the star-shaped handle on engine hood and open the engine hood;
- Fill the oil cup with brake fluid;
- Press the brake pedal repeatedly until the stepping pressure becomes heavy;
- Open the vent on brake cylinder of drum brake, press the brake pedal pressure to the bottom, discharge the residual air from the vent through high level of brake fluid;
- When there is flow of fluid running out of the vent, it indicates that the air discharge is completed, release the brake pedal and close the vent;

CAUTION

During the entire process of operation, there must always be brake fluid in the oil cup.

- Add brake fluid into the oil cup until it fills 2/3 of the cup. Please apply as specified (see Section 2.2.3 for specifications).

4.5.2 Faults and Causes

1	Fault	Brake performance weakened or failure
	Cause	a. Brake pad wear on the brake shoe; b. Brake clearance is too large; c. Brake cylinder failure with leaks.
2	Fault	Load wheel with large rotational
	Cause	a. Brake shoe return spring failure; b. Brake clearance is too small.

5. DRIVE SYSTEM

5

NOTE:

Drive System

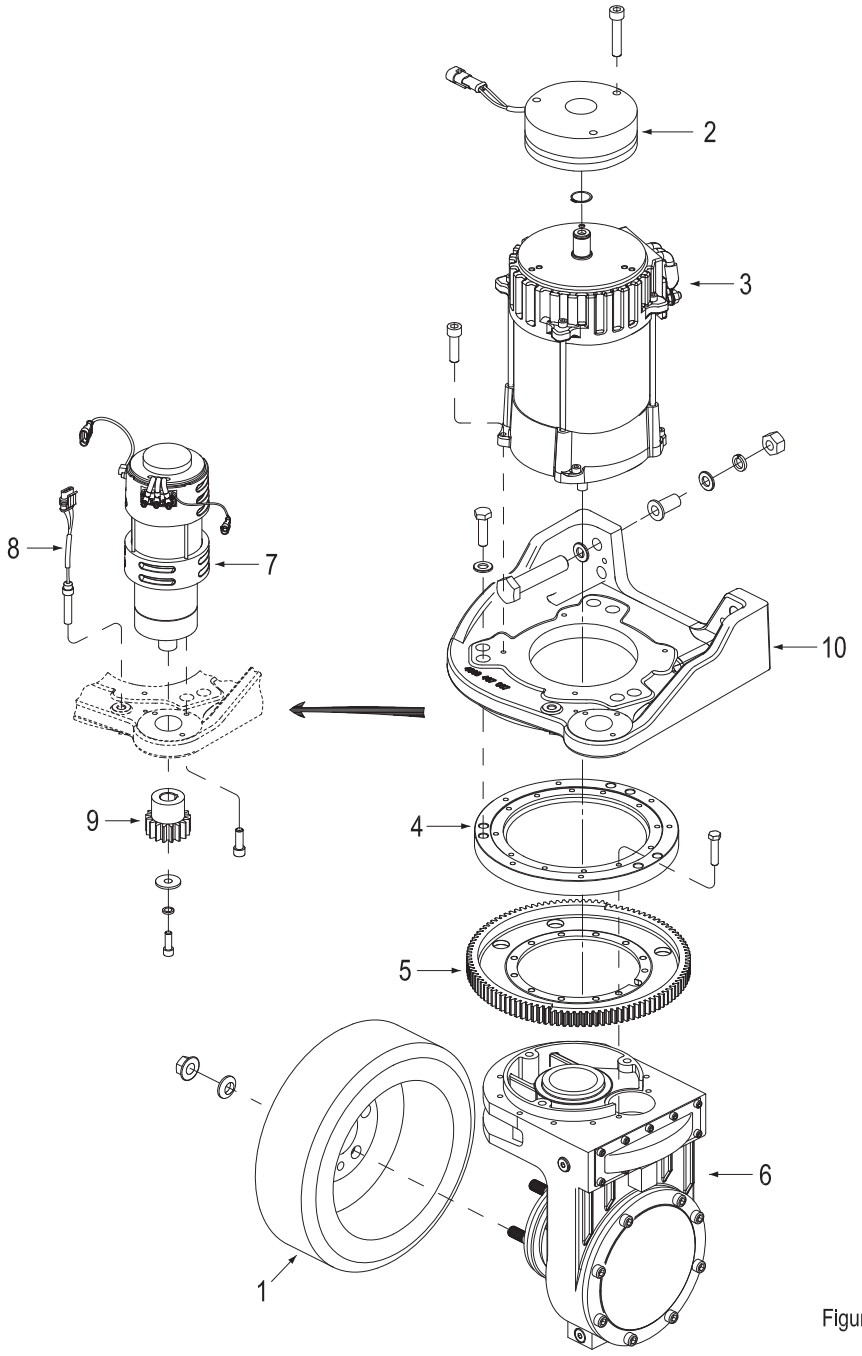


Figure 90201

No.	Name
1	Drive Wheel
2	Electromagnetic Brakes
3	Drive Motor
4	Large Steering Bearing
5	Large Ring Gear

No.	Name
6	Gearbox
7	Steering Motor
8	Proximity Switch
9	Pinion Gear
10	Drive Mounting Base

5.1 Drive Wheel

5.1.1 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 300mm, to prevent the hazards to the maintenance personnel working under the vehicle for caster removal and installation.

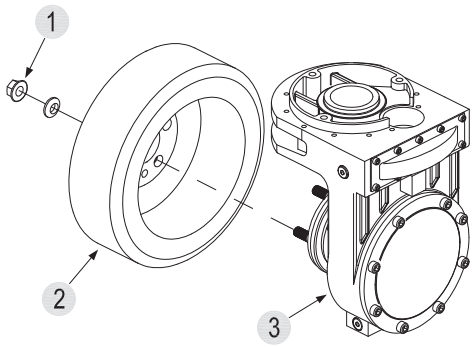


Figure 90202

- Rotate the drive assembly to the right.
- Loosen the seven flange nuts (1) with wrench or socket wrench, and then unscrew the flange nuts and spherical washer by order.
- Remove the drive wheel (2) from the gearbox (3).

Installation

- Install according to the reverse order of removal;

CAUTION

- *Screw the seven nuts as shown in Figure 90203.*
- *Tighten the nuts by order and mark with the torque: 140 n • m.*

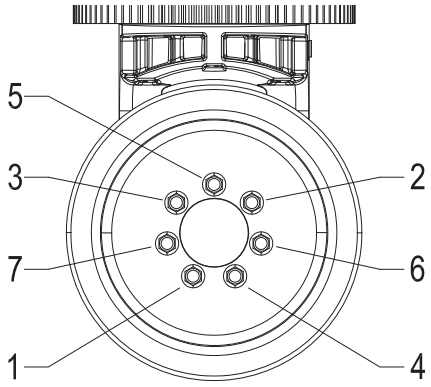


Figure 90203

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.

5.1.2 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

5.2 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.

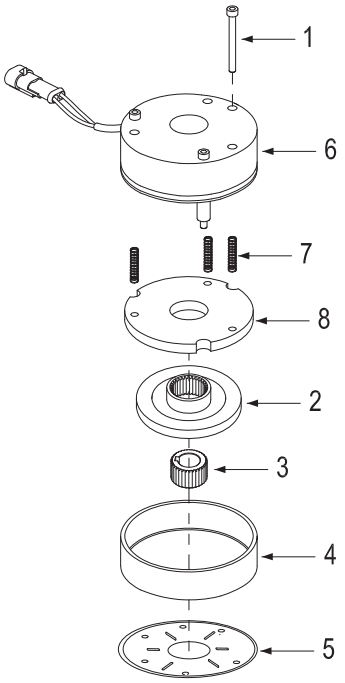


Figure 50205

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 90204

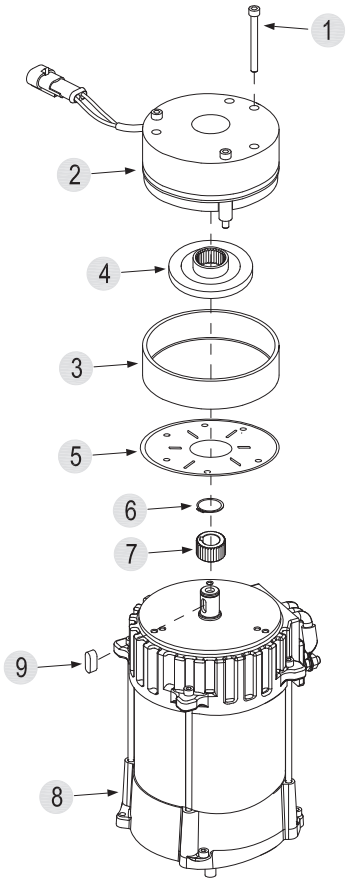


Figure 90204

- Switch off the truck power connections and pull out the brake connectors;
- 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

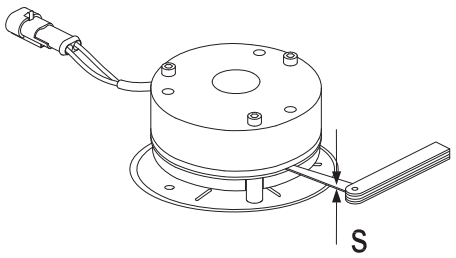


Figure 50208

CAUTION

When the air gap s exceeds 0.4mm, replace the brake pads (2, Figure 50205)

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 50209;

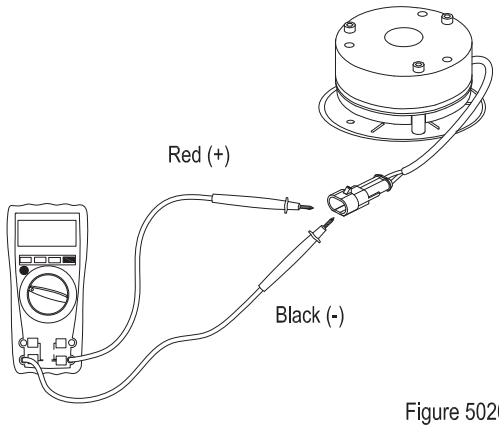


Figure 50209

- 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

5.2.4 Control Circuit Troubleshooting

Brake Control Circuit (Figure 90206)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #43 circuit (circuit between brake and controller) is conducted;
- Check if #44 circuit (circuit between brake and controller) is conducted;

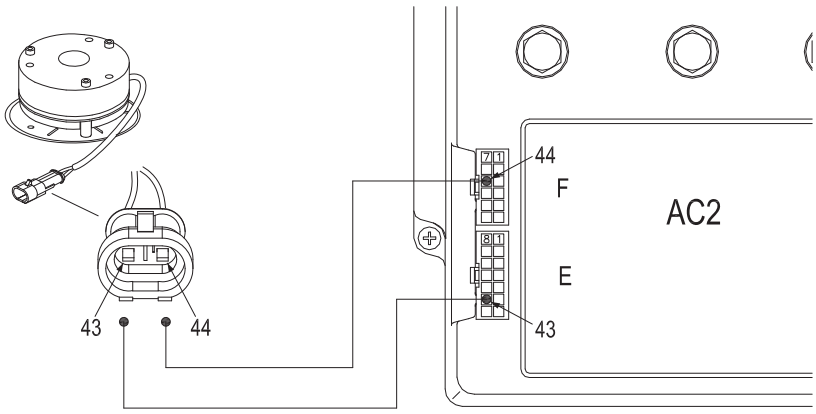


Figure 90206

5.3 Drive Motor

This truck obtains drive force through AC motor.

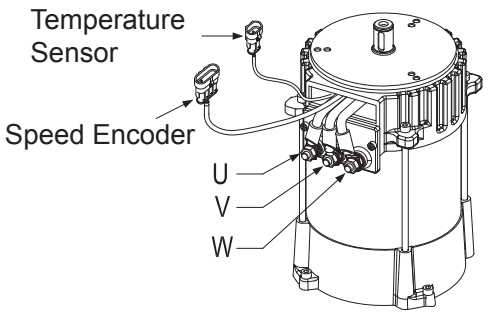


Figure 90207

5.3.1 Removal and Installation

Drive Motor

Removal

Drive motor (3, Figure 90201) is mounted on the drive mounting base (10).

- Switch off the truck power connections and remove the brake;
- Unplug the AMP connector on the drive motor, and remove the U, V and W cables connected between drive motor and controller;
- Unscrew the four screws (1, Figure 90208) from the drive motor and remove the drive motor.

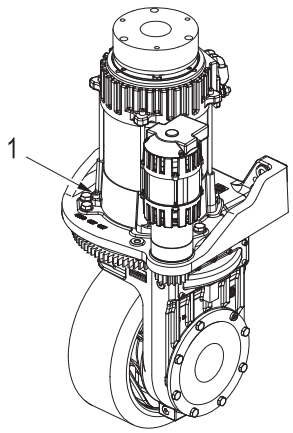


Figure 90208

Installation

- Install according to the reverse order of removal;

CAUTION

- *When installing the motor gear of gearbox onto the shaft of the motor, make sure that the woodruff key on the motor shaft is fully seated on the motor gear;*
- *Motor gear should fully engage with the gear within the gearbox, rotate the gearbox without blocking, and then fix it with four screws;*
- *Requirements on tightening torque of fixing screws: 23 N • m.*

5.3.2 Faults and Causes

1	Fault	Motor does not rotate
	Cause	a. Cable U, V, or W is broken; b. Loosening connections to cable U, V or W ; c. Stator coil open circuit; d. Motor bearing damage; e. Speed encoder or its circuit failure.
2	Fault	Motor is rotating in slow speed and reverse
	Cause	Cable connection error
3	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.
4	Fault	Motor smoking or burning smell
	Cause	Stator winding short circuit, motor burnt

5	Fault	Motor temperature too high, controller failure
	Cause	a. Stator winding short circuit; b. Motor U, V and W terminals with surface ; c. Bearing failure, resulting in severe heating; d. Motor cooling duct blockage with foreign body; e. Overload.
6	Fault	On load, motor speed is turning slow
	Cause	a. Insufficient voltage of battery; b. Overload; c. U, V, W terminals with abnormal voltage input; d. Speed encoder or its circuit failure.

5.3.3 Checking and Testing

U, V, W Terminals

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

CAUTION

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

Resistance Measurement	Judgment
With readings, but very low	Normal *
0 Ω	Winding internal short circuit (replace the motor)
∞ Ω	Winding internal open circuit (replace the motor)
* The difference between the resistance values measured at U-V, V-W and U-W shall not be greater than 2%.	

- Identify if there is leakage current through measuring the resistance between U, V, W and motor housing respectively.
  as shown in the following table:

Resistance Measurement	Judgment
0 Ω	Leakage current (replace the motor)
∞ Ω	Normal *
* For normal motor, U, V and W terminals are insulated from motor housing.	

Temperature Sensor

Temperature sensor is used to monitor motor temperature.

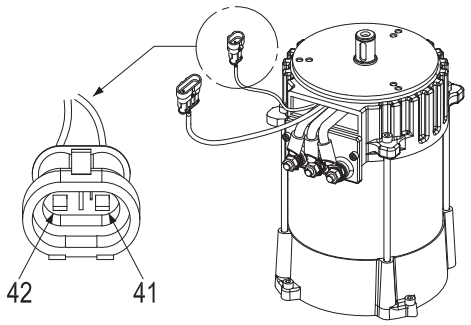


Figure 90209

Measure the resistance between pin connector (41#) and (42#) with a multimeter to identify if the temperature sensor is normal.
As shown in the following table:

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

Speed Encoder

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

Checking

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

Testing

- The vehicle is powered on, measure the voltage between pin connector (37#) and (40#) with a multimeter, normally should be 12V;
- Check if the connection between 38# and 39# is reversed. (If the two circuits are connected reversely, the controller won't report for failure, but the travel speed of the vehicle may slow down)
- Check the “ENCODER” readings on TESTER Menu. Operate the truck, if the display is always “0”:
  speed encoder failure;
  motor encoder disc failure;

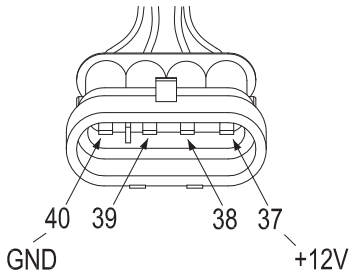


Figure 90210

5.3.4 Control Circuit Troubleshooting

Motor Control Circuit (Figure 90211)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #37/#38/#39/#40 circuit (circuit between motor encoder and controller) is conducted;
- Check if #41/#42 circuit (circuit between motor temperature sensor and controller) is conducted.

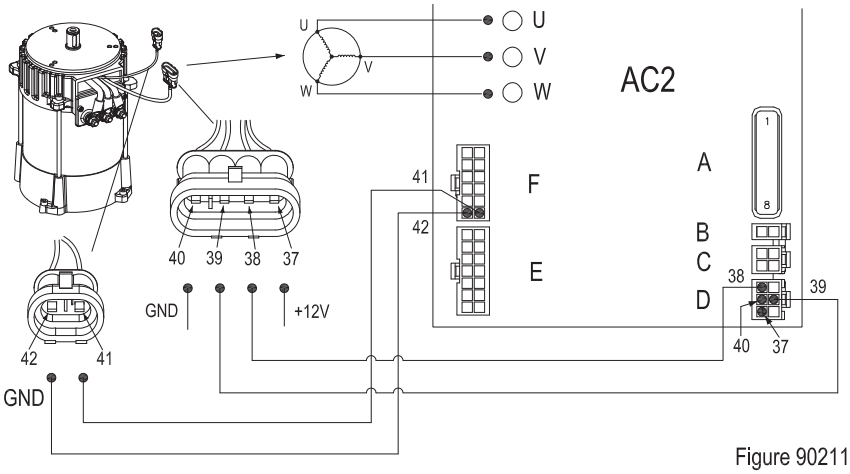


Figure 90211

5.4 Gearbox

5.4.1 Removal and Installation

Removal

The gearbox is installed under the drive mounting base.

- Remove the drive motor (see Section 5.3.1)
- Unscrew the six bolts (1) on the drive mounting base (2) and remove the gearbox;
- Unscrew the twelve bolts (3) on the steering bearing, remove the large steering bearing (4), large ring gear (5) and gearbox (6).

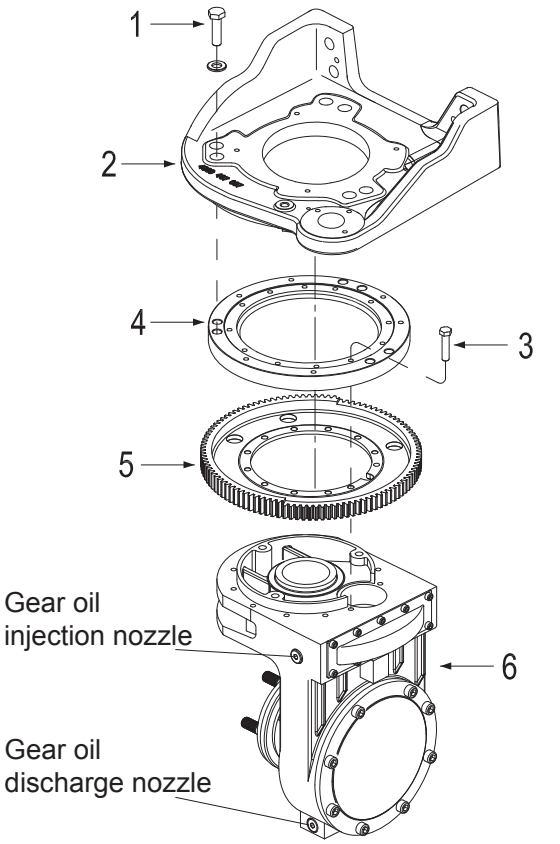


Figure 90212

Installation

- Install according to the reverse order of removal;

CAUTION

- *Before installing the new gearbox, please add gear oil (see Section 2.2.3 for specification and filling amount);*
- *Before installing gearbox, remove the proximity switch first; after the installation is completed, then adjust the proximity switch. (see Section 5.5)*

Check the gear oil level

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

Add / Replace Gear Oil

- Loosen the oil drain plug, drain the gear oil within the tank;
- Remount the oil drain plug, and add the gear oil of same specification with tubing through oiling port:
  gear oil specification: 80W-90 GL-5
  Gear oil filling amount: 3.3L

5.4.2 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.

5.5 Proximity Switch

5.5.1 Removal and Installation

Removal

Proximity switch is installed on the drive mounting base.

- Pull out the AMP connector on proximity switch;
- Loosen Nut (1) and unscrew the proximity switch.

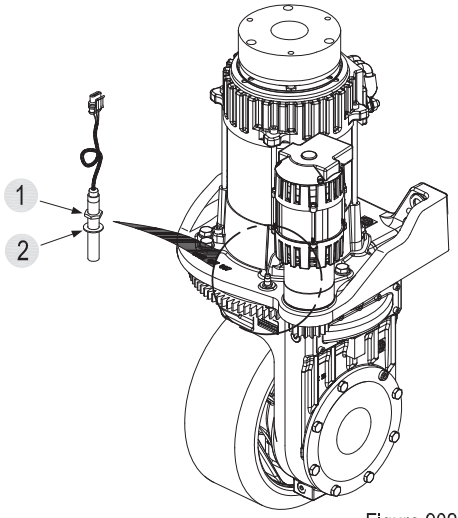


Figure 90213

Installation and Commissioning

- Adjust the position of big ring gear to align the mounting holes of proximity switch to the convex of the big ring gear;
- Screw the proximity switch into the mounting hole on driver's seat. Make sure that Lock Washer (2,Figure 90213) has been mounted;
- Adjust the height of Proximity Switch (3,Figure 90214) to make the spacing between proximity switch end face and upper surface of big ring gear to be between 1~2 mm;
- Turn the key switch on and pull the emergency stop switch, the system will carry out self-test (positioning) to the position of drive wheel;
- The truck starts properly, instrument displays are normal, and the proximity switch is installed properly, tighten Nut (1).

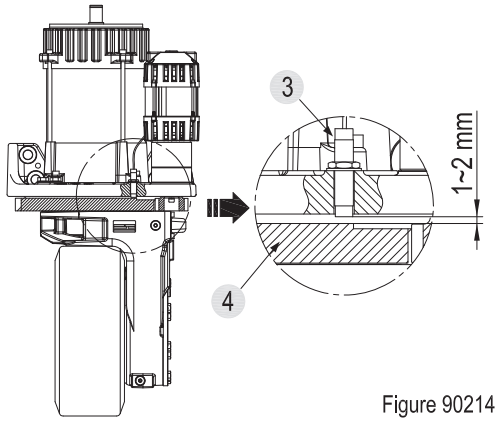


Figure 90214

NOTE

Installation Failure:
Steering positioning failed, drive wheel keeps rotating with system error, and fault information is displayed on the meter (Fault Code 238 EPS NOT ALIGNED).

Carry out the debugging again until the system can start normally and the meter is displaying properly.

5.5.2 Faults and Causes

1	Fault	Drive wheel fails to position and keeps rotating; (the controller reports for error, and fault information is displayed on the meter: EPS NOT ALIGNED)
	Cause	a. Between the proximity switch and the ring gear convex, there are impurities attached, such as iron scrap; b. Proximity switch with too large inductive clearance; c. Proximity switch failure; d. Proximity switch control circuit malfunction.

5.5.3 Checking and Testing

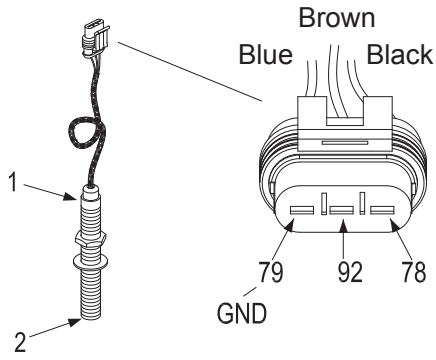


Figure 90215

- The truck adopts NO (normally open) proximity switches: When no signal is triggered, the output wire (78# Black Wire) is dangling, that is, 78# line is not connected with positive power supply input wire (92# Brown Wire).
- LED Indicator (1): when energized and the inductive surface is facing convex of big ring gear, proximity switch will trigger signal, and 78# wire will be connected with 92# wire, LED will be lit.
- Inductive Surface (2): induction of iron or steel objects (upper surface of big ring gear for the truck) with inductive distance of 1~2 mm.

Checking

- Check if the proximity switch and the appearance of wiring harness are in good condition, and if the plug connection is secure;
- Check if the inductive distance is normal, if exceeding inductive range, please re-adjust (see 5.5.2).

Testing

- Start the vehicle;
- Align the inductive surface of proximity switch (2, Figure 90215) to concave of big ring gear, so that it does not sense. Measure if there is 24V voltage between Pin (79#) and Pin (92#) with multimeter. If there is no voltage, check if the circuit is connected; if there is voltage, move on to the next step.
- Measure the voltage between Pin (78#) and Pin (92#). If there is 24V voltage (or the switch is energized under non-induction state, LED is lit), the switch has been damaged, please replace; if there is no voltage, move on to the next step.
- Touch the inductive surface with an iron sheet to make it trigger signals. If there is still no voltage between Pin (78#) and Pin (92#), the switch has been damaged, please replace.

5.5.4 Control Circuit Troubleshooting

Control Circuit (Figure 90216)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #78/#79/#92 circuit (circuit between proximity switch and controller) is conducted.

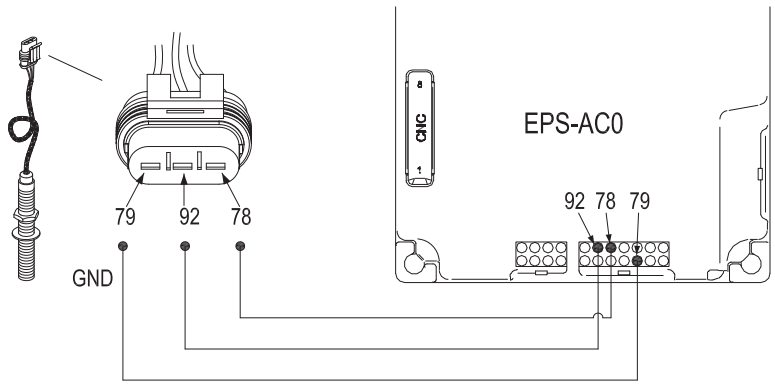


Figure 90216

5.6 Steering Motor

This truck is driven by AC steering motor to the large ring gear, thus achieving the function of steering.

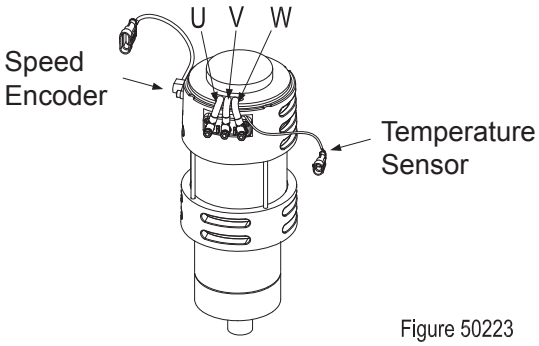


Figure 50223

5.6.1 Removal and Installation

Steering Motor

Removal

Steering motor (7, Figure 90201) is mounted on the drive mounting base (10).

- Switch off the truck power connections;
- Unplug the AMP connector on the steering motor, and remove the U, V and W cables connected between steering motor and controller;
- Unscrew one screw on pinion gear (9, Figure 90201) with a wrench and remove the pinion gear;
- Unscrew three mounting screws and remove the steering motor (7, Figure 90201).

Installation

- Install according to the reverse order of removal;

CAUTION

- *During installation, fasten the bottom surface of steering motor into the groove of motor mounting base, and then tighten the four mounting screws.*

Speed Encoder

Removal

- Switch off the truck power connections;
- Pull out the AMP connector on the speed encoder (2, Figure 50224);
- Loosen the fixing screw (1), and remove the speed encoder (2).

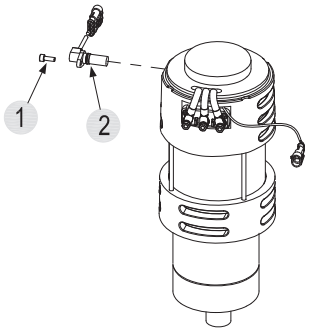


Figure 50224

Installation

- Install according to the reverse order of removal;

5.6.2 Faults and Causes

1	Fault	Motor does not rotate
	Cause	a. Cable U, V, or W is broken; b. Loosening connections to cable U, V or W ; c. Stator coil open circuit; d. Motor bearing damage; e. Speed encoder or its circuit failure.
2	Fault	Motor is rotating in slow speed and reverse
	Cause	Cable connection error
3	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.

4	Fault	Motor smoking or burning smell
	Cause	Stator winding short circuit, motor burnt
5	Fault	Motor temperature too high, controller failure
	Cause	a. Stator winding short circuit; b. Motor U, V and W terminals with surface ; c. Bearing failure, resulting in severe heating; d. Motor cooling duct blockage with foreign body; e. Overload.
6	Fault	On load, motor speed is turning slow
	Cause	a. Insufficient voltage of battery; b. Overload; c. U, V, W terminals with abnormal voltage input; d. Speed encoder or its circuit failure.

5.6.3 Checking and Testing

U, V, W Terminals

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

CAUTION

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

Resistance Measurement	Judgment
With readings, but very low	Normal *
0 Ω	Winding internal short circuit (replace the motor)
∞ Ω	Winding internal open circuit (replace the motor)
* The difference between the resistance values measured at U-V, V-W and U-W shall not be greater than 2%.	

- Identify if there is leakage current through measuring the resistance between U, V, W and motor housing respectively.
  as shown in the following table:

Resistance Measurement	Judgment
0 Ω	Leakage current (replace the motor)
∞ Ω	Normal *
* For normal motor, U, V and W terminals are insulated from motor housing.	

Temperature Sensor

Temperature sensor is used to monitor motor temperature.

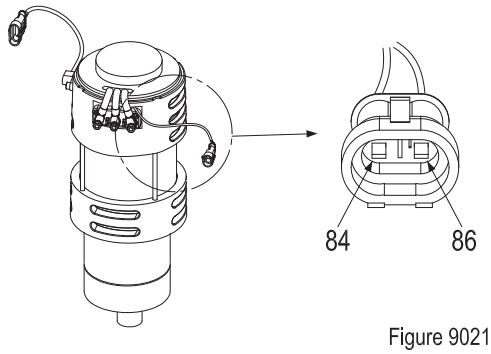


Figure 90217

Measure the resistance between pin connector (84#) and (86#) with a multimeter to identify if the temperature sensor is normal.
As shown in the following table:

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

Speed Encoder

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

Checking

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

Testing

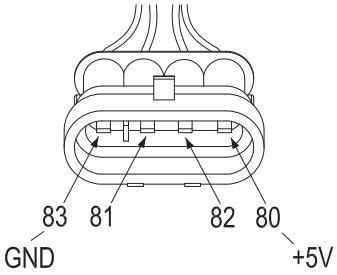


Figure 90218

- The vehicle is powered on, measure the voltage between pin connector (80#) and (83#) with a multimeter, normally should be 5V;
- Check if the connection between 81# and 82# is reversed. (If the two circuits are connected reversely, the controller will report for failure, and the instrument will display fault code: BAD ENCODER SIGN)
- Check “ENC SPEED” readings on TESTER Menu (EPS-AC0). Operate the truck, if the display is always “0”:
  if it is steering motor speed encoder failure, replace the encoder;
  if it is steering motor encoder disc failure, replace the motor;

5.6.4 Control Circuit Troubleshooting

Motor Control Circuit (Figure 90219)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #80/#81/#82/#83 circuit (circuit between motor encoder and controller) is conducted;
- Check if #84/#86 circuit (circuit between motor temperature sensor and controller) is conducted.

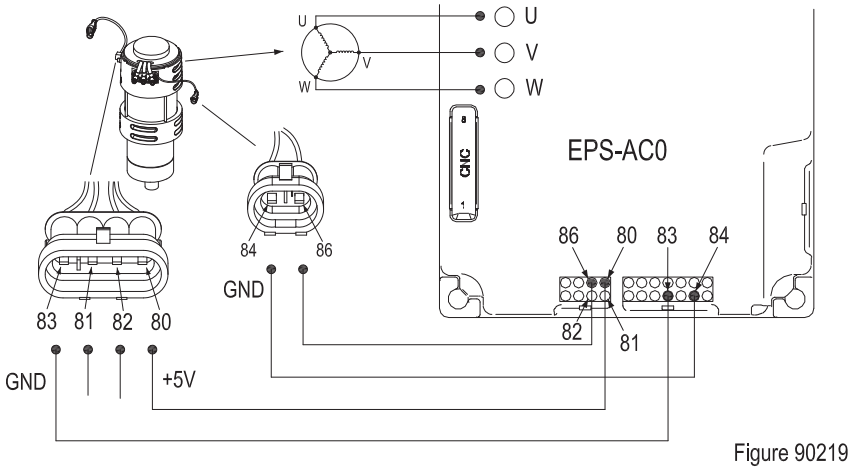


Figure 90219

6. OPERATING SYSTEM

6

NOTE:

6.1 Control Lever

Removal

Control lever is mounted on operating handle (7,Figure 90301).

- Open the plastic cover (2) on the steering wheel (1);
- Unscrew the nut (3) and remove the steering wheel (1);
- Unscrew the screw (4), remove the top cover (6) and bottom cover (5) from operating handle (7);
- Disconnect the stepper motor wiring harness (8);
- Unscrew the fastening screw (9), unscrew the four screws (10) and remove the stepper motor (11).

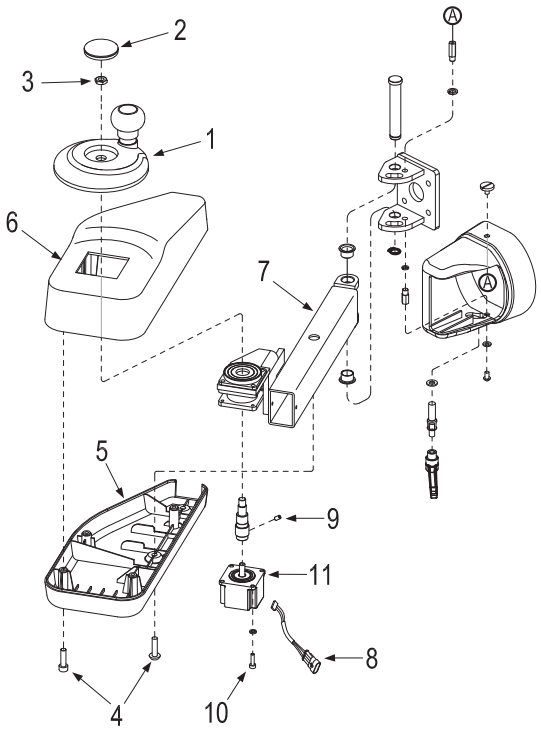


Figure 90301

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 Control Panel

Removal

- Unscrew the 10 screws (1,Figure 90302), raise the front cover (2) up from the chassis;
- Disconnect the components on the front cover from main harness;
- Replace the components that need to be replaced: rocker switch (warning light and headlights), travel switch, key switch, control switch (configuration of CQD16/20 (N) RVF model), emergency stop switch, horn button or instrument.

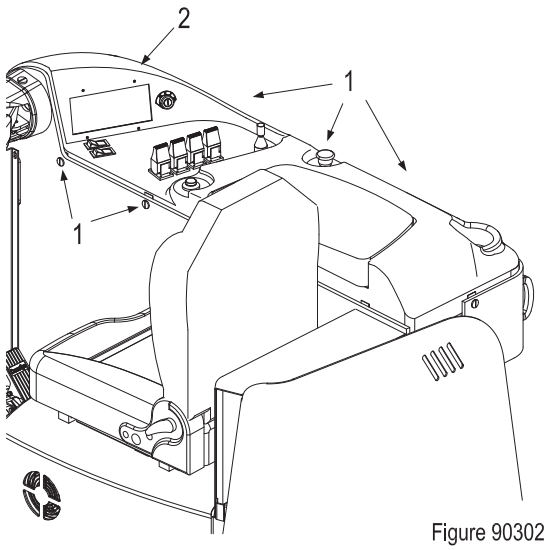


Figure 90302

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 Horn Button

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 horn.

6.3.1 Removal and Installation

See Section 6.2 .

6.3.2 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

6.3.3 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:
  push button switch at original position, broken circuit;
  press the button (key switch to “ON”; emergency stop switch to “Pulled-out” status), the circuit is conducted.

6.3.4 Control Circuit Troubleshooting

Control Circuit (Figure 90312)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #A3 circuit (circuit between press button and power supply positive electrode) is conducted;
- Check if #A16 circuit (circuit between press button and horn) is conducted;
- Check if #A18 circuit (circuit between horn and power supply negative electrode) is conducted.

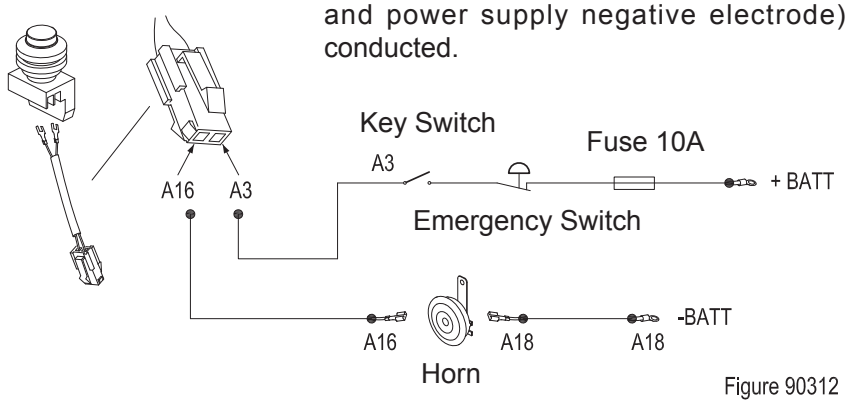


Figure 90312

Horn Checks

Energize the horn with a voltage of 48V:
Horn sounds, the horn is working properly;
Horn does not sound, horn failure, needs to be replaced.

6.4 Control Switch (RVF/NRVF)

Control switch will provide the vehicle with Lifting / Lowering, Forward / Retract, Tilting Forward / Tilting Backward, Left Shifting / Right Shifting and other signal inputs.

6.4.1 Removal and Installation

See Section 6.2 .

6.4.2 Faults and Causes

1	Fault	Operate the control switches, but the vehicle cannot perform corresponding actions
	Cause	a. Control switch failure; b. Control switch circuit not conducted.
2	Fault	Control switches not operated, the vehicle still performs certain action
	Cause	Remote control switch failure

6.4.3 Checking and Testing

Checking

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

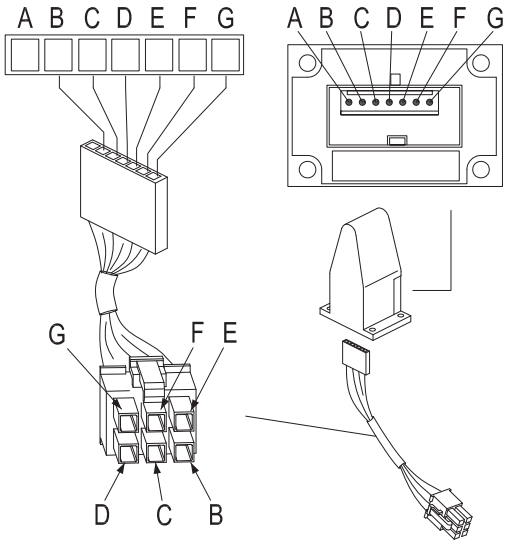


Figure 90304

Testing

- Enter the TESTER Menu to check the status of switches: toggle each control switch separately to check the ON/OFF status. If the display does not change, it indicates there is failure with the control switch or its circuit; (see Section 8.12)
- Turn off the vehicle to check the control switch and its wiring harness. (See Figure 90304)
- Check if the port of each control switch wiring harness is conducted with a multimeter:
  if not conducted, replace the harness of travel switch;
  if conducted, move to the next step.
- Place the control switch at Middle position. Respectively, measure the ON/OFF between pin (G) and pin (E), pin (G) and pin (F) of the control switch:
  if ON, it indicates the control switch failure, needs to be replaced;
  if OFF, indicating the switch is normal, move to the next step.
- Toggle the control switch forward, measure the ON/OFF between pin (G) and pin (E); toggle the travel switch backward, measure the ON/OFF between pin (G) and pin (F) of the control switch:
  if OFF, it indicates the control switch failure, needs to be replaced;
  if ON, indicating the switch is normal, move to the next step.
- Measure the resistance values between pin (B) and pin (D), pin (C) and pin (D) of control switch with a multimeter.
  If the potentiometer of the control switch is normal, the resistance values should be as shown in the following table:

Resistance Measurement		Control switch At Middle position	Control switch With fluctuation
Code	Position		
R_{Total}	B-D	5 kΩ	5 kΩ
R_2	C-D	½ R_{Total}	0 ~ ½ R_{Total} or Changing between ½ R_{Total} ~ R_{Total}
* Resistance Value ±10%			

6.4.4 Control Circuit Troubleshooting

Lift - Lower Switch Control Circuit (Figure 90305)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #5/#6/#8/#9 circuit (circuit between control switch and instruments) is conducted.

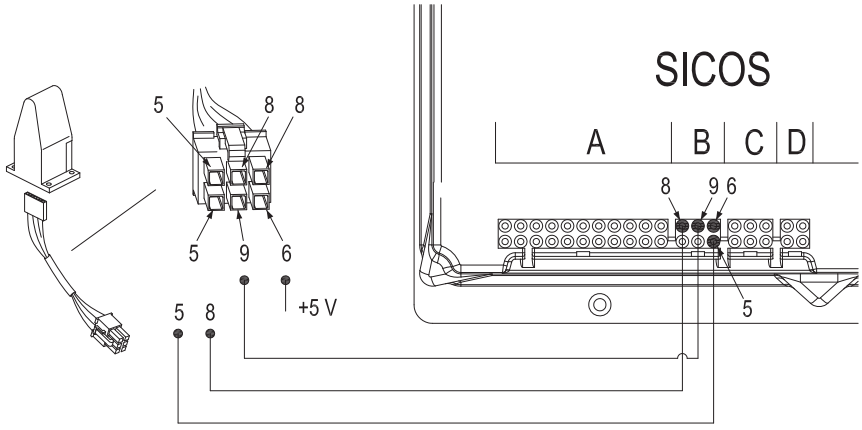


Figure 90305

Forward Shifting - Retract Switch Control Circuit (Figure 90306)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #4/#5/#6/#7 circuit (circuit between control switch and instruments) is conducted.

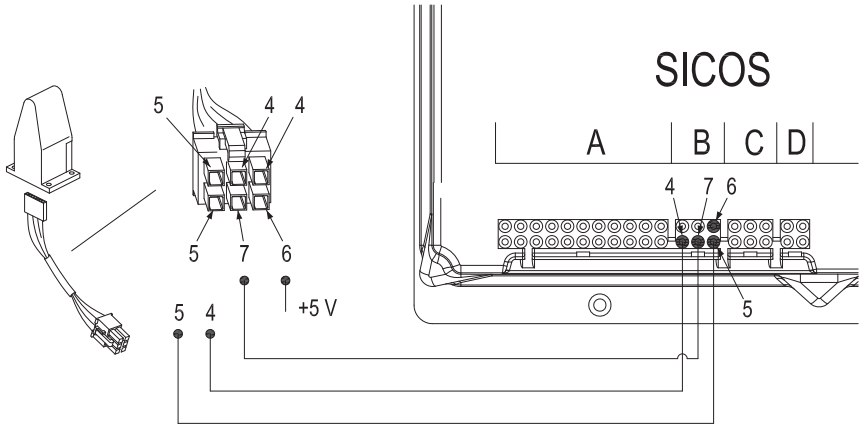


Figure 90306

Forward Tilting – Backward Tilting Switch Control Circuit (Figure 90307)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #10/#11/#12/#13 circuit (circuit between control switch and instruments) is conducted.

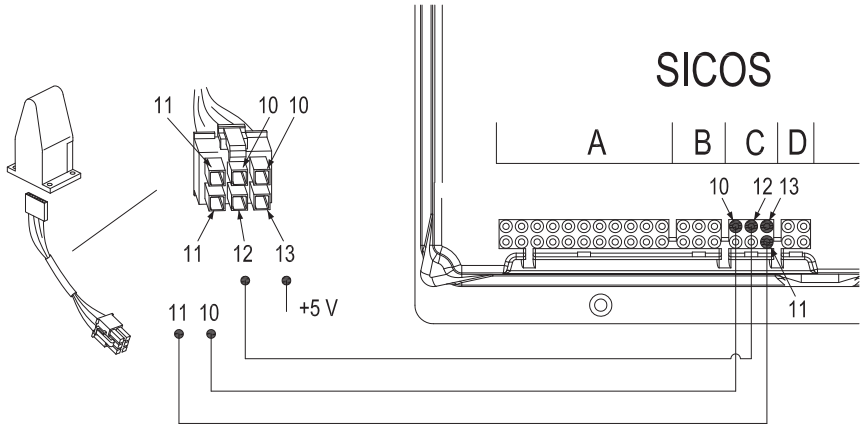


Figure 90307

Left Shifting – Right Shifting Switch Control Circuit (Figure 90308)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #11/#13/#14/#15 circuit (circuit between control switch and instruments) is conducted.

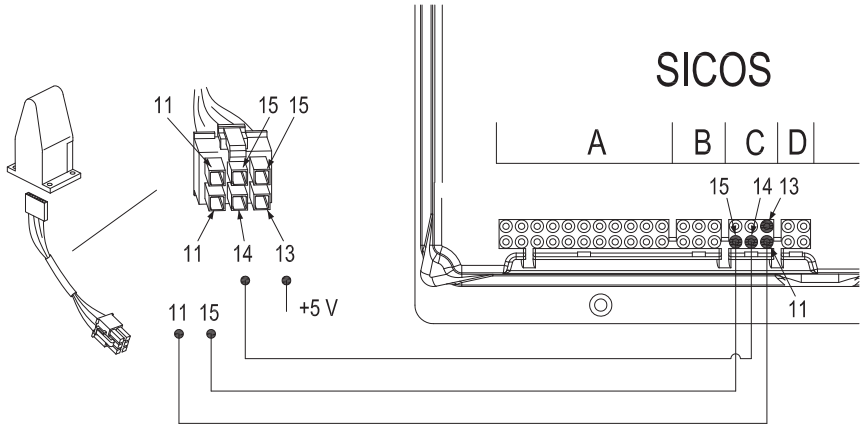


Figure 90308

6.5 Control Switch (RV/NRV)

Control switch will provide the vehicle with input signals for starting the pump motor.

See Section 3.1 for mounting positions of control switch.

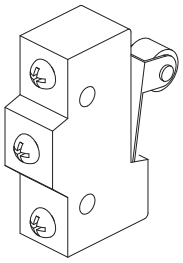


Figure 90316

6.5.1 Removal and Installation

See Section 7.6.1 .

6.5.2 Faults and Causes

1	Fault	Operate the handwheel, but the vehicle cannot perform corresponding actions
	Cause	a. Control switch failure; b. Control switch circuit not conducted.
2	Fault	Handwheel not operated, the vehicle still performs certain action
	Cause	Remote control switch failure

6.5.3 Connection Mode

There are three terminals on the control switch, as shown in Figure 90317.

By pulling the handwheel, the switch can be switched between OFF and ON to control the OFF and ON of the circuit.

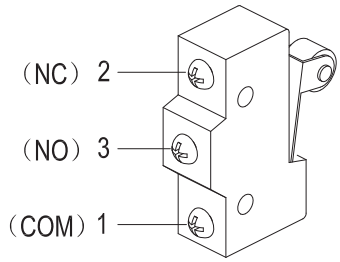


Figure 90317

Normally-open (N0):
Terminal (1) and Terminal (3) for connection of wiring harness connector to switch base.

6.5.4 Checking and Testing

Checking

- Check if the appearance of control switch is in good condition, also check for deformation of handwheel;
- Check if the handwheel is working smoothly and if there is foreign body blockage.

Testing

- Enter the TESTER Menu to check the status of switches: toggle each control switch separately to check the ON/OFF status. If the display does not change, it indicates there is failure with the control switch or its circuit; (see Section 8.12)
- Turn the key switch to "OFF", remove key. Pull out the battery plug and disconnect the power supply;
- Check the ON/OFF normally-open (NO) terminal with a multimeter:
  with handwheel at natural position, Terminal (1) and (3) not conducted;
  toggle the handwheel, Terminal (1) and (3) conducted.
- Check the ON/OFF normally closed (NC) terminal with a multimeter: with handwheel at natural position, Terminal (1) and (2) conducted;
  Toggle the handwheel, Terminal (1) and (2) not conducted.

6.5.5 Control Circuit Troubleshooting

Lift Switch Control Circuit (Figure 90318)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #7/#8 circuit (circuit between control switch and instruments) is conducted.

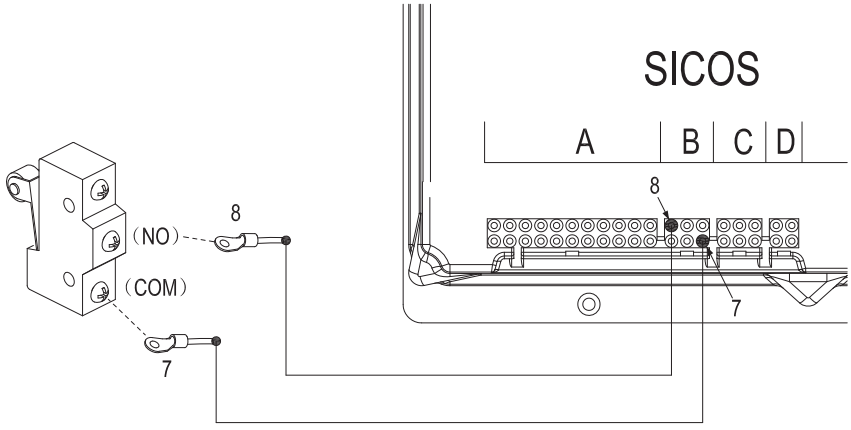


Figure 90318

Forward Shifting - Retract Switch Control Circuit (Figure 90319)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #4/#5 circuit (circuit between control switch and instruments) is conducted.

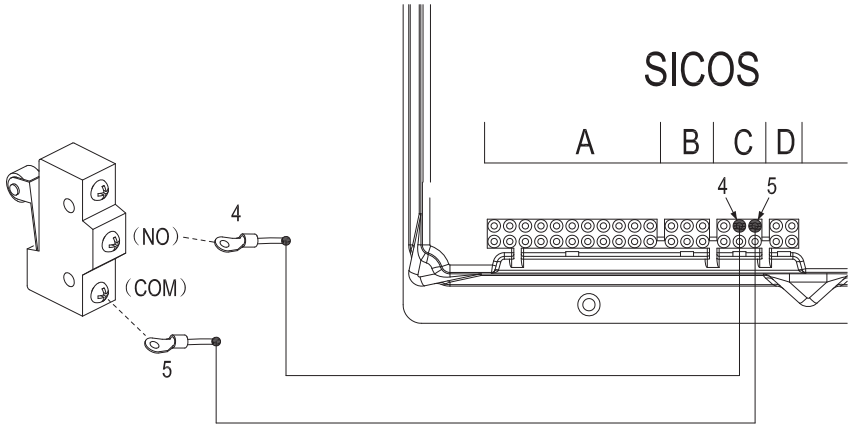


Figure 90319

Forward Tilting – Backward Tilting Switch Control Circuit (Figure 90320)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #10/#11 circuit (circuit between control switch and instruments) is conducted.

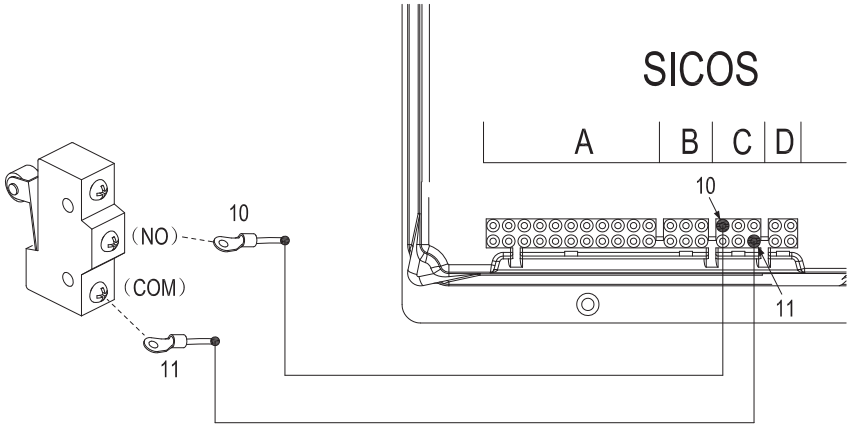


Figure 90320

6

Left Shifting – Right Shifting Switch Control Circuit (Figure 90321)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #14/#15 circuit (circuit between control switch and instruments) is conducted.

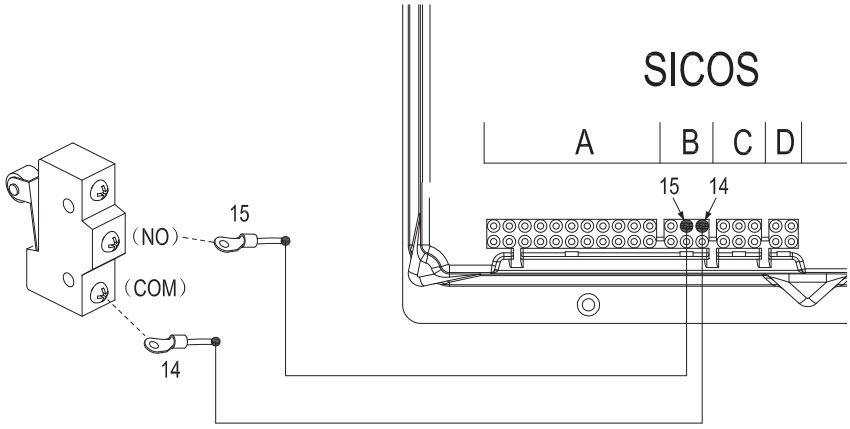


Figure 90321

6.6 Stepper Motor

Stepper motor provides the vehicle with steering input signals.

6.6.1 Removal and Installation

See Section 6.1 .

6.6.2 Faults and Causes

1	Fault	Operate the steering wheel, the vehicle does not respond to the steering signal; the instrument displays fault code: STEER SENSOR KO
	Cause	a. Stepper motor failure; b. Stepper motor circuit not conducted.

6.6.3 Checking and Testing

Checking

- Check if the appearance of the stepper motor and its wiring harness are in good condition, and if the connectors are connected securely;
- Check if the mechanical connection between stepper motor and steering wheel is secure and if there is loosening.

Testing

- Enter TESTER Menu (EPSAC0) to check the stepper motor voltage:

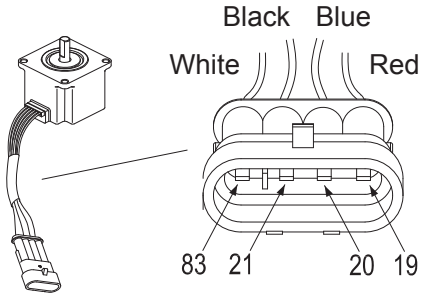


Figure 90309

"STEPPER MOTOR", turn the steering wheel, if the voltage display is always "0", it indicates that the stepper motor has no signal output (see Section 8.12):

- mechanical loosening between steering wheel and step motor;
- stepper motor failure or its circuit not conducted.

- Check if the circuit from controller to stepper motor is conducted.

  If the two circuits are conducted, but the fault still exists, then replace the stepper motor.

6.6.4 Control Circuit Troubleshooting

Stepper Motor Control Circuit (Figure 90310)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #19/#20/#21/#83 circuit (circuit between stepper motor and controller) is conducted.

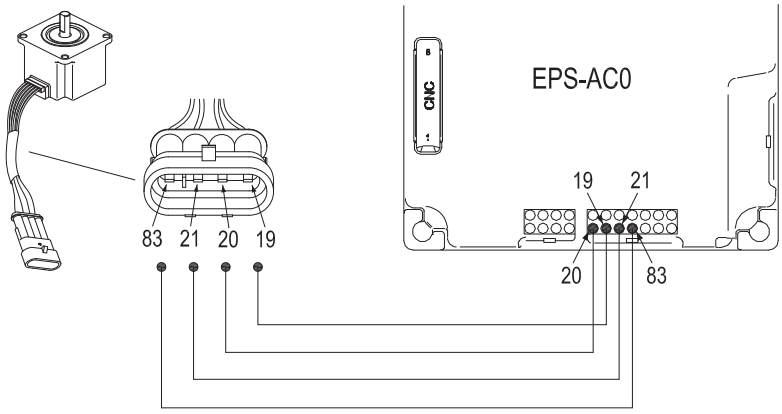


Figure 90310

6.7 Key Switch

Key switch is used to START / STOP the truck.

6.7.1 Removal and Installation

See Section 6.2 .

6.7.2 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)

6.7.3 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.

6.7.4 Control Circuit Troubleshooting

Key Switch Control Circuit (Figure 90311)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #A3/#B2 circuit (circuit between key switch and controller) is conducted.

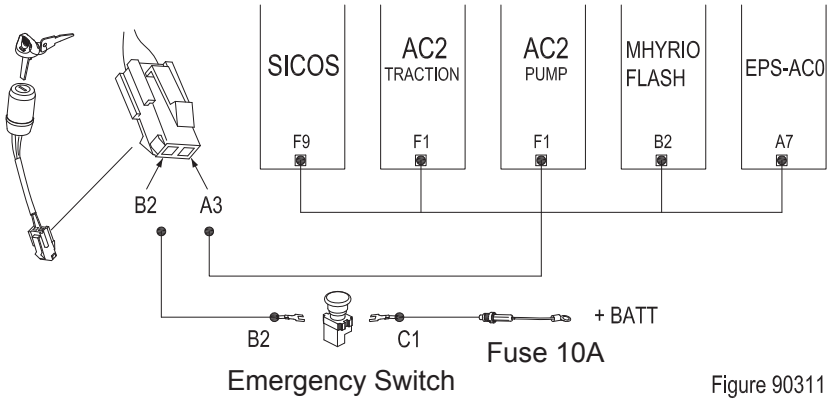


Figure 90311

6.8 Emergency Switch

Emergency switch is used for emergency cut-off of the power supply to all the control circuits.

6.8.1 Removal and Installation

See Section 6.2 .

6.8.2 Faults and Causes

1	Fault	Emergency switch at pulled-out status, the vehicle not energized
	Cause	a. Emergency switch failure; b. Emergency switch circuit not conducted.
2	Fault	Emergency switch pressed, the vehicle still energized
	Cause	a. Emergency switch failure; b. Emergency switch shorted (short circuit)

6.8.3 Checking and Testing

Checking

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

Testing

- Check if the emergency switch circuit is conducted;
- Carry out ON/OFF test to emergency switch with a multimeter:
  Emergency switch in pulled-out status, circuit conducted;
  press the emergency switch, the circuit is opened.

6.8.4 Control Circuit Troubleshooting

Emergency Switch Control Circuit (Figure 90311)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #B2/#C1 circuit is conducted.

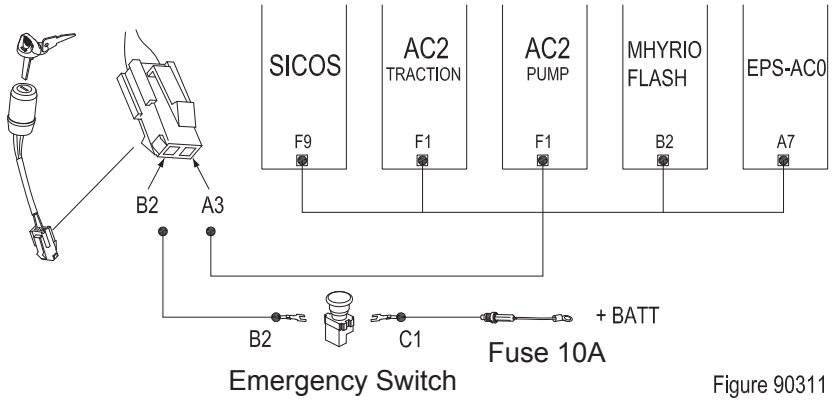


Figure 90311

6.9 Rocker Switch

The rocker switch of this truck is used to control the ON/OFF of headlights and warning light.
The rocker switch is classified by functions as: Headlight Switch and Warning Light Switch

6.9.1 Removal and Installation

See Section 6.2 .

6.9.2 Faults and Causes

1	Fault	Operate the rocker switch, but the vehicle responds with no action
	Cause	a. Rocker switch failure; b. Rocker switch circuit not conducted.
2	Fault	Rocker switch not operated, the vehicle responds with action
	Cause	a. Rocker switch failure; b. Rocker switch shorted (short circuit)

6.9.3 Checking and Testing

Checking

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

Testing

- Check if the rocker switch circuit is conducted;
- Carry out ON/OFF test to press button switch with a multimeter:
  Press button switch at original position, circuit breakage;
  press the button, circuit conducted.

6.9.4 Control Circuit Troubleshooting

Headlight Switch Control Circuit (Figure 90313)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #93 circuit (circuit between switch and converter) is conducted;
- Check if #96 circuit (circuit between switch and headlight) is conducted;
- Check if #94 circuit (circuit between headlight and converter) is conducted.

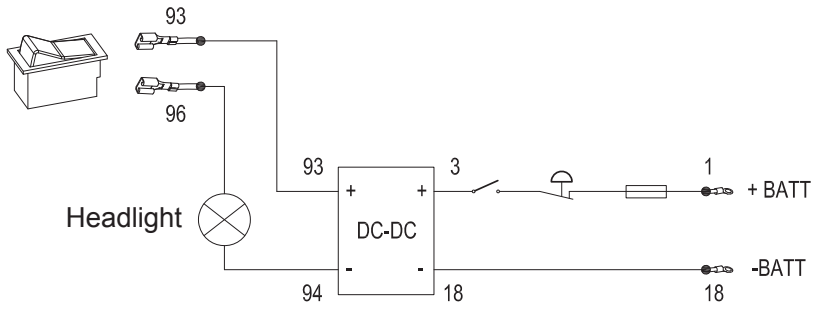


Figure 90313

Warning Light Switch Control Circuit (Figure 90314)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #93 circuit (circuit between switch and converter) is conducted;
- Check if #95 circuit (circuit between switch and warning light) is conducted;
- Check if #94 circuit (circuit between warning light and converter) is conducted.

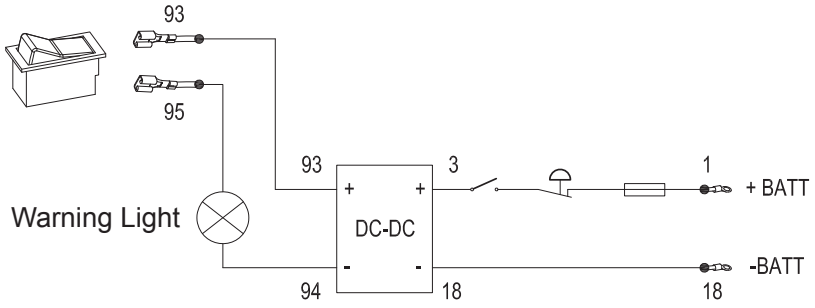


Figure 90314

6.10 Travel Switch

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

6.10.1 Removal and Installation

See Section 6.2 .

6.10.2 Faults and Causes

1	Fault	Press the accelerator pedal, operate travel switch, the vehicle cannot go forward or backward
	Cause	a. Travel switch failure; b. Travel switch circuit not conducted.
2	Fault	Press the accelerator pedal, travel switch not operated, the vehicle goes forward or backward automatically
	Cause	a. Travel switch failure; b. Travel switch shorted (short circuit)

6.10.3 Checking and Testing

Checking

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

Testing

- Enter TESTER Menu to check the status of the switches:
  toggle the switch backward, if the display does not change, then it indicates the travel switch or its circuit failure;(see Section 8.12)
  Toggle the switch forward, if the display does not change, then it indicates the travel switch or its circuit failure;(see Section 8.12)
- Check if the travel switch circuit is conducted;
- Carry out ON/OFF test to press button switch with a multimeter:
  Travel switch at original position, circuit breakage;
  toggle the button, circuit conducted.

6.10.4 Control Circuit Troubleshooting

Travel Switch Control Circuit (Figure 90315)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #17/#24/#25 circuit (circuit between travel switch and controller) is conducted.

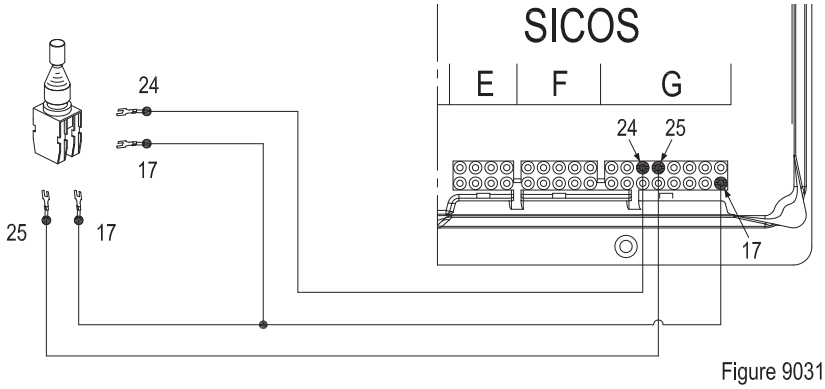


Figure 90315

7. HYDRAULIC SYSTEM

7

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.

Oil pipeline explosion-proof valve is installed at the hydraulic cylinder to prevent the free falling of the load after system failure.

RVF/NRVF Hydraulic Schematic Diagram is as shown in Figure 90401;
RV/NRV Hydraulic Schematic Diagram is as shown in Figure 90402;
See Section 7.10 for hydraulic symbol descriptions.

7.1 Overview

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

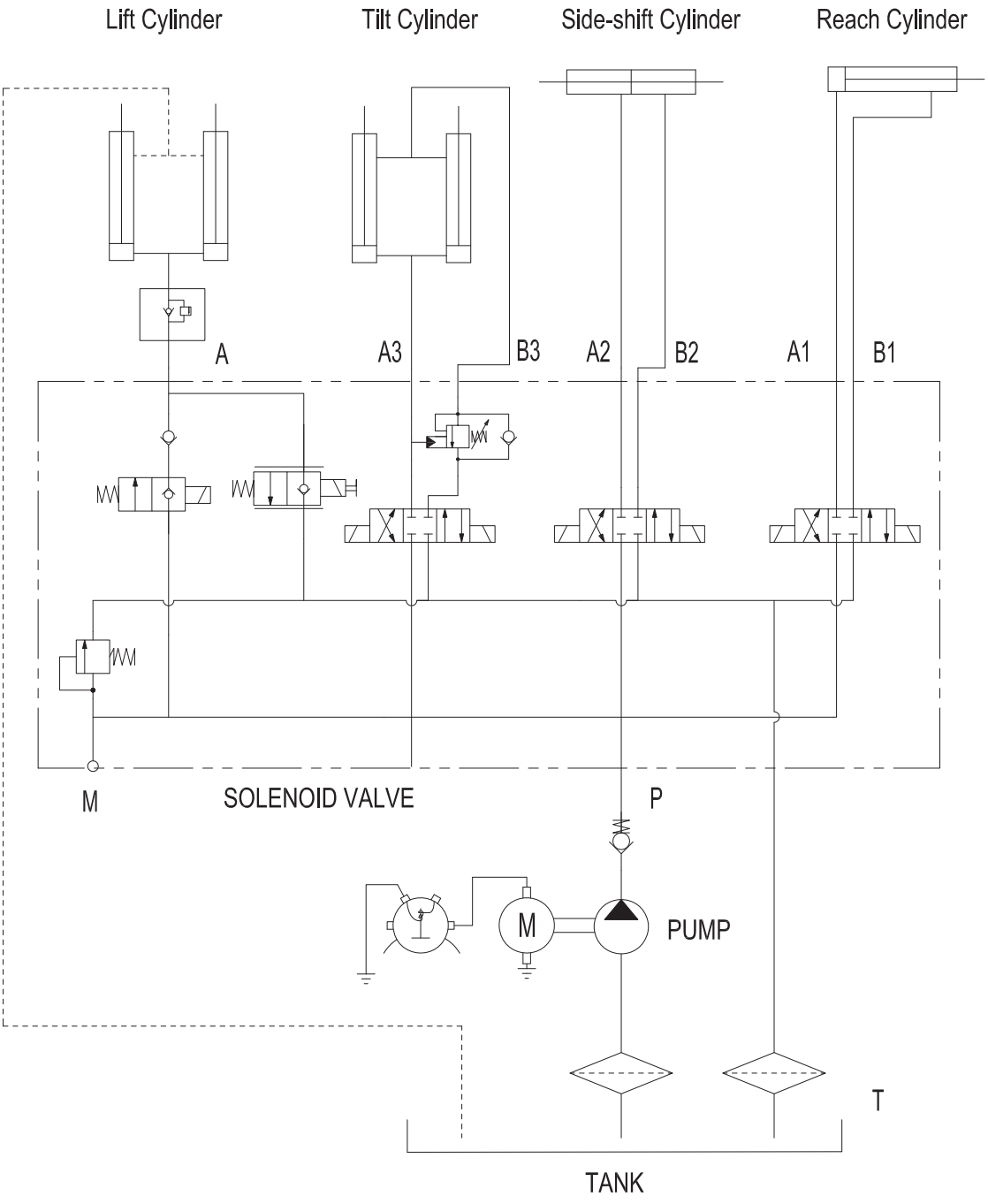


Figure 90401

7.1.2 Hydraulic Schematic Diagram RV/NRV

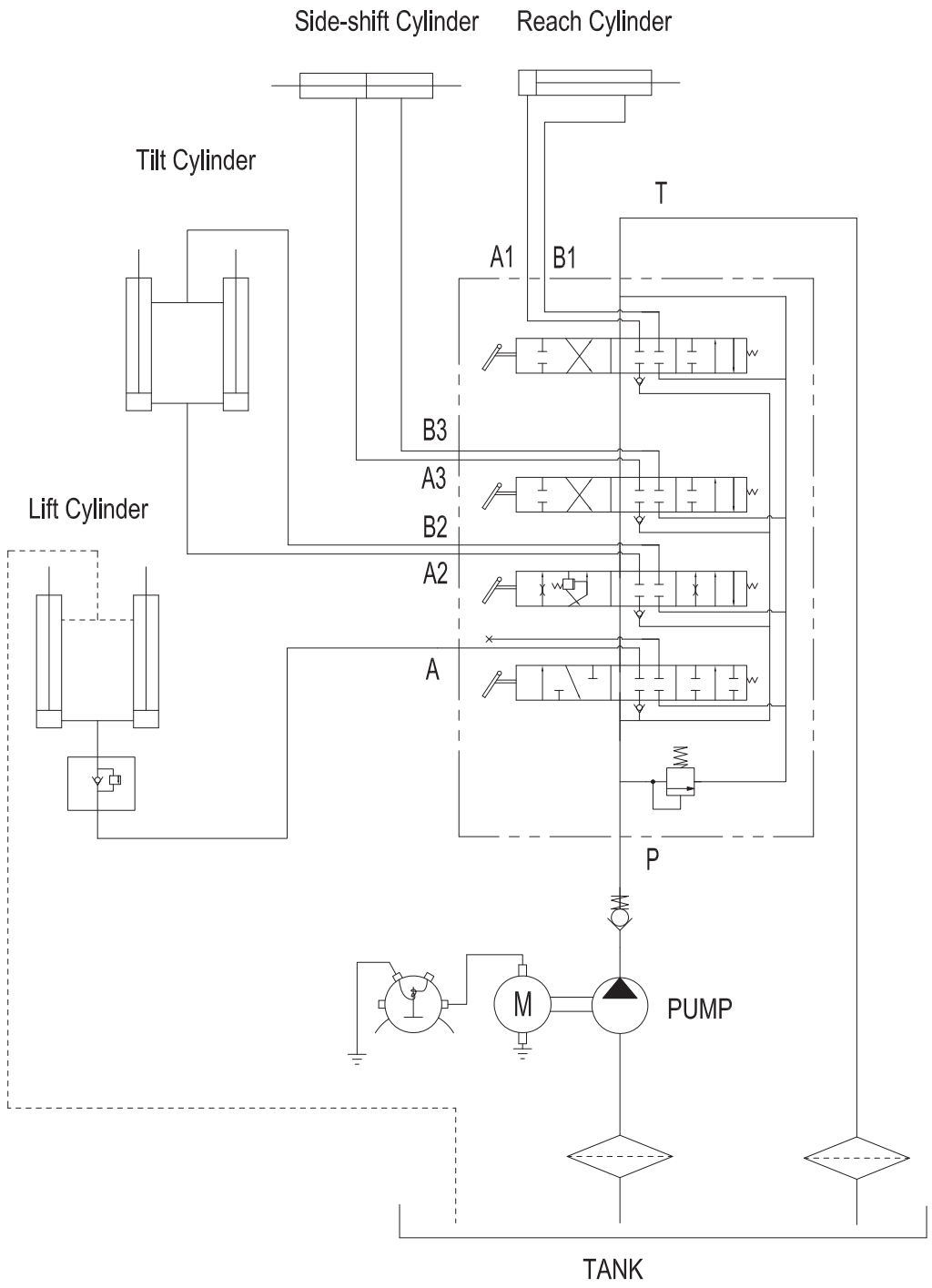


Figure 90402

7.2 Hydraulic Power Unit

7.2.1 Removal and Installation

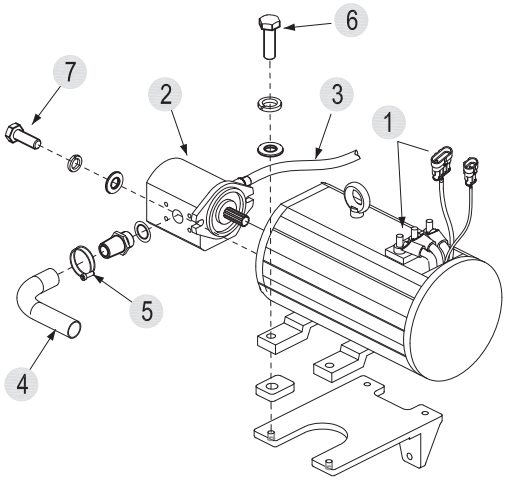


Figure 90403

Removal

- Open the engine hood;
- Remove the AMP connector on the pump motor and pump motor and carry out the following operations to the motor(1) remove the three cables U, V and W connected to the controller;
- Remove the tubing head between gear pump (2) and multi-way valve with a wrench, and then remove the tubing (3);
- Loosen the clamp (5) on inlet tubing (4);
- Loosen the four pump motor mounting bolts (6) and remove the pump motor (1);
- Loosen the two gear motor mounting bolts (7) and remove the gear motor (2).

Installation

- Install according to the reverse order of removal.

CAUTION

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

7.3 Pump Motor

This truck obtains hydraulic power through the AC pump motor.

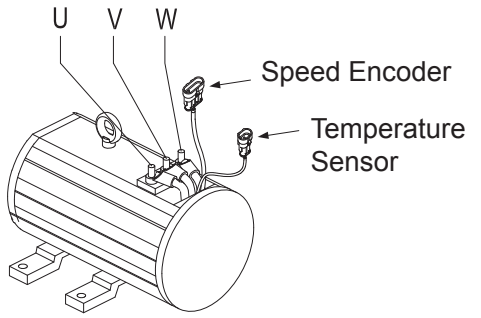


Figure 90404

7.3.1 Removal and Installation

See Section 7.2.1 .

7.3.2 Faults and Causes

1	Fault	Motor does not rotate
	Cause	a. Cable U, V, or W is broken; b. Loosening connections to cable U, V or W ; c. Stator coil open circuit; d. Motor bearing damage; e. Speed encoder or its circuit failure.
2	Fault	Motor is rotating in slow speed and reverse
	Cause	Cable connection error
3	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.
4	Fault	Motor smoking or burning smell
	Cause	Stator winding short circuit, motor burnt

5	Fault	Motor temperature too high, controller failure
	Cause	a. Stator winding short circuit; b. Motor U, V and W terminals with surface ; c. Bearing failure, resulting in severe heating; d. Motor cooling duct blockage with foreign body; e. Overload.
6	Fault	On load, motor speed is turning slow
	Cause	a. Insufficient voltage of battery; b. Overload; c. U, V, W terminals with abnormal voltage input; d. Speed encoder or its circuit failure.

7.3.3 Checking and Testing

U, V, W Terminals

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

CAUTION

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

Resistance Measurement	Judgment
With readings, but very low	Normal *
0 Ω	Winding internal short circuit (replace the motor)
∞ Ω	Winding internal open circuit (replace the motor)
* The difference between the resistance values measured at U-V, V-W and U-W shall not be greater than 2%.	

- Identify if there is leakage current through measuring the resistance between U, V, W and motor housing respectively.
  as shown in the following table:

Resistance Measurement	Judgment
0 Ω	Leakage current (replace the motor)
∞ Ω	Normal *
* For normal motor, U, V and W terminals are insulated from motor housing.	

Temperature Sensor

Temperature sensor is used to monitor motor temperature.

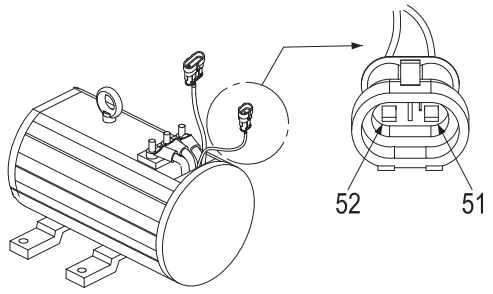


Figure 90405

Measure the resistance between pin connector (51#) and (52#) with a multimeter to identify if the temperature sensor is normal.
As shown in the following table:

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

Speed Encoder

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

Checking

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

Testing

- The vehicle is powered on, measure the voltage between pin connector (47#) and (50#) with a multimeter, normally should be 12V;
- Check if the connection between 48# and 49# is reversed. (If the two circuits are connected reversely, the controller won't report for failure, but the travel speed of the vehicle may slow down)
- Check the “ENCODER” readings on TESTER Menu. Operate the truck, if the display is always “0”:
  speed encoder failure;
  motor encoder disc failure.

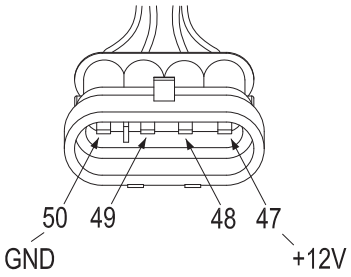


Figure 90406

7.3.4 Control Circuit Troubleshooting

Motor Control Circuit (Figure 90407)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #47/#48/#49/#50 circuit (circuit between motor encoder and controller) is conducted;
- Check if #51/#52 circuit (circuit between motor temperature sensor and controller) is conducted.

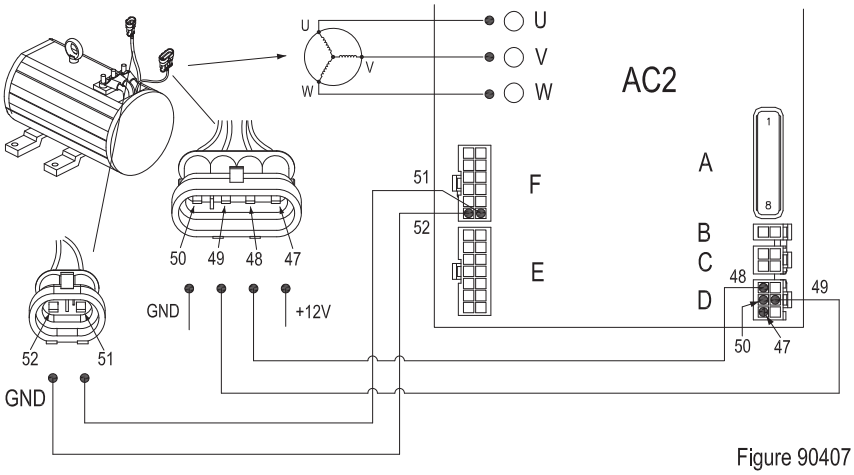


Figure 90407

7.4 Multi-way Reversing Solenoid Valve (RVF/NRVF)

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

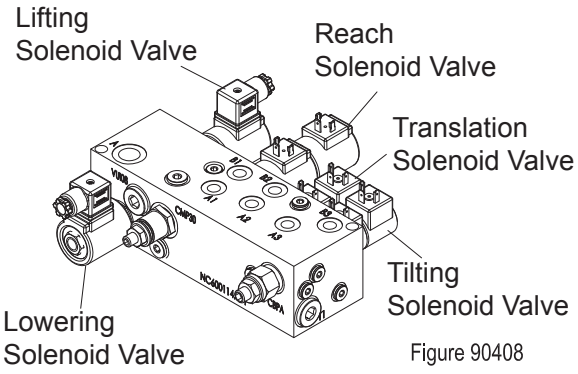


Figure 90408

7.4.1 Removal and Installation

Removal

Multi-way solenoid valve is installed on the chassis bottom plate (under the battery compartment).

- Remove the battery compartment and take out the battery;
- Remove the tubing on the multi-way valve and the wiring harness on the solenoid valve;
- Loosen the three fastening screws on the multi-way solenoid valve with a hex wrench and remove the solenoid valve.

Installation

- Install according to the reverse order of removal.

CAUTION

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

7.4.2 Interface Description

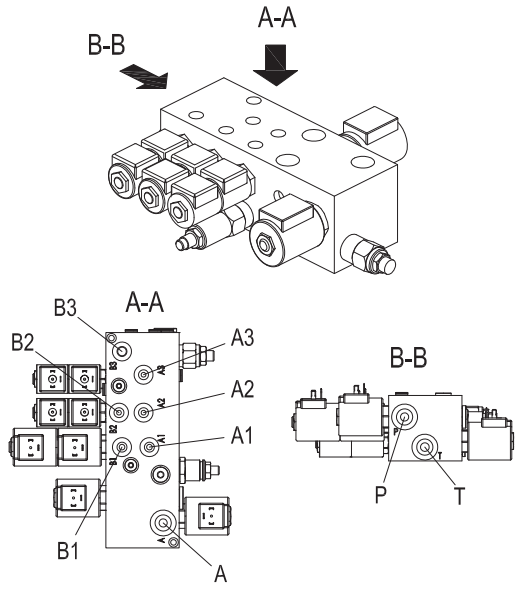


Figure 90410

Symbol	Interface Function	Connection Terminals	Interface Size
A	Lifting, lifting / lowering solenoid valve controls	Lift Cylinder	G1/2
A1	Reach, reach solenoid valve controls	Reach Cylinder	G1/4
B1	Retracting, retracting solenoid valve controls	Reach Cylinder	G1/4
A2	Right shifting, right shifting solenoid valve controls	Side-Shift Cylinder	G1/4
B2	Left shifting, left shifting solenoid valve controls	Side-Shift Cylinder	G1/4
A3	Backward tilting, backward tilting solenoid valve controls	Tilt Cylinder	G1/4
B3	Forward tilting, forward tilting solenoid valve controls	Tilt Cylinder	G1/4
P	Oil Inlet	Gear Pump	G1/2
T	Drainback	Tank	G1/2

7.4.3 Faults and Causes

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

7

7.4.4 Checking and Testing

Checking

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

Testing

- Switch off the power supply of the vehicle;
- Measure the resistance between solenoid valve coil end point A and B to identify if the coil is normal. (See Section 7.5.2)

7.4.5 Control Circuit Troubleshooting

Solenoid Valve Control Circuit (Figure 90409)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if the circuit between solenoid valve and controller is conducted.

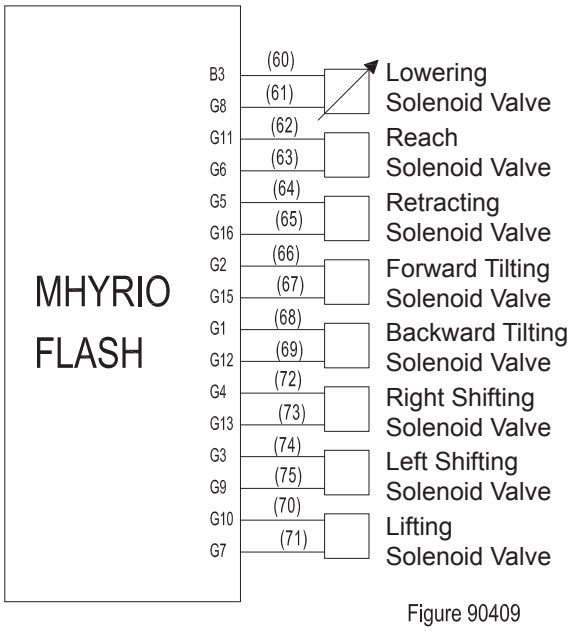


Figure 90409

7.5 Solenoid Valve (RVF/NRVF)

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.

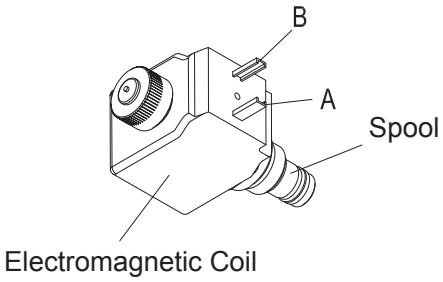


Figure 50410

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. 30 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

See Section 7.4.5 .

7.6 Multi-way Reversing Manual Valve (RV/NRV)

The valve rod is driven by lever to switch the ON and OFF of tubing within the valve body, thus to control the Lifting - Lowering, Forward Shifting - Retract, Tilting Forward - Tilting Backward and Left Shifting - Right Shifting of the vehicle.

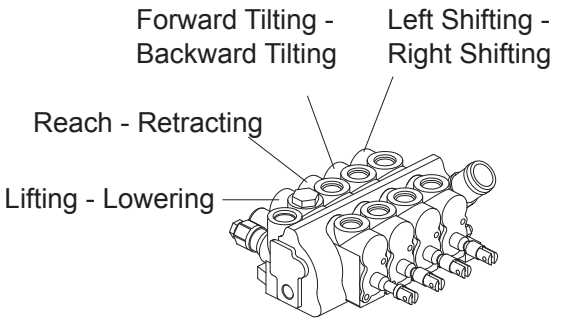


Figure 90411

7.6.1 Removal and Installation

Removal

Multi-way reversing manual valve is installed on the control panel.

- Unscrew the handle head on each control lever (9, Fig 90412);
- Remove front cover; (see Section 6.2)

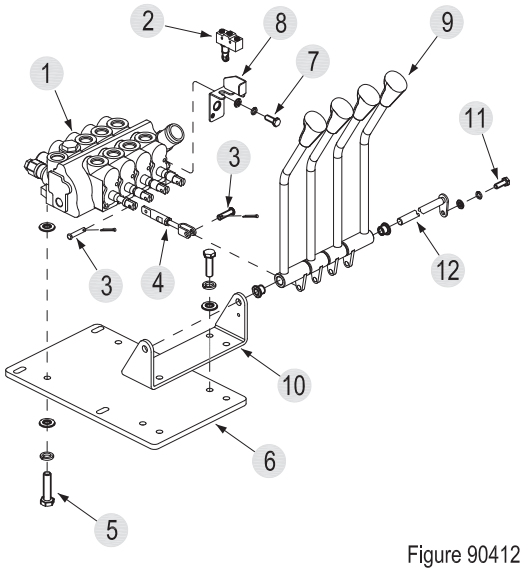


Figure 90412

- Remove the tubing on multi-way valve (1) and wiring harness on control switch (12);
- Remove the cotter pin on pin shaft (3), remove the connecting rod (4) between multi-way valve and control lever;
- Unscrew the two bolts (5) and remove the multi-way valve from the mounting plate (6);
- Unscrew the bolt (7) and remove the control switch mounting plate (8) from the multi-way valve;
- Unscrew the bolt (11), remove the main control pin shaft (12) and control lever (9) from the control lever mounting base (10).

Installation

- Install according to the reverse order of removal;

CAUTION

As some hydraulic oil will be lost when removing the manual multi-way solenoid valve, please add appropriate amount of hydraulic oil after the replacement is completed (see Section 2.2.3 for specifications and adding amount).

Adjustment

- Adjust the length of the connecting rod through operating the nut on the connecting rod (4). When the valve rod of multi-way valve is at original position, adjust the control lever (9) to a vertical position.

7.6.2 Interface Description

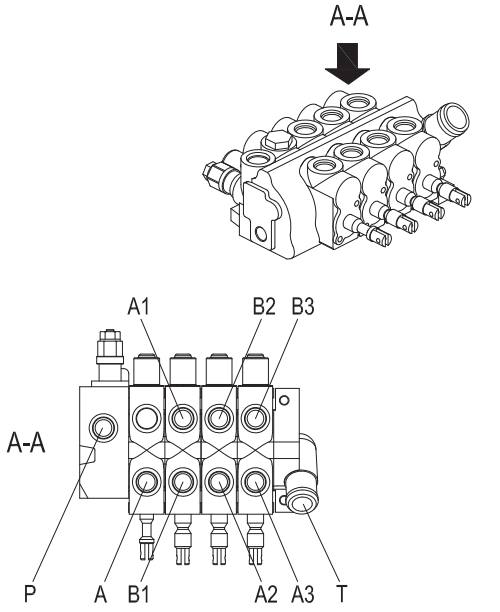


Figure 90413

7.6.3 Faults and Causes

1	Fault	The vehicle cannot perform the hydraulic control instructions
	Cause	a. Valve failure; b. Valve seat blocked by large impurities; c. External leakage: sealing damaged; poor threaded connection; valve body defects; d. High viscosity of hydraulic oil; e. High frequency of use, service life has expired already.
2	Fault	Slow pace of actuator
	Cause	a. Overflow valve in the connection block started; b. Valve seat leakage; c. Valve rod cannot push/pull to bottom; the channel cannot be fully opened; d. High viscosity of hydraulic oil; e. High frequency of use, service life has expired already.

Symbol	Interface Function	Connection Terminals	Interface Size
A	Lifting, lifting / lowering solenoid valve controls	Lift Cylinder	M20×1.5
A1	Reach, reach solenoid valve controls	Reach Cylinder	M20×1.5
B1	Retracting, retracting solenoid valve controls	Reach Cylinder	M20×1.5
A2	Backward tilting, backward tilting solenoid valve controls	Tilt Cylinder	M20×1.5
B2	Forward tilting, forward tilting solenoid valve controls	Tilt Cylinder	M20×1.5
A3	Right shifting, right shifting solenoid valve controls	Side-Shift Cylinder	M20×1.5
B3	Left shifting, left shifting solenoid valve controls	Side-Shift Cylinder	M20×1.5
P	Oil Inlet	Gear Pump	M22×1.5
T	Drainback	Tank	ø25

7.6.4 Checking and Testing

Checking

- Check the valve body for leakage and damage;
- Check the control switch connector for loosening or poor connection of leads.

Testing

- Switch off the power supply of the vehicle;
- Measure the ON/OFF of control switch and its circuit with a multimeter. (See Section 6.10.5)

7.7 Gear Pump

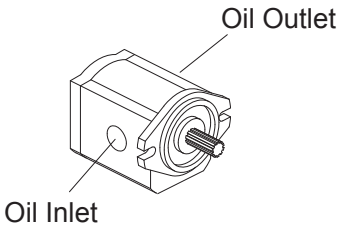


Figure 90414

7.7.1 Removal and Installation

See Section 7.2.1 .

7.7.2 Faults and Causes

1	Fault	Gear pump does not absorb oil or of small flow
	Cause	a. Insufficient hydraulic oil; b. Pump body defects; c. Poor sealing with leakage; d. Oil filter clogging; e. Oil temperature is too high.
2	Fault	Insufficient gear pump output pressure
	Cause	a. Pump body defects; b. Pump body with cracks or leaks; c. Impurities in the pump, oil filter clogging; d. Low viscosity of hydraulic oil; e. Oil temperature is too high; f. Pressure of relief valve adjusted too low or adjustment failure.
3	Fault	Too much vibration and noise
	Cause	a. Pump body defects; b. Gear pump inlet tubing diameter is too small; c. Oil filter clogging, or motor speed is too high; d. Motor and oil pump shaft misalignment.
4	Fault	Oil leaks
	Cause	a. Pump body defects; b. Seal skeleton spring off; c. Shaft sealing surface scratched.
5	Fault	Pump is not functioning properly or blocked
	Cause	a. Pump body defects; b. Pressure valve malfunction; c. Poor alignment of pump and motor coupling; d. Impurities in the pump.

7.7.3 Checking and Testing

Checking

- Check the pump body for leakage and damage;
- Check if the connection of pump and motor is normal, if oil inlet / outlet is connected reversely.

CAUTION

If the gear pump is found with failure, it is recommended to replace the gear pump directly.

7.8 Reach Cylinder

7.8.1 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.

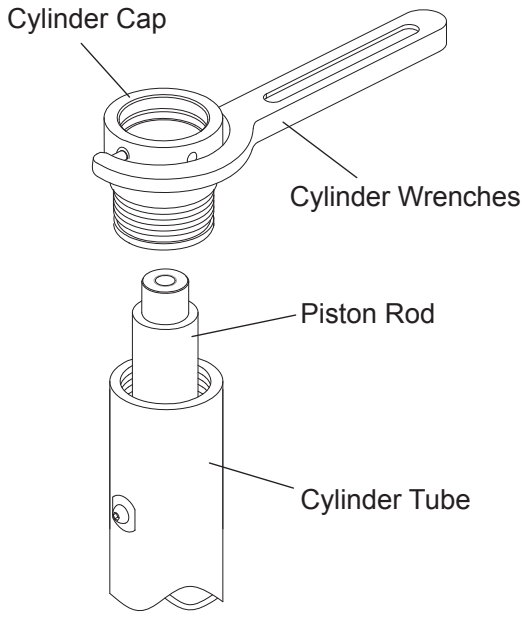


Figure 50402

* See Appendix A - Service Manual - Mast for the removal of lift cylinder, tilt cylinder and side shift cylinder.

7.8.2 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.

* See Appendix A - Service Manual - Mast for the installation of lift cylinder, tilt cylinder and side shift cylinder.

7.8.3 Removal and Installation

Cylinder is installed on the chassis and forward shift mast.(See Figure 90415)

- Shift the mast forward, block the truck wheel with a wooden wedge, press the emergency stop switch and disconnect the key switch;
- Remove the two tubings (6) from the forward shift cylinder (3);

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 the anchor bolt (1) underneath the chassis with socket wrench and pull out the pin shaft (2);
- Unscrew the anchor bolt (4) underneath the forward shift mast with socket wrench and pull out the pin shaft (5);
- Remove the forward tilt cylinder (3);
- Replace with new cylinder and install in reverse order;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency switch and turn on the key switch;
- Repeat reach 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.

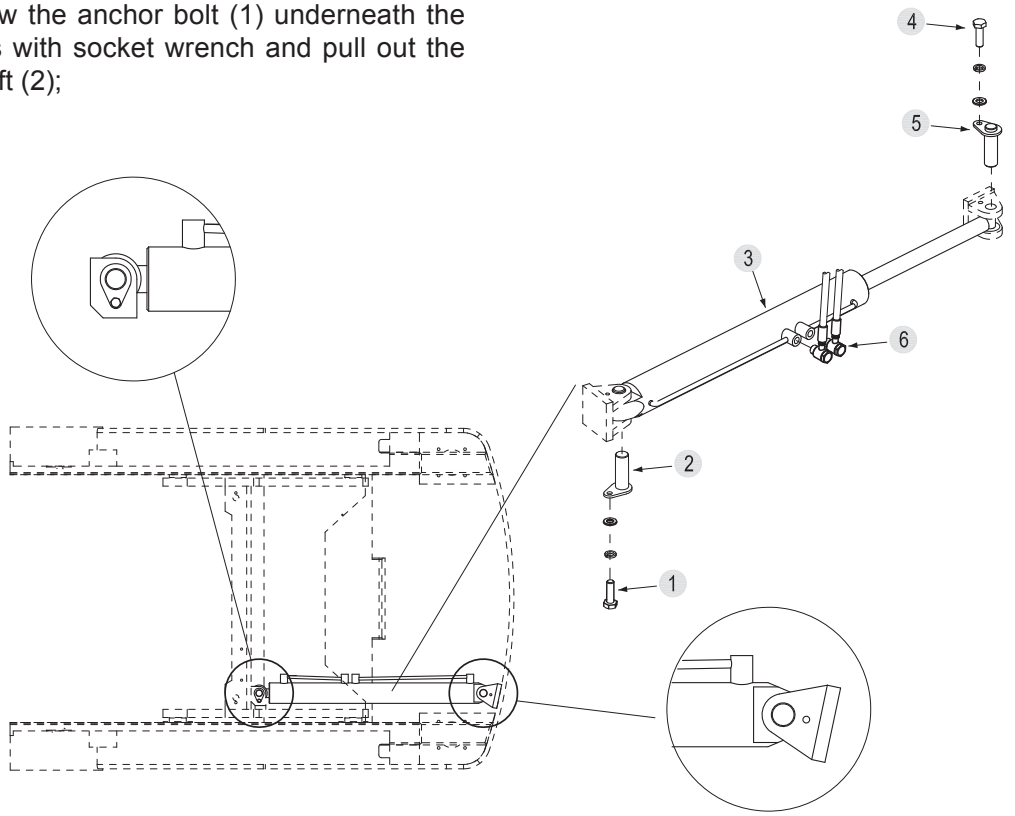


Figure 90415

7.8.4 Cylinder Maintenance

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 (5, Figure 90416) with cylinder wrench;
- Pull out the piston rod (1) from cylinder block (7);
- Remove the seal (9) and support ring (10) on the piston;
- Unscrew the lock screw (11) from the piston and unscrew the piston (8) from the piston rod (1);
- Remove the sleeve (15) and remove the two O-rings (3) inside it;
- Remove the cylinder cap (5) and remove its dust ring (2), O-rings (3), seal (4), O-ring (6) and O-ring (16);
- 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.*
- *When replacing or repairing the cylinder, please refill the lubricant through the grease nipples at both ends of the cylinder.*

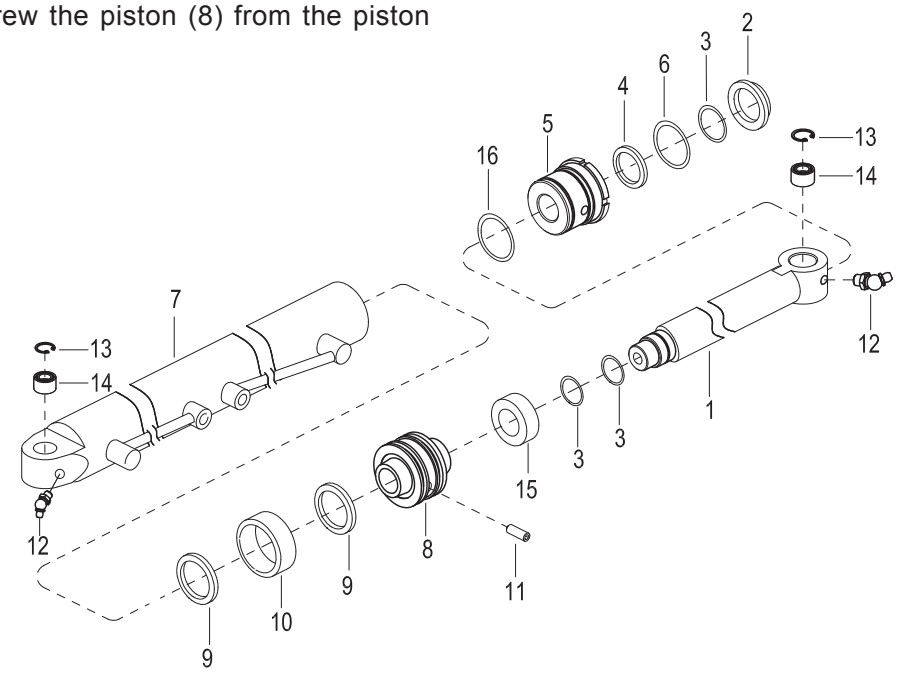
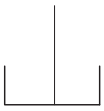
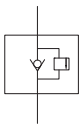
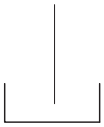
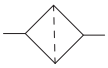
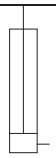
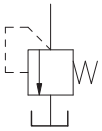
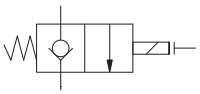
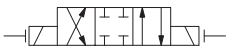
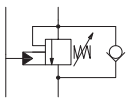
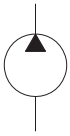


Figure 90416

7.9 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; (RVF/NRVF) a. Multi-way valve failure; (RV/NRV)	1. Check and clean the solenoid valve spool. 1. Check the multi-way manual valve and it installation.
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.

7.10 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)		Cylinder Double-acting direction
	Control line (Drain line)		Relief valve
	Connecting pipe		Solenoid Valve Two-way two-pass
	Port (Test port)		Solenoid Valve Three-way four-pass
	Motor		Balancing valve
	Hydraulic pump		Manual valve Three-way six-pass

7

8. ELECTRICAL SYSTEM

NOTE:

8.1 Controller

Controller Functions

Electrical control of this truck is mainly driven by controller, pump controller and steering controller.

RVF/NRVF

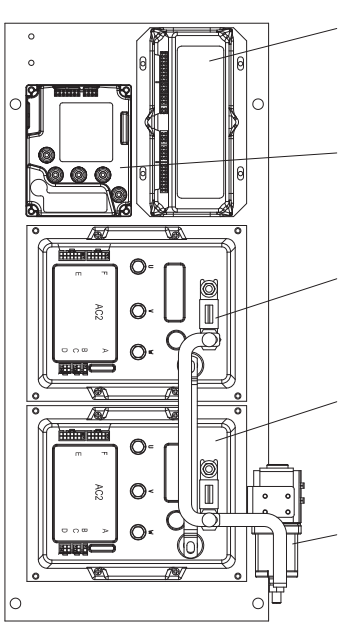


Figure 90501

RV/NRV

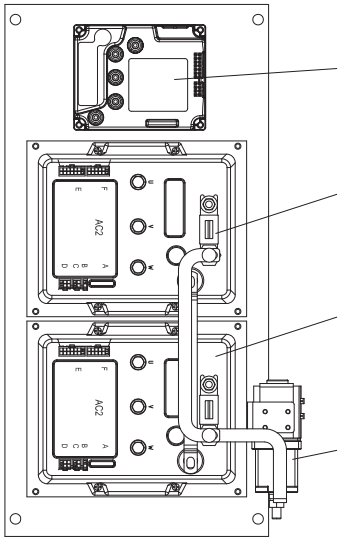


Figure 90502

- Controller:

  traction controller: mainly used for the control of drive motor

  Pump controller: mainly used for the control of pump motor

  Steering controller: mainly used for the control of steering motor

  SICOS controller: mainly used for the control of instrument communication

  MHYRIO FLASH controller: mainly used for the control of solenoid valves

- Other:

  Press button switches, drive speed sensor, steering speed sensor, DC-DC converter, limit switch, foot switch, height encoder, seat switch, etc.

8.1.1 Removal and Installation

Removal

- Remove front cover; (see Section 6.2)
- Remove the wiring harness, cables and copper strips on the controller;
- Unscrew the four screws (1) with a wrench and remove the traction controller (2);

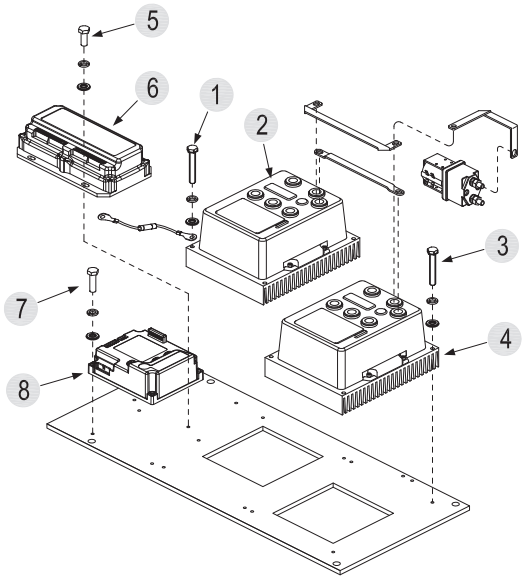


Figure 90503

- Unscrew the four screws (3) with a wrench and remove the pump controller (4);
- Unscrew the four screws (5) with a wrench and remove the solenoid valve controller (6);
- Unscrew the four screws (7) with a wrench and remove the steering controller (8).

Installation

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

8.1.2 Controller Interface Function

Traction Controller (AC2-TRACTION)

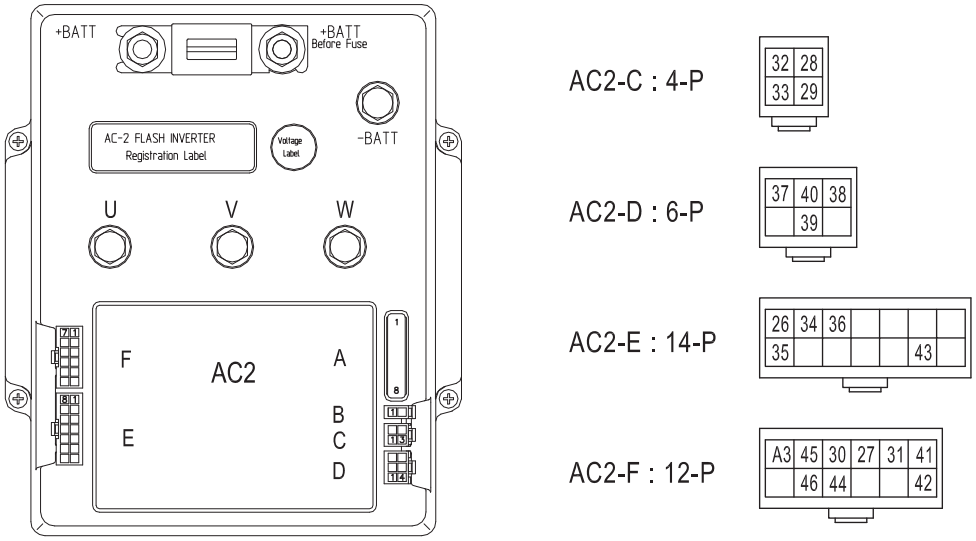


Figure 90504

A Interface (handheld unit communication interface)		
Pin No.	**Signal Name**	**Description**
A#1	PCLRXD	Positive serial reception.
A#2	NCLRXD	Negative serial reception.
A#3	PCLTXD	Positive serial transmission.
A#4	NCLTXD	Negative serial transmission.
A#5	GND	Negative console power supply.
A#6	+12V	Positive console power supply.
A#7	FLASH	It must be connected to A8 for the Flash memory programming.
A#8	FLASH	It must be connected to A7 for the Flash memory programming.

C Interface		
Pin No.	**Signal Name**	**Description**
C#1	CAN-L	Low level CAN-BUS voltage I/O. Connected to pump controller.
C#2	CAN-L-OUT	Low level CAN-BUS voltage I/O. Connected to instruments.
C#3	CAN-H	High level CAN-BUS voltage I/O. Connected to pump controller.
C#4	CAN-H-OUT	High level CAN-BUS voltage I/O. Connected to instruments.

D Interface		
Pin No.	**Signal Name**	**Description**
D#1	+5V/+12V	positive of encoder power supply.
D#2	GND	negative of encoder power supply.
D#3	A	phase A of encoder.
D#5	B	phase B of encoder.

E Interface		
Pin No.	**Signal Name**	**Description**
E#1	CPOT	Accelerator Pedal Enabling Switch Input.
E#2	PPOT	Accelerator Pedal Positive Electrode.
E#3	NPOT	Accelerator Pedal Negative Electrode.
E#8	CPOTB	Accelerator Pedal Voltage Sliding Side.
E#13	BACK.BACK	Electromagnetic Brake - Positive Electrode

F Interface		
Pin No.	**Signal Name**	**Description**
F#1	KEY	Connected to key switch, needs to connect a 6.3-10A fuse.
F#2	PLC	Main Contactor Coil Positive Electrode.
F#3	PBRAKE	Safety Pedal Positive Electrode.
F#4	SEAT	Safety Pedal Signal Input Port.
F#5	SAFETY	Safety Input.
F#6	PTHERM	Drive Motor Temperature Sensor Positive Electrode.
F#8	NLC	Main Contactor Coil Negative Electrode.
F#9	NBRAKE	Electromagnetic Brake - Negative Electrode.
F#12	NTHERM	Drive Motor Temperature Sensor Negative Electrode.

Terminal stud		
Pin No.	**Signal Name**	**Description**
-	-B	Negative of the battery.
-	+B	Positive of the battery.
-	FU, FV, FW	Connection bars of the three motor phases; follow this sequence and the indication on the motor.

Pump Controller (AC2-PUMP)

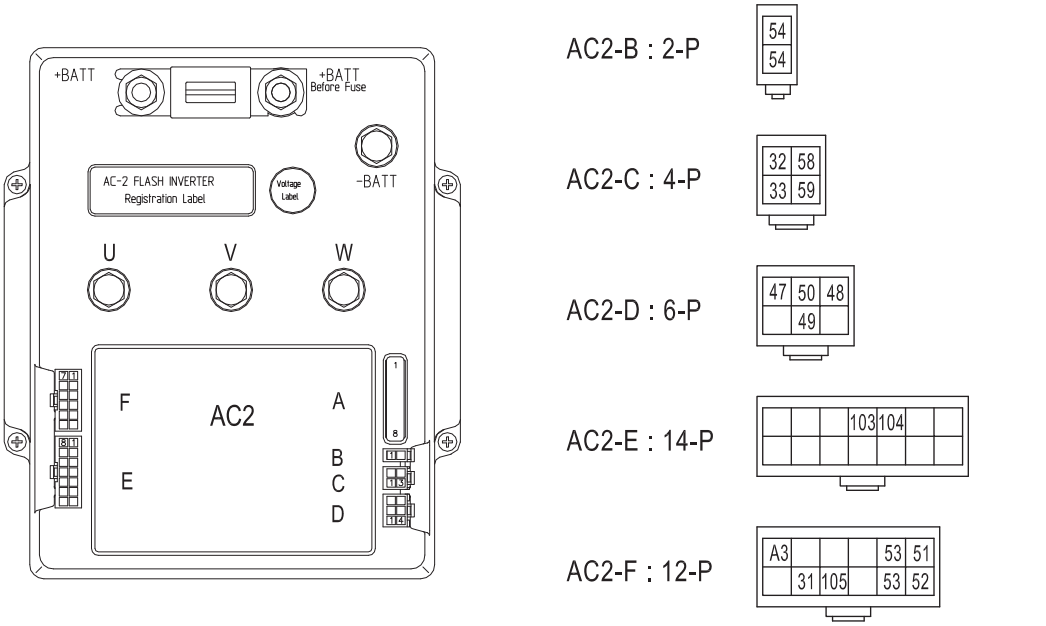


Figure 90505

A Interface (handheld unit communication interface)		
Pin No.	**Signal Name**	**Description**
A#1	PCLRXD	Positive serial reception.
A#2	NCLRXD	Negative serial reception.
A#3	PCLTXD	Positive serial transmission.
A#4	NCLTXD	Negative serial transmission.
A#5	GND	Negative console power supply.
A#6	+12V	Positive console power supply.
A#7	FLASH	It must be connected to A8 for the Flash memory programming.
A#8	FLASH	It must be connected to A7 for the Flash memory programming.

B Interface		
Pin No.	**Signal Name**	**Description**
B#1	MODE-OUT	+12V
B#2	MODE-IN	This input allows the customer to select the software for traction or lifting application. Configuration: MODE-IN: Open (not connected) Traction inverter Close (connected with CNB#1) Pump inverter.

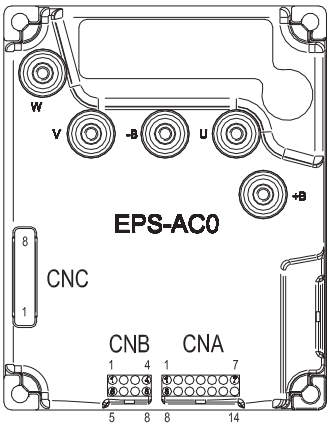
C Interface		
Pin No.	**Signal Name**	**Description**
C#1	CAN-L	Low level CAN-BUS voltage I/O. Connected to traction controller.
C#2	CAN-L-OUT	Low level CAN-BUS voltage I/O. Connected to solenoid valve controller (RVF/NRVF); Connected to steering controller(RV/NRV).
C#3	CAN-H	High level CAN-BUS voltage I/O. Connected to traction controller.
C#4	CAN-H-OUT	High level CAN-BUS voltage I/O. Connected to solenoid valve controller (RVF/NRVF); Connected to steering controller(RV/NRV).

D Interface		
Pin No.	**Signal Name**	**Description**
D#1	+5V/+12V	positive of encoder power supply.
D#2	GND	negative of encoder power supply.
D#3	A	phase A of encoder.
D#5	B	phase B of encoder.

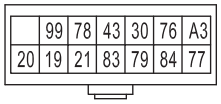
E Interface		
Pin No.	**Signal Name**	**Description**
E#4	CM	Public ports, providing start voltage.
E#5	LIFT ENABLE	Input for potentiometer lifting enable input; it is active HIGH.

F Interface		
Pin No.	**Signal Name**	**Description**
F#1	KEY	Connected to key switch, needs to connect a 6.3-10A fuse.
F#5	SAFETY	Security input, connected to F#11.
F#6	PTHERM	Pump Motor Temperature Sensor - Positive .
F#8	NLC	Main Contactor Coil - Negative Electrode.
F#9	NBRAKE	Cooling Fan - Negative Electrode.
F#11	GND	Connected to F#5 .
F#12	NTHERM	Pump Motor Temperature Sensor - Negative Electrode.

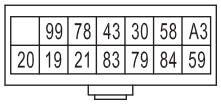
Steering Controller (EPS-AC0)



EPS-AC0-A : 14-P
(RVF/NRVF)



EPS-AC0-A : 14-P
(RV/NRV)



EPS-AC0-B : 8-P

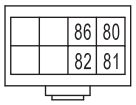


Figure 90506

A Interface		
Pin No.	**Signal Name**	**Description**
A#2	SW2	2nd Toggle Switch.
A#3	SW1	1st Toggle Switch.
A#4	NK1	Safety Switch Lower Voltage Point.
A#5	K1	Safety Switch Higher Voltage Point.
A#6	CANL	Can Bus Low. Connected to solenoid valve controller (RVF/NRVF); Connected to pump controller(RV/NRV).
A#7	KEY	Key Switch Signal Input Port.
A#8	CPOC2 / QL	Stepper Motor Q line.
A#9	CPOC1 / DL	Stepper Motor D line.
A#10	NPOC	Twin SP POT Negative Supply (GND).
A#11	GND	GND. Encoder Negative Supply
A#12	GND	GND. SW1 & SW2 Negative.
A#13	GND	GND. Motor Thermal Sensor Negative.
A#14	CANH	Can Bus High. Connected to solenoid valve controller (RVF/NRVF); Connected to pump controller(RV/NRV).

B Interface		
Pin No.	**Signal Name**	**Description**
B#3	THMOT	Motor Thermal Sensor (KTY84-130) Input.
B#4	+5VDC	Encoder Positive Supply.
B#7	CHB	phase B of encoder.
B#8	CHA	phase A of encoder.

C Interface (handheld unit communication interface)		
Pin No.	**Signal Name**	**Description**
C#1	PCLRXD	Positive serial reception.
C#2	NCLRXD	Negative serial reception.
C#3	PCLTXD	Positive serial transmission.
C#4	NCLTXD	Negative serial transmission.
C#5	GND	Negative console power supply.
C#6	+12V	Positive console power supply.
C#7	FLASH	It must be connected to A8 for the Flash memory programming.
C#8	FLASH	It must be connected to A7 for the Flash memory programming.

Terminal stud		
Pin No.	**Signal Name**	**Description**
-	-B	Negative of the battery.
-	+B	Positive of the battery.
-	FU, FV, FW	Connection bars of the three motor phases; follow this sequence and the indication on the motor.

Instrument (SICOS)

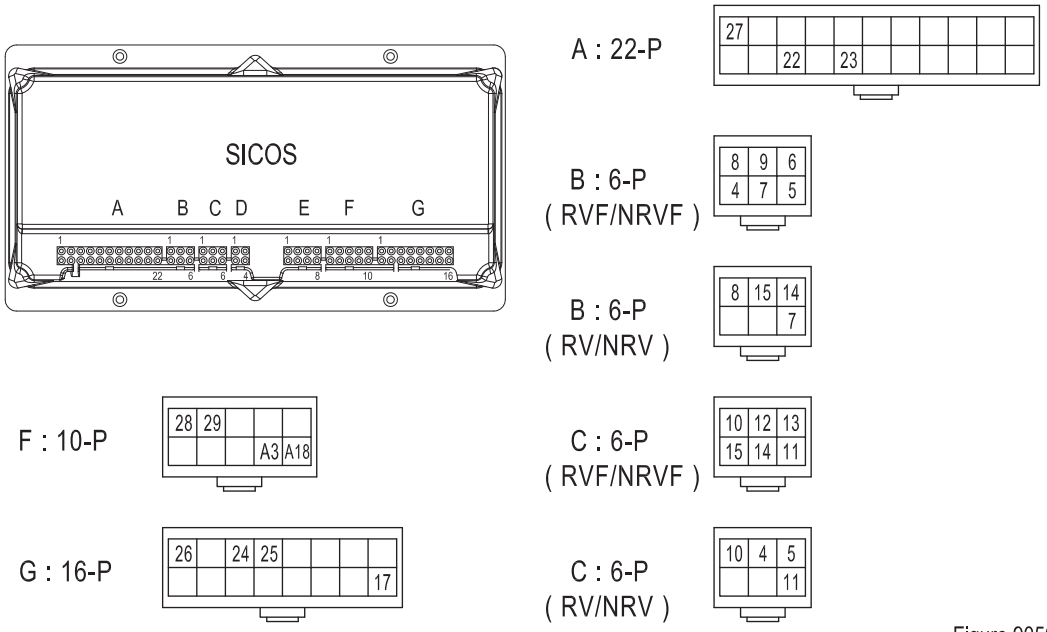


Figure 90507

A Interface		
Pin No.	**Signal Name**	**Description**
A#1	-	Safety pedal communication interface, connected to traction controller.
A#14	-	Seat Switch Signal Input Port.
A#16	-	Seat Switch - Positive Electrode, +48V.

B Interface (RVF/NRVF)		
Pin No.	**Signal Name**	**Description**
B#1	-	Lifting / Lowering Signal Input Port.
B#2	-	Lifting / Lowering Potentiometer Sliding Access Port.
B#3	-	Lifting / Lowering, Forward / Reverse - Negative Electrode.
B#4	-	Forward / Reverse Signal Input Port.
B#5	-	Forward / Reverse Potentiometer Sliding Access Port.
B#6	-	Lifting / Lowering, Forward / Reverse - Positive Electrode, +5V

B Interface (RV/NRV)		
Pin No.	**Signal Name**	**Description**
B#1	-	Lifting Signal Input Port.
B#2	-	Side Shift Signal Input Port.
B#3	-	Side Shift - Positive Electrode, +5V.
B#6	-	Lifting - Negative Electrode.

C Interface (RVF/NRVF)		
Pin No.	**Signal Name**	**Description**
C#1	-	Tilting Signal Input Port.
C#2	-	Tilting Potentiometer Sliding Access Port.
C#3	-	Tilting, Translation - Positive Electrode, +5V.
C#4	-	Translation Signal Input Port.
C#5	-	Translation Potentiometer Sliding Access Port.
C#6	-	Tilting, Translation - Negative Electrode.

C Interface (RV/NRV)		
Pin No.	**Signal Name**	**Description**
C#1	-	Tilting Signal Input Port.
C#2	-	Forward / Reverse Signal Input Port.
C#3	-	Forward / Reverse - Positive Electrode, +5V.
C#6	-	Tilting - Negative Electrode.

F Interface		
Pin No.	**Signal Name**	**Description**
F#1	-	Low voltage terminal, connected to traction controller.
F#2	-	High voltage terminal, connected to traction controller.
F#9	-	Key Switch Signal Input Port.
F#10	-	Power Supply - Negative Electrode.

G Interface		
Pin No.	**Signal Name**	**Description**
G#1	-	Safety pedal communication interface, connected to traction controller.
G#3	-	Forward Signal Input Port.
G#4	-	Reverse Signal Input Port.
G#16	-	Forward / Reverse Switch - Positive Electrode, +48V.

Solenoid Valve Controller (MHYRIO FLASH) RVF/NRVF

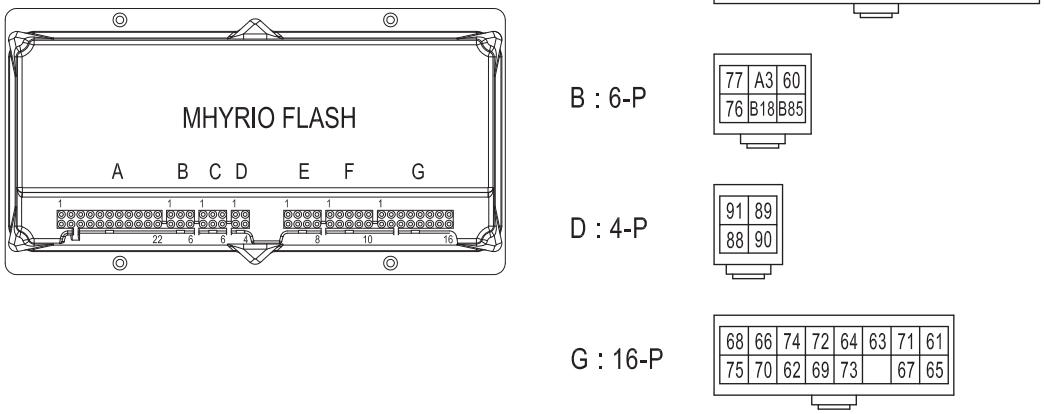


Figure 90508

A Interface		
Pin No.	**Signal Name**	**Description**
A#2	I3	Reset Switch Signal Input Port.
A#4	I5	Forward Shifting Limit Switch Signal Input Port.
A#6	PEV	I3/I5 Positive Electrode.
A#10	CANH	Can Bus High.Connected to pump controller.
A#22	CANL	Can Bus Low.Connected to pump controller.

B Interface		
Pin No.	**Signal Name**	**Description**
B#1	CANH	Can Bus High.Connected to steering controller.
B#2	KEY	Key Switch Signal Input Port.
B#3	PEVS	Lowering Solenoid Valve Coil - Positive Electrode.
B#4	CANL	Can Bus Low.Connected to steering controller.
B#5	-BATT	Power Supply - Negative Electrode.
B#6	PAUX	Power Supply - Positive Electrode.

D Interface		
Pin No.	**Signal Name**	**Description**
D#1	GND	negative of encoder power supply.
D#2	A	phase A of height encoder.
D#3	+12V	positive of encoder power supply.
D#5	B	phase B of height encoder.

G Interface		
Pin No.	**Signal Name**	**Description**
A#1	NEV8	Backward Tilting Solenoid Valve Coil - Negative Electrode.
A#2	NEV7	Forward Tilting Solenoid Valve Coil - Negative Electrode.
A#3	NEV6	Left Shifting Solenoid Valve Coil - Negative Electrode.
A#4	NEV5	Right Shifting Solenoid Valve Coil - Negative Electrode.
A#5	NEV4	Retracting Solenoid Valve Coil - Negative Electrode.
A#6	NEV3	Forward Shifting Solenoid Valve Coil - Negative Electrode.
A#7	NEV2	Lifting Solenoid Valve Coil - Negative Electrode.
A#8	NEV1	Lowering Solenoid Valve Coil - Negative Electrode.
A#9	PEV	Left Shifting Solenoid Valve Coil - Positive Electrode.
A#10	PEV	Lifting Solenoid Valve Coil - Positive Electrode.
A#11	PEV	Forward Shifting Solenoid Valve Coil - Positive Electrode.
A#12	PEV	Backward Tilting Solenoid Valve Coil - Positive Electrode.
A#13	PEV	Right Shifting Solenoid Valve Coil - Positive Electrode.
A#15	PEV	Forward Tilting Solenoid Valve Coil - Positive Electrode.
A#16	PEV	Retracting Solenoid Valve Coil - Positive Electrode.

8.2 Fuse

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

Function		Status		
		Fuse 1	Fuse 2	Fuse 3
Fuse 1 300A		×	O	O
Fuse 2 300A		O	×	O
Fuse 3 10A		O	O	×
1	Drive	×	×	×
2	Hydraulic action	×	×	×
3	Steering	×	×	×
4	Cooling Fan	O	O	×
5	Instrument	×	×	×
6	Horn	O	O	×
7	Warning Light	O	O	×
8	Headlight	O	O	×

× : Failure
O : Normal

8.2.1 Location of Fuses

Fuse 1-2: installed on controllers

Fuse 3: installed on main harness

★ Fuse position in electrical schematic diagram

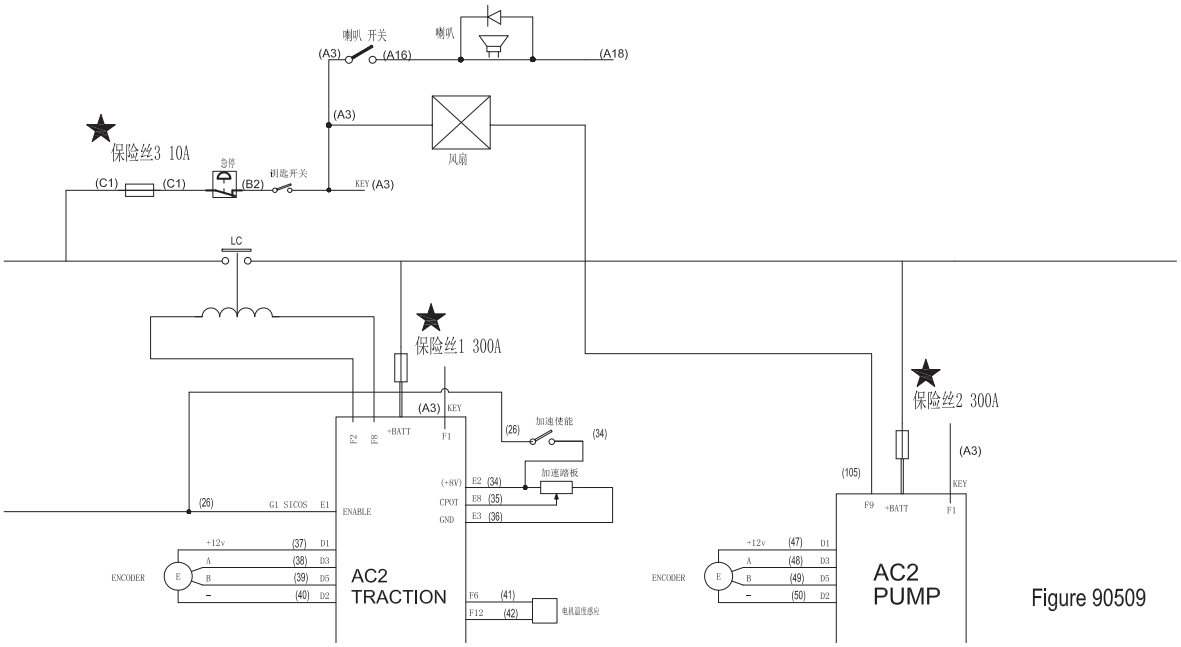


Figure 90509

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 Main Contactor

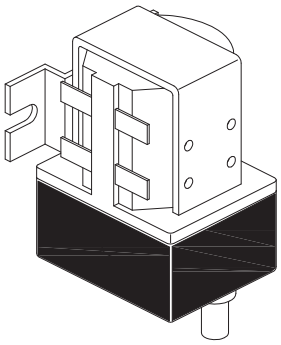


Figure 20506

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

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

8.3.1 Removal and Installation

Main contactor is installed on the electrical mounting plate.

- Remove the cables and wiring harness on the main contactor, and remove the main contactor from the electrical mounting plate;
- Unscrew the two fastening screws (4) with a Phillips screwdriver and remove the top cover of contactor (3);
- Remove the auxiliary contact assembly (2), replace the assembly or coil (6); (when replacing the contacts, replace in pairs)

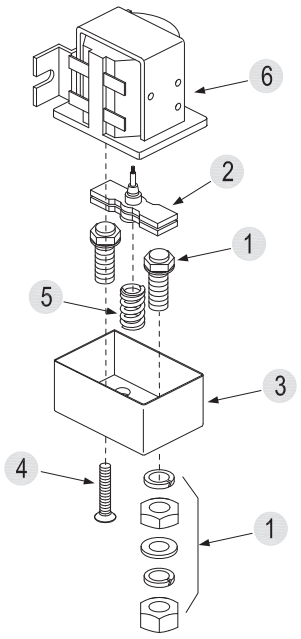


Figure 20507

- After the replacement, re-install in reverse order and tighten the two fastening screws (2);
- Following the reverse order of step 1, fasten the main contactor onto the electrical mounting plate, and re-connect it according to the original connection methods.

8.3.2 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.

8.3.3 Checking and Testing

Visual Inspection

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

Coil Checks

- Disconnect the cables on the contactor;
- Check the resistance of the coil with a multimeter: measurement method is as shown in Figure 20508;
- Identify if the contactor is normal according to the readings of resistance on the multimeter. As shown in the following table:

Resistance Measurement	Judgment
Approx. 145 Ω	Normal
0 Ω	Coil shorting (replace the contactor)
∞ Ω	Coil breaking (replace the contactor)

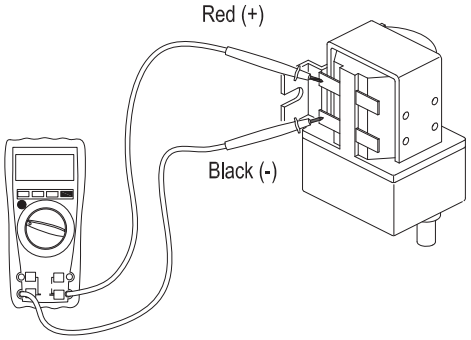


Figure 20508

Contact Checks

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

8.3.4 Control Circuit Troubleshooting

Main Contactor Control Circuit (Figure 90510)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #45/#46 circuit (circuit between contactor and drive controller) is conducted.

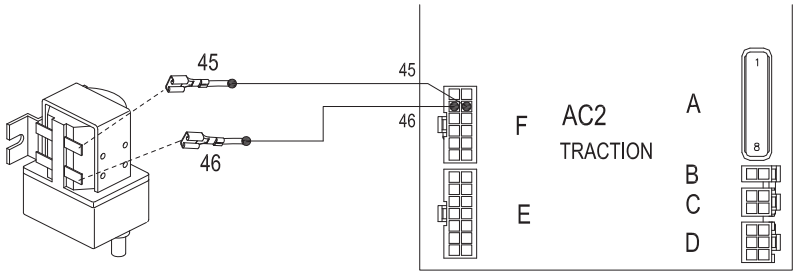


Figure 90510

8.4 Height Display (RVF/NRVF)

RVF/NRVF premium grade truck model can select the optional height display function. This function is primarily achieved through height encoder (5), steel wire rope (7), reset switch (9) and several other core components.

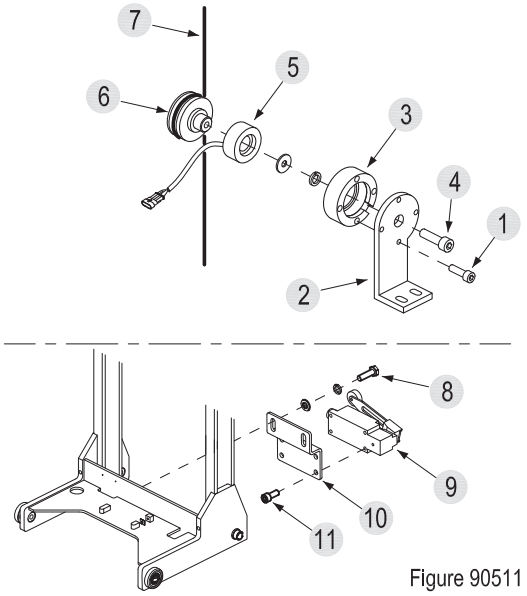


Figure 90511

8.4.1 Removal and Installation

Height Encoder Removal

Height encoder is installed on the horizontal beam of outer mast.

- Disconnect the height encoder (5) connector;
- Unscrew the four bolts (1) on the encoder mounting plate (2) with a wrench and remove the encoder seat (3);
- Unscrew the screw (4) with a wrench and remove the height encoder (5) and encoder roller (6) from the encoder seat (5).

Reset Switch Removal

Reset switch is installed on the horizontal beam of outer mast.

- Raise the middle mast and inner mast with lifting equipment;

CAUTION

Make sure the lifting equipment is solid and secure, and the load capacity should be greater than the total weight of the vehicle, so that to prevent the maintenance personnel from the risk of getting hurt during removal and installation operations under the mast.

- Disconnect the reset switch (9) connector;
- Unscrew the four bolts (8) and remove the switch mounting plate (10);
- Unscrew the four screws (11) and remove the reset switch (9).

Installation

- Install according to the reverse order of removal;

8.4.2 Faults and Causes

1	Fault	Under the lifting status of mast, the instrument does not display height or displays abnormally
	Cause	a. Height encoder failure; b. Encoder circuit failure.
2	Fault	The mast is not lifted, but the instrument reading of height is not 0, and displays fault code of “ENCODER RESET”
	Cause	Reset switch or its circuit failure.

8.4.3 Checking and Testing

Checking

- Check if the appearance of height encoder, reset switch and their wiring harness are in good condition, and if the connectors are connected securely;
- Check if the height encoder, encoder roller and wire rope are installed properly.

Testing

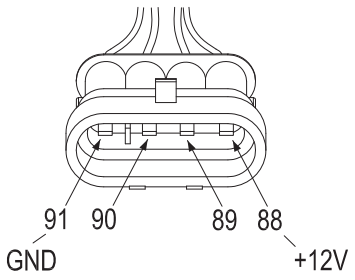


Figure 90512

- The vehicle is powered on, measure the voltage between pin connector (88#) and (91#) with a multimeter, normally should be 12V.

8.4.4 Control Circuit Troubleshooting

Height Display Control Circuit (Figure 90513)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #88/#89/#90/#91 circuit (circuit between encoder and solenoid valve controller) is conducted.

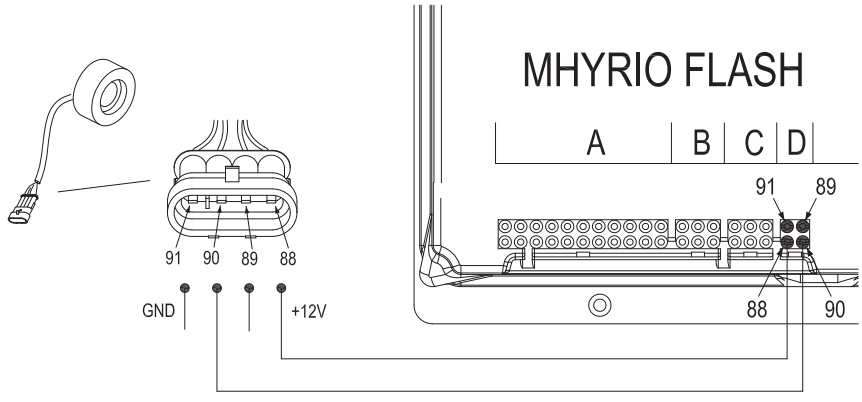


Figure 90513

* See Section 8.5 for reset switch wiring and control circuit.

8.5 Limit Switch

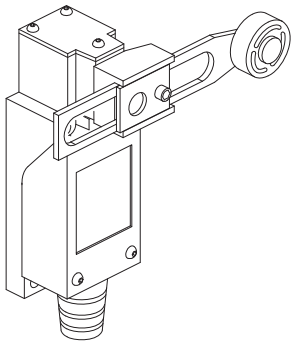


Figure 50511

Limit switch is variable roller lever type. By function:

- Reset Switch (RVF/NRVF)
- Lifting Speed Reduction Switch

8.5.1 Removal and Installation

- Unscrew three fixing screws (1), then the limit switch cover (3) can be removed from the limit switch seat (2);
- Put the wiring harness through the wire protective ring (4) and install the connector to terminals on switch seat (2); (see Section 8.4.2 for the connection methods of three switches)

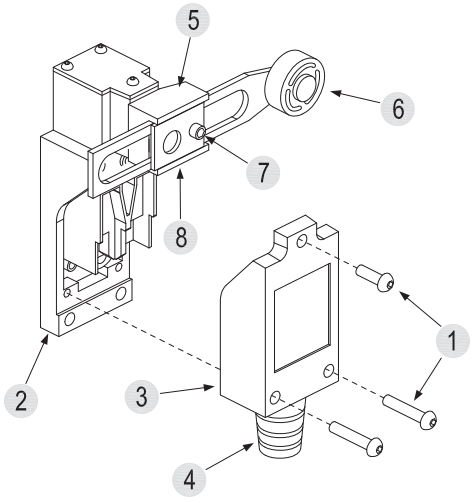


Figure 50512

- Re-install the switch cover (3) onto the switch seat (2) and tighten the fixing screws (1).

CAUTION

When installing waterproof rubber ring, make sure it is fully seated in the mounting slot of the switch seat.

Adjustment

- The direction of roller lever seat (5) can be adjusted through adjusting the adjustment screw (8);
- The sensing distance of roller lever (6) can be adjusted through adjusting the adjustment screw (7).

8.5.2 Connection Mode

Limit switch has 4 terminals, one pair is normally-opened (NO) and the other pair is normally-closed (NC), 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.

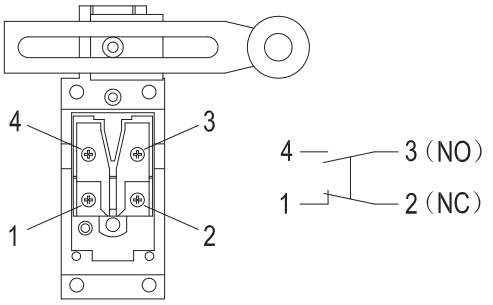


Figure 50513

Reset Switch (RVF/NRVF)

Normally-open (N0):

Terminal (3) and Terminal (4) for connection of wiring harness connector to switch base

Lifting Speed Reduction Switch

Normally-open (N0):

Terminal (3) and Terminal (4) for connection of wiring harness connector to switch base

8.5.3 Faults and Causes

Reset Switch (RVF/NRVF)

1	Fault	The mast is not lifted, but the instrument reading of height is not 0
	Cause	Reset switch or its circuit failure

Lifting Speed Reduction Switch

1	Fault	When speed reduction switch is activated, the speed is not reduced
	Cause	Speed reduction switch is not reset and always in a closed state.

8.5.4 Checking and Testing

Checking

- Check the limit switch for damage and check the roller for deformation;
- Check if the handwheel is working smoothly and if there is foreign body blockage.

Testing

- Enter TESTER Menu to check if each limit switch is working properly; (see Section 8.12)
- Turn the key switch to "OFF", remove key; pull out the battery plug and switch off the power supply.
- Check the ON/OFF normally-open (NO) terminal with a multimeter: with handwheel at natural position, Terminal (3) and (4) not conducted; toggle the handwheel, Terminal (3) and (4) conducted.
- Check the ON/OFF normally closed (NC) terminal with a multimeter: with handwheel at natural position, Terminal (1) and (2) conducted; toggle the handwheel, Terminal (1) and (2) not conducted.

8.5.5 Control Circuit Troubleshooting

Reset Switch Control Circuit (Figure 90514)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #57/#87 circuit (circuit between reset switch and solenoid valve controller) is conducted.

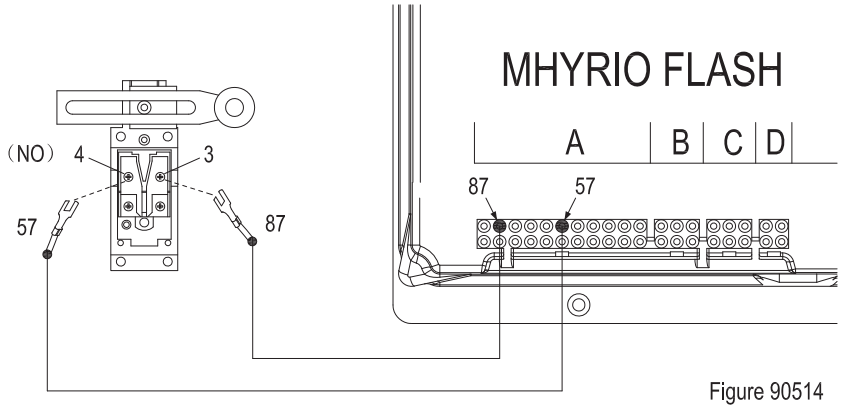


Figure 90514

Lifting Speed Reduction Switch Control Circuit (Figure 90515)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #103/#104 circuit (circuit between lifting speed reduction switch and pump controller) is conducted.

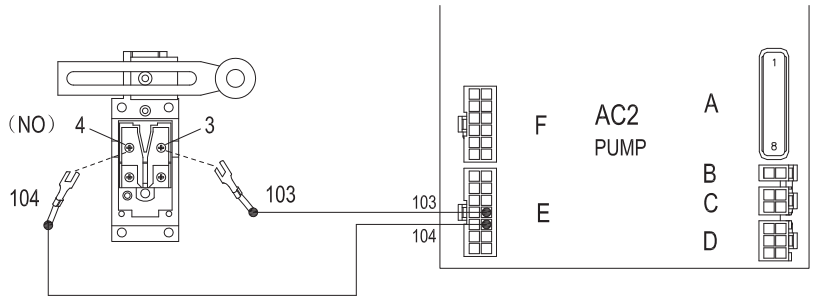


Figure 90515

8.6 Accelerator Pedal

8.6.1 Removal and Installation

Removal

See Section 3.1 for mounting position of accelerator pedal.

- Unscrew the four screws used to fix the pedal and remove the pedal;
- Disconnect the accelerator pedal connector;
- Unscrew the two bolts with wrench and remove the accelerator pedal from the chassis.

Installation

- Install according to the reverse order of removal.

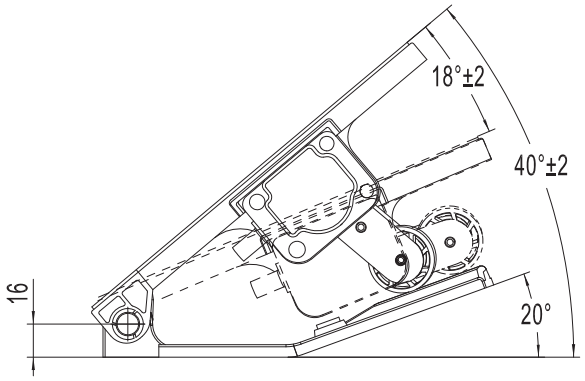
8.6.2 Faults and Causes

1	Fault	Press the accelerator pedal, operate travel switch, the vehicle cannot go forward or backward
	Cause	a. Accelerator pedal failure; b. Accelerator pedal circuit not conducted.
2	Fault	Press the accelerator pedal, travel switch not operated, the vehicle goes forward or backward automatically
	Cause	Accelerator Pedal Failure

8.6.3 Checking and Testing

Checking

- Check if the accelerator pedal is reset properly, also check for damage;



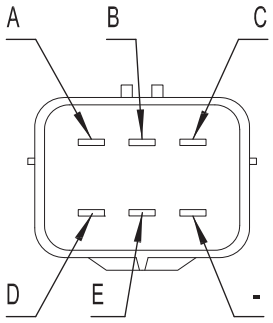


Figure 90516

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

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

Testing

- Enter TESTER Menu through instrument or handheld unit to check the status of the switches:
  "ENABLE SWITCH". Press the accelerator pedal, if the display does not change, it indicates there is failure with the accelerator pedal or its circuit; (see Section 8.12)
- Turn off the vehicle to check the accelerator pedal and its wiring harness. (See Figure 90516)
- Provide a voltage of 12V between accelerator pedal harness connectors (A) and (C), check the voltage at each port of the wiring harness with a multimeter;
- Place the accelerator pedal at original position Measure the voltage between the interfaces with a multimeter.
  as shown in the following table:

Accelerator pedal at original position	
Connection interface	**Voltage Measurement**
A-C	12 V
A-B	0 V
A-E	12 V
B-C	0 V

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

Press the accelerator pedal	
Connection interface	**Voltage Measurement**
A-C	12 V
A-B	Changing within the range of 0V to 9V with the level of pressing
A-E	12 V
B-C	0 V

8.6.4 Control Circuit Troubleshooting

Accelerator Pedal Control Circuit (Figure 90517)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #26/#34/#35/#36 circuit (circuit between accelerator pedal and drive controller) is conducted.

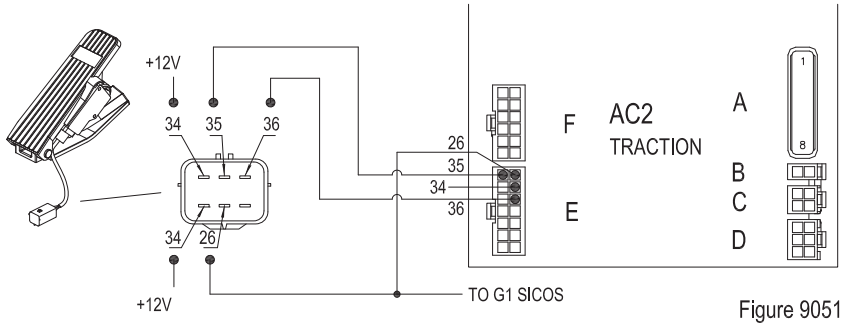


Figure 90517

8.7 Foot Switch

8.7.1 Removal and Installation

Removal

See Section 3.1 for mounting position of foot switch.

- Unscrew the four screws used to fix the pedal and remove the pedal;
- Disconnect the foot switch connector;
- Unscrew the screws (1) at both sides of the foot switch and remove the foot cover (2);
- Unscrew the fastening nut and screw (3), and remove the foot switch from the pedal (4).

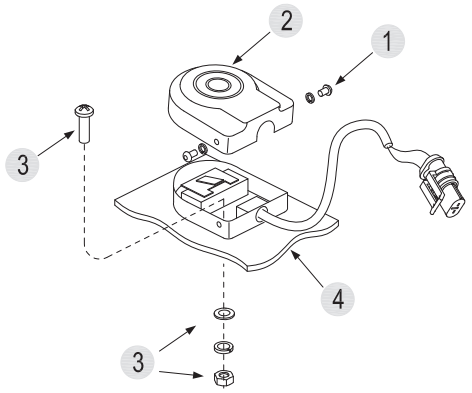


Figure 90518

Installation

- Install according to the reverse order of removal.

CAUTION

Please pay attention to protect the cables from being damaged.

8.7.2 Faults and Causes

1	Fault	Foot switch not pressed, the vehicle can still travel or lift (foot switch indicator on the instrument is off)
	Cause	a. Foot switch failure; b. Foot switch shorted (short circuit).
2	Fault	Foot switch pressed, the vehicle cannot travel (foot switch indicator on the instrument is on)
	Cause	a. Foot switch failure; b. Foot switch with broken circuit.

8.7.3 Checking and Testing

Checking

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

Testing

- Enter TESTER Menu to check the status of the switch: “DEADMAN SWITCH”, press the foot switch, if the display does not change, then it indicates the foot switch or its circuit failure; (see Section 8.12)
- Check if the foot switch circuit is conducted;
- Carry out ON/OFF test to foot switch with a multimeter: Reset the foot switch (original position), the circuit is disconnected; press the foot switch, the circuit is conducted.

8.7.4 Control Circuit Troubleshooting

Foot Switch Control Circuit (Figure 90517)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #27/#30 circuit (circuit between foot switch and drive controller) is conducted.

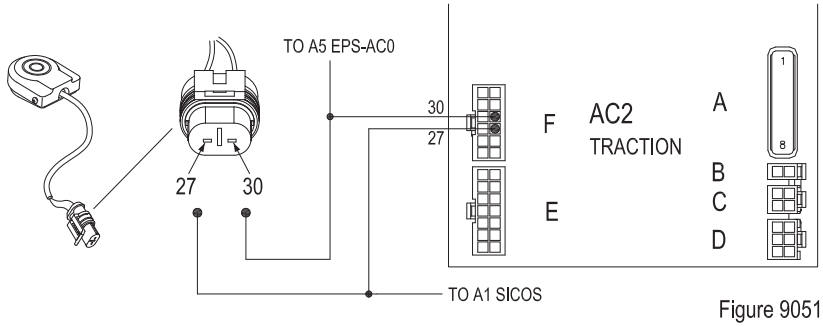


Figure 90519

8.8 DC-DC Converter

DC-DC converter provides converted voltage for warning light and headlights.

Working performance: 48V DC to 12V

8.8.1 Removal and Installation

Removal

- Remove front cover; (see Section 6.2)
- Disconnect the connection between DC-DC converter and main wiring harness;
- Unscrew the four screws (1) with a wrench and remove the converter (2).

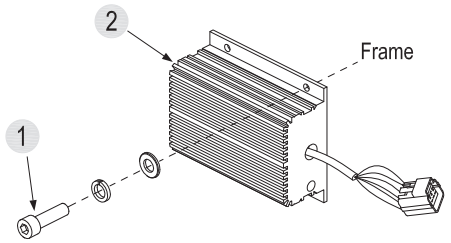


Figure 90520

Installation

- Install according to the reverse order of removal.

8.8.2 Faults and Causes

1	Fault	Turn on the warning light/headlight switch, the warning light/headlights won't light up
	Cause	a. DC-DC converter failure; b. DC-DC converter circuit not conducted.

8.8.3 Checking and Testing

Checking

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

Testing

- Check if the converter circuit is conducted;
- Provide a voltage of 48V between converter interfaces 3 and 18:
  if there is voltage output of 12V between interfaces 93 and 94, the converter is working properly;
  if the output voltage is not 12V, the converter needs to be replaced.

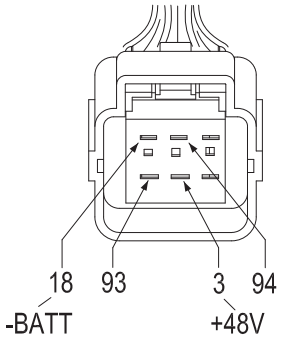


Figure 90521

8.8.4 Control Circuit Troubleshooting

DC-DC Converter Control Circuit (Figure 90522)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #3/#18/#93/#94 circuit (circuit where headlight locates) is conducted.

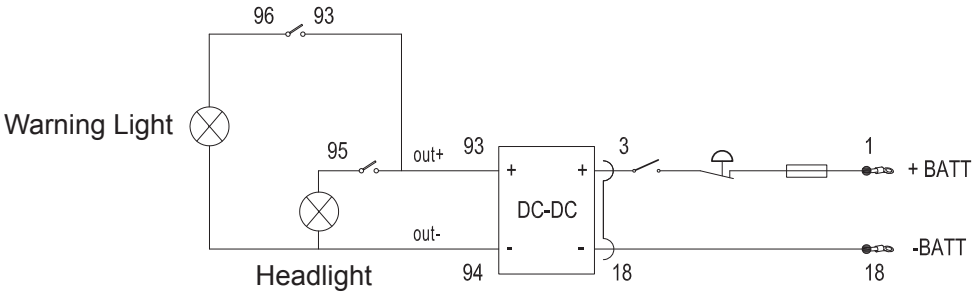


Figure 90522

8.9 Warning Light / Headlight

This truck is installed with one warning light and two headlights on overhead guard.
See Section 3.1

8.9.1 Removal and Installation

Removal

- Disconnect warning light/headlight connectors;
- Remove the warning light/headlights from the overhead guard.

Installation

- Install according to the reverse order of removal.

8.9.2 Faults and Causes

1	Fault	Turn on the warning light/headlight switch, the warning light/headlights won't light up
	Cause	a. Warning light / headlight failure; b. Warning light / headlight circuit not conducted.

8.9.3 Checking and Testing

Checking

- Check if the appearance of warning light / headlight and its wiring harness are in good condition, and if the connectors are connected securely.

Testing

- Check if warning light / headlight circuit is conducted;
- Energize the warning light / headlights with a voltage of 12V:
  If the light is on, then it is normal;
  if the light is not lit, then the light is faulty.

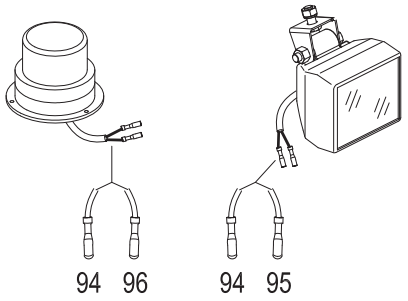


Figure 90523

8.9.4 Control Circuit Troubleshooting

Light Control Circuit (Figure 90522)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #94/#96 circuit (circuit where warning light locates) is conducted.
- Check if #94/#95 circuit (circuit where headlight locates) is conducted.

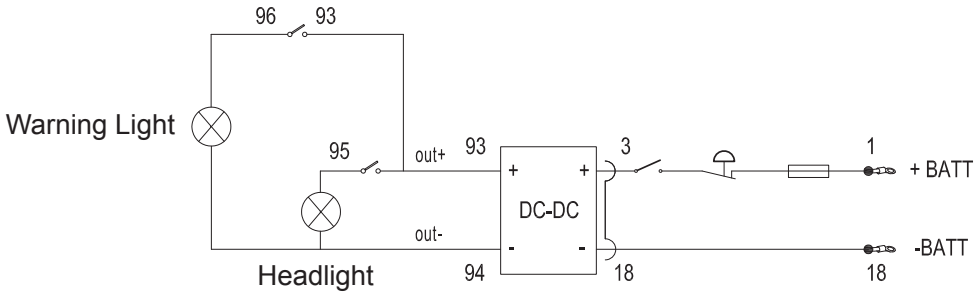


Figure 90522

8.10 Cooling Fan

This truck has two cooling fans, one is installed on the side of engine hood, the other is installed under the cooling aluminum plate of controller. See Section 3.1 for mounting positions.

8.10.1 Removal and Installation

Removal

- Disconnect the cooling fan connector;
- Unscrew the four fastening screws and remove the fan.

Installation

- Install according to the reverse order of removal.

8.10.2 Faults and Causes

1	Fault	Start the truck, the fan at engine hood does not turn
	Cause	a. Fan failure; b. Cooling fan circuit not conducted; c. Fan blocked by foreign bodies inside.

* The fan at the controller won't start when the vehicle is started, only when the temperature of the controller reaches 46 degrees, the fan will then be running.

8.10.3 Checking and Testing

Checking

- Check the cooling fan for blockage of foreign bodies;
- Check if the appearance of cooling fan and its wiring harness are in good condition, and if the connectors are connected securely.

Testing

- Check if the cooling fan circuit is conducted;
- Energize the cooling fan and provide it with a voltage of 48V:
  If the fan turns, it is normal;
  if it does not turn, it needs to be replaced.

8.10.4 Control Circuit Troubleshooting

Fan (at engine cover) Control Circuit (Figure 90524)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check the positive and negative electrodes of the cooling fan circuit are conducted.

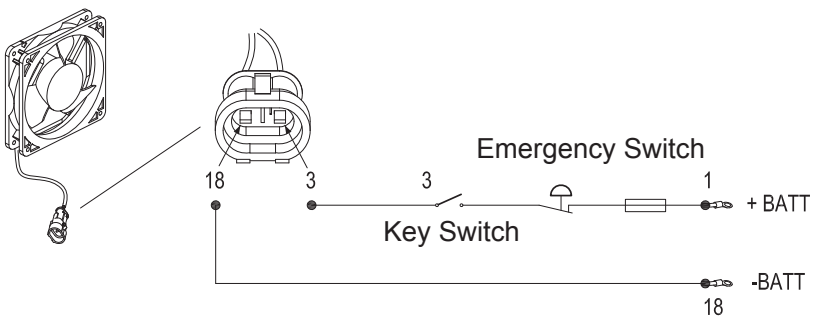


Figure 90524

Fan (at Controller) Control Circuit (Figure 90527)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if the #3/#105 circuit (circuit between fan and pump controller) is conducted.

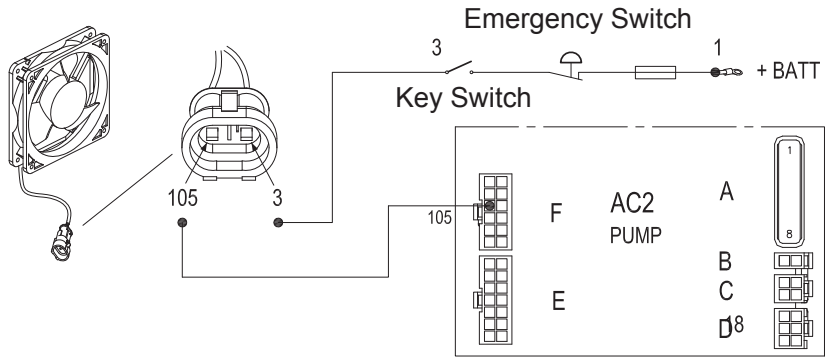


Figure 90527

8.11 Seat Switch

Seat switch is mounted under the seat.

8.11.1 Removal and Installation

Removal

- Disconnect the connections between seat switch and main wiring harness;
- Remove the seat; (see Section 4.4)
- Remove the seat switch under the seat.

Installation

- Install according to the reverse order of removal.

8.11.2 Faults and Causes

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

8.11.3 Checking and Testing

Checking

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

Testing

- Enter TESTER Menu to check the status of the switch:
  press the seat switch, if the display does not change, then it indicates the seat switch or its circuit failure; (see Section 8.12)
- Check if the seat switch circuit is conducted;
- Carry out ON/OFF test to seat switch with a multimeter: Reset the seat switch (original position), the circuit is disconnected; press the seat switch, the circuit is conducted.

8.11.4 Control Circuit Troubleshooting

Seat Switch Control Circuit (Figure 90525)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #22/#23 circuit (circuit between seat switch and instrument controller) is conducted.

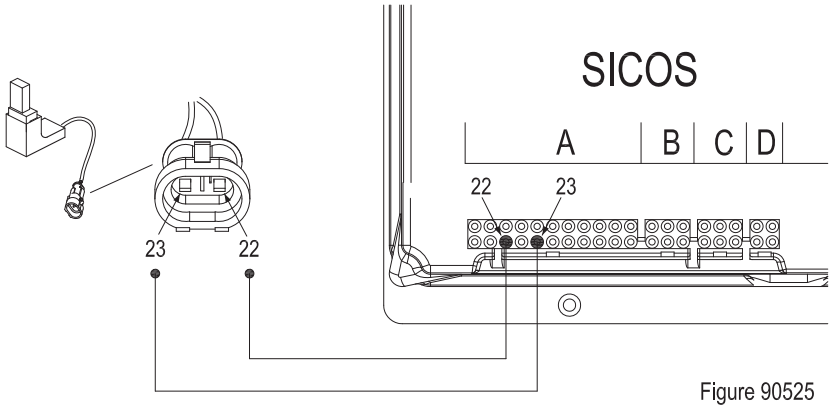


Figure 90525

8.12 Instrument

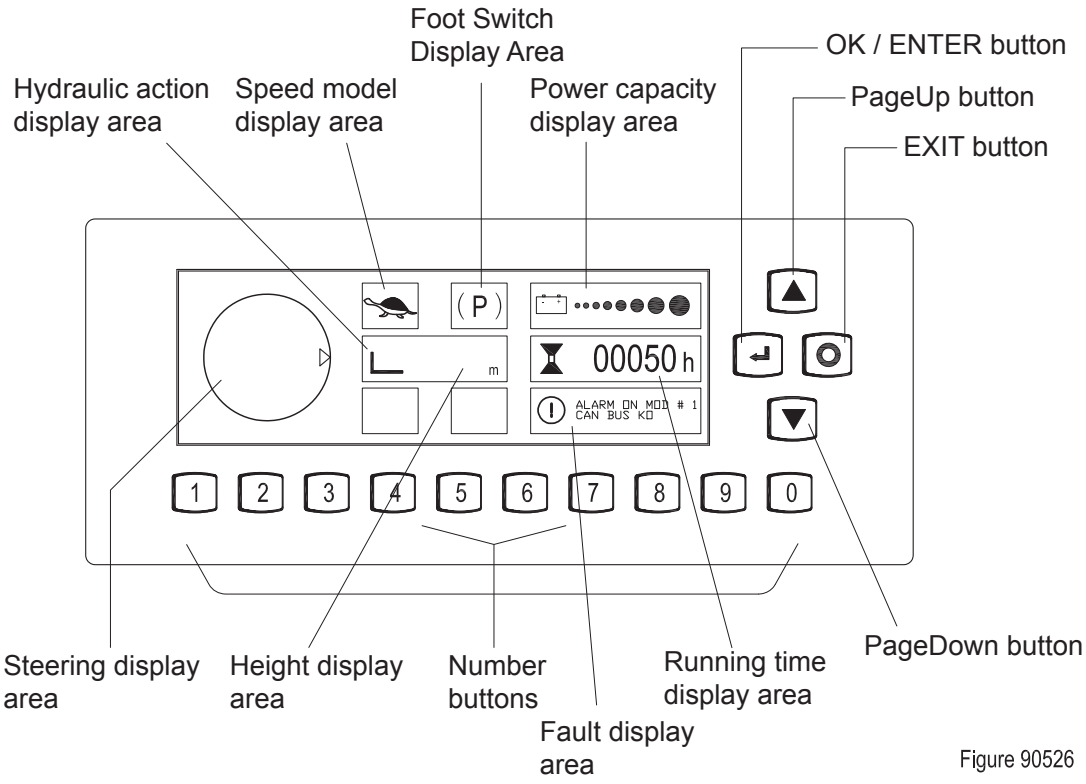
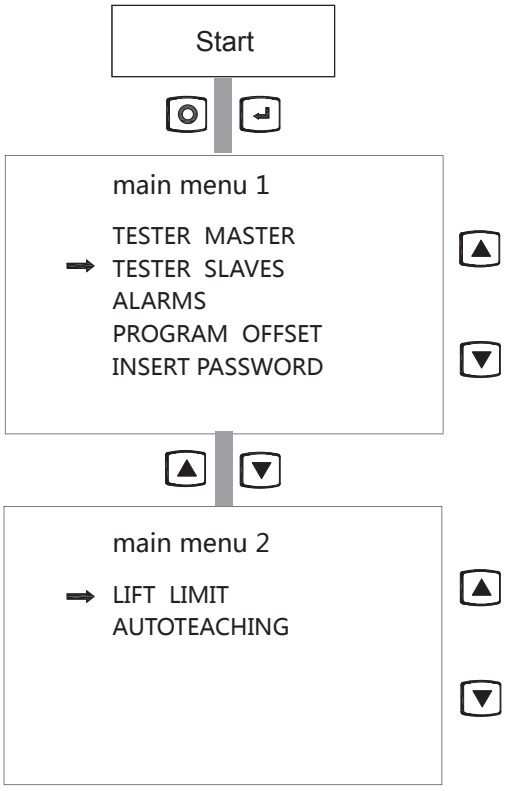


Figure 90526

8.12.1 Instrument Operation Schematics



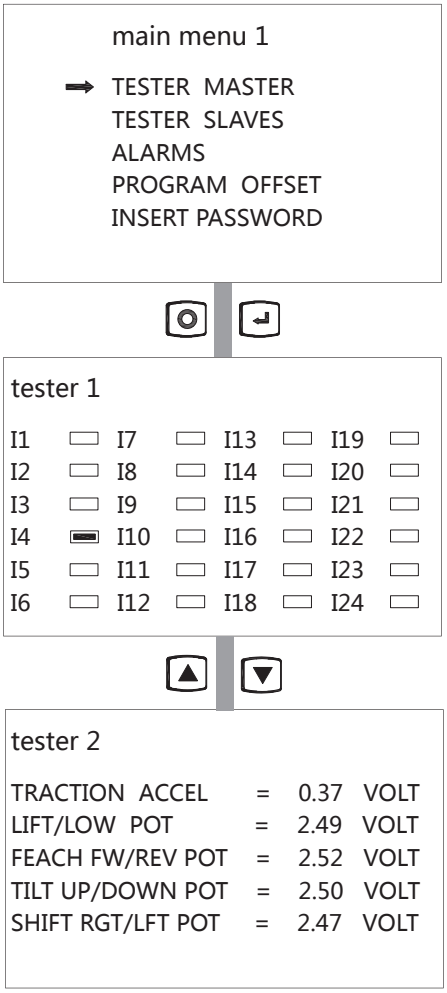
NOTE

TESTER MASTER : Instrument Running Test
TESTER SLAVES : Vehicle Running Test
ALARMS : Error Alrams

- Through navigator keys ▲ and ▼ , can carry out menu switching;
- ↵ Select to ENTER the menu.

8

TESTER MASTER Menu



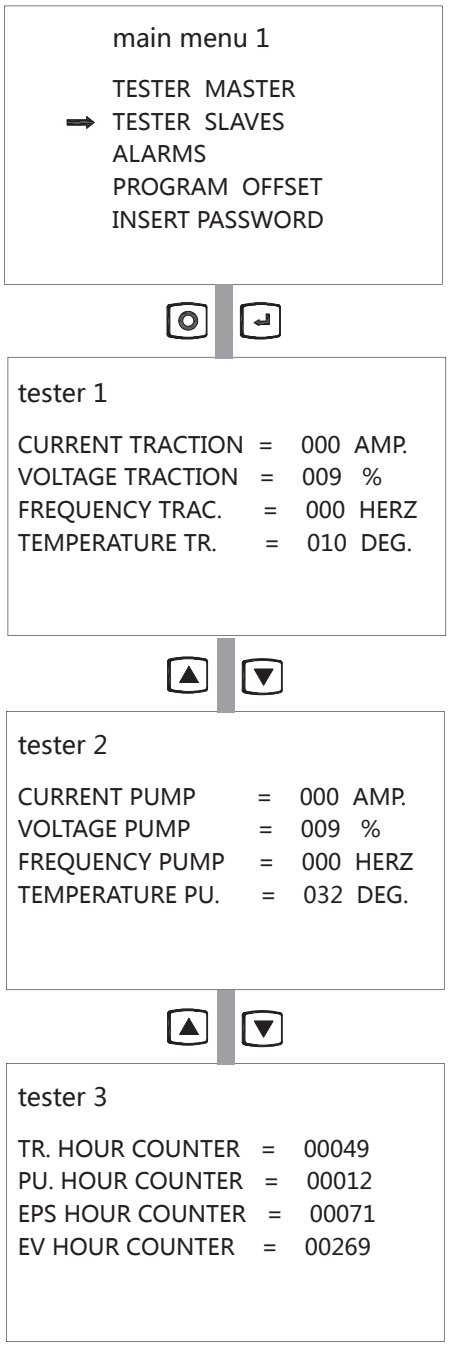
NOTE

▭ : Not running
▬ : Running

tester 1	Description
I1	Check forward switch
I2	Check backward switch
I3	Check accelerator enabling switch
I4	Check seat switch
I5	Check the foot switch
I6	Check lifting speed reduction switch
I7	Check the reset switch
I8	Check lifting - lowering switch
I9	Check forward shift - retracting switch
I10	Check left shifting - right shifting switch
I11	Check forward tilting - backward tilting switch

tester 2	Description
TRACTION ACCEL	Check the accelerator output voltage
LIFT/LOW POT	Check the lifting / lowering potentiometer output voltage
FEACH FW/REV POT	Check the forward shifting / retracting potentiometer output voltage
TILT UP/DOWN POT	Check the forward tilting / backward tilting potentiometer output voltage
SHIFT RGT/LFT POT	Check the left shifting / right shifting potentiometer output voltage

TESTER SLAVES Menu



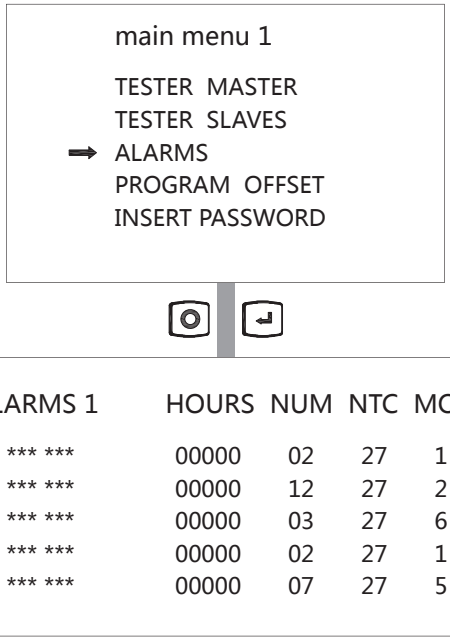
NOTE

tester 1	Description
CURRENT TRACTION	Check the current of drive motor
VOLTAGE TRACTION	Check the voltage of drive motor
FREQUENCY TRAC.	Check the speed of drive motor
TEMPERATURE TR.	Check the temperature of drive motor

tester 2	Description
CURRENT PUMP	Check pump motor curren
VOLTAGE PUMP	Check the voltage of pump motor
FREQUENCY PUMP	Check the speed of pump motor
TEMPERATURE PU.	Check the temperature of pump motor

tester 3	Description
TR. HOUR COUNTER	Drive Controller Working Hours
PU. HOUR COUNTER	Pump Controller Working Hours
EPS HOUR COUNTER	Steering Controller Working Hours
EV HOUR COUNTER	Solenoid Valve Controller Working Hours

ALARMS Menu



ALARMS 1	HOURS	NUM	NTC	MOD
1) *** ***	00000	02	27	1
2) *** ***	00000	12	27	2
3) *** ***	00000	03	27	6
4) *** ***	00000	02	27	1
5) *** ***	00000	07	27	5

NOTE

Code	Description
ALARMS 1	Fault information
HOURS	Runtime of the most recent failure
NUM	Number of the same fault occurs
NTC	Controller temperature upon the malfunction
MOD	Fault alarm controller model: 1 = Instrument (SICOS controller) 2 = Drive Controller 5 = Pump Controller 6 = Steering Controller 9 = Solenoid Valve Controller

8.13 Handheld Unit (Optional)

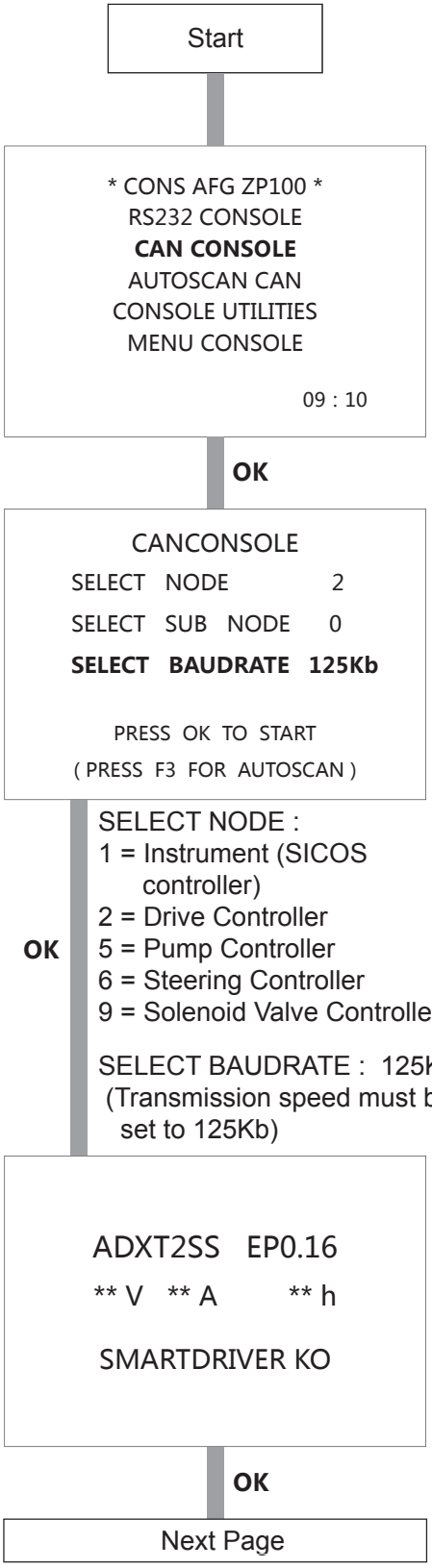
Handheld unit must be used together with controller, if necessary, it can be purchased from our company or dealer.

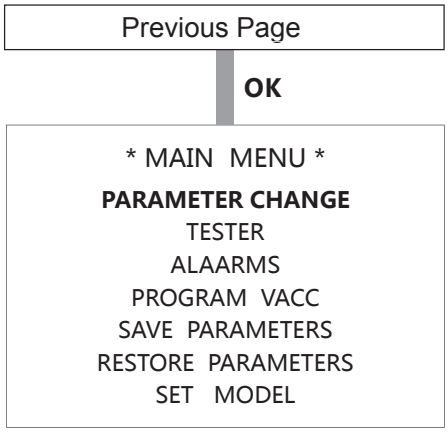
Figure 80513

8.13.1 Handheld Unit Connection

- Remove front cover (see Section 6.2);
- Plug the handheld unit communication cable into the handheld unit communication interface of the controller; (see Section 8.1)
- Turn on the key switch, pull out emergency stop switch, the display of handheld unit will be flashing:
  if the connection is successful: the handheld unit display will be flashing;
  if failed: the display will have no display (check if the circuit connection is normal).

8.13.2 Handheld Unit Menu Options





- With Navigator keys (Figure 80513), you can carry out menu switching;
- “OK”, select ENTER the menu.

PARAMETER CHANGE : parameter change
TESTER : vehicle running test
ALARMS : error alrms
PROGRAM VACC : accelerator match
SAVE PARAMETERS : read parameter
RESTORE PARAMETERS : write parameter
SET MODEL : set node
SET OPTIONS : set options
ADJUSTMENTS : parameter match
SPECIAL ADJUSTMENTS: special parameter match
HARDWARE SETTING : hardware setting

* See “Handheld Unit Operation Manual” for detailed operations

8.13.3 TESTER Menu

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

Traction / Pump Controller (AC2)

Parameters	Description	Remark
BATTERY VOLTAGE	Check the voltage of storage battery	Display the current voltage (V)
STEER ANGLE	Check the drive wheel angle	Display the current angle (°)
HANDLE/SEAT SW.	Check the status of seat switch	If the function is triggered properly, the value will change
CUTBACK SWITCH	Check the status of speed reduction switch	If the function is triggered properly, the value will change
INCHING BACKWARD	-	-
H·S CUTBACK	-	-
BACKWARD SWITCH	Check the backward status of travel switch	If the function is triggered properly, the value will change
FORWARD SWITCH	Check the forward status of travel switch	If the function is triggered properly, the value will change
DESCENT SWITCH	Check the status of lowering switch	If the function is triggered properly, the value will change
LIFTING SWITCH	Check the status of lifting switch	If the function is triggered properly, the value will change
ACCELERATOR	Check the output voltage of travel switch	Display the current voltage (V)
MOTOR TEMPERAT	Check motor temperature	Display the current temperature (℃)
TEMPERAT URE	Check the temperature of controller	Display the current temperature (℃)
BATTERY CHARGE	Check the remaining capacity of battery	Display the current capacity (%)
BATTERY CURRENT	Check the current of battery	Display the current value (A)
CURRENT RMS	Check the motor current	Display the current value (A)
SLIP VALUE	Check the difference between output frequency of controller and the measured frequency	Display the current difference(Hz)
ENCODER	Check the motor speed	Display the current speed(Hz)
FREQUENCY	Check the output frequency of controller	Display the current frequency(Hz)
VOLTAGE BOOSTER	-	-
MOTOR VOLTAGE	Check the motor voltage	Display the current voltage (V)
ENABLE SWITCH	Check the status of accelerator enabling switch	If the function is triggered properly, the value will change
DEADMAN SWITCH	Check the status of foot switch	If the function is triggered properly, the value will change

Steering Controller (EPS-AC0)

Parameters	Description	Remark
STEPPER MOTOR	Check the voltage of stepper motor	Display the current voltage (V)
READ FBPT AT SW1	-	-
SET POINT POT.	-	-
TRUCK SPEED	-	-
SLOPE PEAK	-	-
WHEEL ANGLE	Check the drive wheel angle	Display the current angle (°)
ENC COUNT AT 180	-	-
TRUCK MOVING	-	-
SM ALARM SWITCH	-	-
MM ALARM SWITCH	-	-
AUTO IN PROGRESS	-	-
ACW LIMIT LEVEL	-	-
CW LIMIT LEVEL	-	-
ENDSTROKE ACW	-	-
ENDSTROKE CW	-	-
ENC SPEED	Check the speed of steering motor	Display the current frequency(Hz)
MOTOR CURRENT	Check the current of steering motor	Display the current value (A)
MOTOR VOLTAGE	Check the voltage of steering motor	Display the current voltage (V)
SAT FREQ HZ	-	-
FREQUENCY	Check the output frequency of controller	Display the current frequency(Hz)
MOTOR TEMPERAT	Check the temperature of steering motor	Display the current temperature (℃)
TEMPERATURE	Check the temperature of controller	Display the current temperature (℃)
FEEDBACK ENC.	-	-
FEEDBACK POT.	-	-

8.14 Controller Error Message

Electrical faults are mainly caused by electrical components failure or electrical circuit failure. Wherein, when some components failures which may not affect the ON/OFF of control circuit occur, the instrument won't display fault code (see Chapter 9 - Troubleshooting); while the when the components failures which may affect the ON/OFF of control circuit occur to the electrical circuit, the controller will alarm for error, and fault information will be displayed on the instrument.

8.14.1 Tractiong/Pump Controller

Error Message	Possible cause	Fault elimination
WATCH DOG	The test is made in both running and standby. It is a self-diagnosing test within the logic.	If an alarm should occur, replace the logic.
EEPROM KO	Fault in the area of memory in which the adjustment parameters are stored;this alarm inhibits machine operation.	If the defect persists when the key is switched OFF and ON again, replace the logic. If the alarm disappears, remember that the parameters stored previously have been cancelled and replaced by the default values.
LOGIC FAILURE #1	This alarm signals that an undervoltage / overvoltage protection operation has occurred.Two possible reasons: A) A real undervoltage / overvoltage situation happened. B) Fault in the hardware section of the logic board which manages the overvoltage protection.	Replace the logic card.
LOGIC FAILURE #2	Fault in the hardware section of the logic board which manages the phase' s voltage feedback.	Replace the logic board.
LOGIC FAILURE #3	Fault in the hardware section of the logic board which manages the hardware current protection.	Replace the logic board.
INCORRECT START	This alarm signals an incorrect starting sequence. Possible causes: A) running microswitch failure; B) error in sequence made by the operator; C) incorrect wiring;	if the default persists, replace the logic.
FORW + BACK	The test is carried out continuously. An alarm is signalled when a double running request is made simultaneously. Possible causes: A) defective wiring; B) running microswitch failure; C) incorrect operation;	if the default persists, replace the logic.

Error Message	Possible cause	Fault elimination
CAPACITOR CHARGE	When the key is switched ON, the inverter tries to charge the capacitor through a power resistance, and check if the capacitor are charged within a timeout. If this is not true: an alarm is signalled; the main contactor is not closed. Possible reasons: A) the charging resistance is opened; if it is opened. B) The charging circuit has a failure. C) There is a problem on the power modules.	Replace the inverter.
VMN LOW	The test is carried out during initial diagnosis and in standby. Possible causes: A) problem with the motor connections or the motor power circuit; check if the 3 phases are correctly connected; check if there's a dispersion of the motor towards ground; B) inverter failure	if the default persists, replace the inverter.
VMN HIGH	The test is carried out during initial diagnosis and in standby. Possible causes: A) problem with the motor connections or the motor power circuit; check if the 3 phases are correctly connected; check if there's a dispersion of the motor towards ground; B) inverter failure	if the default persists, replace the inverter.
VACC NOT OK	The test is made in standby. This alarm indicates that the accelerator voltage is 1 V greater than the minimum value programmed by the PROGRAM VACC function. Possible causes: A) the potentiometer is not correctly calibrated; B) the potentiometer is defective.	Troubleshooting,the alarm is eliminated.
PEDAL WIRE KO	This alarm is signalled if a fault is detected in the accelerator unit wiring (NPOT or PPOT cable is interrupted).	Troubleshooting,the alarm is eliminated.
STBY I HIGH	Test carried out in standby. Check if the current is 0. If not verified, an alarm is signalled which inhibits machine operations. Possible causes: A) current sensor failure; B) logic failure: first replace the logic; if the defect persists, replace the power unit.	Troubleshooting,the alarm is eliminated.

Error Message	Possible cause	Fault elimination
CHECK UP NEEDED	This is a warning. It is an information for the user that the programmed time for maintenance is elapsed.	
MAIN CONTACTOR ALARMS	- COIL SHORTED When the key is switched ON the µP checks the MC driver FF SR. If it does not react in a correct way to the µP stimulus, the alarm is signalled. Replace the logic board. The FF SR makes an hardware control of the current in the MC coil. If this is too high, it opens the MC and the alarm is Signalled. Check if there are external shortcircuit and if the ohmic value of the MC is correct; otherwise replace the logic. - DRIVER SHORTED When the key is switched ON, the µP checks that the MC coil driver is not shorted; if it is, this alarm is signalled; replace the logic board. - CONTACTOR DRIVER When the initial diagnosis is finished, the traction logic closes the MC and checks the voltage on the Drain of the driver. If this is not low, an alarm is signalled. Replace the logic. - CONTACTOR OPEN The main contactor coil has been driven by the logic board, but the contactor does not close. Two possible reasons: A) the wires to the coil are interrupted or not well connected. B) the contact of the contactor is not properly working. - CONTACTOR CLOSED The controller checks if the LC contact is closed when the coil isn't driven, trying to discharge the capacitor bank. If they don't discharge, the fault condition is entered. It is suggested to check the contactor contact, if it is mechanically stuck or pasted.	Troubleshooting,the alarm is eliminated.
AUX OUTPUT KO	The µP checks the driver of the electromechanical brake. If the status of the driver output does not correspond to the signal coming from the µP, the alarm is signalled.	if the default persists, replace the logic.

Error Message	Possible cause	Fault elimination
HIGH TEMPERATURE	Inverter temperature is greater than 75 °C. The maximum current is reduced proportionally to the temperature increase. The inverter stops at 100 °C. If the alarm is signalled when the inverter is cold: A) check the wiring of the thermal sensor; B) thermal sensor failure; C) logic failure.	Troubleshooting,the alarm is eliminated.
MOTOR TEMPERATURE	This warning is signalled if the motor temperature switch opens (digital sensor) or if the analog signal overtakes the cut off level. If it happens when the motor is cold, check the wiring.	if the default persists, replace the logic.
THERMIC SENSOR KO	The range of inverter temperature sensor is always checked and a warning is signalled if it is out of range.	When this alarm is signalled, check the connection of the sensors.
MOT. TH. SENSOR KO	The range of motor temperature sensor is always checked and a warning is signalled if it is out of range.	When this alarm is signalled, check the connection of the sensors.
PEDAL FAILURE	This alarm can be activated on request and it is signalled if the accelerator signal is out of the range.	Possible cause: an hardware problem on the logic board or a potentiometer problem (disconnected wire, damaged cursor).
BATTERY LOW	If the "battery check" option is ON, a battery discharge algorithm is carried out. When the charge level is 20%, this alarm is signalled and the current is reduced to the half of the programmed level.	charge
WRONG SET BATT.	When the key is turned ON, the controller check the battery voltage and verifies it is within a window around the nominal value.	Replace the battery with a correct battery.
WAITING FOR NODE	The controller receives from a remote module via CAN Bus the information that it isn't possible to close the LC (the module isn't ready locked in an alarm state). Verify the other modules to determinate in which of them there is the problem.	Troubleshooting,the alarm is eliminated.
HANDBRAKE	The truck does not start because the handbrake switch is opened. Possible causes: A) defective wiring; B) failure of the microswitch; C) incorrect operation of the operator;	if the defect persist, replace the logic.

Error Message	Possible cause	Fault elimination
DATA ACQUISITION	This alarm is signalled in the current gain acquisition phase.	Wait the end of the acquisition activity.
CAN BUS KO	The diagnosis of the CAN-BUS line is present only if the inverter uses this link (depends on the software version). It is signalled if the inverter does not receive any message from the CAN-BUS line.	First of all, check the wiring. If it is ok, the problem is on the logic board, which must be replaced.
SAFETY	This alarm is signalled when the "SAFETY" input is open. The "SAFETY"circuit gets active and opens the drivers of LC and EB and stops the machine.	Verify the “SAFETY” input connection
SAFETY KO	This alarm is present in combi systems (traction + pump).	If a stopping alarm is detected on the pump, the traction also stops. The failure must be looked for in the pump inverter.
ENCODER ERROR	Two consecutive readings of the encoder speed are too much different in between: because of the inertia of the system it is not possible the encoder changes its speed a lot in a short period. Probably an encoder failure has occurred (e.g. one or two channels of the encoder are corrupted or disconnected).	Check both the electric and the mechanical encoder functionality. Also the electromagnetic noise on the sensor bearing can be a cause for the alarm.

8.14.2 Steering Controller (EPS-ACO)

Error Message		Possible cause	Fault elimination
Error	Error text		
6	SERIAL ERR #1	Main uC and Slave uC communicate via a local serial interface. This alarm occurs when the slave uC does not receive the communication from the main uC through this serial interface.	It is necessary to replace the controller.
13	EEPROM KO	It occurs if a test to write and read one location in EEPROM fails. The SW expects to read the written value. It occurs also when the hour counter gives different values between the three redundant locations in which it is recorded. It occurs also when the busy bit of the EEPROM does not rise within 12 msec.	It is necessary to replace the controller.
16	LOGIC FAILURE #4	This alarm occurs in the rest state if the output of the voltage amplifier of the phase Vw-Vv have a drift larger than ±0.25 V.	It is necessary to replace the controller.
17	LOGIC FAILURE #3	This alarm occurs in the rest state if the output of the voltage amplifier of the phase Vu-Vw have a drift larger than ±0.25 V.	It is necessary to replace the controller.
18	LOGIC FAILURE #2	This alarm occurs when the real voltage between phases W and V of the motor is different from the desired.	It is necessary to replace the controller.
19	LOGIC FAILURE #1	This alarm occurs when the real voltage between phases W and U of the motor is different from the desired.	It is necessary to replace the controller.
32	VMN NOT OK	This alarm occurs in the initial rest state after key on if the outputs of the motor voltage amplifiers are not in the window from 2.2 to 2.8 Vdc.	It is necessary to replace the controller.
48	MAIN CONT. OPEN	This alarm occurs only when the setting CAN BUS is PRESENT. Then the eps-ac0 waits for a via CAN information that the traction controller has closed the main contactor. If this information lacks more than about 1.5 secs, this alarm occurs.	Find, on the traction controller, the reason for keeping the main contactor open.

Error Message		Possible cause	Fault elimination
Error	Error text		
53	STBY I HIGH	This alarm occurs two ways: 1) In the initial rest state after key on, if the outputs of the current amplifiers are not comprised in the window 2.2 to 2.8 Vdc. 2) After the initial diagnosis this alarm occurs when the outputs of the current amplifiers at rest have a drift larger than ±0.15 V.	It is necessary to replace the controller.
61	HIGH TEMPERATURE	This alarm occurs if the temperature of the controller base plate overtakes 75 degrees.	Improve the cooling of the controller; otherwise it is necessary to replace the controller.
65	MOTOR TEMPERAT.	This alarm occurs only when DIAG MOTOR TEMP is on and the thermal sensor inside the motor measures a temperature higher than 150 degrees. It occurs also when trying to acquire the motor resistance with a temperature in the motor higher than 150 degree (still with DIAG MOTOR TEMP to ON).	Check the thermal sensor in the motor is right working. If it is, improve the cooling of the motor.
70	HIGH CURRENT	This alarm occurs if the circuit to limit via hardware the current in the motor is either always active at key-on or repeatedly active when the motor is turning.	Check the motor is suited to work with the eps-ac0 (not oversized). Otherwise it is necessary to replace the controller.
71	POWER FAILURE #3	This alarm occurs when the current in the phase V of the motor is zero and the motor is commanded for moving.	Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase V of the motor. Otherwise it is necessary to replace the controller.
72	POWER FAILURE #2	This alarm occurs when the current in the phase U of the motor is zero and the motor is commanded for moving.	Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase U of the motor. Otherwise it is necessary to replace the controller.

Error Message		Possible cause	Fault elimination
Error	Error text		
73	POWER FAILURE #1	This alarm occurs when the current in the phase W of the motor is zero and the motor is commanded for moving.	Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase W of the motor. Otherwise it is necessary to replace the controller.
83	BAD ENCODER SIGN	It occurs in applications with toggle switches when the applied frequency (FREQUENCY) and the motor speed (ENC SPEED) have opposite sign.	Swap in between the two encoder channels (CNB#7 with CNB#8).
84	STEER SENSOR KO	This alarm occurs if the command potentiometer (CPOC1 on CNA#9 or CPOC2 on CNA#8) changes with a jerk larger than MAX SP SLOPE (see 12.4.6.3). This alarm is used to catch a discontinuity in the voltages of the command potentiometer.	Change the twin pot.
85	STEER HAZARD	This is just a warning to inform that the steering controller is limiting the angle in the steering direction. No speed reduction occurs on the traction.	——
218	CLOCK PAL NOT OK	The main uC sends an analog signal towards the slave uC to reset the slave uC on demand. When the slave uC detects this analog signal external to a window from 2.2 to 2.8 and not in the range to generate the reset on demand, the slave uC raises this alarm.	It is necessary to replace the controller.
99	INPUT ERROR #1	It occurs when the voltage on CNA#4 (NK1: Lower Potential Terminal of the Safety Contacts (see 7.6) is higher than 12 V before to turn the safety contacts closed.	When the safety contacts are open, the voltage on CNA#4 is expected to be close to 0 Vdc and this is independent from whether the safety contacts are connected to a plus battery or to a minus battery . In the first case (safety contacts connected to a plus battery), when the safety contacts are open, CNA#4 is connected to a minus battery through a load. Only a harness mistake may connect NK1 to a higher than 12 V voltage.

Error Message		Possible cause	Fault elimination
Error	Error text		
212	MICRO SLAVE #8	It occurs when the encoder counting of the main uC is not matched with the encoder counting of the slave uC.	It is necessary to replace the controller.
219	STEPPER MOTOR MISM	This alarm occurs if the frequency and the amplitude of the voltages from the stepper motor lines are mismatched in between In normal condition when the amplitude of the stepper motor lines increases, the frequency of the stepper motor lines must increase too.	It is necessary to replace the controller.
220	MOTOR LOCKED	This alarm occurs if the current in the steering motor stays close to the maximum current longer than 1 sec.	Search for a mechanical problem locking the motor. To make easier the fault catching, set DEBUG OUTPUT to level 11.
221	MICRO SLAVE #4	It occurs in one of the following conditions: (Open loop application only) If the slave uC detects the stator voltage phasor rotates in the opposite direction respect to the sign of the stepper motor speed, this alarm occurs. (Closed loop application only) If the slave uC detects the stator voltage phasor rotates in the opposite direction respect to the commanded position, this alarm occurs.	It is necessary to replace the controller.
222	FB POT LOCKED	In application with a feedback potentiometer, this alarm occurs if the feedback potentiometer (CPOT on CNB#6) does not change (or changes in the opposite direction) its value even if commanded to change. In application with toggle switches with ENCODER CONTROL to off, this alarm occurs if the feedback encoder counting does not change its value even if commanded to change.	In application with the feedback potentiometer, verify the feedback potentiometer is not mechanically loosened. Check there is not a mechanical block of the steered wheel. Be sure the wiper has not reached its own electrical limit because of too much angle of the steered wheel. Besides, this alarm may occur at the installation when the motor rotates in the wrong direction turning away from the wished

Error Message		Possible cause	Fault elimination
Error	Error text		
223	JERKING FB POT	This alarm occurs if the feedback potentiometer (CPOT on CNB#6) changes with a jerk larger than 0.3 V in 16 msec. This alarm is used to catch a discontinuity in the voltages of the feedback potentiometer.	Change the feedback potentiometer.
225	CURRENT GAIN	This alarm occurs when the parameters to compensate for the gain of the current amplifiers (ADJUSTMENT #03 and ADJUSTMENT #04) have the default values	It is necessary to send the controller to Zapi to perform the maximum current regulation.
226	NO SYNC	Every 16msec, inside the code cycle, the main uC rises and then lowers an input for the slave uC (SYNC). When the slave uC detects no edge for more than 100 msec on this input, this alarm occurs. This is just a watch dog function: when the main uC does not execute the code cycle it does not update the SYNC signal and the slave uC cuts off the steer and traction.	It is necessary to replace the controller.
227	SLAVE COM. ERROR	Main uC and Slave uC communicate via a local serial interface. This alarm occurs when the main uC does not receive the communication from the slave uC through this serial interface.	It is necessary to replace the controller.
237	WAITING DATA	This warning occurs only if CAN BUS is PRESENT. At key-on the eps-ac0 asks to the traction controller to send a list of parameters via CAN Bus. From the request until the parameters are correctly relieved, this warning occurs. The steer is not activated yet, and the safety relays remain open when this warning is present.	——

Error Message		Possible cause	Fault elimination
Error	Error text		
228	POSITION ERROR	This alarm occurs for an error in the redundant test of the feedback sensors.	Check the potentiometer connected to CNB#6 is right working. If toggle switches are connected to CNA#2 and CNA#3, verify they are right working and the setting AUX FUNCTION 11 is correct. Verify also the sensor bearing in the motor (encoder) has not a slip (the sensor bearing has two rings: one is connected to the rotor shaft; the other is connected to the motor frame. Check these two rings are strictly connected to their structure without slip.
238	EPS NOT ALIGNED	This is a real alarm that cut off the traction. It occurs at the initial alignment if the straight-ahead condition is not matched within 6sec. Throughout this 6 secs delay, the steer is not activated yet, the safety relays are open and the traction is stopped.	——
239	WAITING FOR TRAC	At key-on the eps-ac0 needs an assent from the traction controller to close the safety contacts and to turn onto operational mode. Until this assent is not relieved, this warning occurs. The steer is not activated yet and the safety relays remain open when this warning is present.	——
241	ENCODER ERROR	It occurs when ENCODER CONTROL is set ON and the real frequency does not pursuit the commanded frequency	This condition is several times due to either, a mismatching between the Encoder resolution used in the SW and the real encoder resolution, or a wrong connection between the two encoder channels. In this latest case exchange in between the two encoder channels.

Error Message		Possible cause	Fault elimination
Error	Error text		
242	Q LINE SENSOR KO	This alarm occurs when the mean voltage on the Quadrature line of the stepper motor (connection CNA#8) is not null: the voltage on every stepper motor line is a sine wave with null mean voltage.	Check the continuity of the stepper motor connections. In particular the resistance between CNA#8 and the minus battery (with the stepper motor at rest) is expected being very low (close to 30 ohms).
243	D LINE SENSOR KO	This alarm occurs when the mean voltage on the Direct line of the stepper motor (connection CNA#9) is not null: the voltage on every stepper motor line is a sine wave with null mean voltage.	Check the continuity of the stepper motor connections. In particular the resistance between CNA#9 and the minus battery (with the stepper motor at rest) is expected being very low (close to 30 ohms).
245	DATA ACQUISITION	This alarm occurs when the acquiring the motor resistance or when adjusting the parameters to compensate for the gain of the current amplifiers (maximum current factory adjusted).	Recycle the key.
244	GAIN EEPROM KO	The parameters to compensate for the gain of the current amplifiers (ADJUSTMENT #03 and ADJUSTMENT #04) are recorded in a not volatile memory (eeprom) with a redundant handling. In fact every adjustment is recorded in three eeprom locations. If the values in these three locations are different in between this alarm occurs.	It is necessary to send the controller to Zapi to execute the maximum current regulation.
246	MICRO SLAVE KO	In stepper motor application, this alarm occurs if the main uC is detecting a direction of the stepper motor not matched with the one that the slave uC is detecting. In closed loop application, this alarm occurs if the main uC is detecting a direction of the steering error not matched with the one that the slave uC is detecting. Furthermore, this alarm occurs also if the main uC is detecting no steering limitation meanwhile the slave uC is detecting e steering limitation.	It is necessary to replace the controller.

Error Message		Possible cause	Fault elimination
Error	Error text		
247	CAN BUS KO	This alarm occurs only when the setting CAN BUS is PRESENT. Then the eps-ac0 must receive the event messages from the traction controller. If these messages lack more than about 1 sec, this alarm occurs.	Check the CAN Bus communication system and analyse the frames from the traction controller to the steer controllers.
248	S.P OUT OF RANGE	This alarm occurs for a fault on the command potentiometer (CPOC1 on CNA#9, CPOC2 on CNA#8). When a single command pot is chosen, the alarm occurs if its wiper (CPOC1) exits the range from 0.8 Vdc to 4.2 Vdc. When the twin pot is chosen, the alarm occurs if the sum of the two wiper voltages (CPOC1+CPOC2) exits the range from 4.5 Vdc to 5.5 Vdc.	Check the connections of the potentiometer. This alarm occurs when one connection of the command potentiometer is broken.
249	F.B OUT OF RANGE	This alarm occurs for a fault on the feedback potentiometer (CPOT on CNB#6). This alarm occurs if CPOT exits the range from 0.3 Vdc to 4.7 Vdc.	Check the connections of the feedback potentiometer. This alarm occurs when one connection of the feedback potentiometer is broken.
250	MICRO SLAVE	It occurs when the information on the status bus between the main uC and the slave uC is frozen to the 0xFF value (the slave uC does not update the status bus configuration).	It is necessary to replace the controller.
251	KM OPEN	This alarm occurs if the slave uC detects the safety contact, of the main uC, open when expected being closed.	It is necessary to replace the controller.
252	KS OPEN	This alarm occurs if the main uC detects the safety contact, of the slave uC, open when expected being closed.	It is necessary to replace the controller.

Error Message		Possible cause	Fault elimination
Error	Error text		
253	KM CLOSED	This alarm occurs at key on if the slave uC detects the safety contact, of the main uC, closed prior to be commanded.	This alarm occurs if the connection CNA#5 (K1) is around a voltage of 12 Vdc when switching on the key. In fact, when the safety contacts are open, K1 is expected being connected to a battery voltage (not 12 V). Search for a harness problem or replace the controller.
254	KS CLOSED	This alarm occurs if the main uC detects the safety contact, of the slave uC, closed prior to be commanded.	This alarm occurs if the connection CNA#4 (NK1) is around a voltage of 12 Vdc when switching on the key. In fact, when the safety contacts are open, NK1 is expected being connected to a minus battery voltage (not 12 V). Search for a harness problem or replace the controller.

8.14.3 SICOS Controller

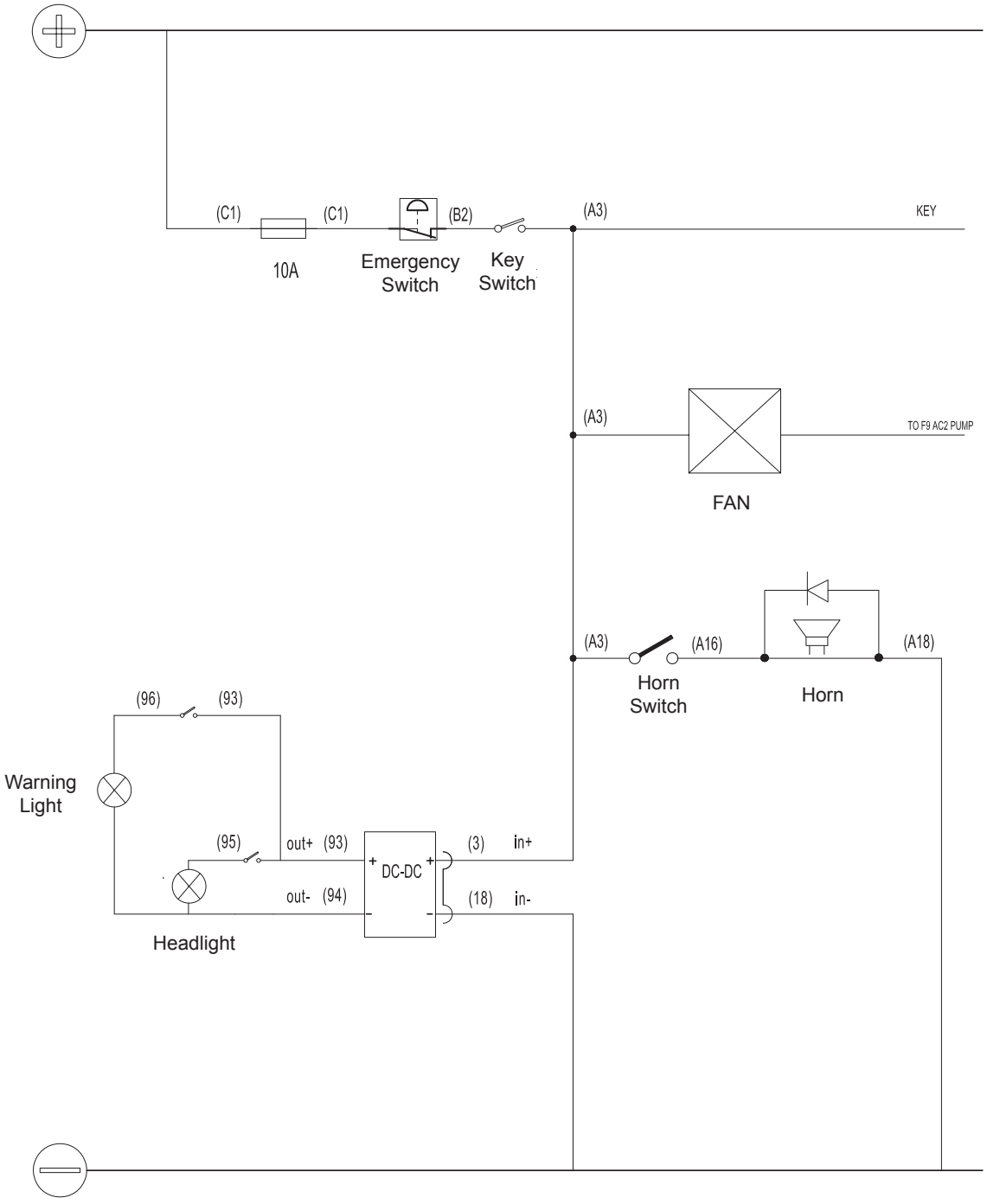
Error Message	Fault elimination
VACC NOT OK	Accelerator high at stand or not correctly programmed
POT #1 NOT OK	Lifting pot high at stand or not correctly programmed
POT #2 NOT OK	Reach pot high at stand or not correctly programmed
POT #3 NOT OK	tilting pot high at stand or not correctly programmed
POT #4 NOT OK	Side shift pot high at stand or not correctly programmed
CAN BUS KO	One of the modules connected to the sicos through CAN BUS don't communicate correctly
CHECK UP NEEDED	Programmed maintenance request
EEPROM KO	EEprom parameters managing error
CLEARING EEPROM	Appears when pressing the buttons EP+DOWN+ENTER at key switch on for at least 10 seconds.The EEPROM is in the re-programming phase.Turning off the key before 10 sec. will not clear EEPROM
BATTERY LOW	Discharged battery (<=20%)
FORW+BACK	Forward and backward switch closed in the same time
INCORRECT START	Pump or traction enable request at key switch on or wrong starting sequence
POWER FAILURE #1	Short circuit on one of the SICOS digital outputs (three auxiliary outputs)
STEER SENSOR KO	Wrong configuration of the steering switches on the steering wheel

8.14.4 Solenoid Valve Controller

Error Message		Fault elimination
Error	Error text	
	EEPROM KO	Fault in the area of memory where the adjustment parameters are stored.This Alarm inhibits machine operation. If the fault continues when the Key Switch is re-cycled, replace the logic. If the fault disappears, the previously stored Parameters will have been replaced by the default parameters.
	CAN BUS KO	There is a problem related to the CAN-BUS line. The error is signalled if the MHYRIO FLASH controller does not receive any message from the SICOS CAN-BUS line. First of all, check the wiring. If it is ok, the problem is on the logic board, which must be replaced.

8.15 Electrical Schematic Diagrams RVF/NRVF

8.15.1 Electrical Schematic Diagram RVF/NRVF (1/6)



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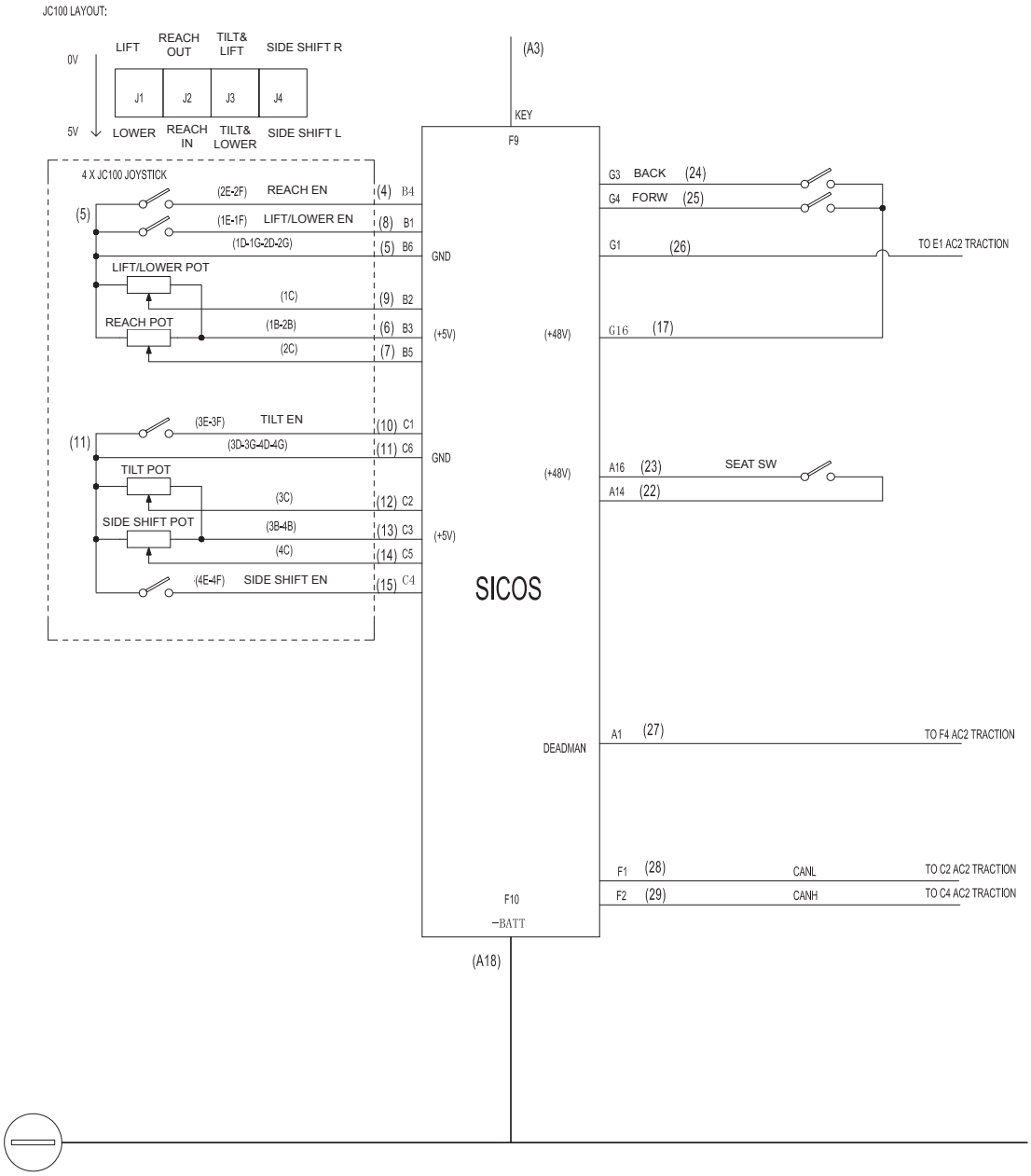
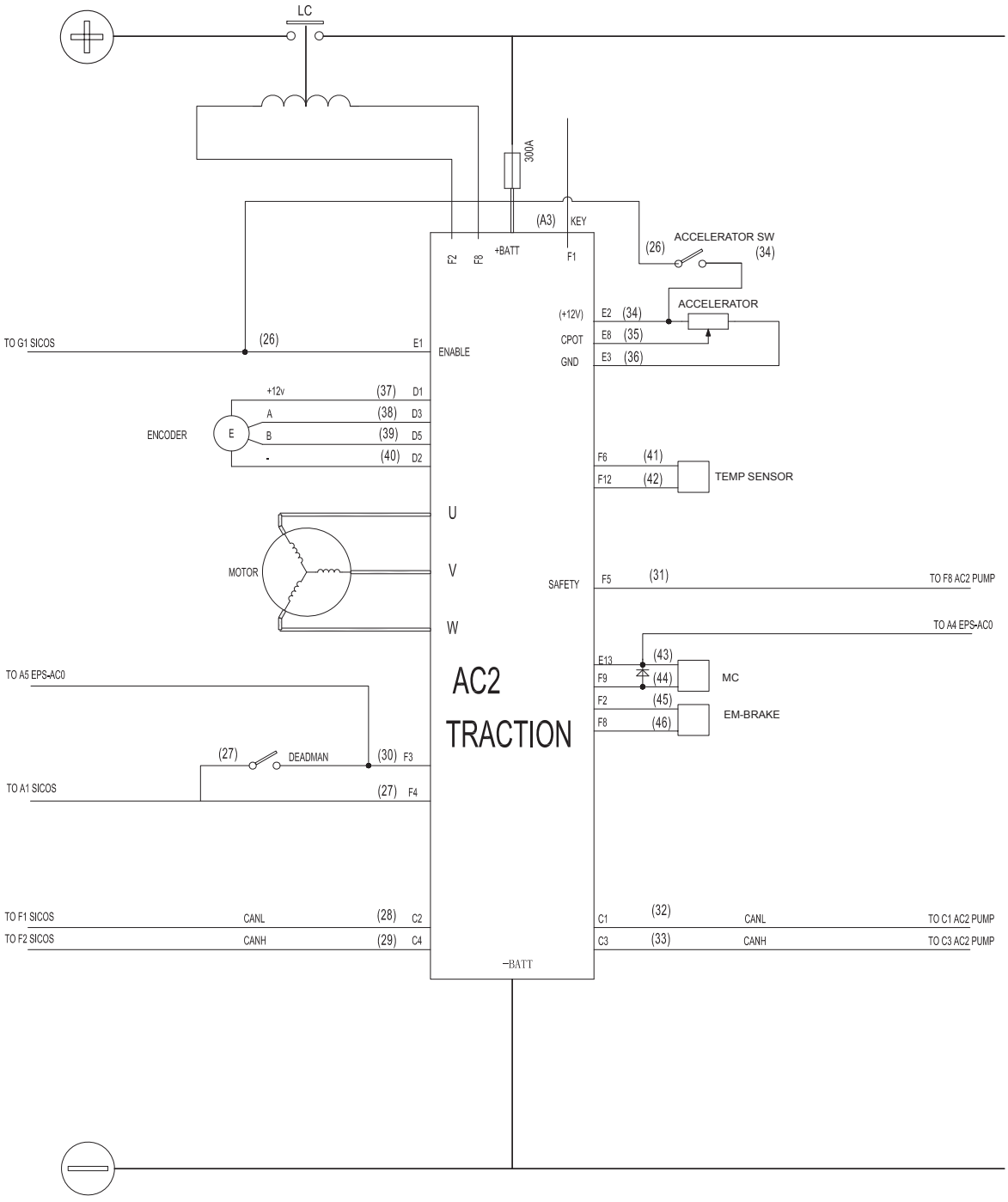
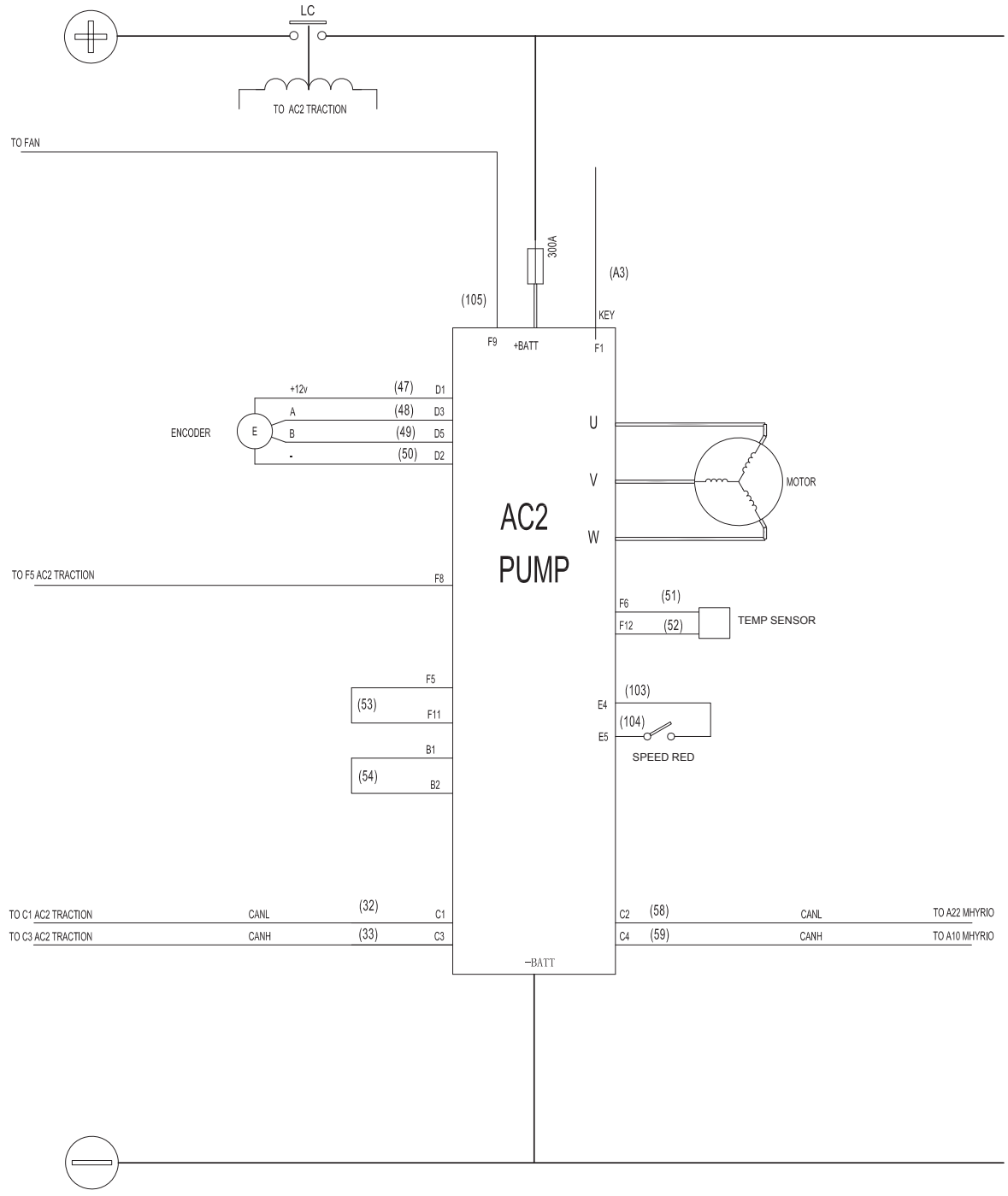
8.15.2 Electrical Schematic Diagram RVF/NRVF (2/6)



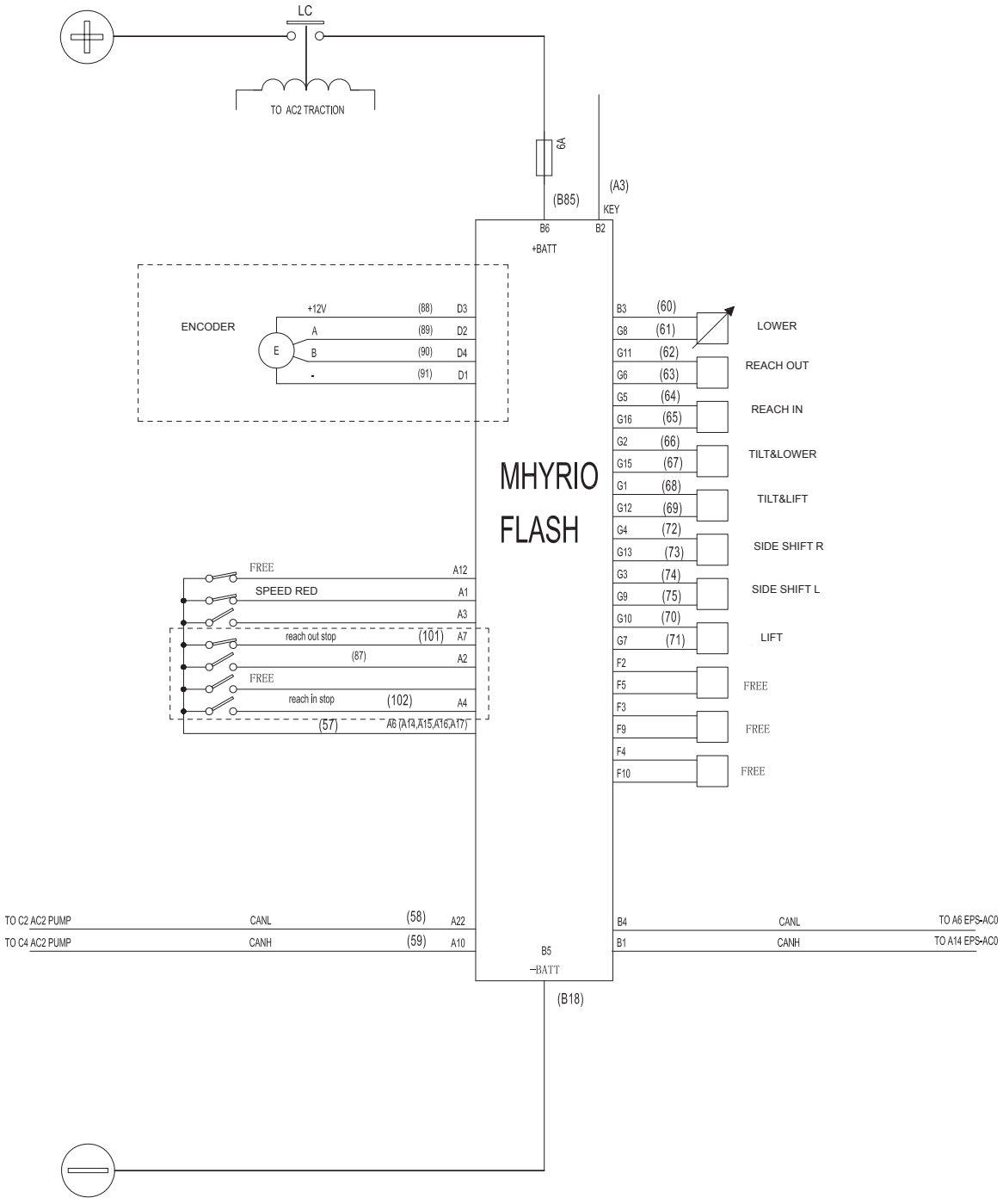
8.15.3 Electrical Schematic Diagram RVF/NRVF (3/6)



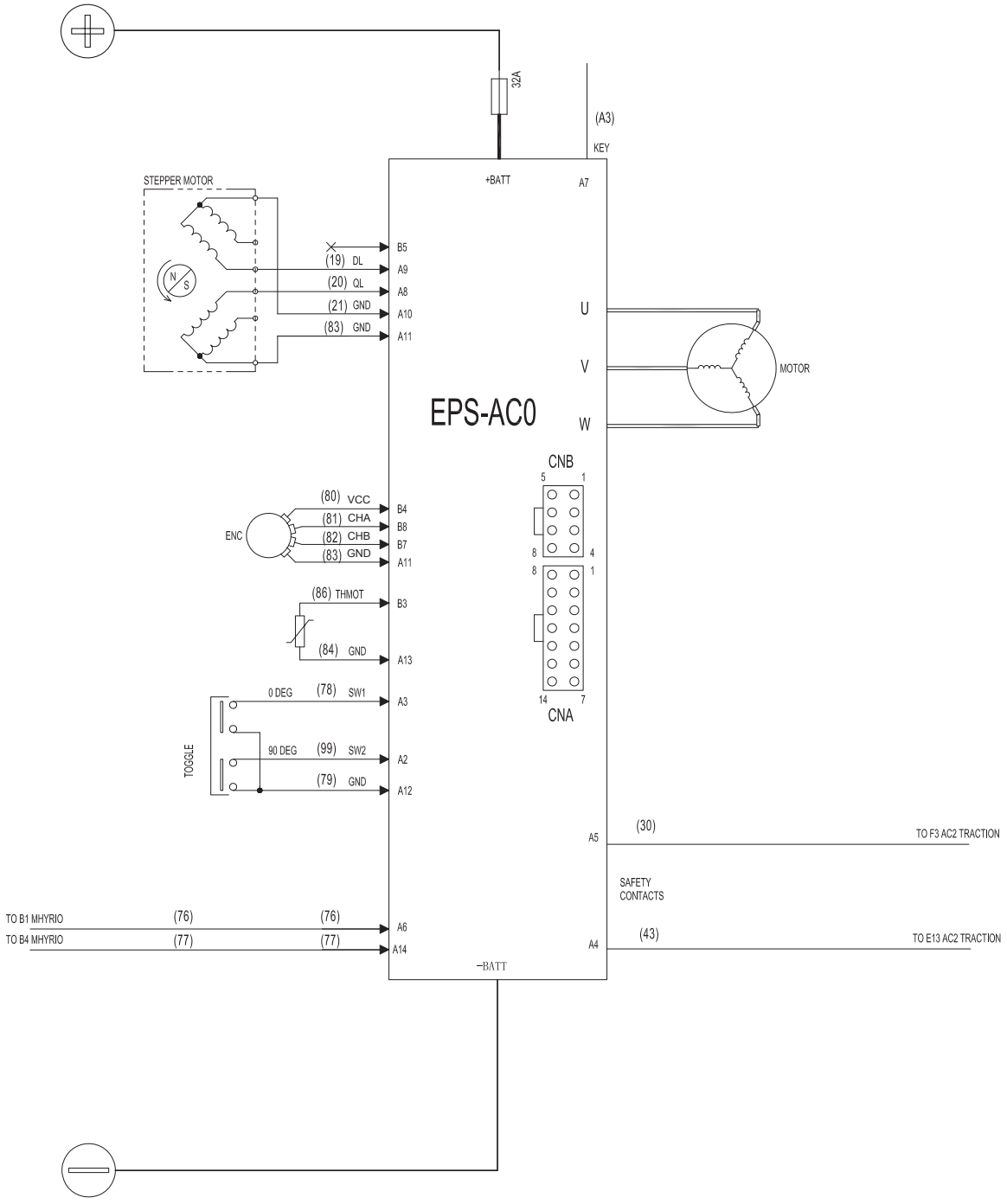
8.15.4 Electrical Schematic Diagram RVF/NRVF (4/6)



8.15.5 Electrical Schematic Diagram RVF/NRVF (5/6)

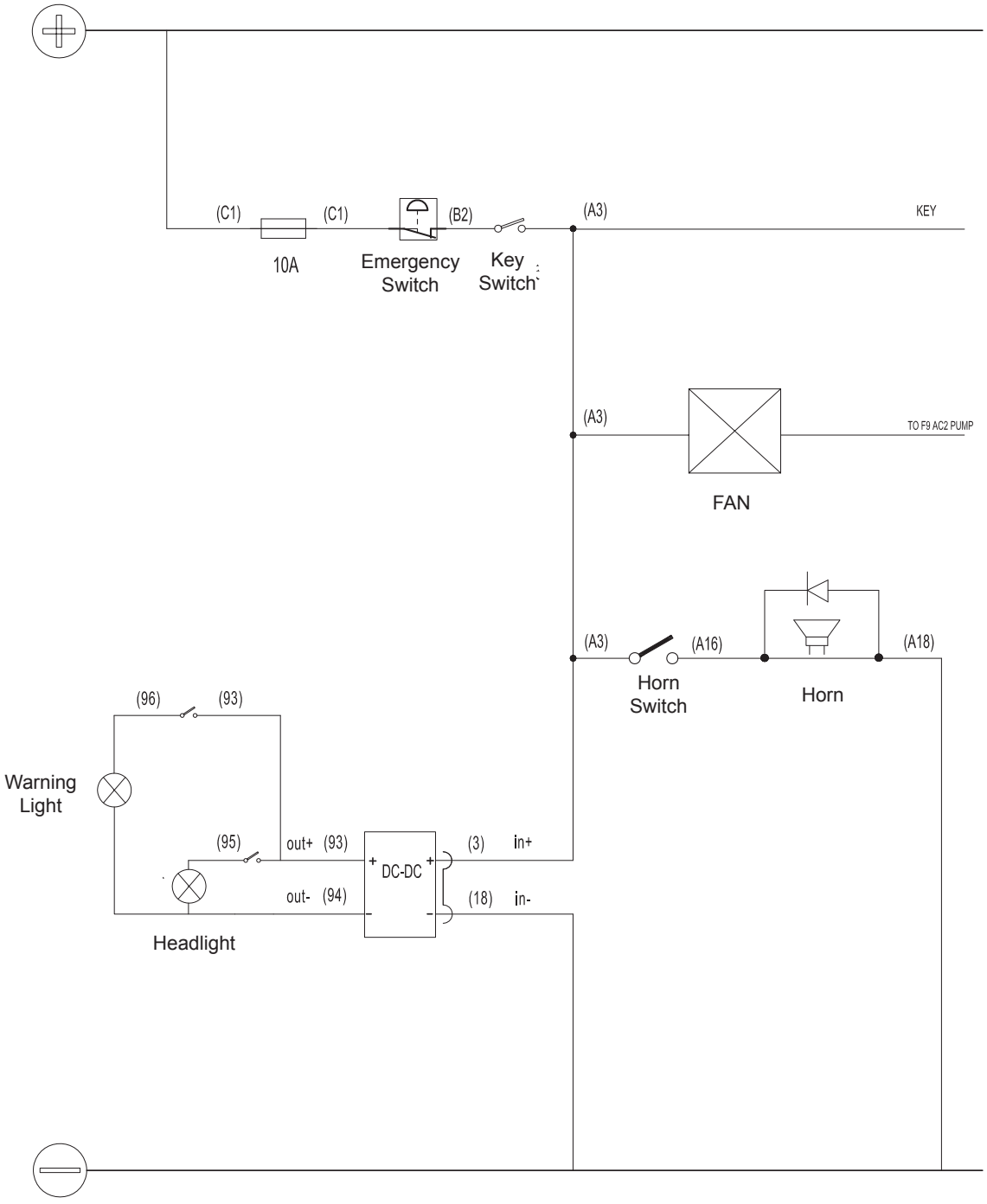


8.15.6 Electrical Schematic Diagram RVF/NRVF (6/6)

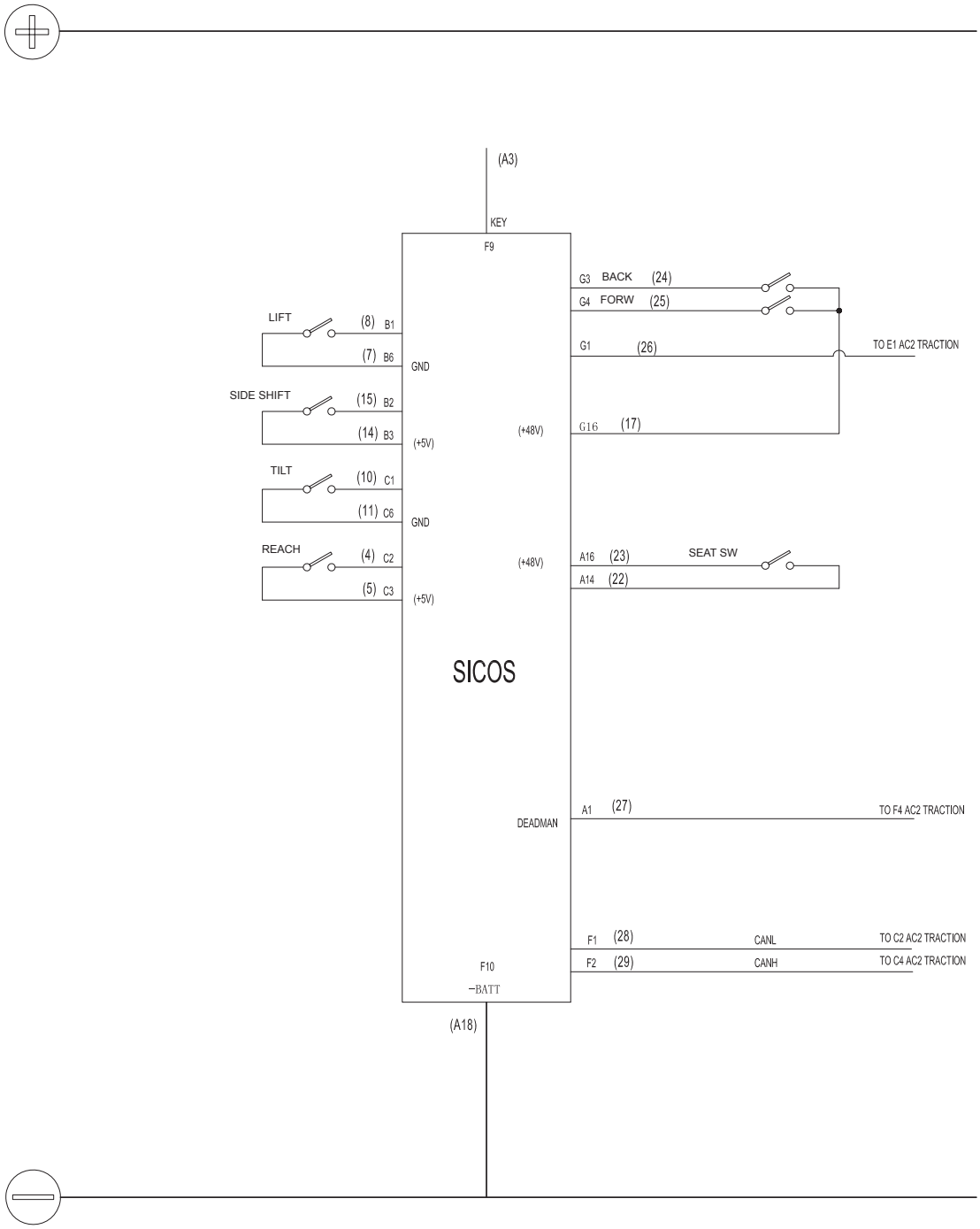


8.16 Electrical Schematic Diagrams RV/NRV

8.16.1 Electrical Schematic Diagram RVF/NRVF (1/5)



8.16.2 Electrical Schematic Diagram RVF/NRVF (2/5)



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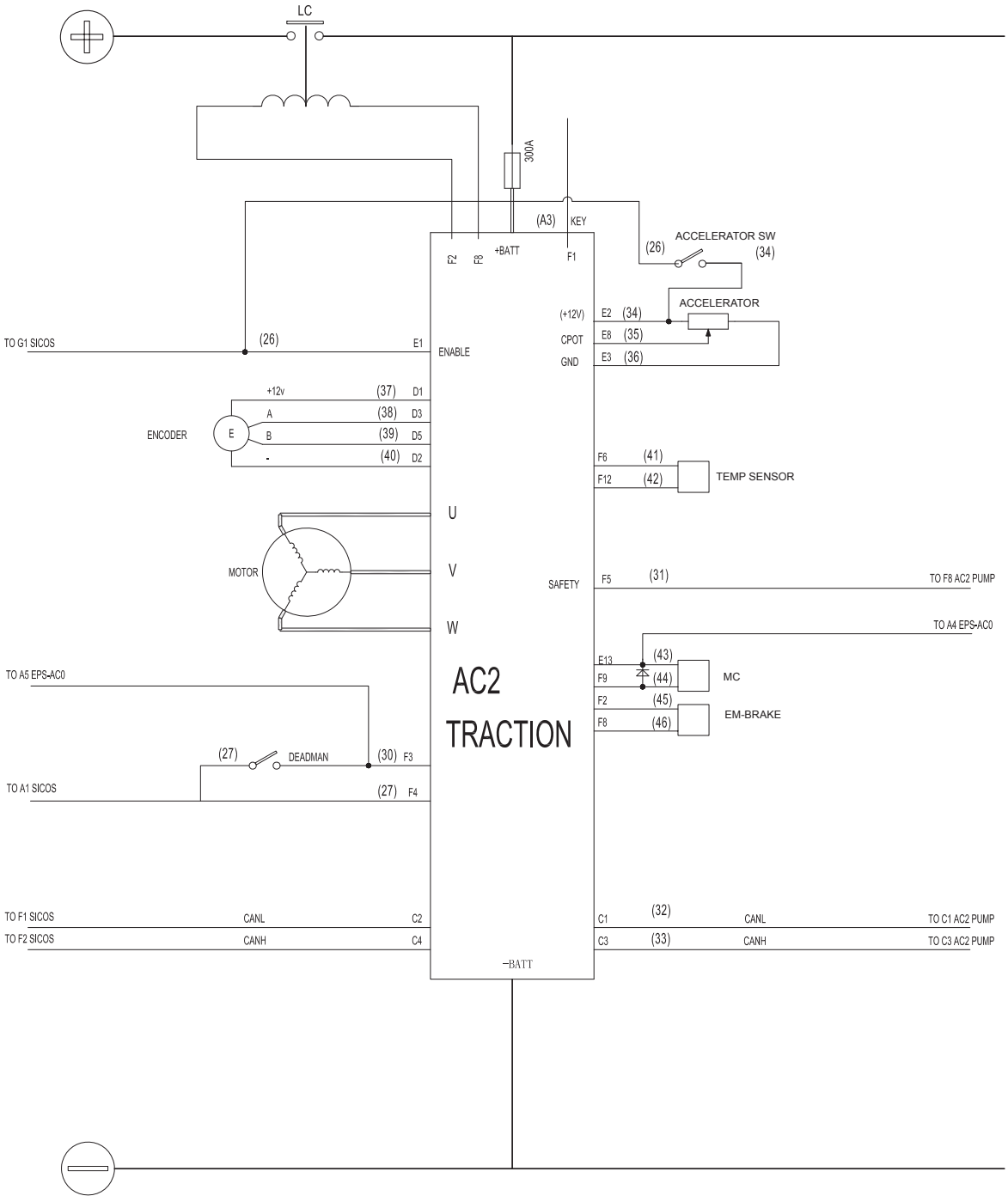
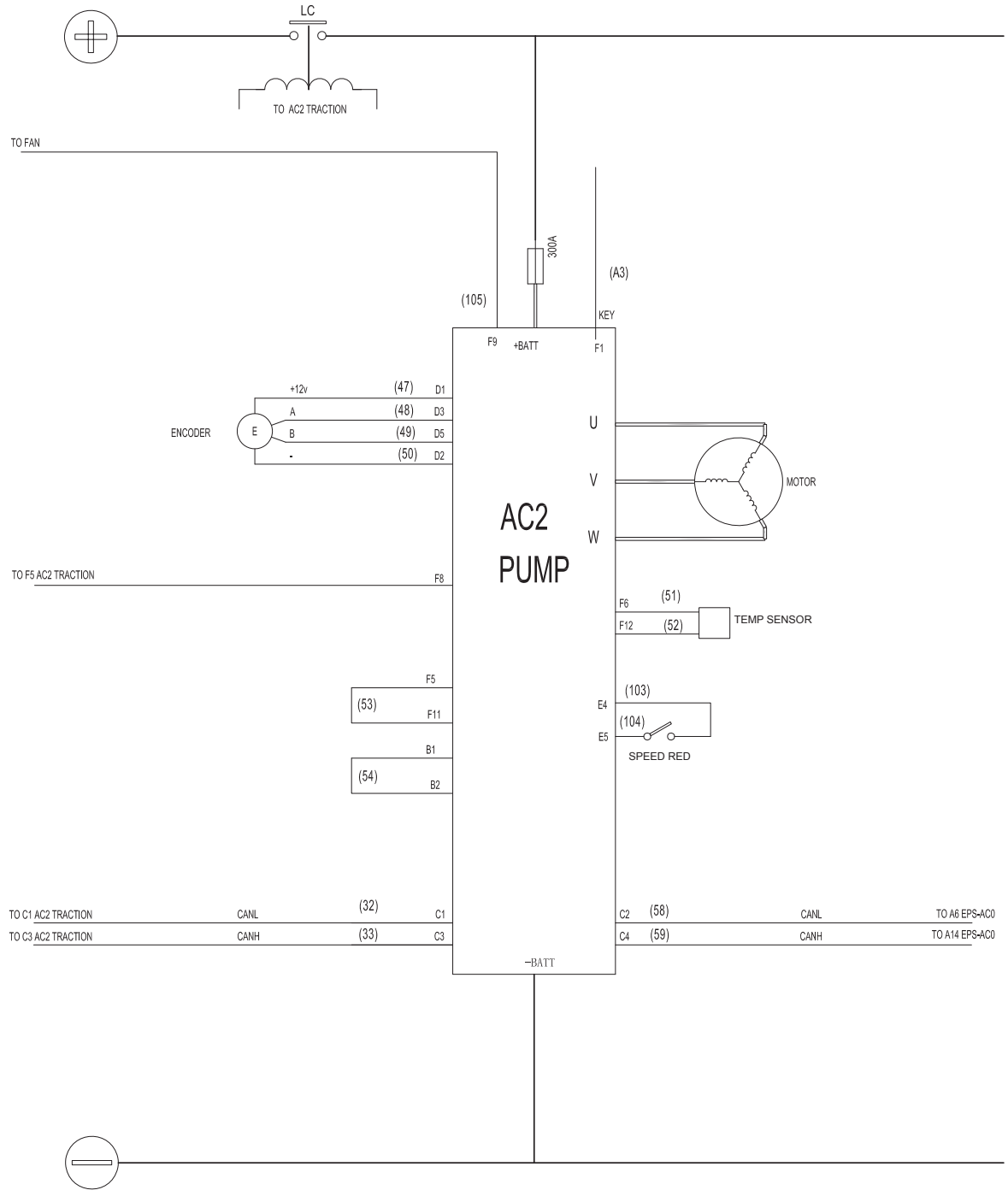
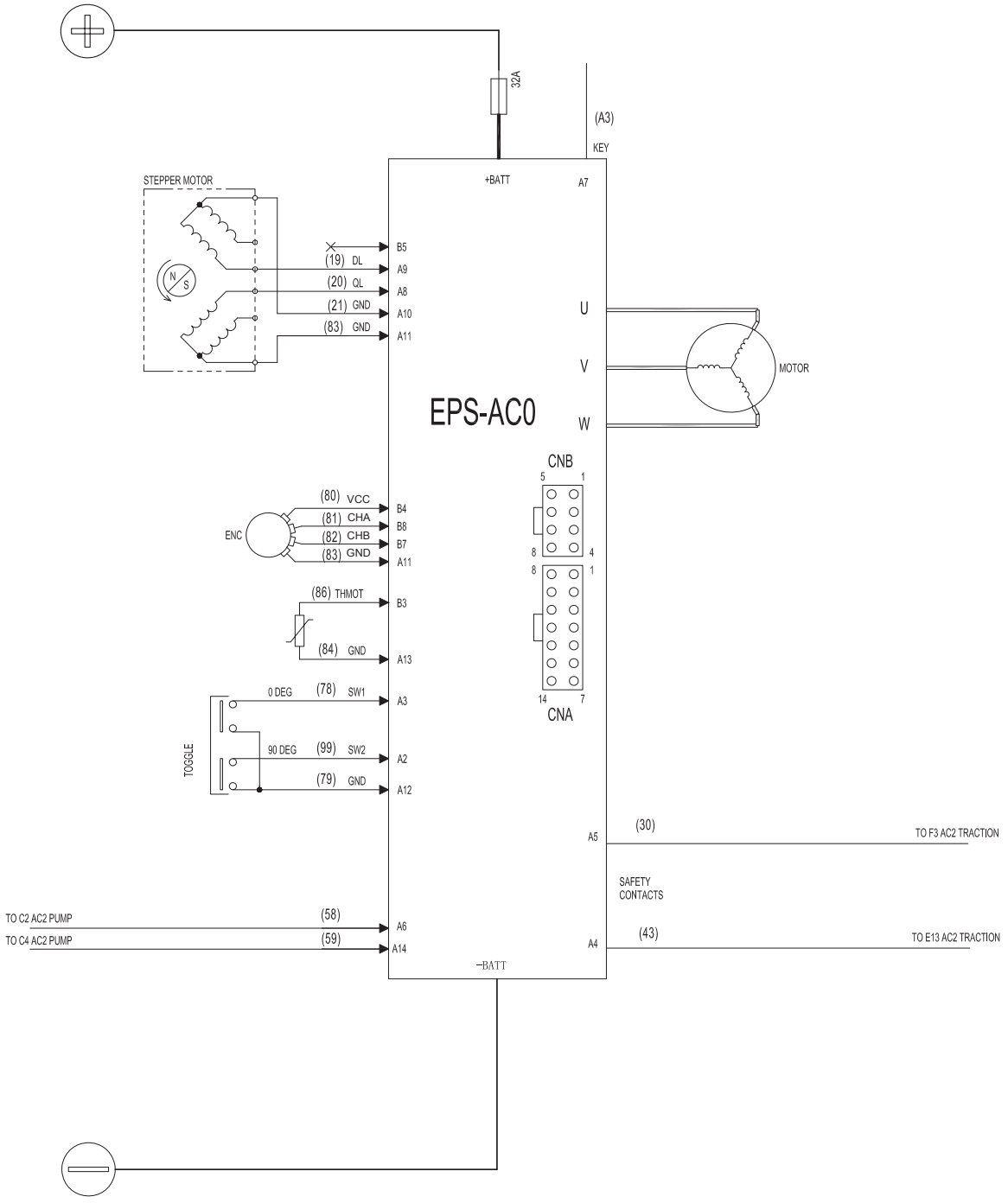
8.16.3 Electrical Schematic Diagram RVF/NRVF (3/5)



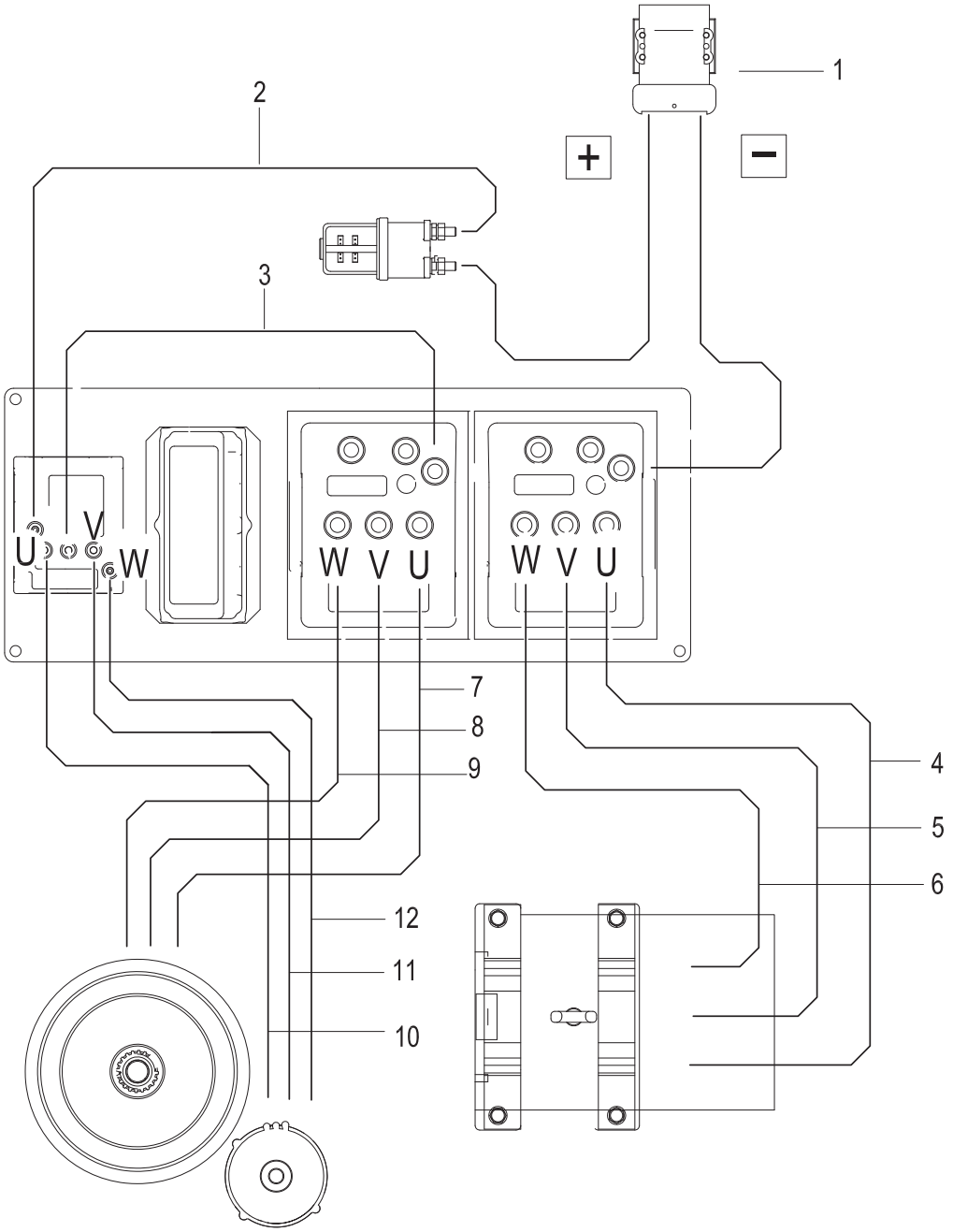
8.16.4 Electrical Schematic Diagram RVF/NRVF (4/5)



8.16.5 Electrical Schematic Diagram RVF/NRVF (5/5)



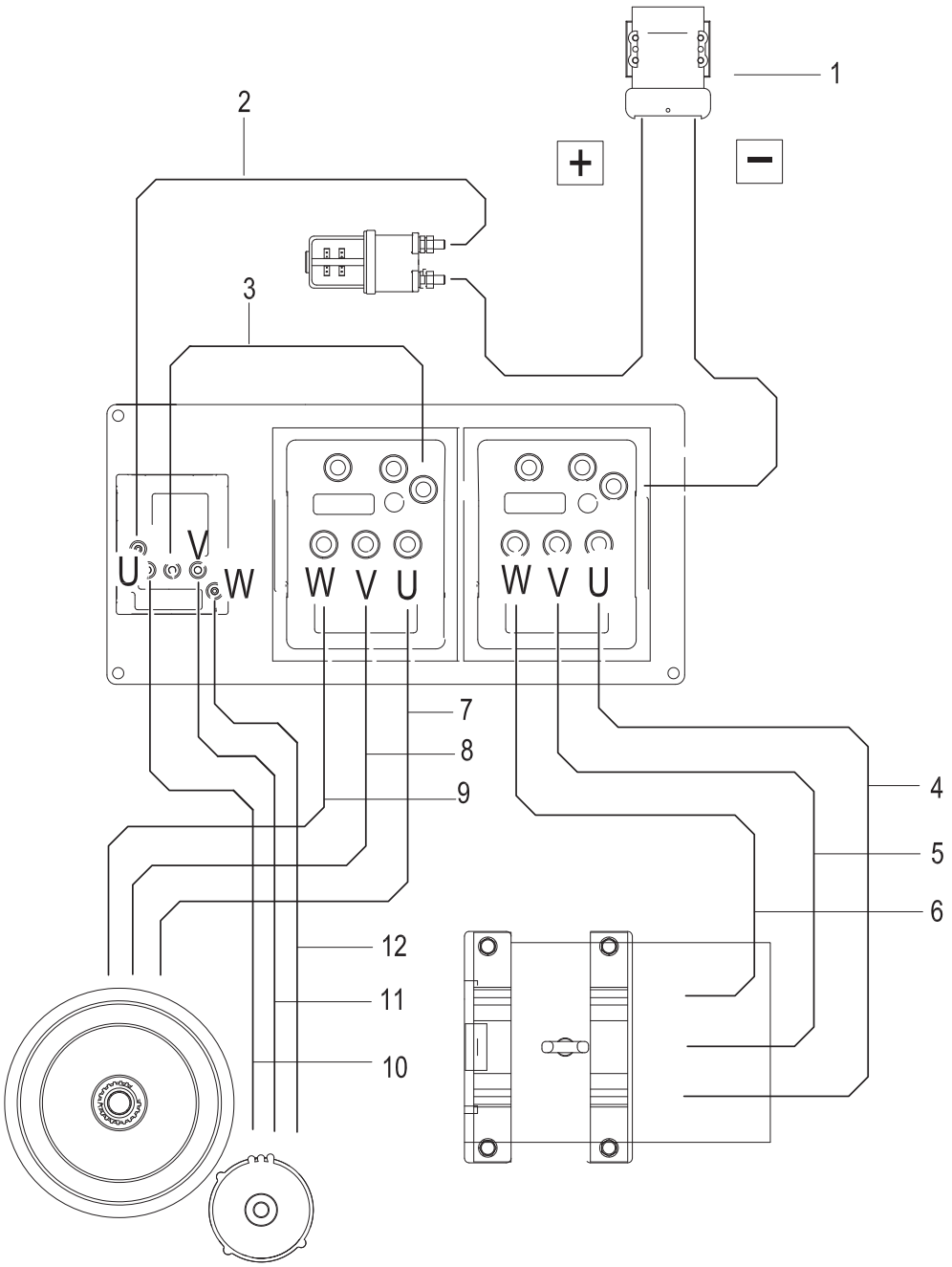
8.17 Cable Wiring Diagrams (RVF/NRVF)



No.	Name
1	Power Supply Cable
2	Cable Positive Electrode
3	Cable Negative Electrode
4	Pump Motor Cable U
5	Pump Motor Cable V
6	Pump Motor Cable W

No.	Name
7	Drive Motor Cable U
8	Drive Motor Cable V
9	Drive Motor Cable W
10	Steering Motor U
11	Steering Motor V
12	Steering Motor W

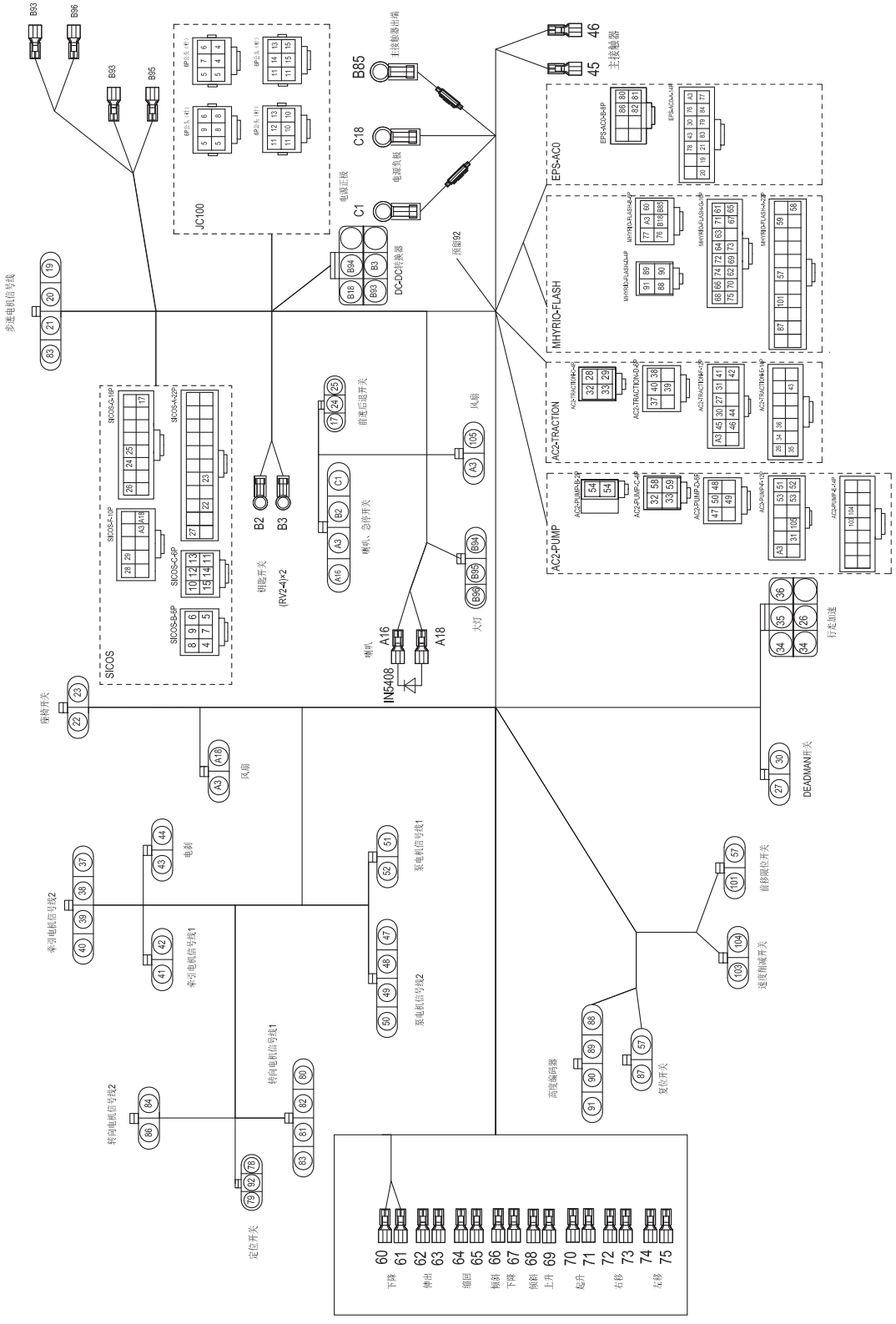
8.18 Cable Wiring Diagrams (RV/NRV)



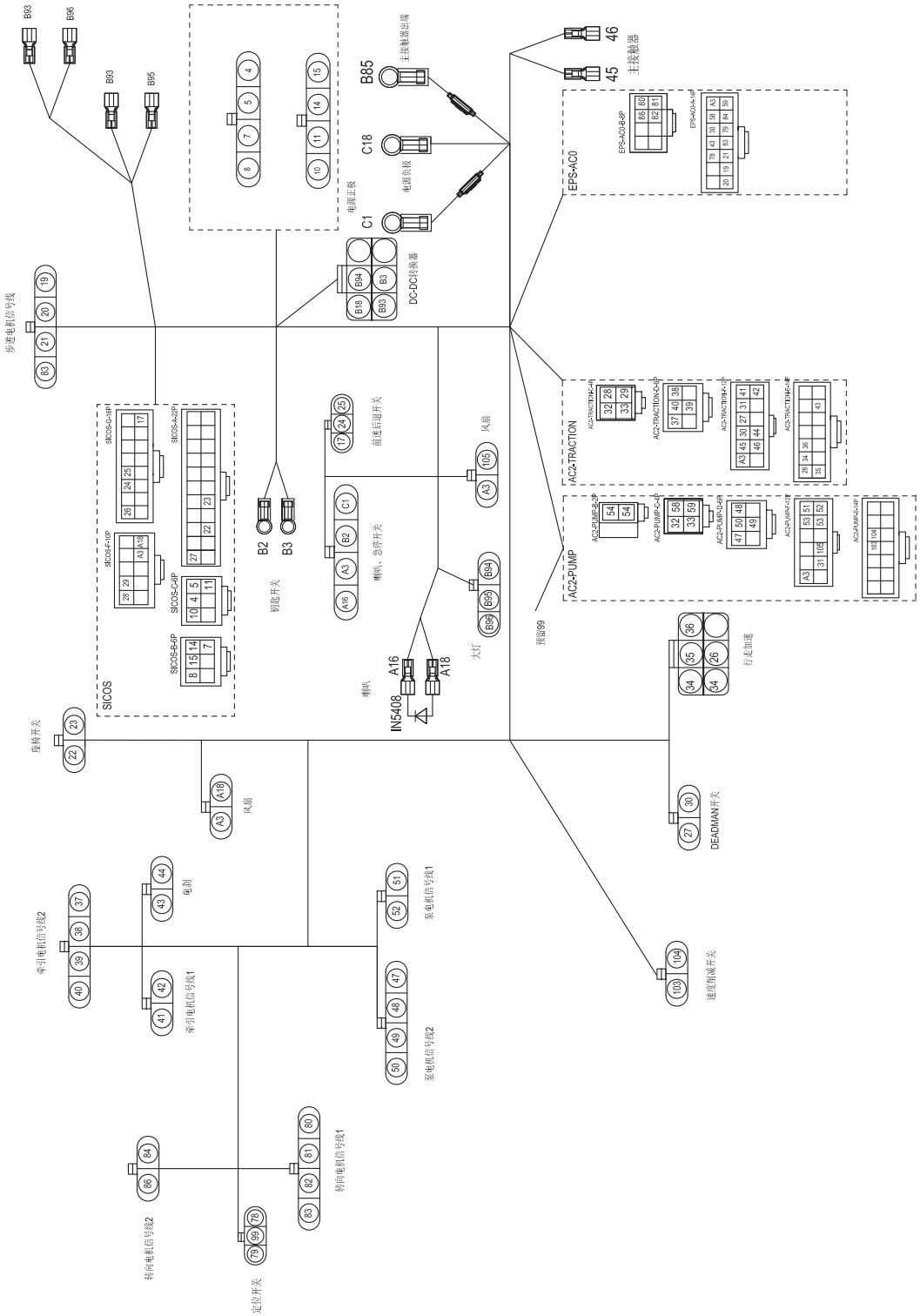
No.	Name
1	Power Supply Cable
2	Cable Positive Electrode
3	Cable Negative Electrode
4	Pump Motor Cable U
5	Pump Motor Cable V
6	Pump Motor Cable W

No.	Name
7	Drive Motor Cable U
8	Drive Motor Cable V
9	Drive Motor Cable W
10	Steering Motor U
11	Steering Motor V
12	Steering Motor W

8.19 Wiring Harness and Connectors (RVF/NRVF)



8.20 Wiring Harness and Connectors (RV/NRV)



8

9. TROUBLESHOOTING

NOTE:

9.1 Preparation Before Troubleshooting

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

CAUTION

- *Even if key switch is turned off, the controllers are still energized.*
- *Before checking or repairing the controllers, make sure the 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
48V	Greater than 48V	Normal
	Less than 48V	Needs to be charged

NOTE

Enter TESTER Menu to check the battery voltage.(see Section 8.12)

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 - Storage 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

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 6.7) 4. Check emergency stop switch and its circuit (see Section 6.8)
Travel Fault	1. Forward and reverse moving failures of the vehicle, but other functions are normal	a. Foot switch and seat 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. Controller failure	Controller failure error, carry out troubleshooting according to the fault code information on the instrument (see Section 8.14). 1) Check if the foot switch and seat switch or the connection of its circuit is normal;(See Section 8.7 and Section 8.11) 2) Electromagnetic brake and its connecting circuit; (see Section 5.2) 3) Check the travel switch and its connection circuit; (see Section 6.10) 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. Drive motor speed encoder failure b. Controller failure	Controller failure error, carry out troubleshooting according to the fault code information on the instrument (see Section 8.14). 1) Check if the motor rotation is normal; 2) Check the electromagnetic brake or its connection circuit (see Section 5.2) 3) Check the speed encoder and its connection circuit; (see Section 5.3) 4) Remove the gearbox, check if the gear rotation is smooth and if there is blocking; (see Section 5.4) 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. Foot switch and seat switch or its circuit connection failure b. Pump motor or its circuit connection failure c. Control switch or its circuit connection failure d. Controller failure	1. Pump motor does not work: 1) Check if the foot switch and seat switch or the connection of its circuit is normal (see Section 8.7 and Section 8.11); 2) Check the pump motor and its connection circuit; (see Section 7.3) 3) Check the control button and its connection circuit; (see Section 6.4 or 6.5) 4) Replace the controller.
		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 7.9) 6) Wash or replace the solenoid spool (see Section 7.5) 7) Wash or replace the valve body (see Section 7.4 or 7.6)
	2. The vehicle cannot be lowered	a. Solenoid valve (or manual valve) or its circuit connection failure b. Lowering switch or its circuit connection failure c. Valve failure; d. Cylinder deformation or blocked e. Explosion-proof valve blocked	1) Check the lowering button and its connection circuit; (see Section 6.4 or 6.5) 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 7.9) 4) Clean or replace the valve; (see Section 7.4 or 7.6); 5) Replace the explosion-proof valve (see Appendix A)

* 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 (see Section 7.4 or 7.6)
	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 (see Section 7.4 or 7.6)
	5. Unstable Lifting / Lowering of Vehicle	a. Chain loosening; b. Poor lubrication between steel channel and rollers; c. Improper adjustment of rollers, or blocked; d. Accumulator failure;	1) Adjust the chain tension; (see Appendix A1-1.1) 2) Check if the steel channel grease is normal, clean and re-lubricate steel channel and rollers; 3) Adjust the side roller spacing through roller screw; or replace the roller; 4) Replace the accumulator.
* Under the circumstances of normal lifting and lowering, if failure occurs to any of other hydraulic actions (forward/backward shifting, forward/backward tilting and left/right shifting), perform troubleshooting to the corresponding control switch and its control circuit.			
Steering Fault	1. The vehicle cannot be steered (the vehicle can travel)	a. Stepper motor or its circuit connection failure b. Steering motor or its circuit connection failure c. Proximity switch or its circuit connection failure d. Steering controller failure	Controller failure error, carry out troubleshooting according to the fault code information on the instrument (see Section 8.14). 1) Check if the mechanical connection between the steering wheel and stepper motor is solid; (see Section 6.1) 2) Check the stepper motor or its connection circuit; (see Section 6.6) 3) Check the steering motor or its connection circuit; (see Section 5.6) 4) Check the proximity switch or its connection circuit. (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**
Other Failures	1. Lights do not light	a. Light failure or circuit not conducted	Check the light and its circuit connection (see Section 8.9)
	2. 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 6.3) 2) Check the horn and its connection circuit; (see Section 6.3)

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

9

APPENDIX

NOTE:

A SERVICE MANUAL - MAST

A

LET'S GROW TOGETHER!

NOTE:

A1 Two-stage Mast

A1-1 Removal and Installation

Removal

- Disconnect the connections between lifting - lowering tubing, forward tilting tubing, backward tilting tubing, left shifting tubing and right shifting tubing, and mast tubing;
- Remove the connections between forward shift cylinder and the mast mounting base; (see Section 7.8)
- Unscrew the screw (1) and remove the forward shift safety block (2) from the forward shift guide rails;
- Wrap the sling (3) around the upper beam of inner and outer masts, slightly lift the mast with crane and remove the mast from the guide rails.

Installation

- Install according to the reverse order of removal.

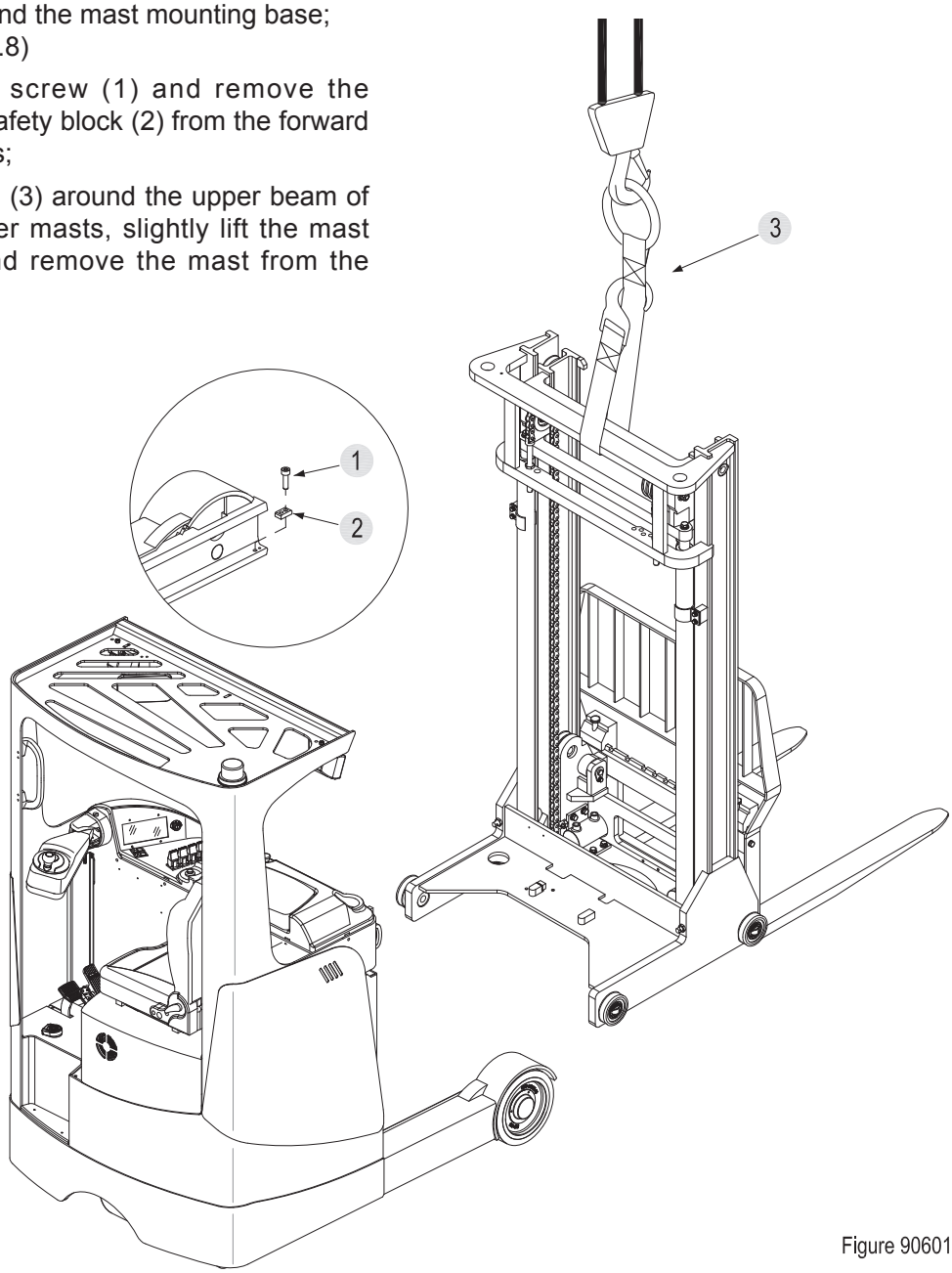


Figure 90601

A1-2 Lifting Chains

A

A1-2.1 Chain Adjustment

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

CAUTION

Switch off the power supply before any adjustments or operations!

- Loosen the upper and lower lock nuts (2) on chain bolt;
- Through screwing upward the adjusting nut (9) in the middle, the chain will slowly tension;
- When the chain is adjusted to be tensioned with no obvious loosening, fasten the upper and lower lock nuts;

CAUTION

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

- Pull out emergency stop switch and turn on the key switch;
- Through repeatedly lifting/lowering the mast to test if the chain is tensioned. If the chain is still loose, repeat the steps above.

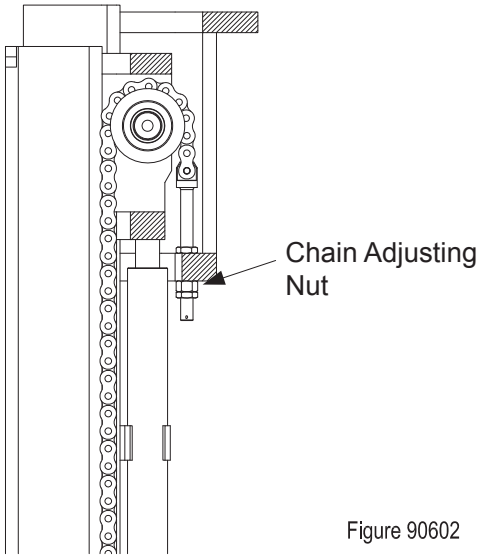


Figure 90602

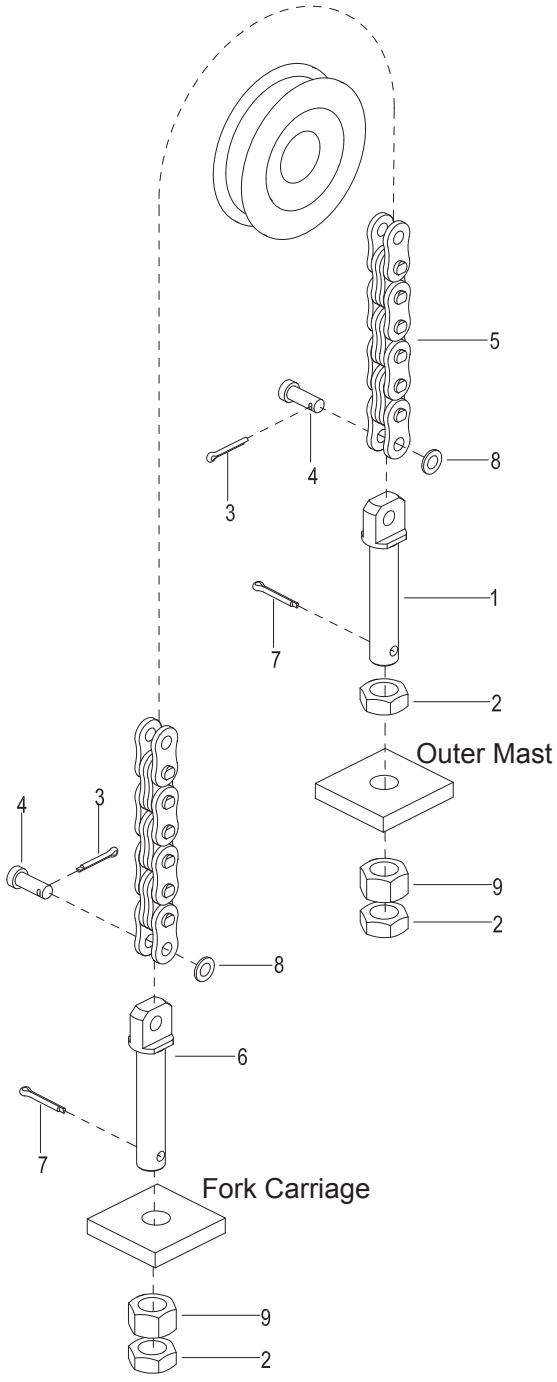


Figure 90603

A1-2.2 Chain Replacement

- Block the truck wheels with wooden wedges, raise the fork carriage with lifting tools to make the chains loose for the following removal;

CAUTION

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

- Remove the cotter pin (7, Figure 90603) and unscrew the lock nut (2) and adjusting nut (9) from the chain joint (1) and chain joint (6);
- Remove the cotter pin (3) and flat washer (8), pull out the pin shaft (4), separate the chains (5) from the chain joint (1) on outer mast;
- Remove the chain assembly from the chain sprocket;
- Replace with new chains and hang the new chain assembly onto the chain sprocket;
- Put the chain connector (6) through the fork carriage chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Put the chain connector (1) through the outer mast chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Adjust the chains according to Section A1-2.1.

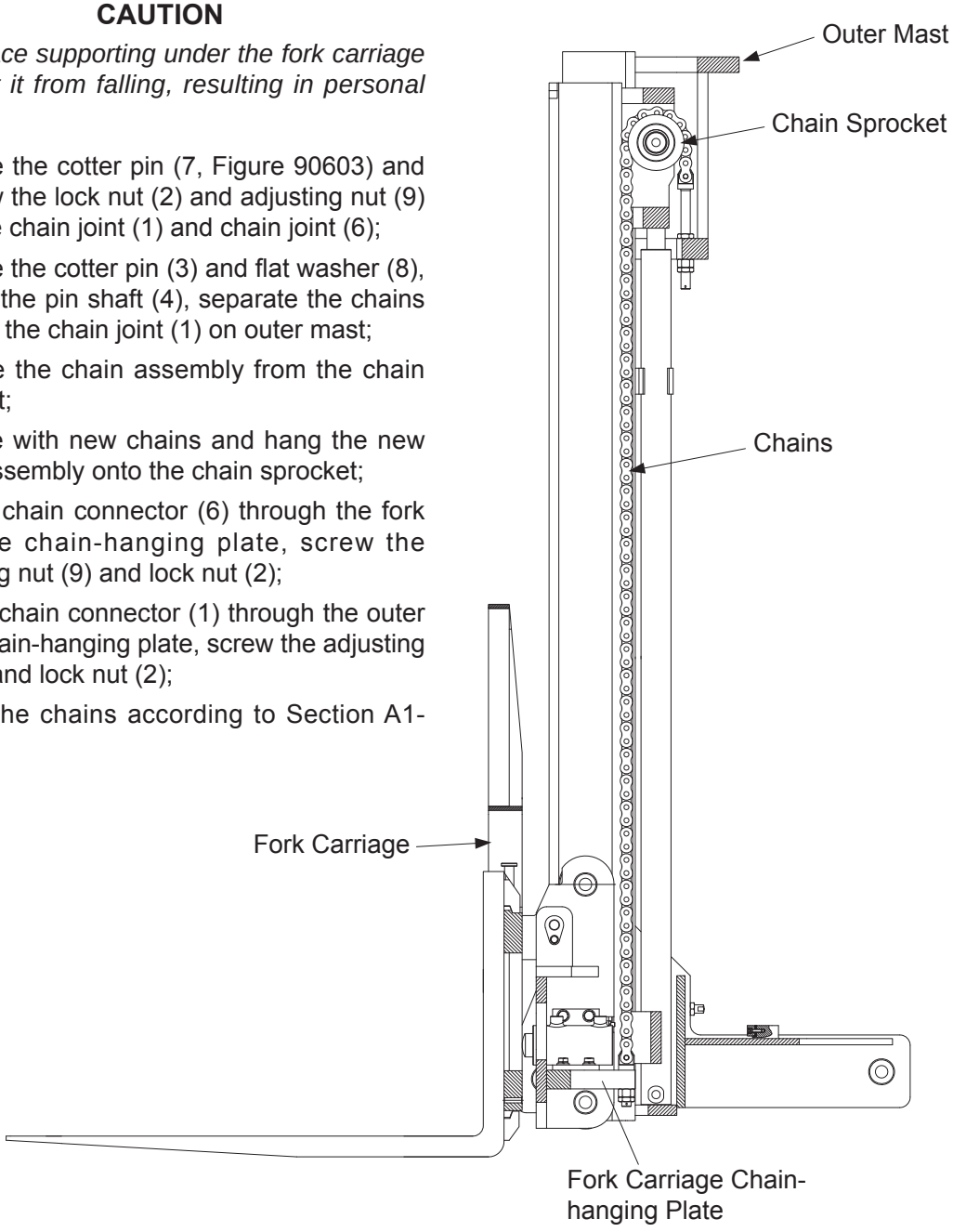


Figure 90604

A1-3 Mast Tubing

A

Code	Description
A	Lifting / Lowering Mast Tubing
B	Forward Tilting Mast Tubing
C	Backward Tilting Mast Tubing
D	Left Shift Mast Tubing
E	Right Shift Mast Tubing

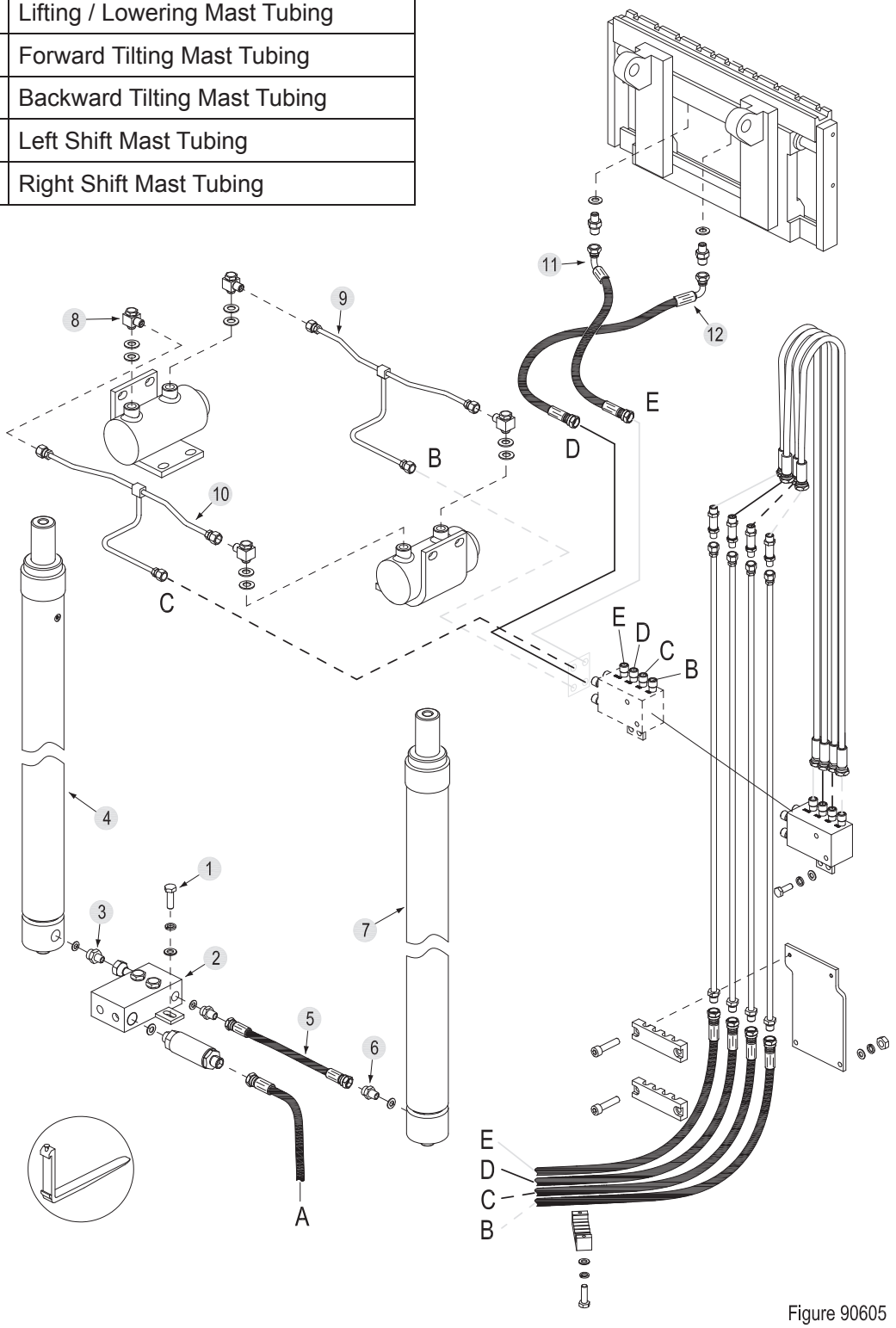


Figure 90605

A1-4 Lift Cylinder

A1-4.1 Cylinder Removal (with mast on the vehicle)

Left Cylinder Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheels with wooden wedges, raise the inner mast (2, Figure 90606) for 500mm with lifting tools, insert wooden block between inner mast and the ground for supporting;
- Unscrew the two bolts (1, Figure 90605), and unfix the five-pass components (5);
- Unscrew the joints on five-pass components and separate it from straight coupling (3);

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 the bolt (3, Figure 90606) and remove the cylinder clamp (4);

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.

- Unscrew the mounting bolt (8) from the bottom of the cylinder;
- Unscrew the bolt (6), lift the cylinder (5) up and remove it from the truck.

Right Cylinder Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheels with wooden wedges, raise the inner mast (2, Figure 90606) for 500mm with lifting tools, insert wooden block between inner mast and the ground for supporting;
- Remove the tubing (5, Figure 90605) to make it separate from the direct coupling (6);

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 the bolt (3, Figure 90606) and remove the cylinder clamp (4);

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.

- Unscrew the bolt (6) and bolt (8), lift the cylinder (5) up and remove it from the truck.

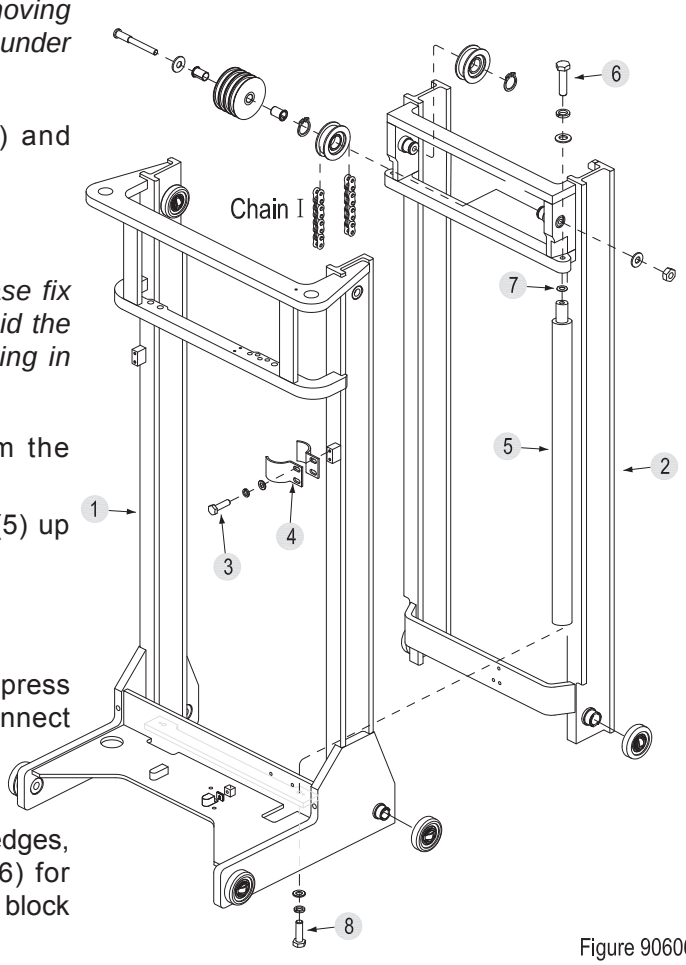


Figure 90606

A

A1-4.2 Cylinder Maintenance

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 90607) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Remove the guide bush (5) from the cylinder tube (6);
- Pull out the piston rod (1) from the cylinder tube;
- Remove the support ring (7), seal (9) and cover plate (8) 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.

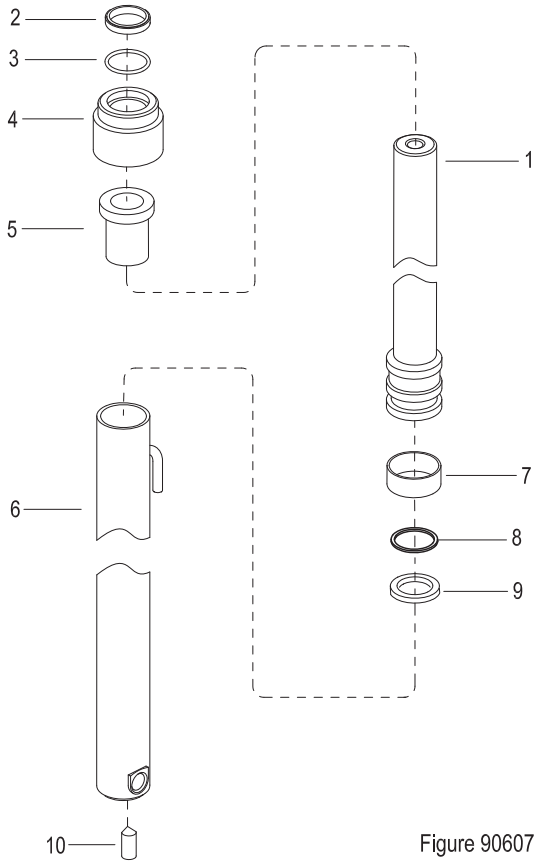


Figure 90607

A1-4.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A1-4.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat 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.

A1-5 Tilt Cylinde

A1-5.1 Cylinder Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Unscrew the two articulated joints (8, Figure 90605) from the tilt cylinder, disconnect the connections between forward tilt pipe (9), backward tilt pipe (10) and the tilt 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 the four 4 bolts (5, Figure 90608) and remove the tilt cylinder (6).

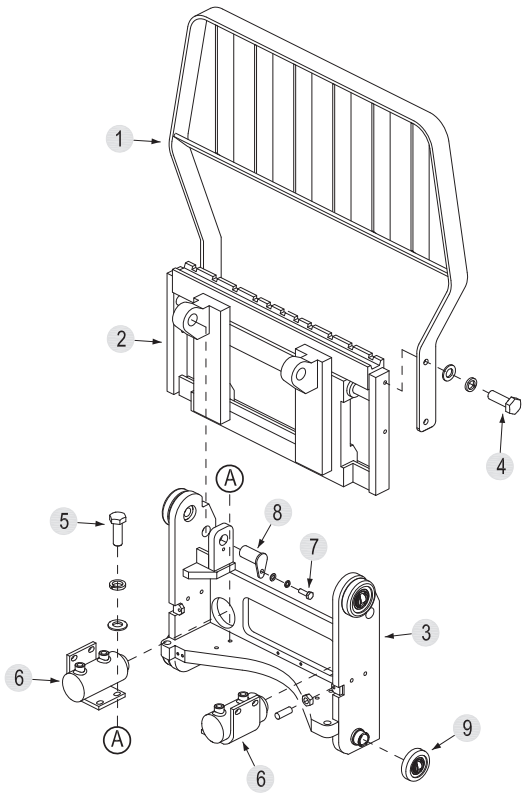


Figure 90608

A1-5.2 Cylinder Maintenance

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.*

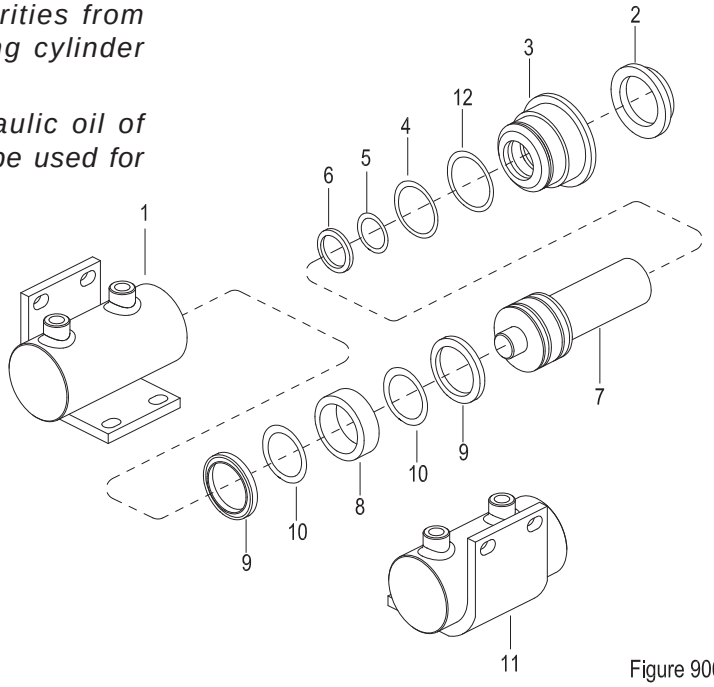


Figure 90609

A

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom;
- Unscrew the cylinder cap (3, Figure 90609) with cylinder wrench;
- Remove the dust ring (2), O-rings (12), seal (4), O-ring (5) and O-ring (6) from the cylinder cap;
- Pull out the piston rod (7) from the cylinder tube (1);
- Remove the support ring (8), seal (9) and cover plate (10) 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.

A1-5.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A1-5.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat forward tilting - backward tilting of the 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.

A1-6 Built-in Side Shifter

A1-6.1 Side Shifter Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Unscrew the four bolts (4, Figure 90608), remove the retaining shelf (1) from the built-in side shifter (2);

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.

- Remove the right shifting tubing (11, Figure 90605) and left shifting tubing (12) from the built-in side shifter;

CAUTION

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

- Unscrew the bolt (7, Figure 90608), pull out the pin shaft (8) and remove the built-in side shifter (2).

A1-6.2 Side Shifter Installation

- Install the side shifter according to the reverse order of removal according to A1-6.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat left shifting - right shifting operations to discharge the air within the tubing and side shift cylinder;
- Check the hydraulic oil level and make sure that the liquid is at standard level.

A1-6.3 Side Shifter Maintenance

CAUTION

- *Carry out the maintenance work in a clean environment to prevent impurities from entering into cylinder, causing cylinder damage.*
- *During the installation, hydraulic oil of the same specifications must be used for cleaning or lubrication.*
- *Apply grease into each grease nipple with a grease gun.(See Section 2.2.3)*

- Unscrew the four bolts (16) and remove the two adjustable lower hooks (13);
- Remove the lower side shift bracket (19), upper sliding block (8) and lower sliding block (11) from the side shift bracket;
- Pry out the damping sleeve (1) and pull out the piston (2) from the side shift bracket;
- Hammer out the end cap (4) and remove the dust ring (3) from the end cap;
- Remove the retaining ring (5) and seal (6) on the cylinder tube;
- Clean with hydraulic oil of the same specifications;
- Replace the problem parts and assembly in reverse steps.

CAUTION

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

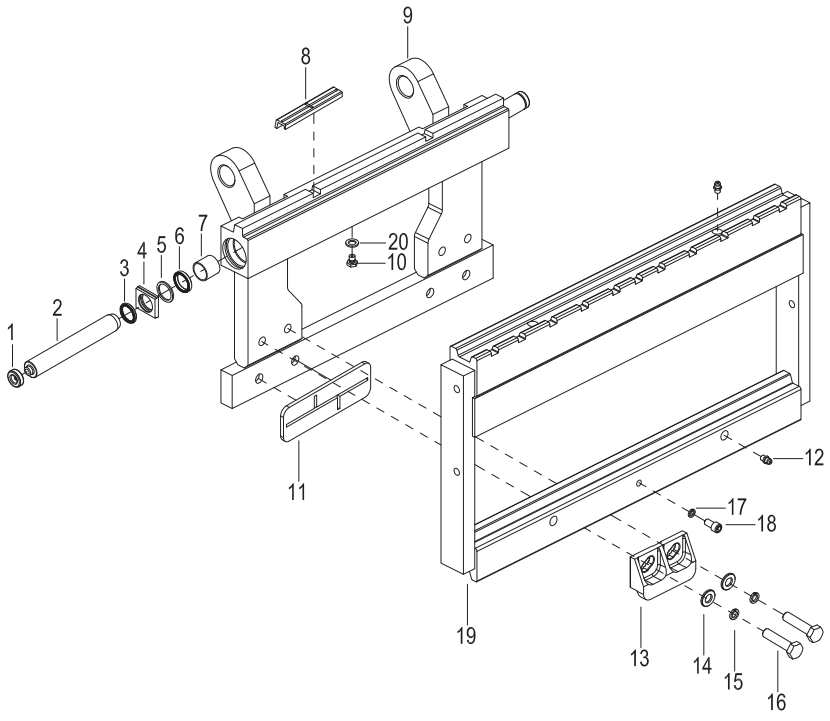


Figure 90627

A

A2 Three-stage Mast (Lifting Height ≤ 7.5 m)

A2-1 Removal and Installation

Removal

- Disconnect the connections between lifting - lowering tubing, forward tilting tubing, backward tilting tubing, left shifting tubing and right shifting tubing, and mast tubing;
- Remove the connections between forward shift cylinder and the mast mounting base; (see Section 7.8)
- Unscrew the screw (1) and remove the forward shift safety block (2) from the forward shift guide rails;
- Wrap the sling (3) around the upper beam of the three masts, slightly lift the mast with crane and remove the mast from the guide rails.

Installation

- Install according to the reverse order of removal.

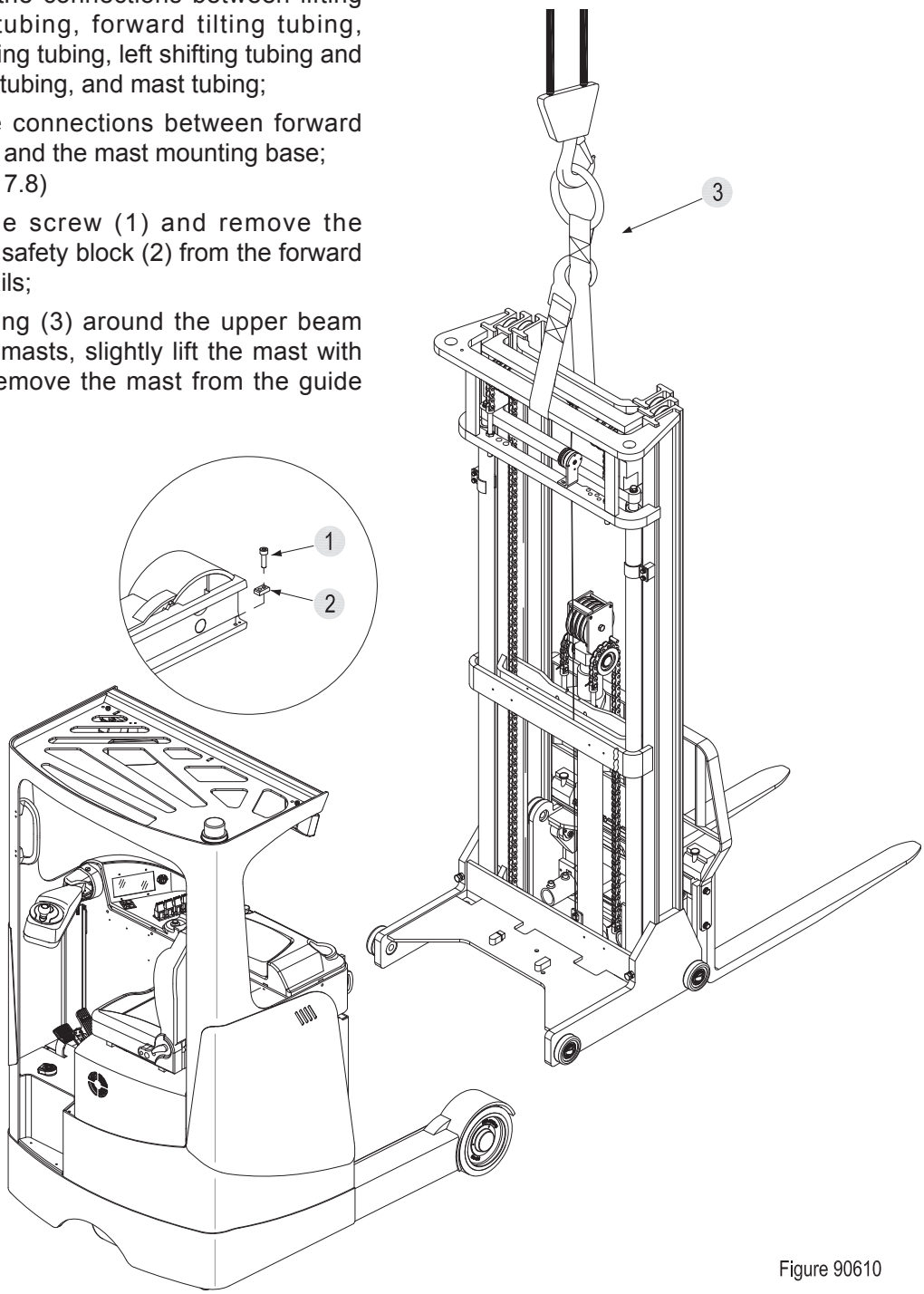


Figure 90610

A2-2 Lifting Chains

A2-2.1 Chain Adjustment

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

CAUTION

Switch off the power supply before any adjustments or operations!

- Loosen the upper and lower lock nuts (2) on chain bolt;
- Through screwing upward the adjusting nut (9) in the middle, the chain will slowly tension;
- When the chain is adjusted to be tensioned with no obvious loosening, fasten the upper and lower lock nuts;

CAUTION

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

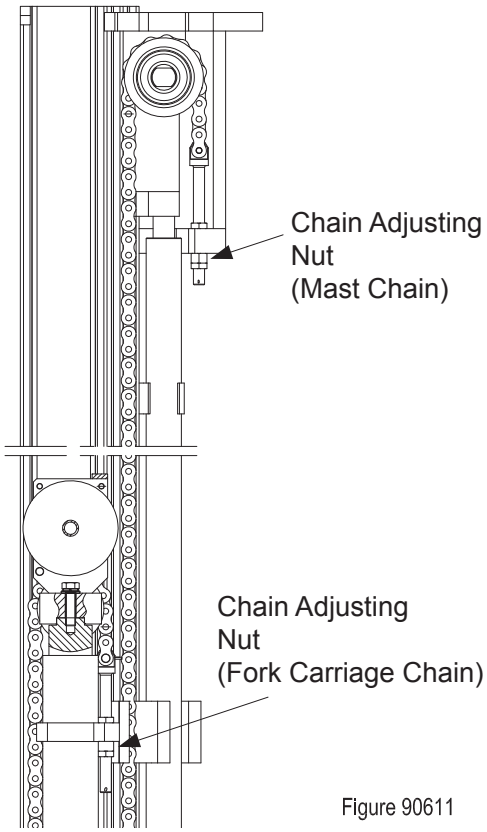


Figure 90611

- Pull out emergency stop switch and turn on the key switch;
- Through repeatedly lifting/lowering the mast to test if the chain is tensioned. If the chain is still loose, repeat the steps above.

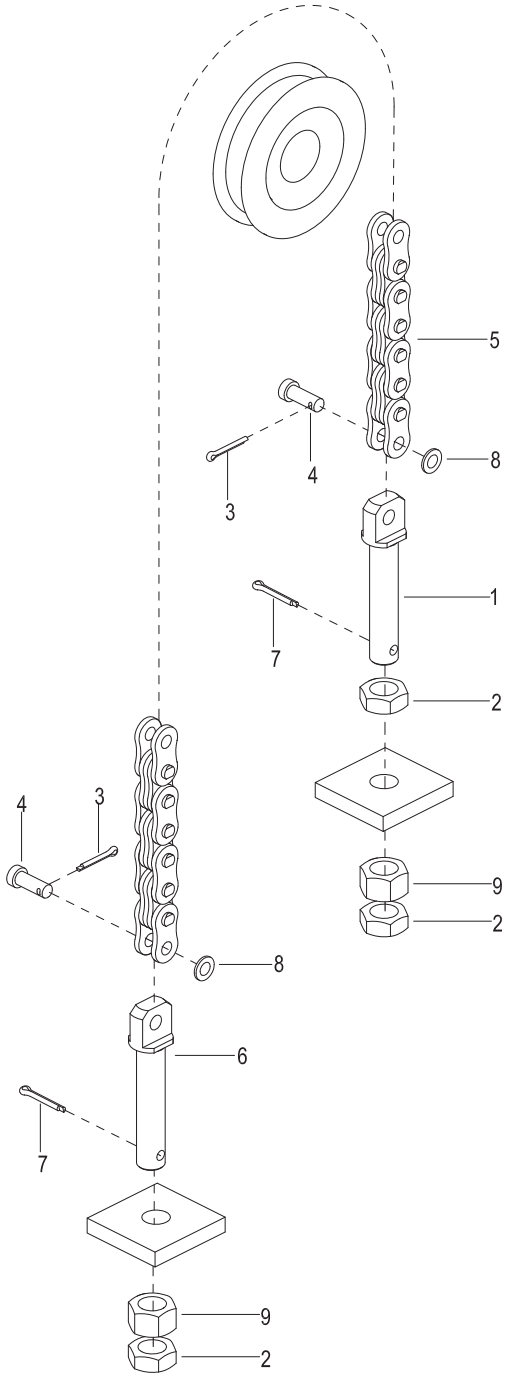


Figure 90603

A

A2-2.2 Chain Replacement

A2-2.2.1 Mast Chains

- Block the truck wheels with wooden wedges, raise the inner mast (8, Figure 90613) for 500mm, insert wooden block between inner mast and the ground for supporting;

CAUTION

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

- Remove the cotter pin (7, Figure 90603) and unscrew the lock nut (2) and adjusting nut (9) from the chain joint (1) and chain joint (6);
- Remove the chain assembly from the chain sprocket (5 Figure 90612);
- Remove the cotter pin (3, Figure 90603) and flat washer (8), pull out the pin shaft (4), separate the chains (5) from the chain joint (1) and chain joint (6);
- Replace with new chains and hang the new chain assembly onto the chain sprocket;
- Put the chain connector (6) through the inner mast chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Put the chain connector (1) through the outer mast chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Adjust the chains according to Section A2-2.1.

A2-2.2.2 Fork Carriage Chains

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

CAUTION

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

- Remove the cotter pin (7, Figure 90603) and unscrew the lock nut (2) and adjusting nut (9) from the chain joint (1) and chain joint (6);
- Remove the chains from the chain sprocket (10 Figure 90613);
- Remove the cotter pin (3, Figure 90603) and flat washer (8), pull out the pin shaft (4), separate the chains (5) from the chain joint (1) and chain joint (6);
- Replace with new chains and hang the new chain assembly onto the chain sprocket;
- Put the chain connector (6) through the fork carriage chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Put the chain connector (1) through the middle cylinder chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Adjust the chains according to Section A2-2.1.

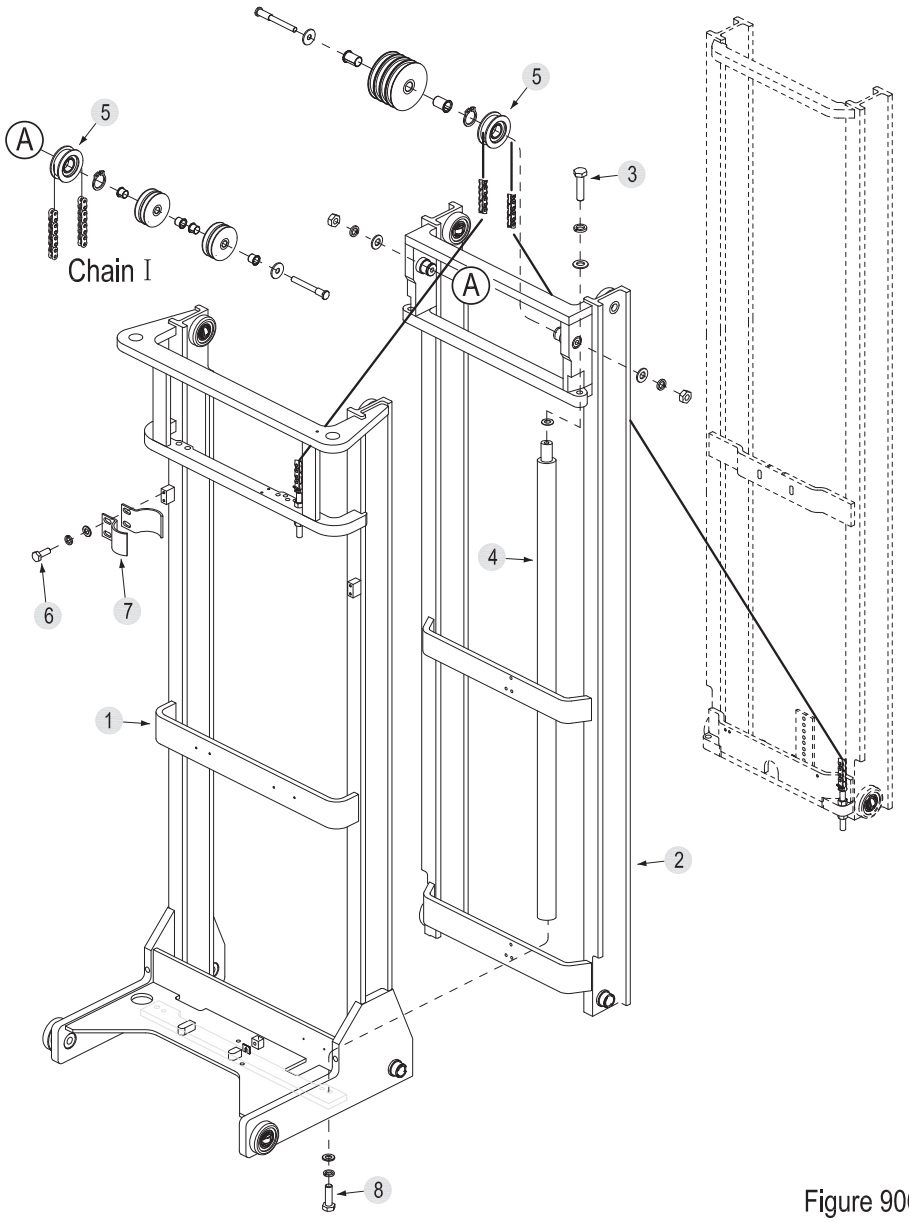


Figure 90612

A

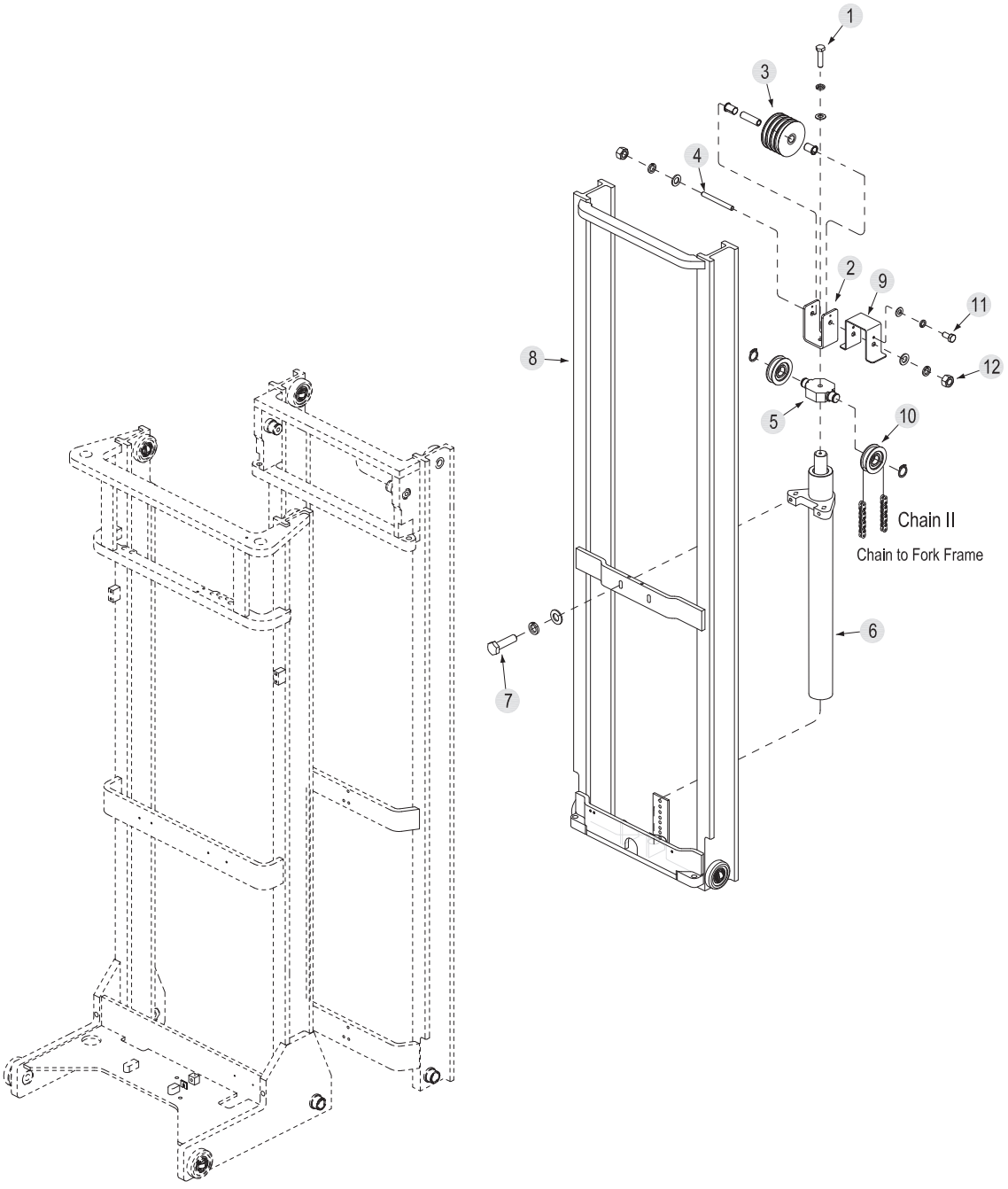


Figure 90613

A2-3 Mast Tubing

Code	Description
A	Lifting / Lowering Mast Tubing

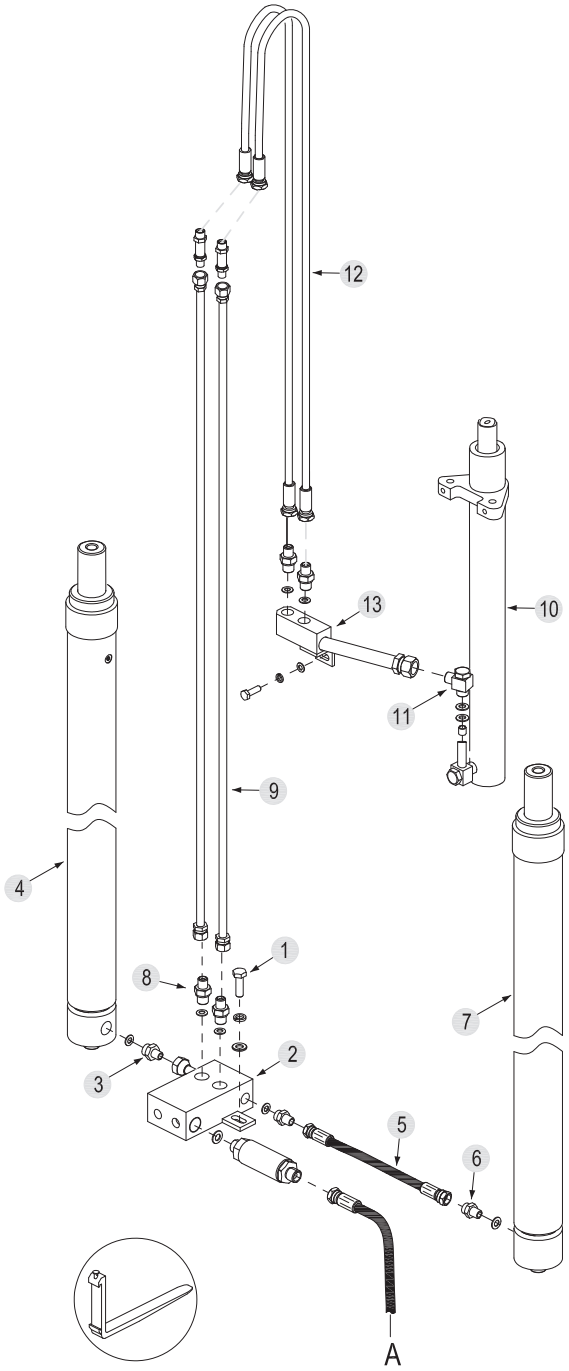


Figure 90614

A

Code	Description
B	Forward Tilting Mast Tubing
C	Backward Tilting Mast Tubing
D	Left Shift Mast Tubing
E	Right Shift Mast Tubing

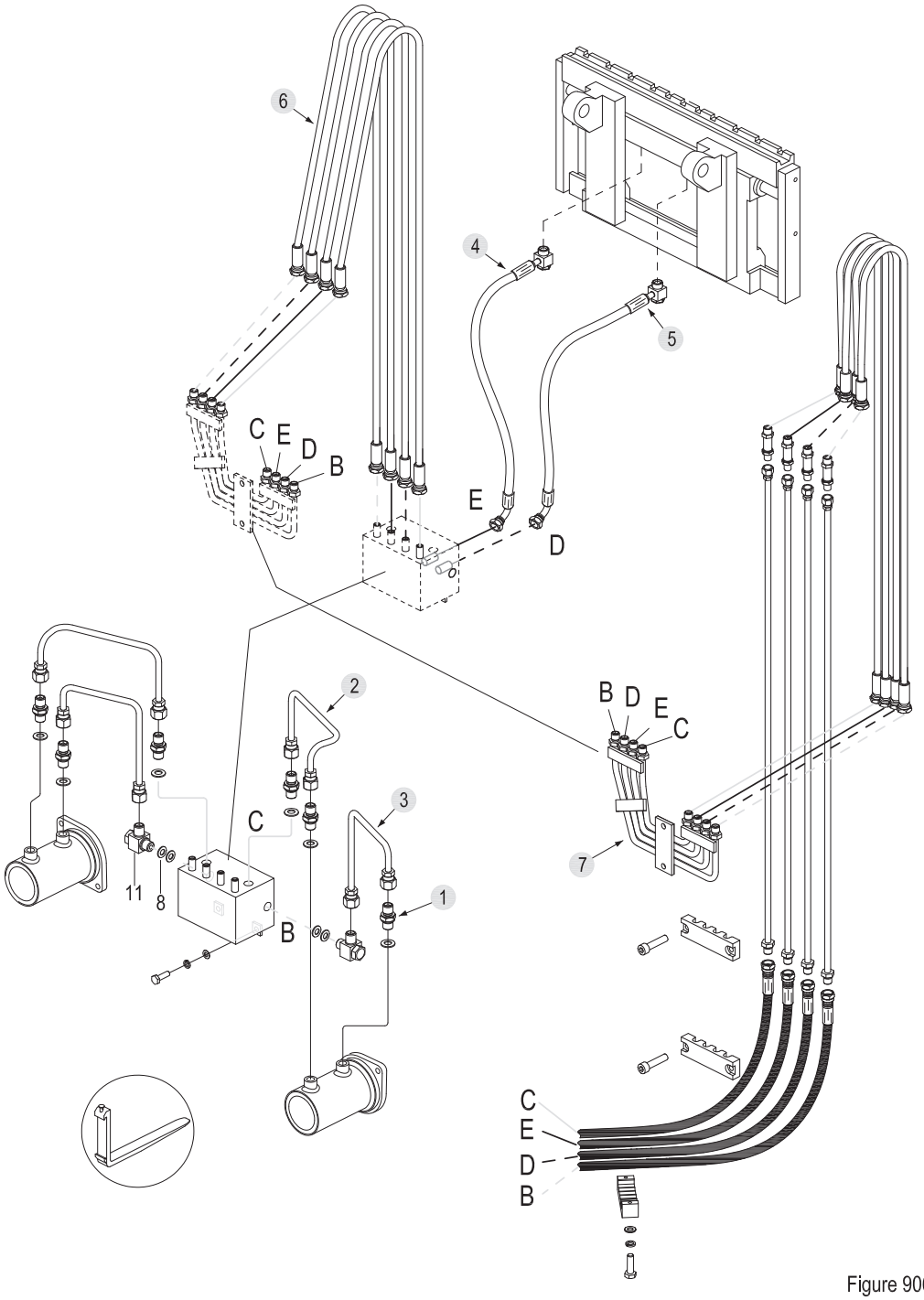


Figure 90615

A2-4 Lift Cylinder

A2-4.1 Cylinder Removal

Left Cylinder Removal (with mast down)

- Remove the mast from the chassis according to Section A2-1;
- Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting;
- Disconnect the connections between two rigid pipes (9, Fig 90614) and five-pass assembly (2);
- Unscrew the two bolts (1), and unfix the five-pass components (5);
- Unscrew the joints on five-pass components and separate it from straight coupling (3);

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 the bolt (6, Figure 90612) and remove the cylinder clamp (7);

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.

- Unscrew the mounting bolt (8) from the bottom of the cylinder;
- Unscrew bolt (6) and remove the cylinder (4) from the mast.

Right Cylinder Removal(with mast down)

- Remove the mast from the chassis according to Section A2-1;
- Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting;
- Remove the tubing (5, Figure 90614) to make it separate from the direct coupling (6);

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 the bolt (6, Figure 90612) and remove the cylinder clamp (7);

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.

- Unscrew the mounting bolt (8) from the bottom of the cylinder;
- Unscrew bolt (6) and remove the cylinder (4) from the mast.

Full Free Middle Cylinder (with mast on the vehicle)

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Remove retaining shelf (see Section A2-6.1);
- Block the truck wheels with wooden wedges, raise the fork carriage for 500mm with lifting tools, insert wooden block between it and the ground for supporting;

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.

- Loosen the articulated joints (11, Figure 90614) to separate the middle cylinder and rigid pipe assembly (13);
- Disconnect the connections between the four tubings (6, Figure 90615) around the middle cylinder and rigid pipe assembly (7);
- Remove the fork carriage chains according to Section A2-2.2.2;

A

- Unscrew bolt (11, Figure 60613) and remove the middle cylinder roller guard (9);
- Unscrew the nut (12), remove the middle cylinder tube shaft (4) and middle cylinder four rollers (3);
- Unscrew the bolt (1) and remove the middle cylinder fixing plate (2) and sprocket seat (5) from the cylinder (6);

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.

- Unscrew the bolt (7), separate the cylinder (6) from the inner mast (8);
- Remove the cylinder (6) from the truck.

A2-4.2 Cylinder Maintenance

Lifting Side Cylinder

CAUTION

- *Use suitable hose clamps to avoid cylinder deformation caused by severely tight hose clamp.*
- *Carry out the maintenance work in a clean environment to prevent impurities from entering 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 90607) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Remove the guide bush (5) from the cylinder tube (6);
- Pull out the piston rod (1) from the cylinder tube (6);

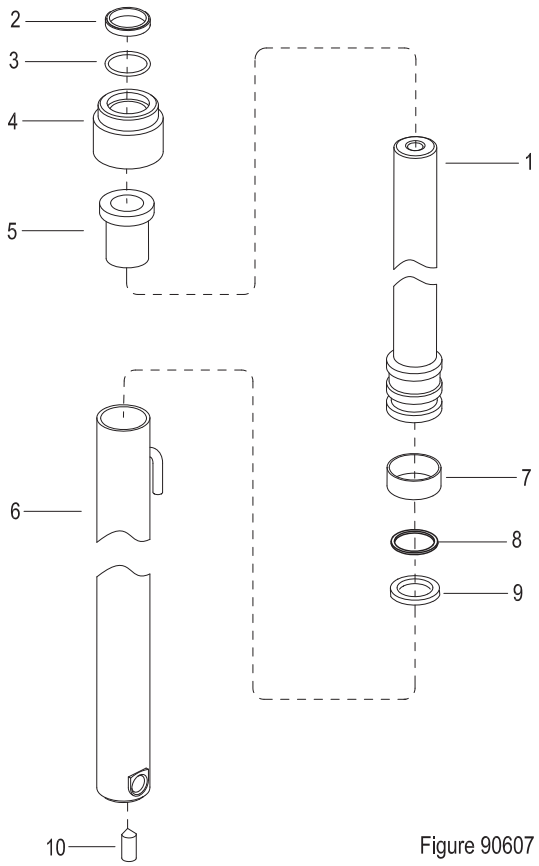


Figure 90607

- Remove the support ring (7), seal (9) and cover plate (8) 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.

Full Free Middle Cylinder

CAUTION

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

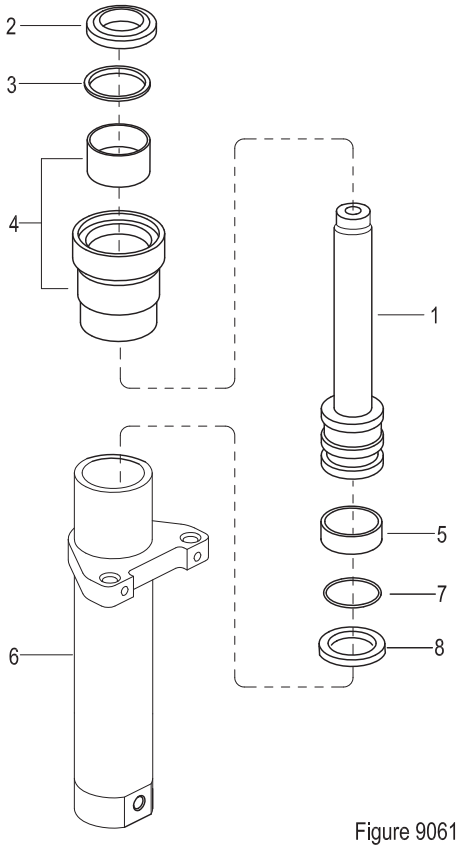


Figure 90616

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom;
- Unscrew the cylinder cap (4, Figure 90616) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Pull out the piston rod (1) from the cylinder tube (6);
- Remove the support ring (5), seal (8) and cover plate (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.

A2-4.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A2-4.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat 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.

A2-5 Tilt Cylinde

A

A2-5.1 Cylinder Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Remove retaining shelf; (see Section A2-6.1)
- Unscrew the two direct joints (1, Figure 90615) from the tilt cylinder, disconnect the connections between forward tilt pipe (3), backward tilt pipe (2) and the tilt 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.

- Slightly raise the side shifter (2), unscrew the two bolts (5, Figure 90617) from the gap between side shifter and fork carriage, and remove the tilt cylinder (6 or 10).

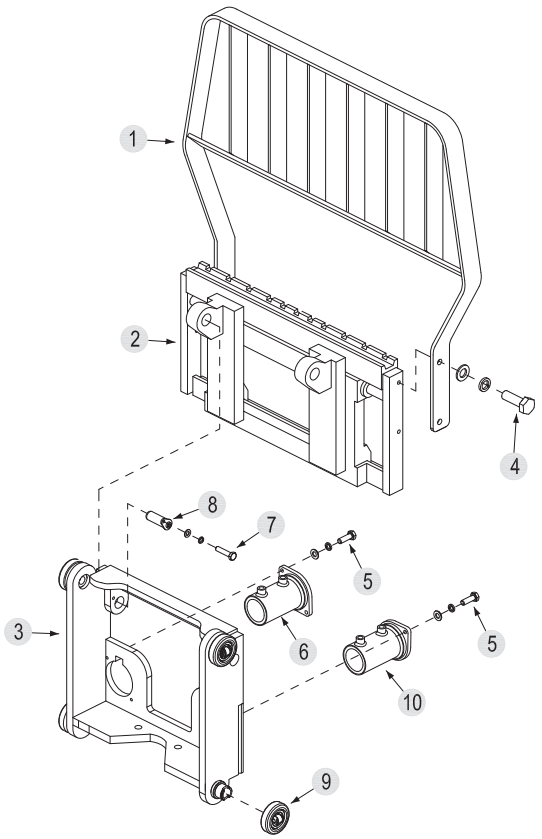
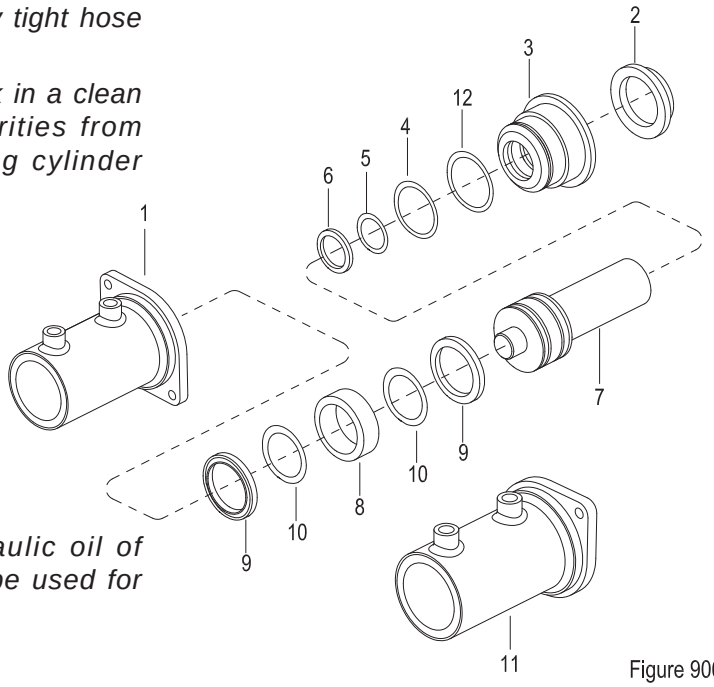


Figure 90617

A2-5.2 Cylinder Maintenance

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.*

Figure 90618

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom;
- Unscrew the cylinder cap (3, Figure 90618) with cylinder wrench;
- Remove the dust ring (2), O-rings (12), seal (4), O-ring (5) and O-ring (6) from the cylinder cap;
- Pull out the piston rod (7) from the cylinder tube (1);
- Remove the support ring (8), seal (9) and cover plate (10) 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.

A2-5.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A2-5.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat forward tilting - backward tilting of the 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.

A2-6 Built-in Side Shifter

A2-6.1 Side Shifter Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Unscrew the four bolts (4, Figure 90617), remove the retaining shelf (1) from the built-in side shifter (2);

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.

- Remove the right shifting tubing (4, Figure 90615) and left shifting tubing (5) from the built-in side shifter;

CAUTION

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

- Unscrew the bolt (7, Figure 90617), pull out the pin shaft (8) and remove the built-in side shifter (2).

A2-6.2 Side Shifter Installation

- Install the side shifter according to the reverse order of removal according to A2-6.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat left shifting - right shifting operations to discharge the air within the tubing and side shift cylinder;
- Check the hydraulic oil level and make sure that the liquid is at standard level.

A

A2-6.3 Side Shifter Maintenance

CAUTION

- *Carry out the maintenance work in a clean environment to prevent impurities from entering into cylinder, causing cylinder damage.*
- *During the installation, hydraulic oil of the same specifications must be used for cleaning or lubrication.*
- *Apply grease into each grease nipple with a grease gun.(See Section 2.2.3)*

- Unscrew the four bolts (16) and remove the two adjustable lower hooks (13);
- Remove the lower side shift bracket (19), upper sliding block (8) and lower sliding block (11) from the side shift bracket;
- Pry out the damping sleeve (1) and pull out the piston (2) from the side shift bracket;
- Hammer out the end cap (4) and remove the dust ring (3) from the end cap;
- Remove the retaining ring (5) and seal (6) on the cylinder tube;
- Clean with hydraulic oil of the same specifications;
- Replace the problem parts and assembly in reverse steps.

CAUTION

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

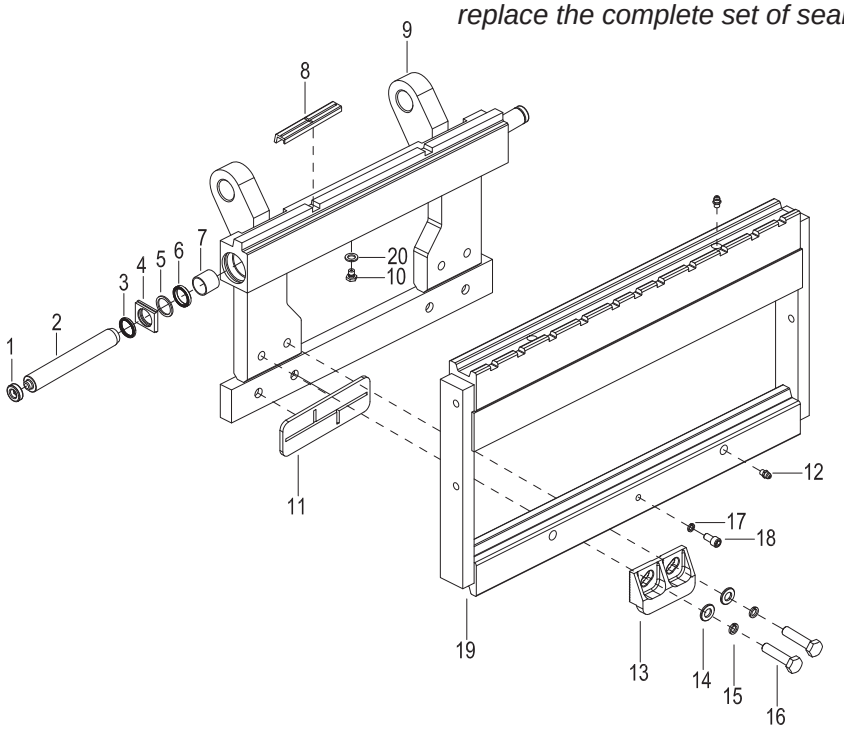


Figure 90627

A3 Three-stage Mast (8.0 m≤ Lifting Height ≤ 9.5 m)

A3-1 Removal and Installation

Removal

- Disconnect the connections between lifting - lowering tubing, forward tilting tubing, backward tilting tubing, left shifting tubing and right shifting tubing, and mast tubing;
- Remove the connections between forward shift cylinder and the mast mounting base; (see Section 7.8)
- Unscrew the screw (1) and loosen the wheel shaft (5);
- Unscrew the nut (4) and remove the forward shift safety block (2) from the forward shift guide rails;
- Wrap the sling (3) around the upper beam of the three masts, slightly lift the mast with crane and remove the mast from the guide rails.

Installation

- Install according to the reverse order of removal.

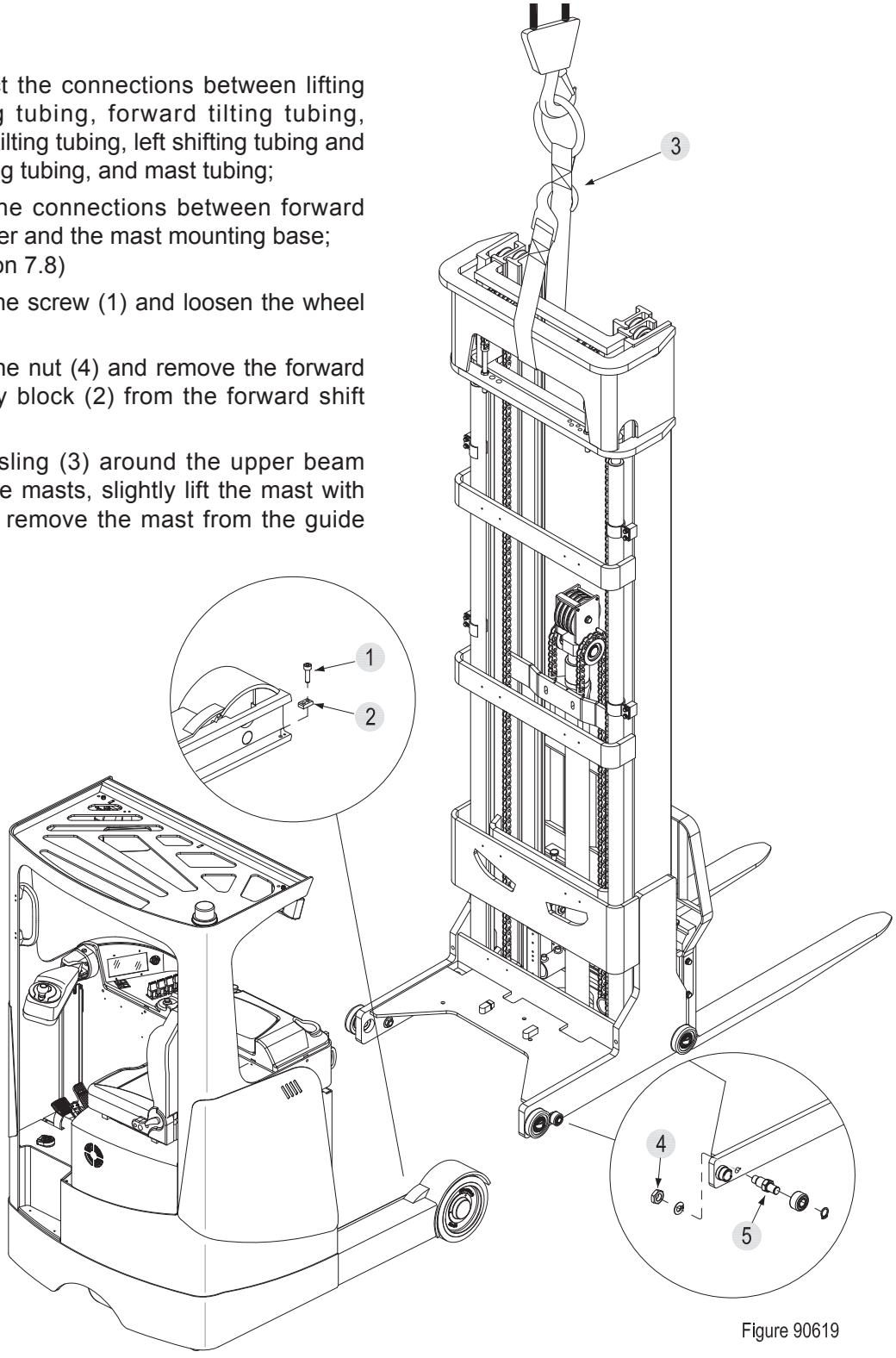


Figure 90619

A

A3-2 Lifting Chains

A3-2.1 Chain Adjustment

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

CAUTION

Switch off the power supply before any adjustments or operations!

- Loosen the upper and lower lock nuts (2) on chain bolt;
- Through screwing upward the adjusting nut (9) in the middle, the chain will slowly tension;
- When the chain is adjusted to be tensioned with no obvious loosening, fasten the upper and lower lock nuts;

CAUTION

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

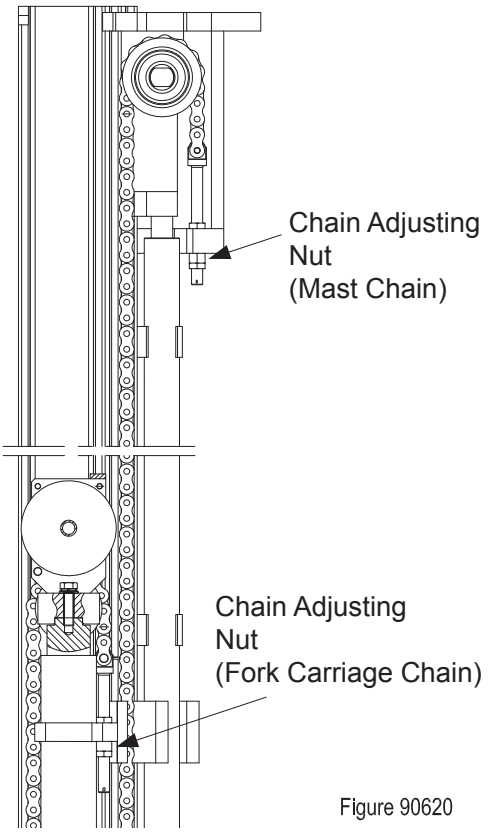


Figure 90620

- Pull out emergency stop switch and turn on the key switch;
- Through repeatedly lifting/lowering the mast to test if the chain is tensioned. If the chain is still loose, repeat the steps above.

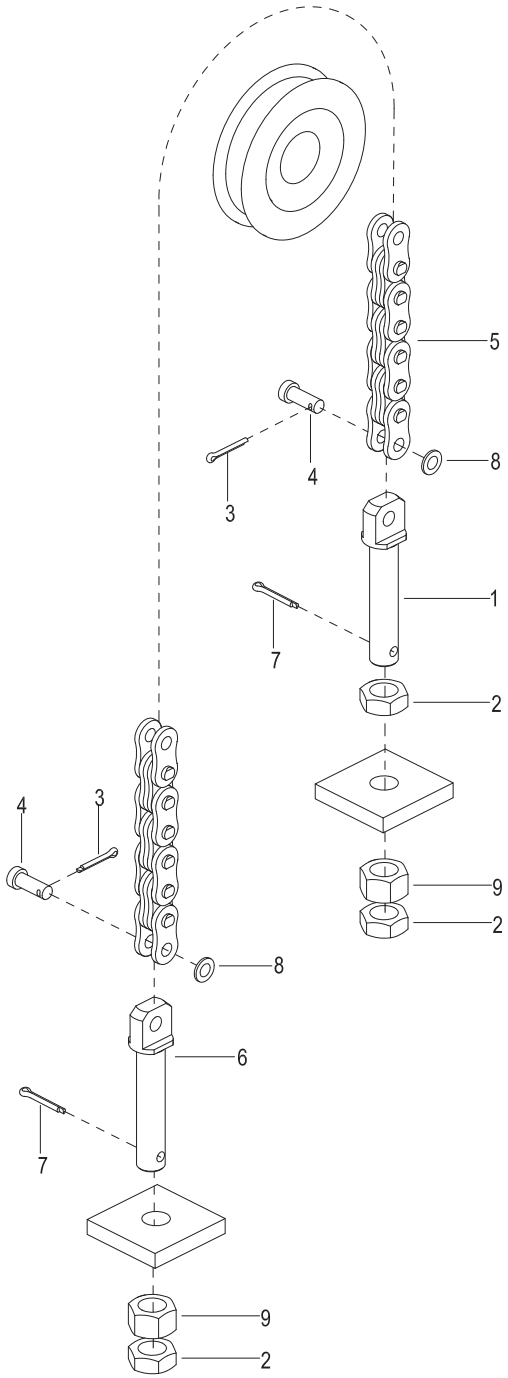


Figure 90603

A3-2.2 Chain Replacement

A3-2.2.1 Mast Chains

- Block the truck wheels with wooden wedges, raise the inner mast (8, Figure 90622) for 500mm, insert wooden block between inner mast and the ground for supporting;

CAUTION

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

- Remove the cotter pin (7, Figure 90603) and unscrew the lock nut (2) and adjusting nut (9) from the chain joint (1) and chain joint (6);
- Remove the chain assembly from the chain sprocket (5,Figure 90621);
- Remove the cotter pin (3, Figure 90603) and flat washer (8), pull out the pin shaft (4), separate the chains (5) from the chain joint (1) and chain joint (6);
- Replace with new chains and hang the new chain assembly onto the chain sprocket;
- Put the chain connector (6) through the inner mast chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Put the chain connector (1) through the outer mast chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Adjust the chains according to Section A3-2.1.

A3-2.2.2 Fork Carriage Chains

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

CAUTION

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

- Remove the cotter pin (7, Figure 90603) and unscrew the lock nut (2) and adjusting nut (9) from the chain joint (1) and chain joint (6);
- Remove the chains from the chain sprocket (10, Figure 90622);
- Remove the cotter pin (3, Figure 90603) and flat washer (8), pull out the pin shaft (4), separate the chains (5) from the chain joint (1) and chain joint (6);
- Replace with new chains and hang the new chain assembly onto the chain sprocket;
- Put the chain connector (6) through the fork carriage chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Put the chain connector (1) through the middle cylinder chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Adjust the chains according to Section A3-2.1.

A

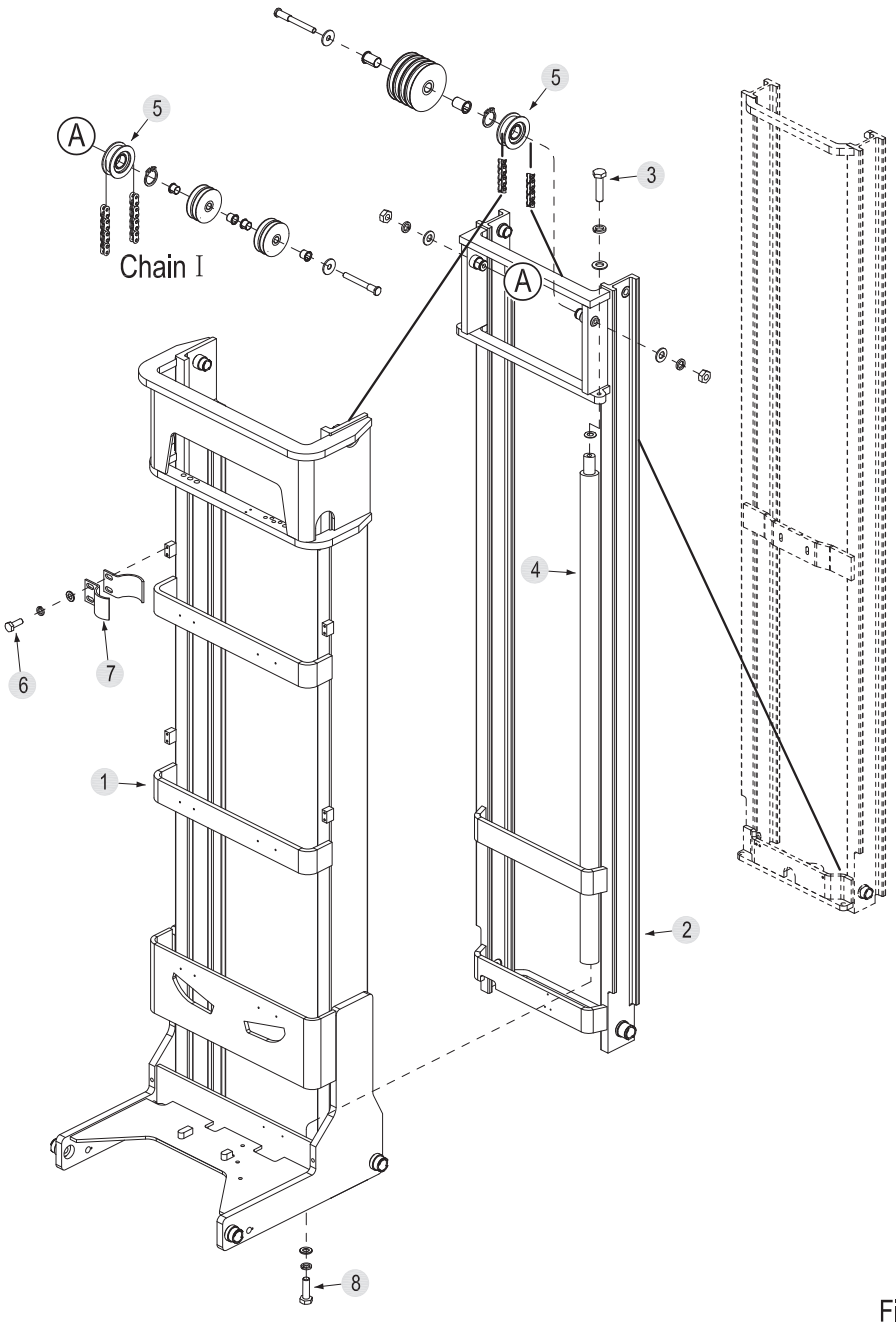


Figure 90621

A

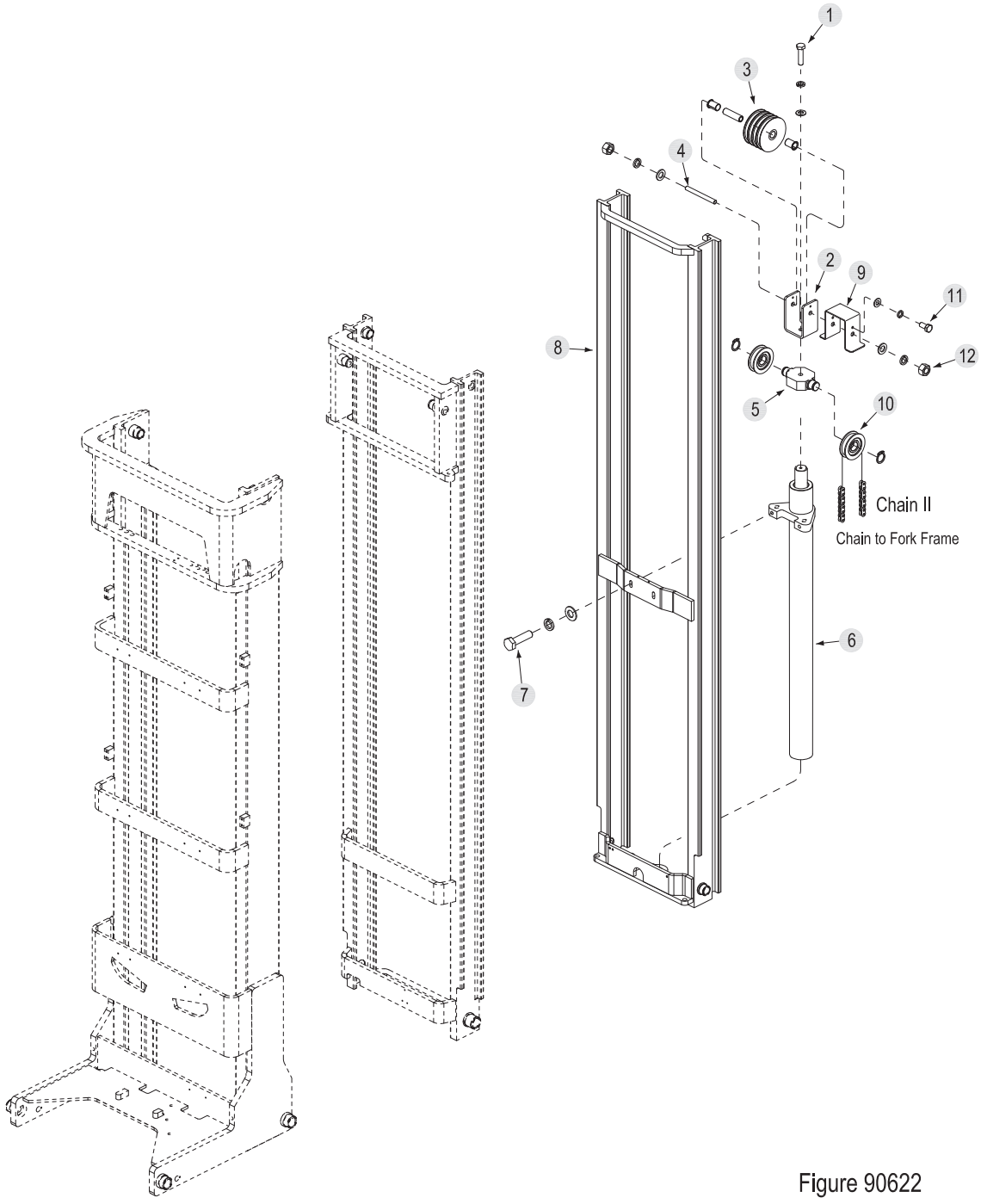


Figure 90622

A3-3 Mast Tubing

A

Code	Description
A	Lifting / Lowering Mast Tubing

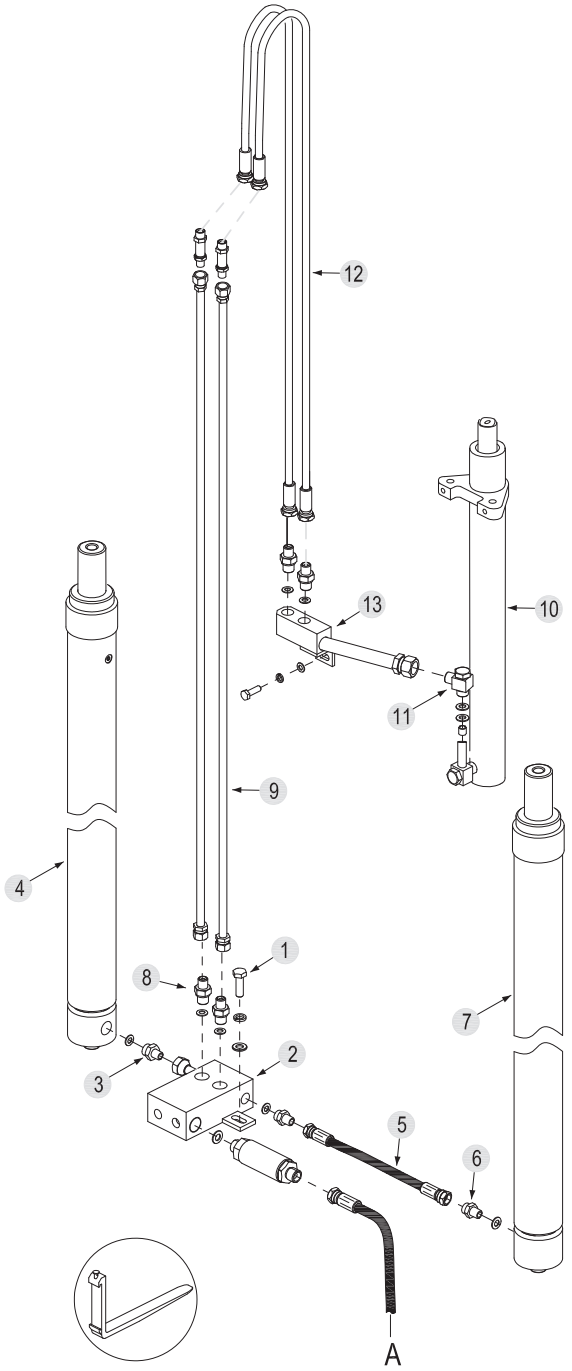


Figure 90614

Code	Description
B	Forward Tilting Mast Tubing
C	Backward Tilting Mast Tubing
D	Left Shift Mast Tubing
E	Right Shift Mast Tubing

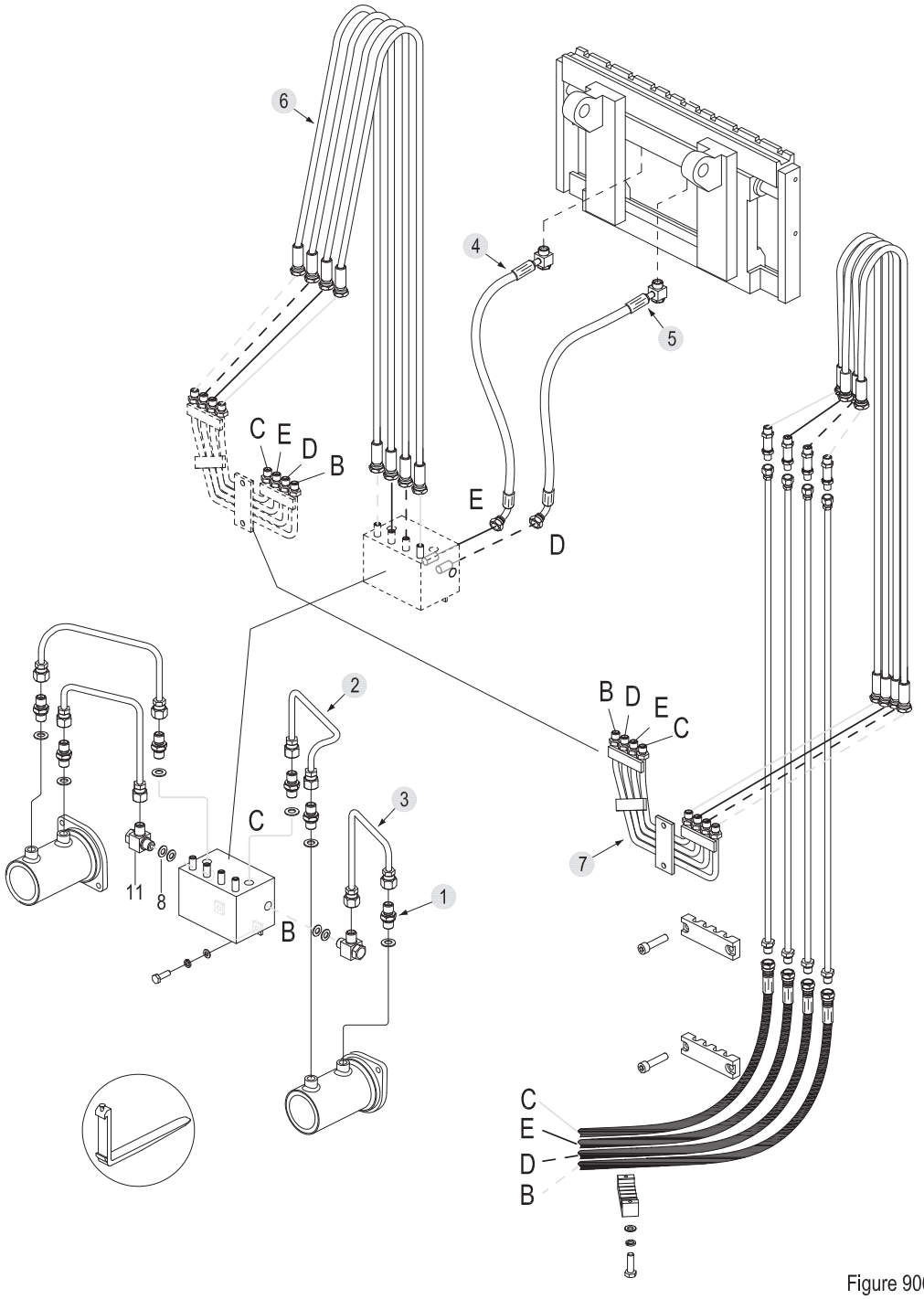


Figure 90615

A

A3-4 Lift Cylinder

A3-4.1 Cylinder Removal

Left Cylinder Removal (with mast down)

- Remove the mast from the chassis according to Section A3-1;
- Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting;
- Disconnect the connections between two rigid pipes (9, Fig 90614) and five-pass assembly (2);
- Unscrew the two bolts (1), and unfix the five-pass components (5);
- Unscrew the joints on five-pass components and separate it from straight coupling (3);

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 the bolt (6, Figure 90621) and remove the cylinder clamp (7);

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.

- Unscrew the mounting bolt (8) from the bottom of the cylinder;
- Unscrew bolt (6) and remove the cylinder (4) from the mast.

Right Cylinder Removal(with mast down)

- Remove the mast from the chassis according to Section A3-1;
- Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting;
- Remove the tubing (5, Figure 90621) to make it separate from the direct coupling (6);

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 the bolt (6, Figure 90621) and remove the cylinder clamp (7);

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.

- Unscrew the mounting bolt (8) from the bottom of the cylinder;
- Unscrew bolt (6) and remove the cylinder (4) from the mast.

Full Free Middle Cylinder (with mast on the vehicle)

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Remove retaining shelf (see Section A3-6.1);
- Block the truck wheels with wooden wedges, raise the fork carriage for 500mm with lifting tools, insert wooden block between it and the ground for supporting;

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.

- Loosen the articulated joints (11, Figure 90614) to separate the middle cylinder and rigid pipe assembly (13);
- Disconnect the connections between the four tubings (6, Figure 90615) around the middle cylinder and rigid pipe assembly (7);
- Remove the fork carriage chains according to Section A3-2.2.2;

- Unscrew bolt (11, Figure 60622) and remove the middle cylinder roller guard (9);
- Unscrew the nut (12), remove the middle cylinder tube shaft (4) and middle cylinder four rollers (3);
- Unscrew the bolt (1) and remove the middle cylinder fixing plate (2) and sprocket seat (5) from the cylinder (6);

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.

- Unscrew the bolt (7), separate the cylinder (6) from the inner mast (8);
- Remove the cylinder (6) from the truck.

A3-4.2 Cylinder Maintenance

Lifting Side Cylinder

CAUTION

- *Use suitable hose clamps to avoid cylinder deformation caused by severely tight hose clamp.*
- *Carry out the maintenance work in a clean environment to prevent impurities from entering 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 90607) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Remove the guide bush (5) from the cylinder tube (6);
- Pull out the piston rod (1) from the cylinder tube (6);

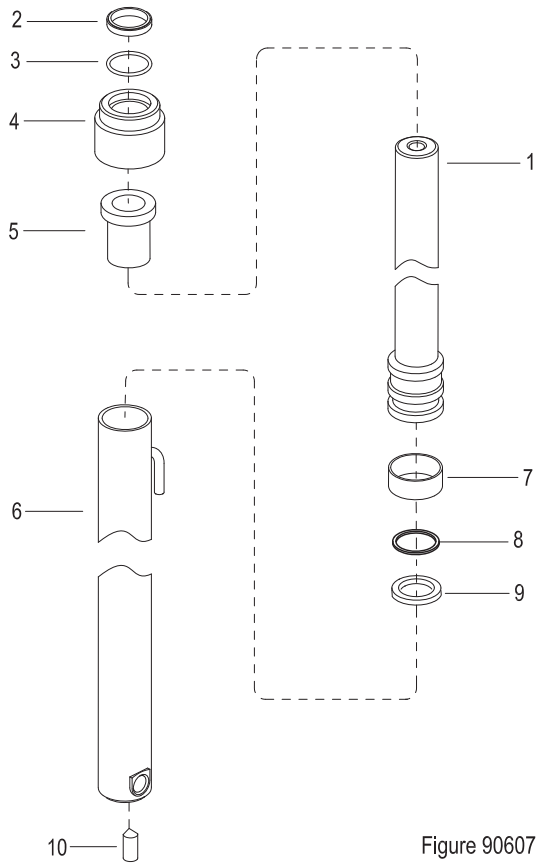


Figure 90607

- Remove the support ring (7), seal (9) and cover plate (8) 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.

A

Full Free Middle Cylinder

CAUTION

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

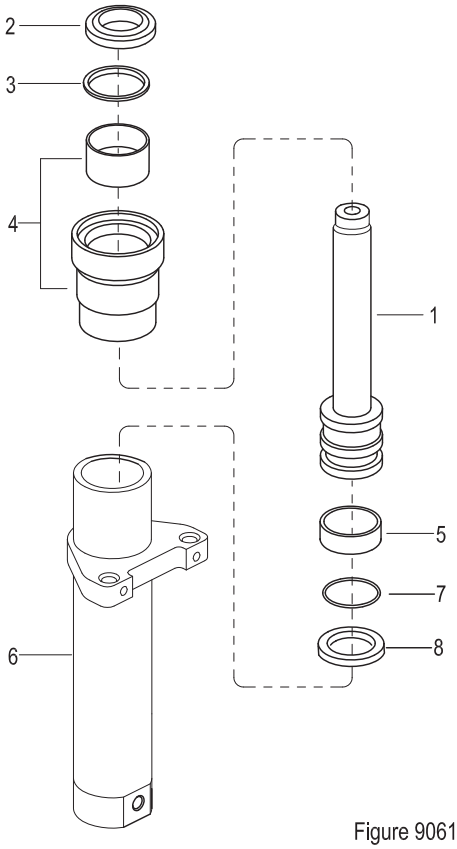


Figure 90616

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom;
- Unscrew the cylinder cap (4, Figure 90616) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Pull out the piston rod (1) from the cylinder tube (6);
- Remove the support ring (5), seal (8) and cover plate (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.

A3-4.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A3-4.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat 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.

A3-5 Tilt Cylinde

A3-5.1 Cylinder Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Remove retaining shelf; (see Section A3-6.1)
- Unscrew the two direct joints (1, Figure 90615) from the tilt cylinder, disconnect the connections between forward tilt pipe (3), backward tilt pipe (2) and the tilt 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.

- Slightly raise the side shifter (2), unscrew the two bolts (5, Figure 90617) from the gap between side shifter and fork carriage, and remove the tilt cylinder (6 or 10).

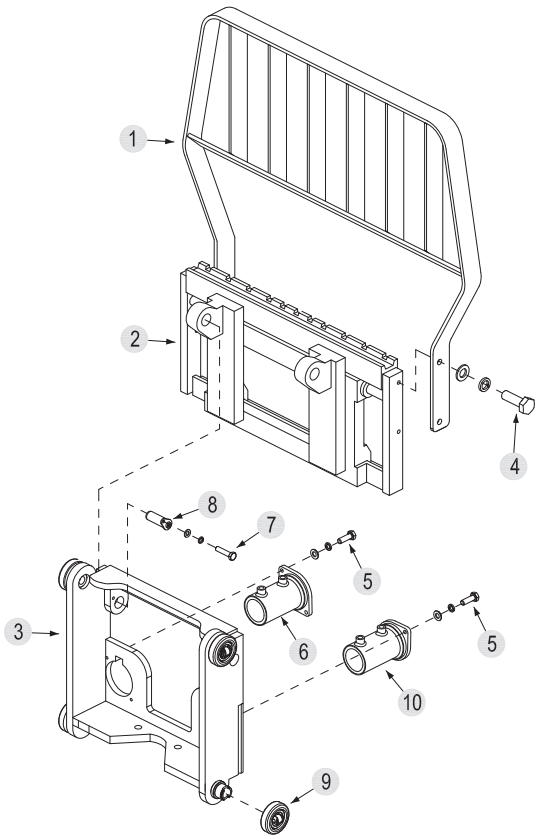
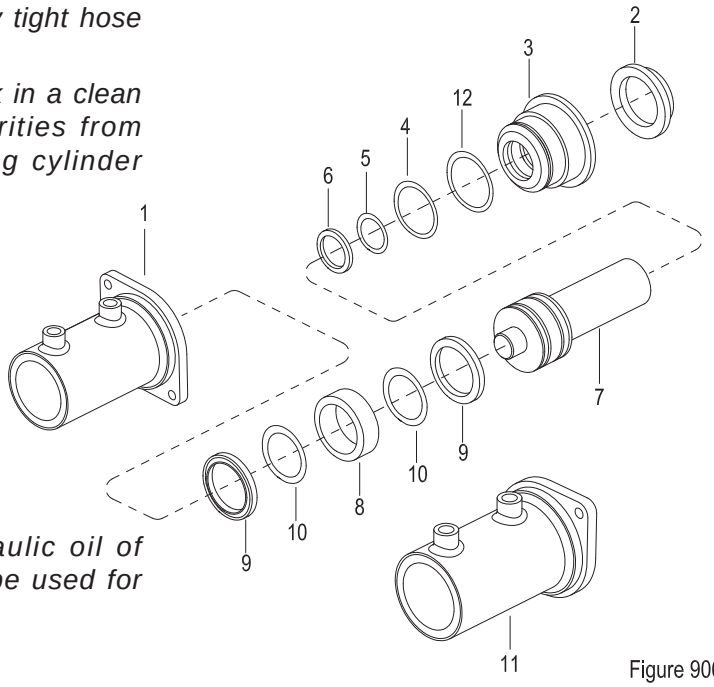


Figure 90617

A3-5.2 Cylinder Maintenance

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.*

Figure 90618

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom;
- Unscrew the cylinder cap (3, Figure 90618) with cylinder wrench;
- Remove the dust ring (2), O-rings (12), seal (4), O-ring (5) and O-ring (6) from the cylinder cap;
- Pull out the piston rod (7) from the cylinder tube (1);
- Remove the support ring (8), seal (9) and cover plate (10) 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.

A3-5.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A3-5.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat forward tilting - backward tilting of the 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.

A3-6 Built-in Side Shifter

A3-6.1 Side Shifter Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Unscrew the four bolts (4, Figure 90617), remove the retaining shelf (1) from the built-in side shifter (2);

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.

- Remove the right shifting tubing (4, Figure 90615) and left shifting tubing (5) from the built-in side shifter;

CAUTION

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

- Unscrew the bolt (7, Figure 90617), pull out the pin shaft (8) and remove the built-in side shifter (2).

A3-6.2 Side Shifter Installation

- Install the side shifter according to the reverse order of removal according to A3-6.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat left shifting - right shifting operations to discharge the air within the tubing and side shift cylinder;
- Check the hydraulic oil level and make sure that the liquid is at standard level.

A3-6.3 Side Shifter Maintenance

CAUTION

- *Carry out the maintenance work in a clean environment to prevent impurities from entering into cylinder, causing cylinder damage.*
- *During the installation, hydraulic oil of the same specifications must be used for cleaning or lubrication.*
- *Apply grease into each grease nipple with a grease gun.(See Section 2.2.3)*

- Unscrew the four bolts (16) and remove the two adjustable lower hooks (13);
- Remove the lower side shift bracket (19), upper sliding block (8) and lower sliding block (11) from the side shift bracket;
- Pry out the damping sleeve (1) and pull out the piston (2) from the side shift bracket;
- Hammer out the end cap (4) and remove the dust ring (3) from the end cap;
- Remove the retaining ring (5) and seal (6) on the cylinder tube;
- Clean with hydraulic oil of the same specifications;
- Replace the problem parts and assembly in reverse steps.

CAUTION

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

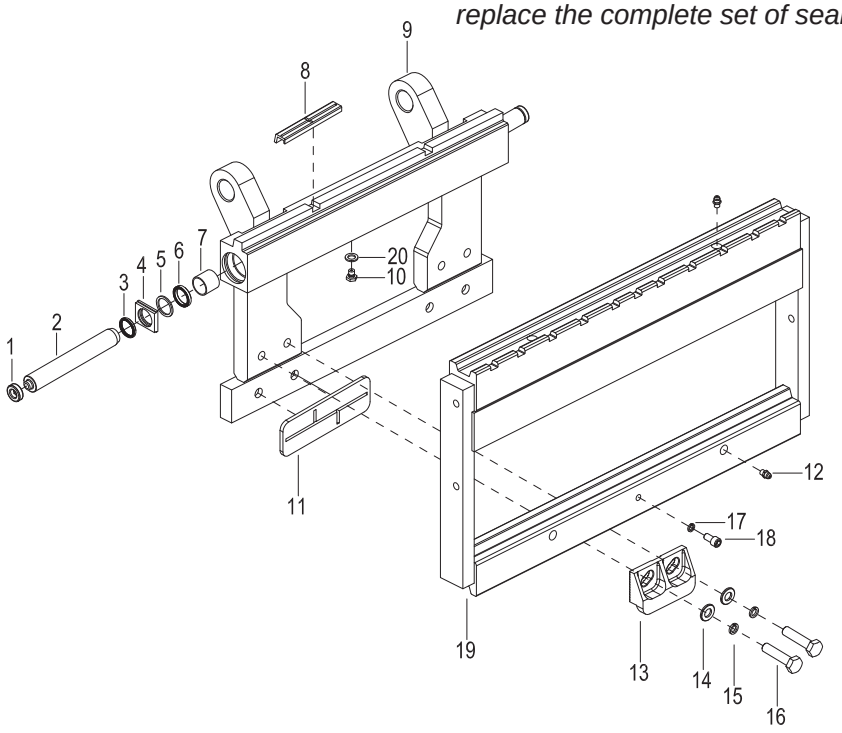


Figure 90627

A

A4 Three-stage Mast
(10 m≤ Lifting Height ≤ 11 m)

A4-1 Removal and Installation

Removal

- Disconnect the connections between lifting - lowering tubing, forward tilting tubing, backward tilting tubing, left shifting tubing and right shifting tubing, and mast tubing;
- Remove the connections between forward shift cylinder and the mast mounting base; (see Section 7.8)
- Unscrew the screw (1) and loosen the wheel shaft (5);
- Unscrew the nut (4) and remove the forward shift safety block (2) from the forward shift guide rails;
- Wrap the sling (3) around the upper beam of the three masts, slightly lift the mast with crane and remove the mast from the guide rails.

Installation

- Install according to the reverse order of removal.

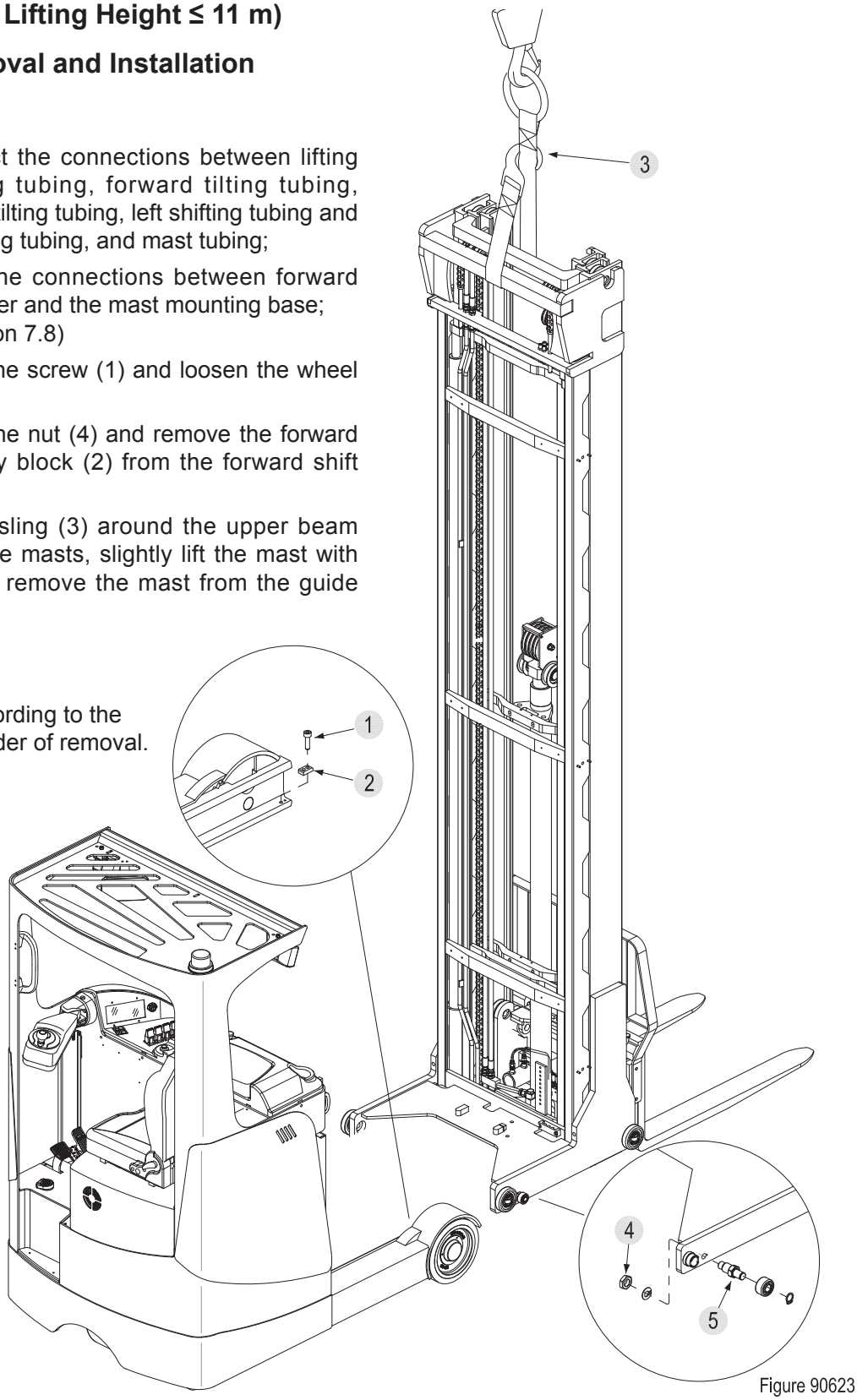


Figure 90623

A4-2 Lifting Chains

A4-2.1 Chain Adjustment

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

CAUTION

Switch off the power supply before any adjustments or operations!

- Loosen the upper and lower lock nuts (2) on chain bolt;
- Through screwing upward the adjusting nut (9) in the middle, the chain will slowly tension;
- When the chain is adjusted to be tensioned with no obvious loosening, fasten the upper and lower lock nuts;

CAUTION

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

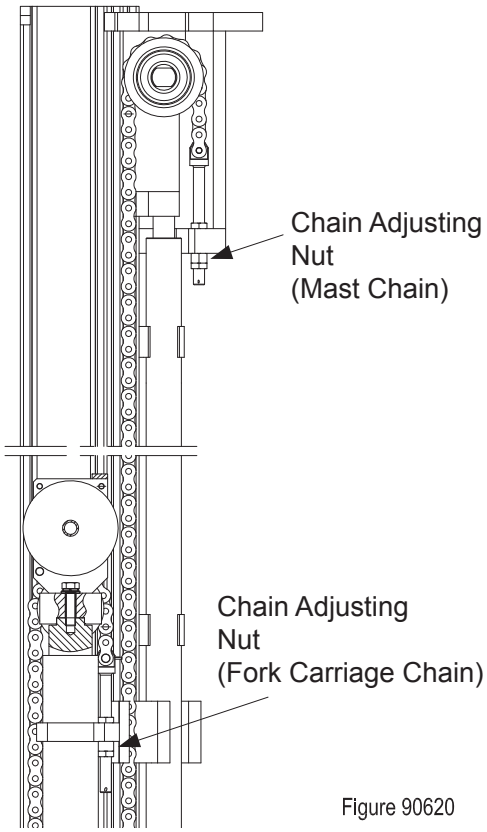


Figure 90620

- Pull out emergency stop switch and turn on the key switch;
- Through repeatedly lifting/lowering the mast to test if the chain is tensioned. If the chain is still loose, repeat the steps above.

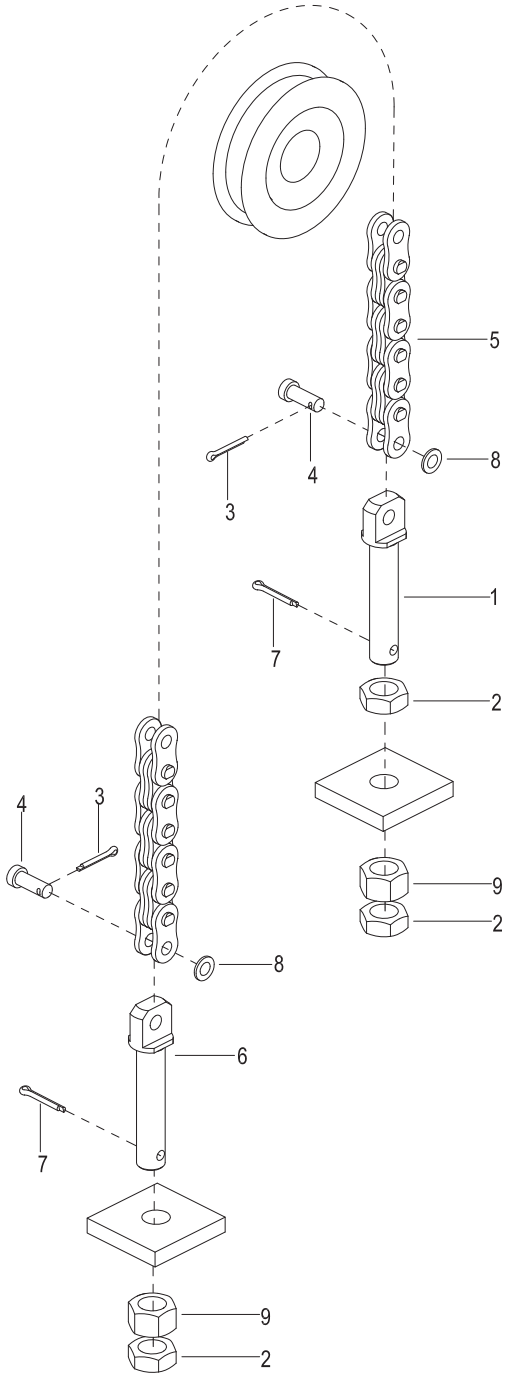


Figure 90603

A

A4-2.2 Chain Replacement

A4-2.2.1 Mast Chains

- Block the truck wheels with wooden wedges, raise the inner mast (8, Figure 90625) for 500mm, insert wooden block between inner mast and the ground for supporting;

CAUTION

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

- Remove the cotter pin (7, Figure 90603) and unscrew the lock nut (2) and adjusting nut (9) from the chain joint (1) and chain joint (6);
- Remove the chain assembly from the chain sprocket (5,Figure 90624);
- Remove the cotter pin (3, Figure 90603) and flat washer (8), pull out the pin shaft (4), separate the chains (5) from the chain joint (1) and chain joint (6);
- Replace with new chains and hang the new chain assembly onto the chain sprocket;
- Put the chain connector (6) through the inner mast chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Put the chain connector (1) through the outer mast chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Adjust the chains according to Section A4-2.1.

A4-2.2.2 Fork Carriage Chains

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

CAUTION

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

- Remove the cotter pin (7, Figure 90603) and unscrew the lock nut (2) and adjusting nut (9) from the chain joint (1) and chain joint (6);
- Remove the chains from the chain sprocket (10, Figure 90625);
- Remove the cotter pin (3, Figure 90603) and flat washer (8), pull out the pin shaft (4), separate the chains (5) from the chain joint (1) and chain joint (6);
- Replace with new chains and hang the new chain assembly onto the chain sprocket;
- Put the chain connector (6) through the fork carriage chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Put the chain connector (1) through the middle cylinder chain-hanging plate, screw the adjusting nut (9) and lock nut (2);
- Adjust the chains according to Section A4-2.1.

A

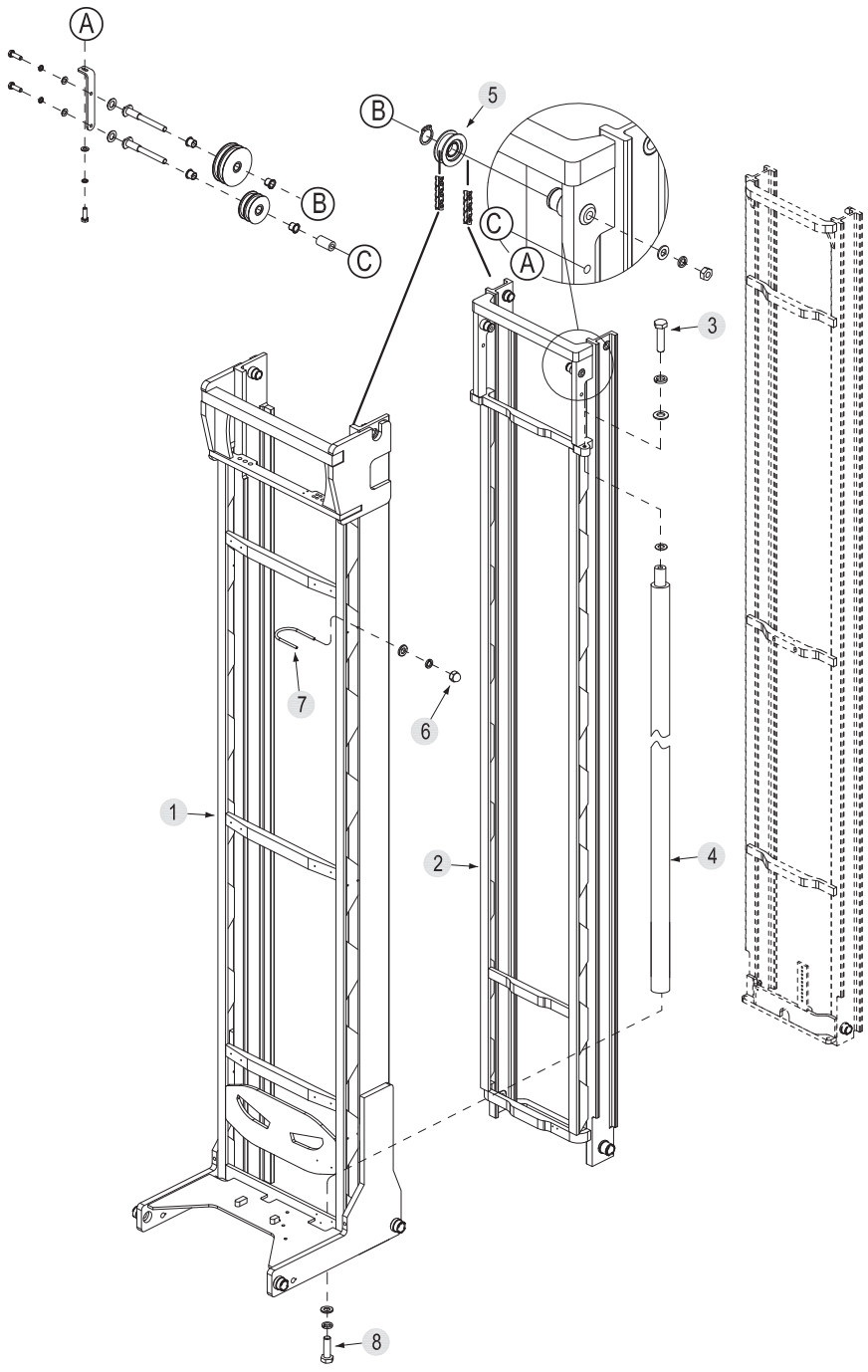


Figure 90624

A

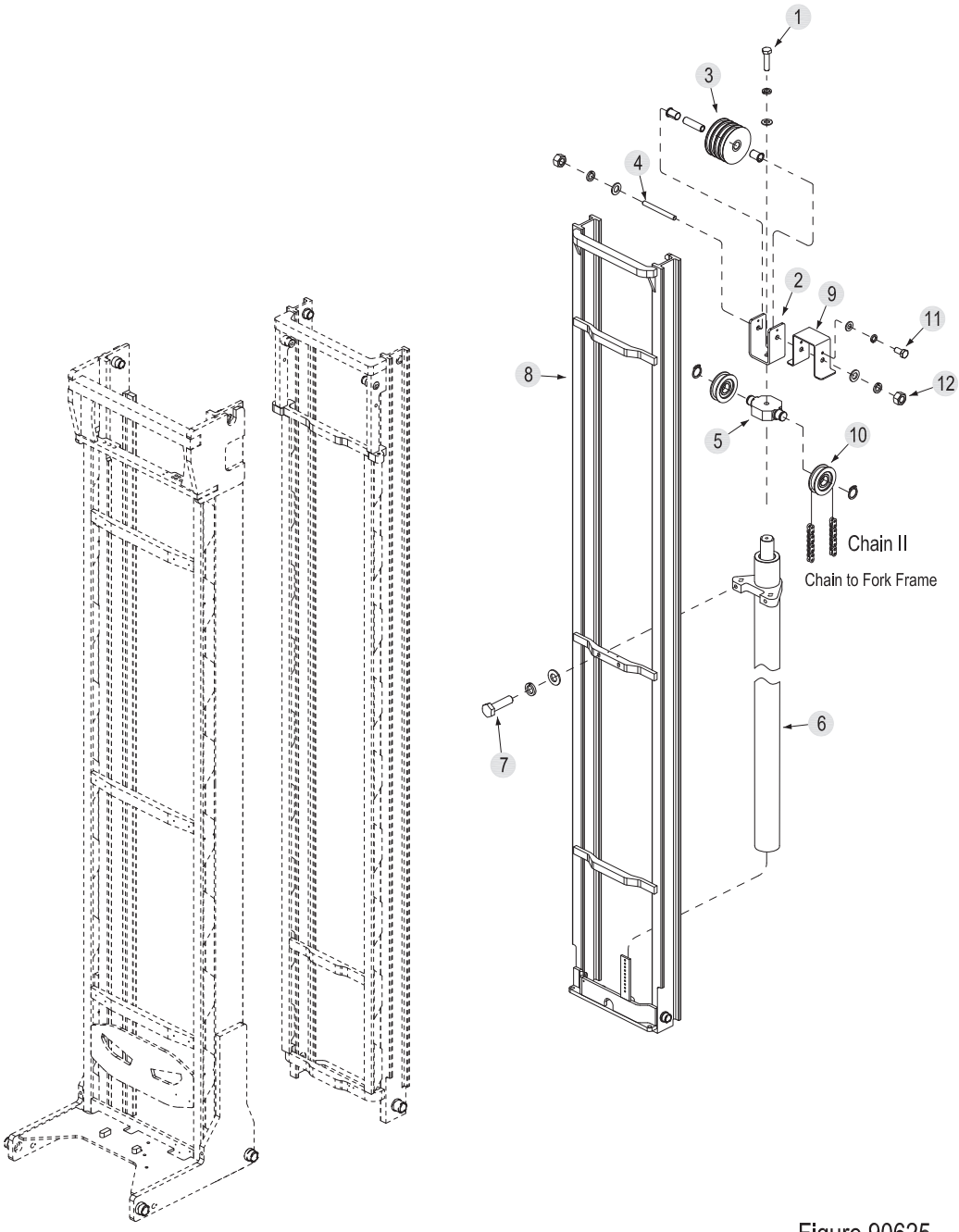


Figure 90625

A4-3 Mast Tubing

Code	Description
A	Lifting / Lowering Mast Tubing

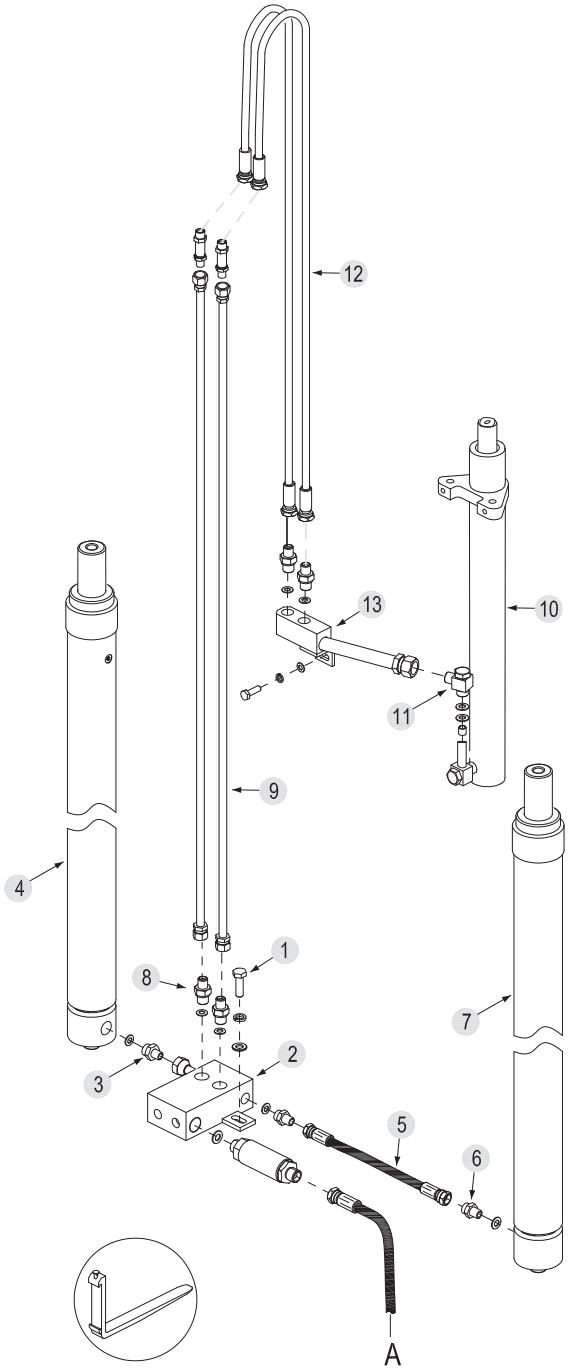


Figure 90614

A

Code	Description
B	Forward Tilting Mast Tubing
C	Backward Tilting Mast Tubing
D	Left Shift Mast Tubing
E	Right Shift Mast Tubing

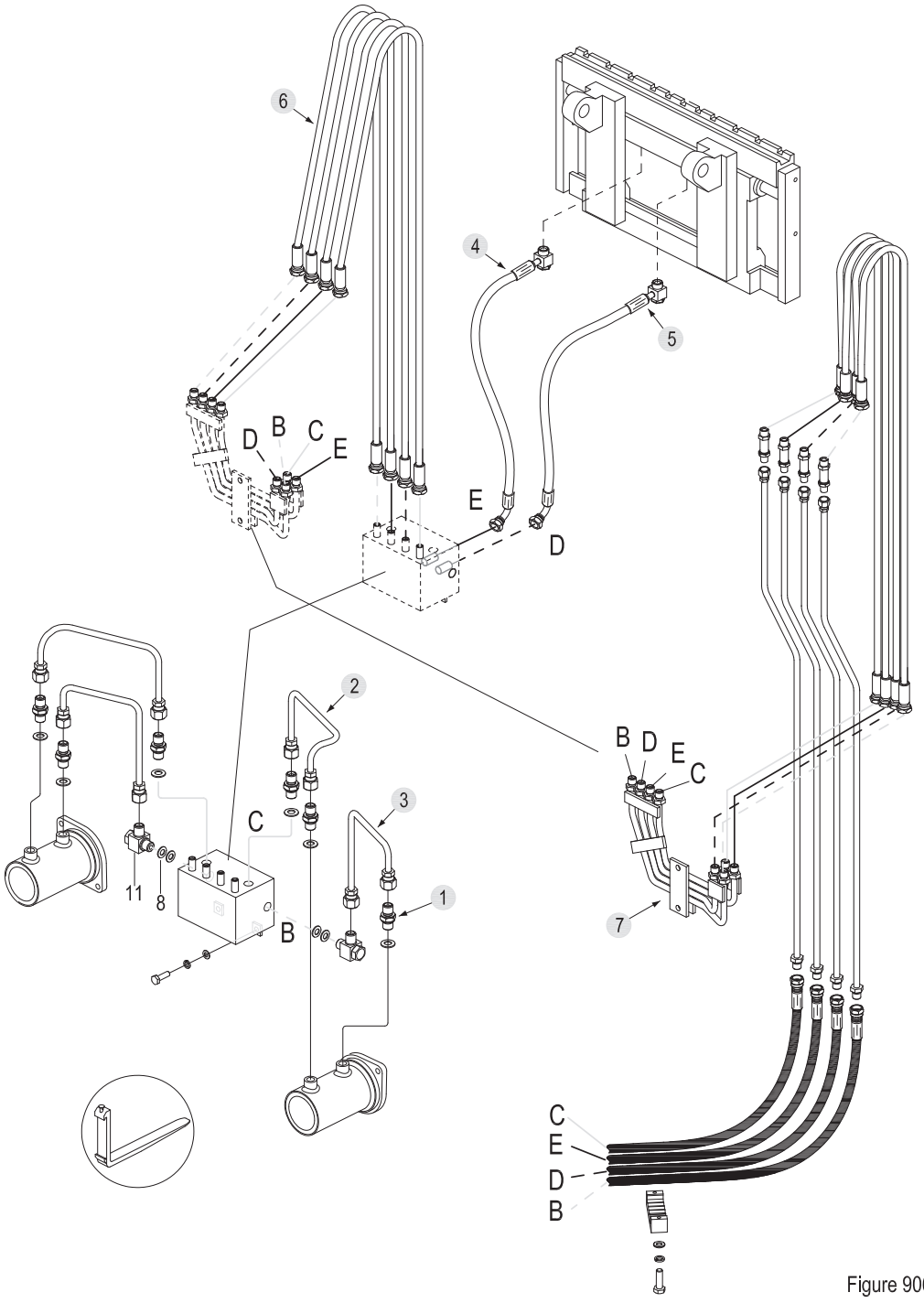


Figure 90626

A4-4 Lift Cylinder

A4-4.1 Cylinder Removal

Left Cylinder Removal (with mast down)

- Remove the mast from the chassis according to Section A4-1;
- Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting;
- Disconnect the connections between two rigid pipes (9, Fig 90614) and five-pass assembly (2);
- Unscrew the two bolts (1), and unfix the five-pass components (5);
- Unscrew the joints on five-pass components and separate it from straight coupling (3);

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 the bolt (6, Figure 90624) and remove the cylinder clamp (7);

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.

- Unscrew the mounting bolt (8) from the bottom of the cylinder;
- Unscrew bolt (6) and remove the cylinder (4) from the mast.

Right Cylinder Removal(with mast down)

- Remove the mast from the chassis according to Section A4-1;
- Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting;
- Remove the tubing (5, Figure 90621) to make it separate from the direct coupling (6);

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 the bolt (6, Figure 90624) and remove the cylinder clamp (7);

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.

- Unscrew the mounting bolt (8) from the bottom of the cylinder;
- Unscrew bolt (6) and remove the cylinder (4) from the mast.

Full Free Middle Cylinder (with mast on the vehicle)

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Remove retaining shelf (see Section A4-6.1);
- Block the truck wheels with wooden wedges, raise the fork carriage for 500mm with lifting tools, insert wooden block between it and the ground for supporting;

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.

- Loosen the articulated joints (11, Figure 90614) to separate the middle cylinder and rigid pipe assembly (13);
- Disconnect the connections between the four tubings (6, Figure 90626) around the middle cylinder and rigid pipe assembly (7);
- Remove the fork carriage chains according to Section A4-2.2.2;

A

- Unscrew bolt (11, Figure 60625) and remove the middle cylinder roller guard (9);
- Unscrew the nut (12), remove the middle cylinder tube shaft (4) and middle cylinder four rollers (3);
- Unscrew the bolt (1) and remove the middle cylinder fixing plate (2) and sprocket seat (5) from the cylinder (6);

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.

- Unscrew the bolt (7), separate the cylinder (6) from the inner mast (8);
- Remove the cylinder (6) from the truck.

A4-4.2 Cylinder Maintenance

Lifting Side Cylinder

CAUTION

- *Use suitable hose clamps to avoid cylinder deformation caused by severely tight hose clamp.*
- *Carry out the maintenance work in a clean environment to prevent impurities from entering 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 90607) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Remove the guide bush (5) from the cylinder tube (6);
- Pull out the piston rod (1) from the cylinder tube (6);

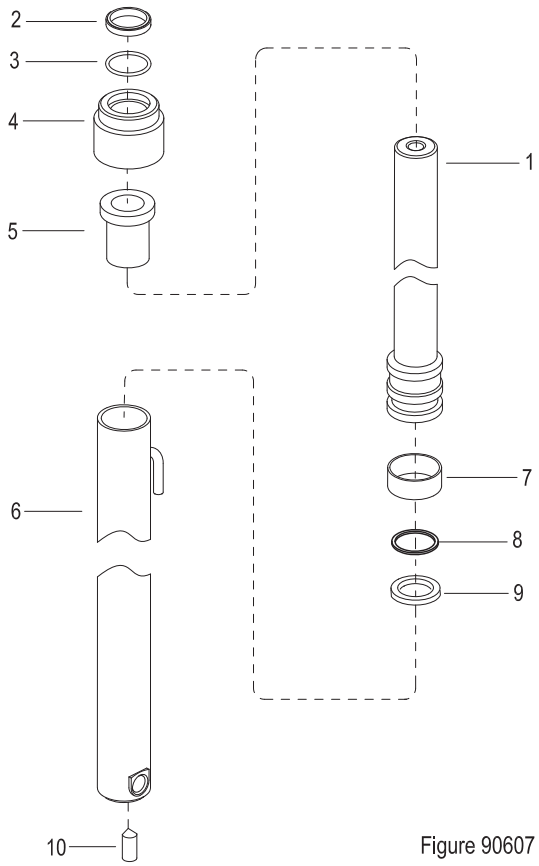


Figure 90607

- Remove the support ring (7), seal (9) and cover plate (8) 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.

Full Free Middle Cylinder

CAUTION

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

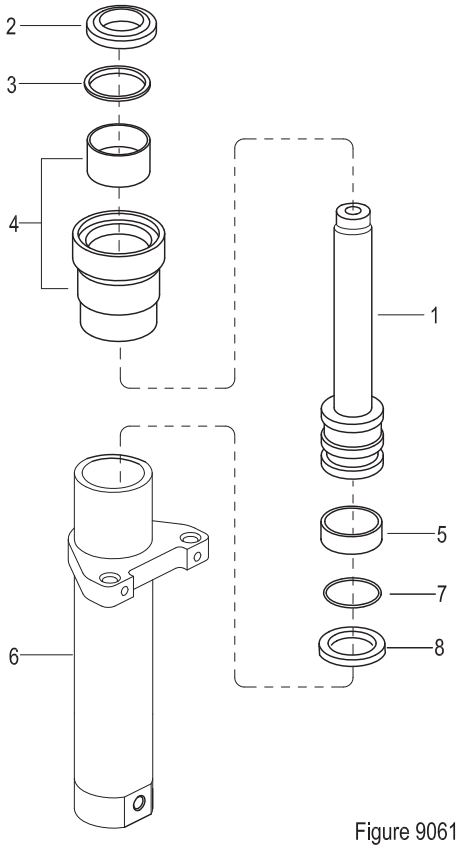


Figure 90616

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom;
- Unscrew the cylinder cap (4, Figure 90616) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Pull out the piston rod (1) from the cylinder tube (6);
- Remove the support ring (5), seal (8) and cover plate (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.

A4-4.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A4-4.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat 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.

A

A4-5 Tilt Cylinde

A4-5.1 Cylinder Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Remove retaining shelf; (see Section A4-6.1)
- Unscrew the two direct joints (1, Figure 90626) from the tilt cylinder, disconnect the connections between forward tilt pipe (3), backward tilt pipe (2) and the tilt 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.

- Slightly raise the side shifter (2), unscrew the two bolts (5, Figure 90617) from the gap between side shifter and fork carriage, and remove the tilt cylinder (6 or 10).

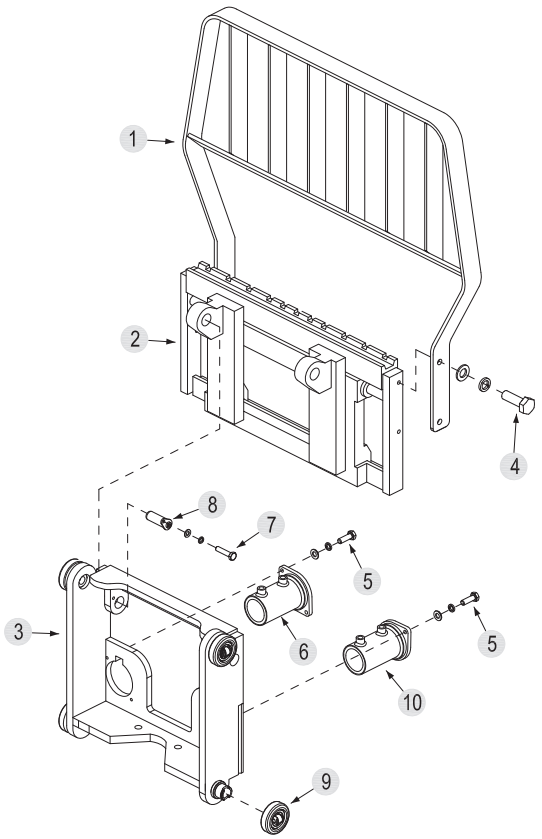
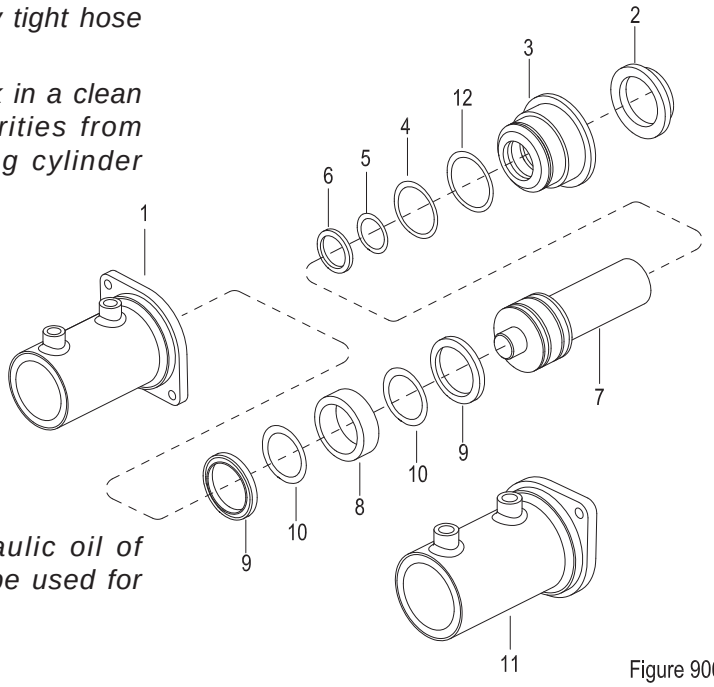


Figure 90617

A4-5.2 Cylinder Maintenance

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.*

Figure 90618

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom;
- Unscrew the cylinder cap (3, Figure 90618) with cylinder wrench;
- Remove the dust ring (2), O-rings (12), seal (4), O-ring (5) and O-ring (6) from the cylinder cap;
- Pull out the piston rod (7) from the cylinder tube (1);
- Remove the support ring (8), seal (9) and cover plate (10) 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.

A4-5.3 Cylinder Installation

- Install the cylinder according to the reverse order of removal according to A4-5.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat forward tilting - backward tilting of the 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.

A4-6 Built-in Side Shifter

A4-6.1 Side Shifter Removal

- Shift the mast forward to the bottom, press the emergency stop switch and disconnect the key switch;
- Block the truck wheel with wooden wedge;
- Unscrew the four bolts (4, Figure 90617), remove the retaining shelf (1) from the built-in side shifter (2);

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.

- Remove the right shifting tubing (4, Figure 90626) and left shifting tubing (5) from the built-in side shifter;

CAUTION

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

- Unscrew the bolt (7, Figure 90617), pull out the pin shaft (8) and remove the built-in side shifter (2).

A4-6.2 Side Shifter Installation

- Install the side shifter according to the reverse order of removal according to A4-6.1;
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch;
- Repeat left shifting - right shifting operations to discharge the air within the tubing and side shift cylinder;
- Check the hydraulic oil level and make sure that the liquid is at standard level.

A

A4-6.3 Side Shifter Maintenance

CAUTION

- *Carry out the maintenance work in a clean environment to prevent impurities from entering into cylinder, causing cylinder damage.*
- *During the installation, hydraulic oil of the same specifications must be used for cleaning or lubrication.*
- *Apply grease into each grease nipple with a grease gun.(See Section 2.2.3)*

- Unscrew the four bolts (16) and remove the two adjustable lower hooks (13);
- Remove the lower side shift bracket (19), upper sliding block (8) and lower sliding block (11) from the side shift bracket;
- Pry out the damping sleeve (1) and pull out the piston (2) from the side shift bracket;
- Hammer out the end cap (4) and remove the dust ring (3) from the end cap;
- Remove the retaining ring (5) and seal (6) on the cylinder tube;
- Clean with hydraulic oil of the same specifications;
- Replace the problem parts and assembly in reverse steps.

CAUTION

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

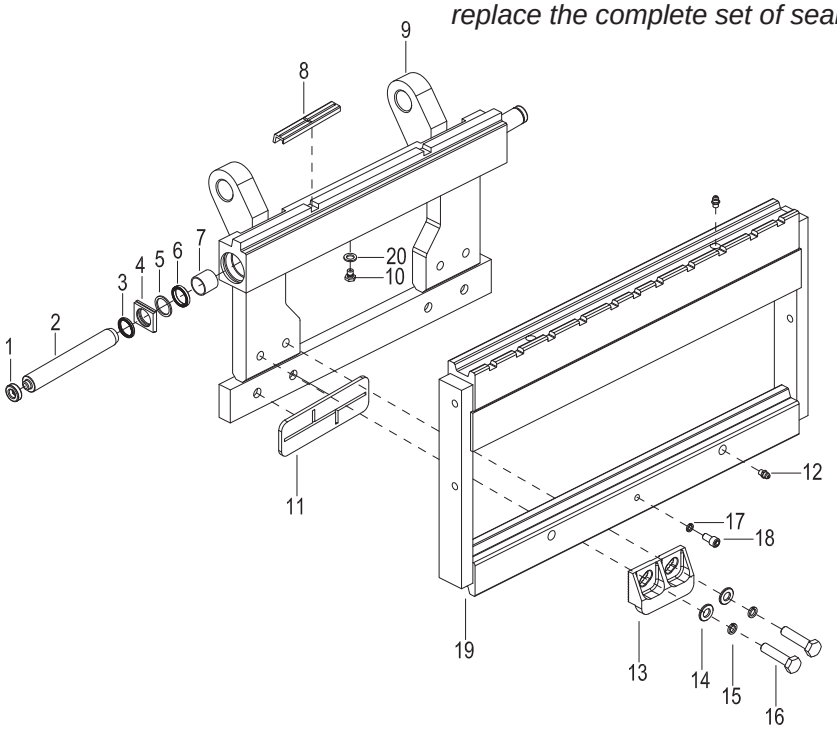


Figure 90627

B SERVICE MANUAL - BATTERY

B

LET'S GROW TOGETHER!

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

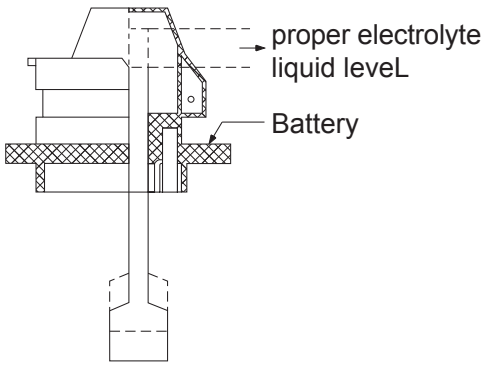
- Control the electrolyte fluid level. Check the electrolyte fluid level when the charging is about to complete. If necessary, add distilled water into the electrolyte when the charging is about to complete to make the fluid level reach the rated standard.

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

B

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

C

NOTE:

CQD16/20
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 / Warning Light		
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.		