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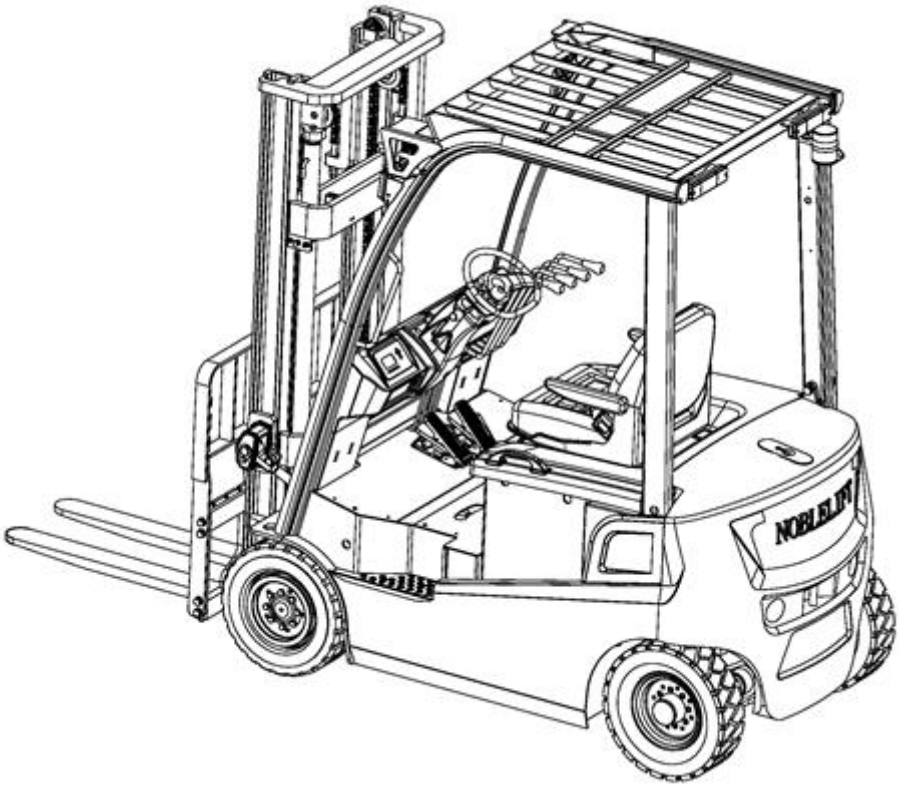
⚠ WARNING

Do not use the forklift before reading and understanding the operating instructions as well as the waring decals on the truck.
Keep for future reference.



Service Manual

FE4P16-20 Q series

battery counterbalanced forklift truck

NOBLELIFT INTELLIGENT EQUIPMENT CO., LTD.

Catalogue

1. General

1-1. How to use this manual

1-1-1. Composition of this manual

This service manual mainly provides engineers and technicians service information for forklift repair and maintenance, which excludes vehicle operation instructions.

The introduction section of this manual introduces the functions of the vehicle with attention to its different components. More detailed specific information is available in the main body of this manual for you, including the schematic diagram of the vehicle components, the principle they work, the check lists, the maintenance procedures as well as the data and information as needed for maintenance and repair

To facilitate a quick and easy access to the services and training information as required by the readers, the sections of this manual are categorized as per different systems of the vehicle (Please refer to the table below).

Section	Headings
1	Commonly
2	Electronic System
3	Driving/Braking System
4	Hydraulic System
5	Lifting System
6	Steering System
7	Schematic Diagram
8	Battery Charger

1-1-2 Definitions of Warning Signs

The following three warning signs are applicable to this Manual: "Danger", "Warning" and "Caution". Each label is intended to indicate the severity and nature of the potential hazard, the consequences, as well as preventive measures against hazards. You will find these signs throughout this manual. Please ensure your careful attention to such signs, as they are included for your safety intensively.

⚠ Danger

This signs represents a dangerous situation that could result in death or serious injury if not avoided

⚠ Warning

This signs represents a dangerous situation that could result in death or serious injury if not avoided

⚠ Note

The label indicates a dangerous situation that could result in minor injuries if not avoided

1-2 Glossary

The terms referred in this service manual and their descriptions are as follows.

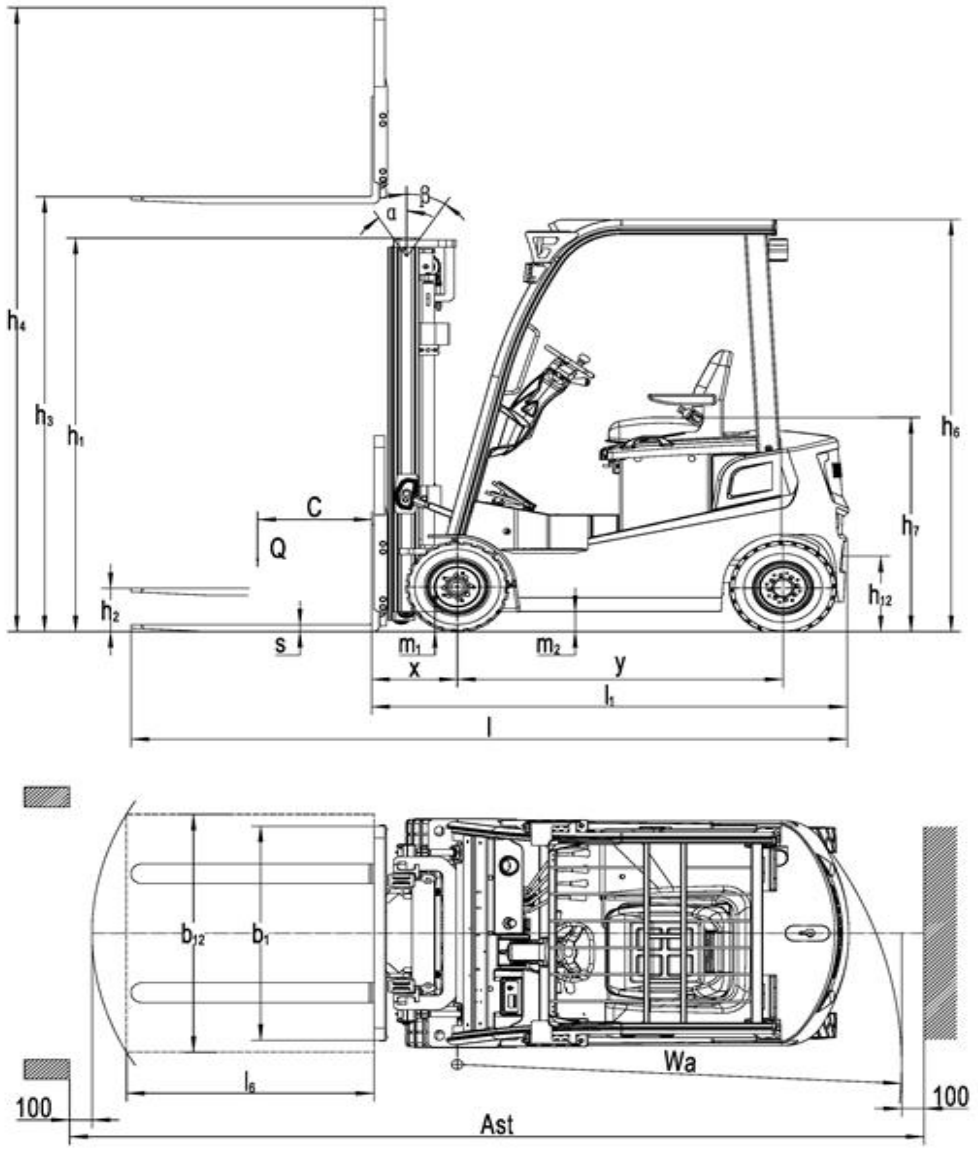
Item	Descriptions
Accelerator	A device that converts mechanical motion to an analog voltage mode and transmit to a controller to control the speed at which a vehicle is driven
Actuator	A device (e.g. a hydraulic cylinder and motor) that converts hydraulic power into mechanical force and motion.
Ampere (A)	A measurement unit of current. The current of a voltage passing through an ohmic resistor.
Battery	Two or more batteries, which are inter-connected with each other to provide current.
Coulomb meter	(Battery Discharge Indicator) an electrically controlled display that shows the operator the current charge of a battery.
Busbar	A re-conducting conductor that wired to other smaller conductors.
Communication Modes	CAN (Controller Area Network) is the standard for communication among microcontrollers and/or devices.
Condenser	A device for short-time electrical energy storage.
Goods Holder	A supporting structure on which a fork is mounted
Check Valve	A valve that allows oil to flow in one direction rather than in the other
Circuit	A path along which current can travel from the positive (+) side of the source to the negative (-) side. This can be obtained with wires and electrical components.
Connector	A part of a wire assembly or harness wired to another wire assembly or harness to for an easier Disassembly and Assembly operation.
Co-contactor	A switch, relay, or part of a contactor that opens or closes a circuit.
Components of Co-contactor	An electrical element consisting of an electromagnetic coil and a set of heavy contact tips, which controls current flow through the coil, create a magnetic field, and close or open contact tips
Coil of Co-contactor	An electromagnet used to open or close contact tips in a contactor component.
Control Valve	A valve unit includes multiple directional blocks, each of which has a corresponding actuator
Counterweight	The weight mounted on the back of the forklift to ensure a stable status, especially when lifting heavy loads
Current Limiting	The maximum permissible armature current of the stopped drive motor during the pulse.
Oil Cylinder	A container that maintains pressurized oil and converts hydraulic power into rectilinear motion
DC-DC Convertor	A device that converts a high-voltage DC onto a low-voltage DC.
Digital Signal	A signal in which the element can be either of two different values, e.g. high voltage and low voltage.
Diode	A semiconductor device that allows current to flow from the anode to the cathode in one direction
Directional Valve	A valve that directs the flow of oil according to the position of the valve element.
Instrument	An electrical device that converts voltage input into a visual output.
Drive Axle	A device that receives power from a driving motor
Driving Controller	A control device to drive an electric motor, which includes an inverter and a logic

	circuit.
Handheld Programmer	A maintenance tool program to calibrate and diagnose CURTIS controllers of trucks.
Parking Brake	A pair of brakes that electromagnetically activate their respective motors upon the stationary of the vehicle.
Encoder	A device that detects the direction and speed of a motor to produce a pulse signal.
Fan	A device that generates an airflow to cool an electric motor and a controller.
Filter	A mechanical device used to accommodate a filter element, or a filter device used to prevent contamination flow through a system
Flow Protector	A valve that prevents the hydraulic oil extraction of the control valve from the lifting cylinder when the hydraulic line breaks unexpectedly, which prevents the backstay from dropping suddenly.
Flow Regulator	A valve that reduces the pressure by limiting the flow of a hydraulic line
Pallet Fork	L shape rod for cargo pickup
Friction Plate	When meshing with helical gears, the friction disc stops the drive shaft movement when it is compressed by the steel plate
Fuse	A component of a circuit that opens upon an overlarged current flowing through a given part of the circuit
Fixture	A fitting o secure an assembly consisting of two or more wires
Radiator	A mounting frame for cooling semiconductors.
Hydraulic System	A hydraulic element circuit to convey oil pressure
Hydraulic Oil Tank	A chamber for the oil storage in a hydraulic system
Mandatory Sign	A symbol indicating the state of a vehicle when it is on or flashing.
Seat Switch	A switch to disable the vehicle movement when the operator leaves the seat.
Main Hydraulic Pump	A gear pump uses mechanical power from an electric motor to pressurize the oil stored in a tank and distribute to various actuators
Portal	The front vertical structure of the forklift extends and retracts to lift and lower the load.
Master Cylinder	The hydraulic cylinder which is responsible for the start-up of the driving brake
Needle Valve	A valve to lower the backstay manually when the lifting lever is not available.
Normal State	A term used with switches or relays. Their "normal state" means that they are not under any control of stress, temperature, pressure or electricity.
Ohm (Ω)	A resistance unit. The resistance will be such that one volt shall push one ampere of current through it only.
Timely	The time it takes for a current to flow through a transistor.
Open Circuit	A connection or component of a circuit without continuity.
Hole	A limited passage in a hydraulic circuit, including a limited flow or pressure generation in a given chamber(e.g. a small bore).
Top Cover	A overhead frame structure which protects the operator from falling objects
Overload	A condition that the existing voltage or current is greater than the capacity of a given circuit or component.
Piston Rod	A part that push oil into the cylinder chamber
Suffocated	The part of an electric brake in which the current generated is directed back to the armature.
Port	An input or output point on a hydraulic element
Power Socket	A connecting socket that installed on the forklift.

Pressure	a fluid force as per unit area
Proximity Detector	A sensor which can detect the presence of objects nearby without any physical contact.
Pump Controller Unit	A control device for a hydraulic motor, which includes an inverter and a logic circuit.
Safety Valve	A valve that limits the pressure of the hydraulic system by releasing excess oil
Resistance	A component made of a material with a specific current impedance.
Return Filter	A filter to collect contaminants in oil returned to a hydraulic tank
Rotor	A part of rotating motor.
Outline	A bar chart of an electrical or electronic component that uses symbols to show the individual components as well as how the wires and connectors work electrically
Serial Port	A port that communicates one-to-one with the controller.
Service Brake	A pair of brakes built into the drive shaft to enable the vehicle when the operator applies the pedal for stationary
Short Circuit	An unwanted electrical connection between two or more components.
Side Shifter	An accessory that moves the fork and its load to the left and right
Socket	The male contact of the connector which slides over the male contact of the other connector (pin).
Magnetic Valve	A directional valve that moves the valve element when the magnetic coil is equipped with a magnetic valve.
Solid State	A term that refers to semiconductor components or circuits that wired without moving parts, e.g. diodes and transistors.
Stator	a fixing part in the motor
Steering Shaft	A column that connects the steering wheel to the steering gear to allow the operator to use steering wheel controller
Jociey Stick	A hydraulic component that deliver oil to the right or left side of the steering cylinder as required by the operator
Steering System	Hydraulic element loop, including steering unit, circuit and actuator
Steering Gear	A axle mounted on the rear wheel of a vehicle
Switch（SW）	The component to control a circuit by opening or closing the circuit.
System	Electrical components, circuits, and connections that provide power for specific tasks.
Thermal Sensor	A sensor activated at a pre-conditioned temperature.
USB	A connecting device providing a power supply of 5V.
Valve	A component that controls the pressure, direction, or velocity of a hydraulic system
Voltage	A measurement unit of electrodynamic force. A volt is the force that required for an ampere of current to pass through an ohmic resistor in a circuit.
Watt	A unit of power measurement. The power for one volt to push one ampere of current through an ohmic resistor. The outcomes of amperage (current) multiplied by volts (voltage) is watts (power).
Wire	A path of conductors to provide for current flow in and out of different electrical components.
Wiring Diagram	A visualized figure that represents a component in the way it actually looks, which is used to show the locations of components, and the connections between them.
Zener Diode	A special diode to regulate voltage or protect a system from overvoltage.

1-3 Appearance and Specifications

Overall dimensions of the vehicle



Parameter Table of FEXQ Balanced Weight Forklift

Distinguishing mark	Model	FEXP	
	Manufacturer`s type designation	FE4P16Q	FE4P20Q
	Drive type：(battery, diesel, petrol, gas, manual)	Electromotion	
	Operator type: hand, pedestrian, standing, seated, order-picker	Seated	
	Rated capacity/ rated load Q(kg)	1600	2000
	Load centre distance C(mm)	500	500
	Load distance, centre of drive axle to fork x(mm)	381	381

	Wheelbase y(mm)	1450	1490
Weight	Service weight KG	3100	3500
	Axle loading, laden front/ rear KG	4200/500	4880/540
	Axle loading, unladen front/ rear KG	1490/1610	1670/1750
Tires/ chassis	Tire size, front	18×7-8	18×7-8
	Tire size, rear	6.50-10-10PR	6.50-10-10PR
	Wheels, number front/ rear(x=driven wheels)	2x/2	2x/2
	Tread, front b_{10}(mm)	960	960
	Tread, rear b_{11}(mm)	180	180
Dimensions	Portal inclination (forward/backwarding) α/β(°)	5/7	5/7
	Retraction Height of Portal h_1(mm)	2008	2008
	Retraction height of free lifting h_2(mm)	100	100
	Lifting height h_3(mm)	3000	3000
	Extension height of Portal h_4(mm)	3981	3981
	Height of overhead guard h_6(mm)	2075	2075
	Height of seat h_7(mm)	1030	1030
	Height of traction pin h_{10}(mm)	465	465
	Total length l_1(mm)	2845	3130
	Length of body(to pallet fork end) l_2(mm)	1925	2060
	Total width b_1/b_2(mm)	1135	1135
	Size of pallet fork s/e/l(mm)	35/100/920	40/120/1070
	Width of fork arm carrier b_3(mm)	1040	1040
	Ground clearance m_1(mm)	123	95
	Wheelbase centre clearance from groun m_2(mm)	105	105
	Aisle width for pallets 1000X1200 lengthways	3248	3383

	Ast(mm)		
	Radius of turning Wa(mm)	1950	1950
Performance	Travel speed, laden/ unladen km/h	14/15	13/14
	Lift speed, laden/ unladen mm/s	320/420	300/420
	Max. gradeability, laden/ unladen S_2 30min %	10/15	10/15
Electric-engine	Drive motor rating (S_2 60 min) kW	6.5	6.5
	Lift motor rating (S_3 15%) kW	8.6	8.6
	Battery voltage/ nominal capacity K_5 V/Ah	48/300	48/300
	Battery weight kg	400	400
Additional	Type of drive unit	AC	AC
	Working pressure of accessory MPa	14.5	14.5
	Sound pressure level at driver's seat,ACC TO EN 12 053 dB(A)	73	73

1-4 Safety Notes

The following safety sections contains the following subsections: general, personal safety, maintenance safety, compressed air hazards, hydraulic oil hazards, mechanical hazards, electrical hazards, and fire & burning hazards. Each heading are attached with the precautions you should take
for your safety while working in your vehicle.

Readers are advised with responsibility to read this manual thoroughly, and understand and follow all the following precautions. Please also note that the safety instructions listed below are not only for the safety of the readers, but also for those around them. Therefore, please be sure to read the following instructions carefully for the purpose of your own personal safety and the safety of those around you:

General

Safety Instructions

Please be familiar with the visible safety instructions on the vehicle, which includes warning signs, stickers, carvings, etc. Make sure to read the them before operating, lubricating, or repairing the vehicles (Please refer to the safety section of the Operations and Maintenance Manual).

Make sure that all safety rules, regulations and instructions are followed when performing maintenance tasks. Special attention is required to the danger warning in this manual, which will detail you the potential dangerous conditions.

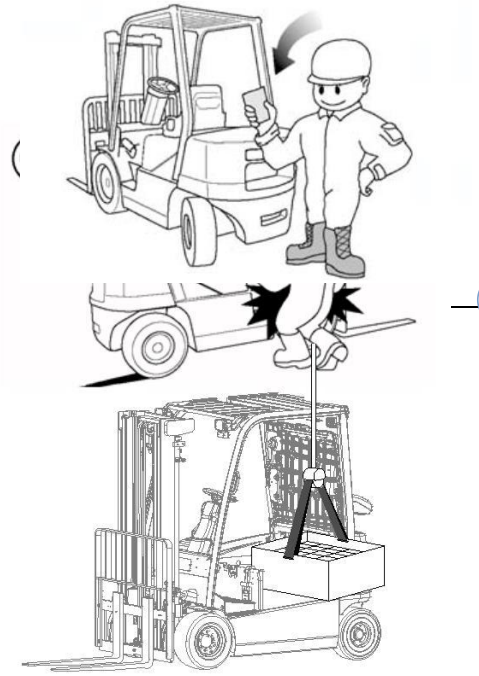
Do not assume that you can replace the steps outlined in this manual with your previous maintenance experience of similar models. Weight and specifications vary from different models and care is required to avoid any dangerous condition, injury and/or component damage.

Personal Safety

Do not operate or service a vehicle without authorization or training.

Do not operate or service a vehicle after alcohol or drugs taking which will impair your judgement.

If you have any disease or condition that restricts physical activity, please do not operate or service the vehicle.



Working Garment

If you are wearing baggy clothes or have long hair that is not handled safely, please do not operate the vehicle or carry out maintenance.Both can be caught by any moving part and cause serious injuries

Appropriate protective equipment is required when performing maintenance tasks. Protective gear may include a hard helmet, glasses/visor, ear protectors,
gloves and protective shoes.

Masks are required when polishing the body and an air breathing device is advised when painting.

Welder gloves, welding masks/goggles, aprons and other suitable welding clothing are required when welding.

Security of Service

Pre-service

Make sure that the vehicle is kept in a clean, open environment, and is free from any traffic and personnel

Please ensure that the vehicle is parked safely and will not move suddenly.
Place the wooden props in front and back of the wheels and make sure that the parking brakes will mesh correctly.

Make sure that the vehicle is empty and unoccupied, the cargo forks are lowered, all the hydraulic controls are in neutral position and the key is switched to OFF. Place a "do not operate" or similar warning signs to the start switch or the controller before repairing or servicing the forklift.

Make sure the tools are in good condition.

Disassembly and Installation

Make sure the working environment is clean, clean and dry before installing the vehicle.

When using steps, ladders or walkways for installation or removal, please face the vehicle.

Please follow these steps and grab the handle to install or remove parts.

When you are unable to follow these steps, please use a ladder, scaffold, or work platform to perform maintenance operations safely.

Work platform is advised to perform maintenance for safe operations.

Lifting

Check the weight of each component before removal. Partial components of the vehicle may so heavy that it may cause serious injuries

When removing any components, please use appropriate lifting procedures

A hoist is required avoid back injuries when lifting parts weighing 23kg (50lbs) or more.

Ensure all chains, hooks, slings and the like are in good condition and in correct capacity. Make sure the hook is positioned correctly. Lifting ring bolts should not be loaded laterally during lifting operation.

Disassembly/Assembly

Make sure that the assembly/disassembly site is kept clean and dry and that hand tools are kept clean.

When tightening/loosening bolts and nuts, please use a properly sized wrench and always pull towards the body. A wrench with the wrong size or pushing off the body to loosen/tighten the bolt or nut may cause an accident as the handle slips.

If two or more people are working together, signs or signals are required for communication so that the work is done in an agile manner as if it were done by one person.

Be careful when removing the cover. Slowly loosen the last bolt or two opposite direction nuts from the cover plate unit, twist the cover plate to loosen tension or other pressure, and then completely remove the last bolt or two nuts.

Re-install all fasteners with the same numbered part. If any fasteners need to be replaced, please use qualified fasteners and be careful to not use metric system fasteners with British fasteners together.

Hazards of Compressed Air

Please wear protective mask, protective clothing and protective shoes in cleaning operation。

The maximum air pressure for cleaning must be less than 205 kPa (30 psi).

Hazard of Hydraulic Oil

Please follow the following safety instructions for hydraulic system maintenance carefully.

Oil removal under pressure, even if the pinhole size leaks, can penetrate the body elements and cause serious damage and possibly death.

Please wear gloves, goggles, and make sure that your arms and legs are completely covered.

Release all pressure from the hydraulic system before disconnecting or removing any piping, fittings or related item, and wait for the runner system to cool down.

Do not touch the pressurized hose by hand, or bending or striking.

Do not check pinhole leakage by hand, which is the most common method of oil-related injury! Please use cardboard or other solid surfaces instead.

When removing the filler cover, vent and plug, please place the cloth on the port to prevent pressured liquid spraying or splashing

A container shall be prepared to capture any hydraulic fluid that may flow from the hose/port.

Make sure that all raised components are properly locked.

When reinstalling lines, make sure tighten them to the correct torque, and ensure that all heat shields, fixtures and guards are properly installed to avoid overheating, vibration or friction with other components during operation.

Lines must be installed correctly to prevent oil from being sprayed into the shield on the hot exhaust components in case of any pipe or seal failure.

Mechanical Hazards

Keep all the objects away from the fan blades, or they will throw or cut any object or tool that falls or is pushed in.

Do not operate the machine when any rotating parts are damaged and do not touch any other parts during the operation. Please check the balance of any damaged or changed high-speed rotating part before re-use.

The equipment shall be properly supported and the component shall be installed when working under the vehicle.

Do not expect the hydraulic cylinder to be always mounted. If the control lever is moved or the hydraulic line breaks, any accessories may fall off.

Debris or other debris will fly away from the object upon impact.

Make sure the flying debris doesn't hurt anyone before hitting the object.

Electrical Hazards

Do not damage any wire during disassembly operation. When re-installing wiring, make sure it is installed correctly

Do not wire to any oily cable.

Do not smoke or expose batteries to any spark or flame when checking, charging or repairing the batteries.

The chain and metal tools shall be kept away from the top of the battery.

Electrolyte is an acid that can cause injury if it comes into contact with the skin or eyes.

Fire and Burning Hazards

Attention shall be paid to the hot parts on the machine that has just stopped and to the hot oil in the pipes and compartments to avoid scalding.

All hydraulic oils, many lubricants and some coolant mixtures are flammable. If the pipe is loose or damaged, there may be a fire.

All hydraulic oils and lubricants shall be stored in appropriately marked containers and be away from unauthorized personnel.

All oily rags or other flammable materials shall be stored in a protective container and kept in a safe place.

Do not weld or flame cut pipes or pipe containing easy fuel.

Before welding or flame cutting, please clean them thoroughly with a nonflammable solvent.

Remove all residual flammable materials from the forklift and then collect, like fuel and oil.

1-5 Maintenance

The following provides the key items and replaceable components to be checked during maintenance intervals.

Note: all maintenance and repair should be carried out by a qualified authorized engineer except for the routine inspection of the vehicle driver.

Note: careless disposal of waste oil is not only harmful to the environment, but also to human health. Waste oil should always be kept in containers and disposed of by authorized personnel at a designated locations.

Necessary Check as Required

Item	Inspection Standard and Method
Instrument Board	Press Enter You can access diagnostic mode by pressing this button while driving
Idler Wheel of Goods Holder	Measure the distance from the bottom of the inner frame to the bottom of the sliding frame bearing to ensure a upright inner frame and then adjust the squeezed roller.
The power module	Must be fully discharged before contact with any electrical components.
Fuse Holders	Check the removed components fuses and replace if necessary. 5A：Backup/parking light, relay/power supply, fan, strobe, flash, rear/headlight 10 A：key switch 20 A：DC-DC Convertor and Horn 500 A：main fuse
Operator's Seat	Check that the operator's seat for proper working and gently lubricate the slider track.
Wheel bolting	Make sure that the wheel bolts and nuts are fixed as follows: Tightening torque of rear wheel : 430 Nm Tightening torque of drive wheel：600±75 N·m（442.5±55 lb·ft）
Drive axle gear box	Check gear box for lubricant Refill the lube oil into the plug opening for shell level inspection.

Check every10 service hours or daily

Item	Inspection Standard and Method
Check by walking around	Check for loose parts and fasteners. Check the indicator lights of instrument board for abnormalities. Check if the speakers and other alarms are working properly. Check if the frame and lifting chain are worn and if the pins/rollers are abnormal. Check rack, fork and accessories for damage and abnormality. Check tires, valves and wheels for abnormalities. Check the ceiling for damage and abnormality. Check the hydraulic system for oil leakage and damage. Check the drive axle for oil leakage. After adjusting the driver's seat and placing the control lever in neutral, please open the key switch and check the overall operation of the system.
Portal	Lubricate the beam where the roller is.
Battery	Check the battery box for loose connections, worn cables and limits on properly secured battery limits. Clean the top of the battery. If necessary, clean the top of the battery with a solution of 0.5 kilograms (1 pound) of baking soda and 4 liters (1 gallon) of hot water. Check the density of the battery. If the specific gravity reading is below 1.150, the battery must be charged. Check the electrolyte levels of all cells. Keep the electrolyte level about 13 mm (0.50 in) above the plate. Add water as needed. Use distilled water only. Water should be added to the battery after charging
Indicator lights of instrument board	Check whether the parking brake light is working normally and all the indicator lights
Tyres and wheels	Check tires and wheels for wear, cutting, grooves and contamination.

First check shall be made after 50-100hours or a week later

Item	Inspection Standard and Method
Drive Axle	Replace gear oil

Check every 500 service hours or ever 3 months

Item	Inspection Standard and Method
Tilting cylinder	Lubricate chassis and mast pivot bolt fittings. Check pins for loose retaining bolts or worn. Measuring and adjusting the extension of cylinder rod (Max. 3.18mm / 0.13in) Standard tightening torque of bolt：95±15 N·m（70±11 lb·ft）
Crosshead roller	Check crosshead roller guard and retainer for damage.
Portal, chain and accessories	Check if the lifting cylinder, tilt cylinder and the attached controller are in normal operation. Check the rack bolts and nuts for looseness and remove contaminants if any. Check the pallet fork and accessories for proper operation. Lubricate all chains with a brush and check for abnormal anchor points.
Steering Shaft	Accessories to lubricate the steering shaft.
Drive Axle	Replace gear oil
Control Panel	Clean control panel. Maximum allowable pressure：205 kPa（29.7 psi）
F / R switch	Check the tightness of the F/R switch mounting bracket and adjust as needed. Check for loose wiring and secure it as needed.
Parking Brake	Check the parking brake to ensure that the vehicle is stationary at a 15% gradient and repair or replace if necessary.
Hydraulic Oil	Check the hydraulic oil level and refill if necessary.

Check every 1,000 service hours or every 6 months

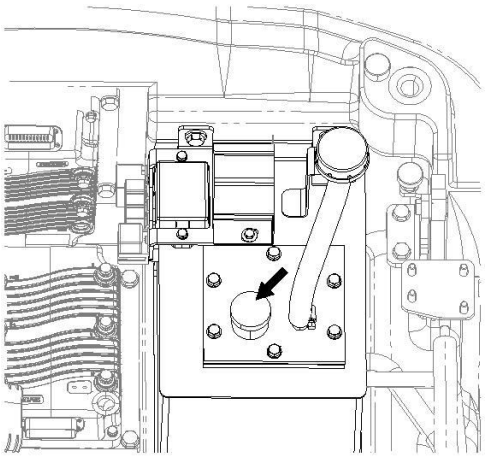
Item	Inspection Standard and Method
Drive and hydraulic pump motor	De-dust and check drive motor and end cover area. Maximum allowable pressure：205 kPa（29.7 psi）
Hydraulic oil return filter	Replace the return oil filter in the hydraulic tank.
Tyres and wheels	Check tires for worn, cuts, grooves, contaminants and the like. Check the wheel components for cracks, wear, damage, corrosion and the like. Standard torque of drive wheels：180 N·m （133 lb·ft）
Lifting chain	Perform the lifting chain wear test by measuring the wear of the link and pin.

Check every2,000 service hours or annularly

Item	Inspection Standard and Method
Hydraulic System	Replace hydraulic tank and filter.
Rear wheel	Remove and assemble the rear wheels to re-assemble the bearings.
Basic maintenance	A regular check-up shall be made at least every 12 months under normal circumstances. If the vehicle are working with long hours or under heavy load, please check the vehicle every 6 months in regularly. If any of the following conditions are found, please replace: the crack healing on the fork, welding, bracket and the like

1-6 Lube

The following is a detailed description of the lubricant as required and the parts to be lubricated.



1-6-1 Lubricating Oil Specification

The following lubricants are recommended for chains and connecting rods:

Item	Specification
1	DIN 51825 Standard Oil and Grease

1-6-2 Hydraulic Oil （HYDO）

Hydraulic oils shall be qualified with anti-wear, anti-foam, anti-rust and anti-oxidation additives for heavy duty use as described by the oil supplier. ISO viscosity grade 46 is usually preferred.

Note: the correct hydraulic oil should be used to for the maximum service life and performance of hydraulic system components. The above hydraulic oils are recommended for most hydraulic and hydrostatic systems.

If the hydraulic fluid becomes cloudy, it is evidenced that the water or air has entered the system. Water or air in the system will cause pump failure.

Drain all hydraulic oil, re-tighten all hydraulic suction clamps, and then clean and refill the system.

Gear oil

Failure to comply with recommendations will result in excessive wear of gears leading to shortened service life.

API GL-4 or SAE 80W oil is acceptable

Note: Noblelift does not mix multi-stage oils for transmissions. Multistage oils with high molecular weight polymers as vi improvers lose their viscosity effectiveness due to the permanent and temporary shear of vi improvers and hence are not recommended for use in drives and compartments of drive system

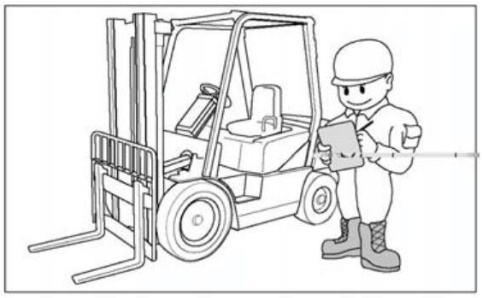


Figure1-17

1-7 Instructions of Disassembly/Assembly

The following parts of Disassembly/Assembly include the following sections: the preparation before disassembly, the inspection and test before disassembly, the matters to be attended during disassembly, the matters to be attended after disassembly, the matters to be attended during assembly, the handling of common parts and hydraulic piping fittings.

The precautions to be taken for proper disassembly/assembly operations are listed in each heading.

Preparation before disassembly

Remove dust and contaminants from the vehicle before transferring to the maintenance centre. Dust or contaminants that enter the maintenance centre may contaminate parts and enter inside to introduce scratches. The electric forklift are operating on an electrical system.

No water shall be allowed inside the system.

To avoid unnecessary disassembly, please prepare necessary tools and place parts inside boxes with priority to site cleaning

Check and test before disassembly

Be sure to record any problems before starting the disassembly, which can prevents unnecessary disassembly, loss of replacement parts, and repeated failures as caused by the same problem.

To prevent failures, record failures and replace required parts are required.

The following information shall be also checked and recorded:

Vehicle model number, serial number and operation hours

Reasons of the vehicle needs to be dismantled

Check for symptoms, locations and causes of failures (repeat the same failure if needed)

Check any part which is not suitable.

Check the parts for damage or looseness.

If possible, check the maintenance condition of the vehicle.

Notes for disassembly

Disassembly：

Determine the way of parts assembly (front/rear, left/right and up/down) for the sequence of disassembly.

Before starting to disassemble parts, attention shall be paid to the join points of parts with arrow marks to avoid misplacing parts during assembly

Please use the right tools to remove specific parts.

If no part is removed, even when mounting bolts and nuts, do not use excessive force.

Do not overstrain. Check and find the causes

Put the disassembled parts on one side in the order of disassembly, and place signs or marks on similar parts.

Store bolts, nuts and other common parts in an orderly manner.

Check and test in disassembly

The cause of the fault is sometimes found in the process of disassembly. Therefore, it is important to carefully examine the condition of the friction surfaces and the contact parts.

During disassembly, gaps, deformations, projections and other factors that may cause failures shall be measured and recorded.

Keep the distance

Make sure that the installed spacers and gaskets will produce the required specific clearance.

Remove pressure fittings

Remove any dent or mark that caused by area hammering and polishing.

If any pressing part is released, please identify and eliminate the cause to avoid problems during assembly.

Bearing Disassembly

Do not remove the bearing forcibly, and a bearing puller is advised.

Notes after disassembly

Be clean

Clean disassembled parts and keep them away from contaminants.

Special attention should be paid to removing contaminants from the oiling or component lines.

When cleaning special parts, increase the number of detergent containers and clean several times.

Kerosene or neutral anhydride diesel is suitable for cleaning viscous oils in bearings.

When using dangerous chemical cleaners, be careful to avoid a skin or eye contact.

Used oil should be disposed of in designated containers at designated locations.

Dustproof

A dust cover is advised to keep cleaned parts free of dust and contaminants and to block up the ends of all pipes.

Any part you may store should be rust-proof before re-installing.

Notes for assembly

Parts installation

All parts shall be kept clean before assembly. All surfaces shall be checked for defects and repaired if necessary. Any contaminant shall not be smeared or rubbed on the surface, which may shorten the service life of the parts.

Before starting assembly, a cleaner is required to remove the rust inhibitor from the parts.

Before assembly, the markings that put the parts together shall be identified.

Bearings, bushings, and seals shall be assembled with press tools and specific parts shall be handled with specified tools.

Before pressing parts, the surface shall be lubricated with lube.

Tighten the bolts and nuts

To ensure a uniform torque of bolts and nuts, the tighten order shown in figure 1-19 shall be followed and then the other end of the other side shall be tightened. This method is known as the "template method", which gradually repeats loosening and fastening to ensure even contact.

Fix the bolts, nuts or other important fasteners that cannot be visually inspected with wires, cotter pins, lock washers or other components as shown in figure 1-20.

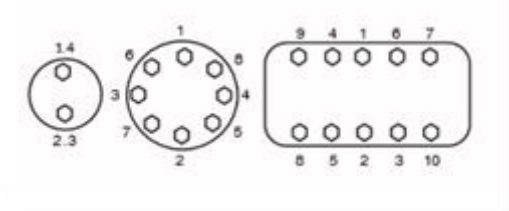


Figure 1-19

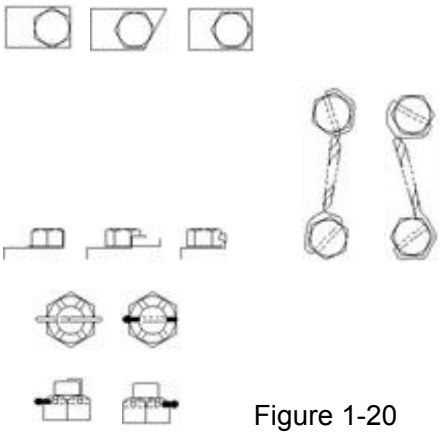


Figure 1-20

Assembly Inspection

At each step of the assembly process, each part's number shall be checked and recorded.

Reassemble the gaskets

Install the gasket and washer in the same position as before, and then check the gap for correctness.

Assembly adjustment

If no adjustments are required, assemble them to the same length as before

Assemble pressed parts

Scratches and dents shall be repaired as needed and be kept clean before insertion.

Please note that press fittings that are not adequately tightened may become loose.

Assemble keys and keyways

Check if the keyway and key are loose and in contact with the key head. If the keyhead touches the keyway, then the rest of the keyhead shall be removed.

Handling the general parts

Handling the packaging

Packing, as well as gaskets &copper packing should be replaced as instructed. After using the adhesive, please assemble the gasket specified in this maintenance manual. The followings shall be noted when applying the adhesive to the gasket:

Old adhesive, scratches, dust, paint and grease shall be thoroughly removed from the washer surface.

Apply appropriate sealant evenly to both sides of the washer and wait a few minutes until dry.

Once the sealant is dry enough to touch, it won't stick to your hand.

Assemble the parts

Please soak the leather package in oil before use.

Handling the O-rings

Please remember to check the condition of the O rings.

Hardened O-rings shall not be stored for long.

The O-rings to be used shall be the specified once in the parts list. For example, the O rings used in engine oil are made of special materials, such as silicone rubber, and are resistant to heat and aging.

Installing different types of O-rings in this situation can cause serious damage to the system and its components.

The O-rings shall be lubricated to avoid surface scratching during installation. Silicone rubber O rings are prone to damage, hence attention is required to avoid overstretch.

Handling the oil seal

Oil seals shall be prevented from dust sedimentation, especially on the lips, and there shall be no rust or scratch.

Lips opposite to the seal shall be lubricated evenly.

The surface of the shaft where the seal is installed shall be checked for contamination, rust, or scratches and grease or lubricant shall be applied so that the seal can be easily installed.

Oil seal installation.

By gently rubbing the wire on the surface, please check the surface of the oil seal lip for scratches.

If there is any scratch, please replace the oil seal.

When inserting the oil seal, please use the guide device and fixture as shown in figure 1-22 to avoid any damage to the oil seal.

After the oil seal is inserted, the inclination shall be checked (tilt tolerance: 0.2 mm /00 mm, diameter 0.008 in. /3.937 in.).When applying adhesive to oil seal, make sure that there is no adhesive in contact with the lip surface. All residual adhesive shall be removed from the guide and fixture before inserting another seal.

Bearing handling

The followings shall be noted to properly assemble bearings and avoid damage to bearings:

The dust and other contaminants that may shorten the service life of the bearing shall be thoroughly removed.

The bearing shall be kept packaged until it is installed.

Do not affect the bearing.

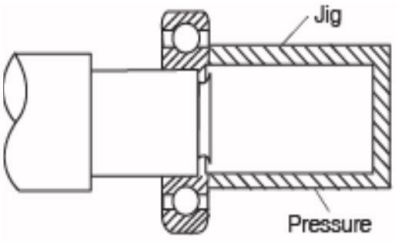
Do not over-turn the bearing to remove the purifier by compressed air.

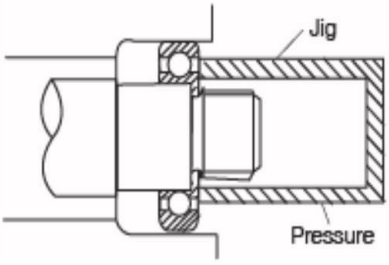
The oil seal ring shall be installed in the correct direction.

Please note the following when installing the bearing.

Neither hit the outer ring with a hammer for installation, nor hit the inner ring to insert the outer ring. Such hammer strike may damage the bearing track.

When you are insert the inner ring of the bearing with a reasonable tolerance, the fixture shown in figure 1-23 is required with pressure to the inner ring. For hot insertion, the bearing shall be heated to 120℃（248℉）. However, please note that excessive heating can reduce the hardness of the bearing surface.





When inserting non-split bearings with inner and outer rings with reasonable tolerances, the fixture shown in figure 1-24 shall be applied and both inner and outer rings shall be pressed.

Handle the retainer

When removing or installing the retainer, a pair of right ring tongs is required and attention shall be paid against over-pressure on retainer. After installing the retaining ring, the retaining ring shall be checked for correct

insertion.

Hydraulic circuit fittings

1. For metal tube to hose installation, the tube shall be installed and all bolts shall be tightened by hands.
2. Tighten the bolt at the rigid end.
3. Install hose and tighten all bolts by hands
4 .Place all the hose in a position where it will not contact with the machine or other hoses.
5. Tighten the bolts at both joints
6. Start up the engine.
7. Move the control lever to full position.
8. Inspect the hose during tool movement. Make sure that the hoses do not contact any machines or other hose.
9. Shut off the motor
10. If necessary, place the hose in a new position so that it will not touch the position when moving the tool.

Fitting assembly with straight thread and O rings (for different applications)

1. Place the lock nut (3), support washer (4) and o-ring seal (5) as far away from the fitting body (2) as possible.
2. Tie the joints to the part it is using until the support washer (4) just touches the surface of the part.
3. Place the joint assembly in the correct position, and turn the joint body (2) outward to 359°(counter-clockwise) .
4. Tighten the locking nut (3) to the torque as shown in the correct diagram for the used fitting.
5. If the end shape of the fitting body is the same as shown in figure 1-25 (elbow or straight), please place the sleeve over the tube before connecting the tube to the end.

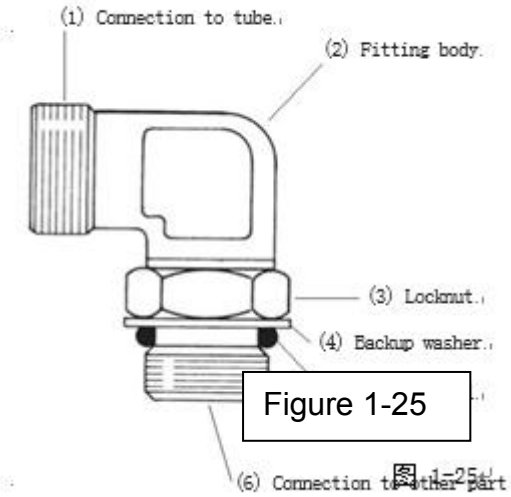


Figure 1-25

Note: if the joint is a connector (direct connector), then the lock nut on the main body shall be replaced by the hexagon nut. To install this type of joint, the hexagon joint shall be tightened to the surface of the parts into which it enters.

Tighten accessories of other types

Pipe fittings (shear sleeve) of high load: please turn the nut with a wrench until a slight reduction in torque is felt after the pipe passes through the nut and touches the shoulder in the fitting body, which indicates that the sleeve has been removed from the nut

High seal fittings: place the nut and sleeve on the pipes with the short end of the sleeve toward the end of the pipes. Press the pipe end against the counterbore in the body of the fittings and tighten the nut until it is above the last thread of the body. As soon as the fitting is removed and reinstalled, the remaining space will be available.

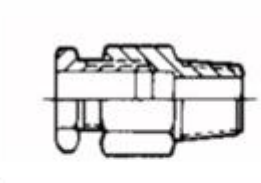


Figure 1-26

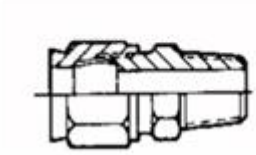


Figure 1-27

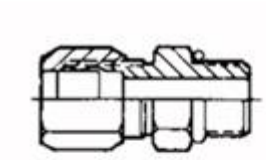


Figure 1-28

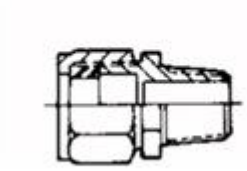


Figure 1-29

Flexible fittings: please place the nuts and sleeves on the pipes and push the pipes as far as possible into the countersunk holes of the fitting bodies. Tighten the nut until it touches the hexagonal part of the body.

1-8 Standard Torque

1-8-1 Standard torque of bolts and nuts

Be careful that the metric and British size fasteners shall not be mixed in used. Mismatched or incorrect fasteners may cause damages or malfunctions to the vehicle or personal injuries.

Exceptions to these torques may be provided in the service manual if required.

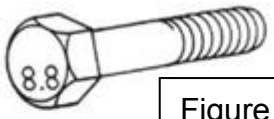
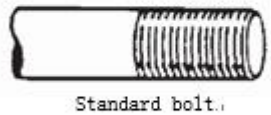


Figure 1-30

Before installing any hardware, make sure that the components are close to a new state. Threads of bolts and nuts shall not be worn or damaged. Hardware shall be free from rust and corrosion.

Hardware shall be cleaned with a non-corrosive cleaner with oil application to threads and bearing surfaces. Oil shall be not applied if thread locks or other compounds are to be used.



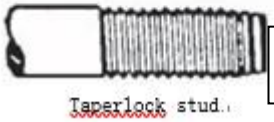


Figure 1-31

The fastener shall be kept in good condition and reused only in fine conditions after loosening.

Make sure to choose the same size and grade of fasteners for replacement.

Generally, you can identify the strength of the bolts based on the numbers marked on the heads (e.g. 8.8 or 10.9) as shown in figure 1-30. The following table are listing the standard torques for typical bolts, nuts and the taper bolts as shown in figure 1-31.

For metric fasten

Thread size(mm)	Metric nuts and bolts		Metric taperlock stud	
	（N · M）	Pounds/feet	（N · M）	Pounds/feet
M6	12 ± 3	9 ± 2	8 ± 3	6 ± 2
M8	28 ± 7	20 ± 5	17 ± 5	13 ± 4
M10	55 ± 10	40 ± 7	35 ± 5	26 ± 4
M12	100 ± 20	75 ± 15	65 ± 10	48 ± 7
M14	160 ± 30	120 ± 22	–	–
M16	240 ± 40	175 ± 30	110 ± 20	80 ± 15
M20	460 ± 60	340 ± 44	170 ± 30	125 ± 22
M24	800 ± 100	600 ± 75	400 ± 60	300 ± 45
M30	1600 ± 200	1200 ± 150	650 ± 80	480 ± 60
M36	2700 ± 300	2000 ± 225	870 ± 100	640 ± 75

For British fasteners

Thread size(inch)	British nuts and bolts		British taperlock stud	
	（N · M）	Pounds/feet	（N · M）	
1/4	12 ± 3	9 ± 2	8 ± 3	6 ± 2
5/16	25 ± 6	18. 0 ± 4. 5	17 ± 5	13 ± 4
3/8	47 ± 9	35 ± 7	35 ± 5	26 ± 4
7/16	70 ± 15	50 ± 11	45 ± 10	33 ± 7
1/2	105 ± 20	75 ± 15	65 ± 10	48 ± 7
9/16	160 ± 30	120 ± 20	–	–
5/8	215 ± 40	160 ± 30	110 ± 20	80 ± 15
3/4	370 ± 50	275 ± 35	170 ± 30	125 ± 22
7/8	620 ± 80	460 ± 60	260 ± 40	190 ± 30
1	900 ± 100	660 ± 75	400 ± 60	300 ± 45
1 1 / 8	1300 ± 150	950 ± 100	500 ± 70	370 ± 50
1 1 / 4	1800 ± 200	1325 ± 150	650 ± 80	480 ± 60
1 3 / 8	2400 ± 300	1800 ± 225	750 ± 90	550 ± 65
1 1 / 2	3100 ± 350	2300 ± 250	870 ± 100	640 ± 75

1-8-2 Standard torques for fastening fittings

Standard torques for O-ring surface seal fittings

Thread size(inch)	Accessories for straight thread o-ring	
	(N · M)	Pounds/feet
5/ 16-24	5.0±1.5	45±15
3/ 8-24	12±2	110±20
2/7 - 16	20±4	15±3
1/ 2-20	40±5	30±4
9/ 16-18	40±5	30±4
3/ 4-16	100±15	75±10
7/ 8-14	135±15	100±10
1 1 / 16-12	200±25	150±20
1 3 / 16-12	250±25	185±20
1 5 / 16-12	300±40	225±30
1 5 / 8-12	300±40	225±30
1 7 / 8-12	300±40	225±30
2 1 / 2-12	300±40	225±30

Thread size(inch)	Sealing joint nuts for O-ring face	
	(N · M)	Pounds/feet
9/ 16-18	16±3	12±2
1 / 16-16	30±4	22±3
1 / 16-16	50±7	37±5
1 14	90±10	65±7
1 3 / 16-12	120±15	90±10
1 7 / 16-12	160±20	120±15
1 11 / 16-12	190±20	140±15
2-12	215±25	160±20

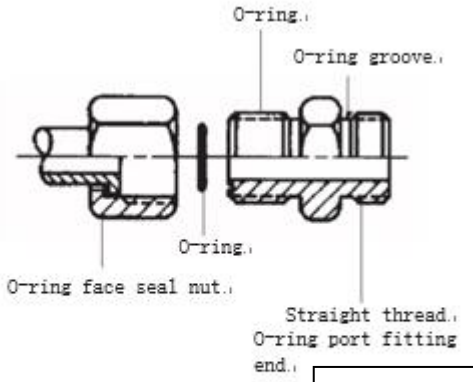


Figure 1-32

Hose clamp - belt type

Clamp width	New hose torque	Torque for re-tightening
7 9 mm (0.312 in)	0 9±0.2 N·m (8±2 lb·in)	0.7±0.2 N·m (6 ±2 lb·in)
10.5 mm (0.531 in)	4 5±0.5 N·m (40±5 lb·in)	3.0±0.5 N·m (25 ±5 lb·in)
10.9 mm (0.625 in)	7 5±0.5 N·m (65±5 lb·in)	4.5±0.5 N·m (40 ±5 lb·in)

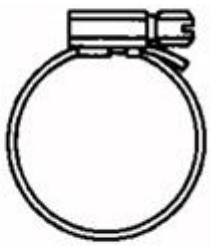


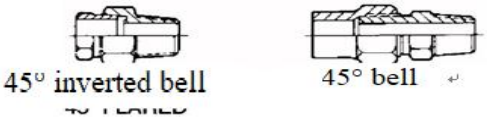
Figure 1-33

37° bell and straight threaded O - ring accessories

Pic 1-34

37℃ bell and straight threaded O - ring accessories（Sealing accessories for O - ring surface are excluded）				
Nominal pipe external diameter		Thread diameter（in）	Standard torque	
Metric	Inch	Inch	(N·M)	Ponds/Feet
3↓18	0.125	5/16	5.0±1.5	4±1
4↓76	0.188	3/8	11.0±1.5	8±1
6↓35	0.250	7/16	16±2	12±1
7↓94	0.312	1/2	20±5	15±4
9↓52	0.375	9/16	25±5	18±4
9↓52	0.375	5/8	35±5	26±4
12.70	0.500	3/4	50±7	37±5
15.88	0.625	7/8	65±7	48±5
19.05	0.750	1-1 / 16	100±10	75±7
22.22	0.875	1-3 / 16	120±10	90±7
25.40	1.000	1-5 / 16	135±15	100±11
31.75	1.250	1-5 / 8	180±15	135±11
38.10	1.500	1-7 / 8	225±15	165±11
50.80	2.000	2-1 / 2	320±30	240±22

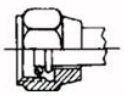
45° bell shape and 45° inverted bell fittings



1-35

45° bell shape and 45° inverted bell fittings				
Nominal pipe external diameter		Thread diameter（in）	Standard torque	
Metric	Inch	Inch	（N·M）	Ponds/Feet
3↓18	0.125	5/16	5.0±1.5	4±1
4↓76	0.188	3/8	8.0±1.5	6±1
6↓35	0.250	7/16	11±2	8±1
7↓94	0.312	1/2	17±3	13±2
9↓52	0.375	5/8	30±3	22±4
11.11	0.438	11/16	30±3	22±2
12.70	0.500	3/4	38±4	28±3
15.88	0.625	7/8	50±5	37±4
19.05	0.750	1-1 / 16	90±8	65±6
22.22	0.875	1-1 / 4	100±10	75±7

Thread fittings for air conditioning and conical pipes



o-rings

45 ° flare

1-36

AC Accessories						
Thread diameter (in.)	Mounting end of O-rings		45° flaring end			
			steel tube		aluminum pipe	
	(N · M)	Ponds/Feet	(N · M)	Ponds/Feet	(N · M)	Ponds/Feet
5/8 8-18	18 ± 4	13 ± 3	30 ± 3	22 ± 2	23 ± 3	17 ± 2
3/4 4-16	37 ± 4	27 ± 3	52 ± 5	38 ± 4	33 ± 4	24 ± 3
7/8 8-14	40 ± 4	30 ± 3	60 ± 7	44 ± 5	38 ± 4	28 ± 3
1 1 / 16-14	45 ± 5	33 ± 4	75 ± 8	55 ± 6	50 ± 5	37 ± 4

Thread fittings for conical pipes				
Thread diameter (in.)	Threads with le2200e sealant		Threads without sealant	
	(N · M)	Ponds/Feet	(N · M)	Ponds/Feet
1/4 16-27	15	11	20	15
1/4 8-27	20	15	25	18
1/8-14	25	18	35	26
3/8 8-18	35	26	45	33
1/2 2-14	45	33	60	45
3/4 4-14	60	45	75	55
1 11 1/2	75	55	90	65
1 1 / 4-11 1/2	95	70	110	80
1 1 / 2-11 1/2	110	80	130	95
2 11 1/2	130	95	160	120

2 Electronic System

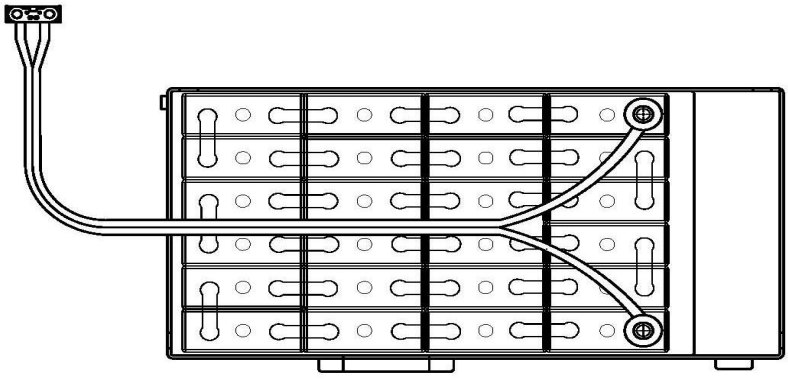
2-1 General

This model is equipped with an electrical system with the following components:

1. The battery supplies the power to the electrical system [Section 2-2]
2. The emergency switches may be pressed in emergency to turn off all DC and AC circuits [Section 2-3]
3. Motors, controllers, and associated equipment are providing the necessary drive and pump power to the vehicle based on their interactions with sensors, switches, relays, actuators, as well as various parameter settings. [Section 2-4]
4. When the load is supplied at a current above the limit, the fuse will protect all DC loads from overcurrent by cutting off the load's power supply. [Section 2-5-1]
5. The DC-DC converter converts the high voltage of the battery to a low voltage or a low voltage load [section 2-5-2]
6. Other DC loads that activated by the operator's direct requirements will work independently of the controller. First, such DC loads not regulated by controllers and are not the purpose of controllers' signals. However, they may interact with controllers in some configuration. Such loads include light sets and horns.[Section 2-5-3 to 2-5-5]
7. The instrument board monitors the vehicle, informs the user of its condition and provides basic functions for mode setting, diagnosis and calibration [Sections 2-6]
8. The handheld programmer provides the same functions as the instrument board, but are detailed [sections 2-7]

2-2 Battery (Lead Battery)

2-2-1 Appearance and Specifications



Item	Specification
Dimension of battery compartment	1005mm×520mm×720mm
Total battery weight	775Kg
Battery connector	REMA160A
Battery cable length	1500mm
Battery cable size	More than 2/0 GA（50 mm 2 ）

Specific gravity depends on temperature

Temperature								Charging Level
-15° C (5 ° F)	-5° C (23 ° F)	0° C (32 ° F)	5° C (41 ° F)	15° C (59 ° F)	25° C (77 ° F)	35° C (95 ° F)	45° C (113 ° F)	
1.108	1.101	1.098	1.094	1.087	1.08	1.073	1.066	0%
1.118	1.111	1.108	1.104	1.097	1.09	1.083	1.076	5%
1.128	1.121	1.118	1.114	1.107	1.1	1.093	1.086	10%
1.138	1.131	1.128	1.124	1.117	1.11	1.103	1.096	15%
1.148	1.141	1.138	1.134	1.127	1.12	1.113	1.106	20%
1.158	1.151	1.148	1.144	1.137	1.13	1.123	1.116	25%
1.168	1.161	1.158	1.154	1.147	1.14	1.133	1.126	30%
1.178	1.171	1.168	1.164	1.157	1.15	1.143	1.136	35%
1.188	1.181	1.178	1.174	1.167	1.16	1.153	1.146	40%
120%	1.191	1.188	1.184	1.177	1.17	1.163	1.156	45%
121%	1.201	1.198	1.194	1.187	1.18	1.173	1.166	50%
1.218	1.211	1.208	1.204	1.197	1.19	1.183	1.176	55%
1.228	1.221	1.218	1.214	1.207	1.2	1.193	1.186	60%
1.238	1.231	1.228	1.224	1.217	1.21	1.203	1.196	65%
1.248	1.241	1.238	1.234	1.227	1.22	1.213	1.206	70%
1.258	1.251	1.248	1.244	1.237	1.23	1.223	1.216	75%
1.268	1.261	1.258	1.254	1.247	1.24	1.233	1.226	80%
1.278	1.271	1.268	1.264	1.257	1.25	1.243	1.236	85%
1.288	1.281	1.278	1.274	1.267	1.26	1.253	1.246	90%
1.298	1.291	1.288	1.284	1.277	1.27	1.263	1.256	95%
1.308	1.301	1.298	1.294	1.287	1.28	1.273	1.266	100%

2-2-2 Function

Characteristics of lead batteries

This model uses a lead battery as a power source for its electrical system.

The lead battery is mainly composed of positive plate, negative plate, electrolyte, separator, battery tank, battery cover, electrode, liquid injection cover, etc. The electrode of the exhaust battery is composed of lead and lead oxide, of which the electrolyte is an aqueous solution of sulfuric acid. Main advantages: stable voltage, cheap price; Disadvantages: low energy density (i.e, energy stored per kilogram of battery), short service life and high frequency of daily maintenance. The service life of the old ordinary battery life is generally about 2 years, of which the height of electrolyte shall be checked and the distilled water shall be added. However, with the development of technology, lead-acid batteries have become more durable and easier to maintain.

The plastic covers that can be unscrewed at the top with a vent hole is the most apparent feature of the lead-acid batteries. These caps are designed for distilled water refilling, and electrolytes and gases checking. Theoretically, lead-acid batteries shall be checked for the density of electrolyte and liquid level height during each maintenance, and distilled water should be added if reduced

2-2-3 Test

A. Battery condition check

Weak batteries can cause problems in the controller and power circuit.

The battery shall be ensured with a good condition before troubleshooting other areas.

Preliminary steps

Verify the polarity on the battery connector and control panel for correctness.

The positive terminal cable shall be located at the line fuse while the negative terminal shall be located at the negative terminal of the control panel.

When the vehicle is in operation

Battery load test >

1. Turn the range switch on the multimeter to read the battery voltage.
2. Connect the battery
3. Connect the multimeter leads with B+ (1) and B- (2) of the controller.
4. Please operate the hydraulic system (temporarily keeping the tilting lever at its maximum position) in the safe area while reading the voltage indicated on the multimeter.
5. If the indication is below the limit (46.0v), the battery shall be charged or repaired before the troubleshooting.

When the vehicle does not work and the battery is suspicious.

Battery pressure drop test

1. The voltage of each battery shall be measured when the vehicle is powered on and the pump motor is running.
2. The normal voltage of each battery should be between 1.95V and 2.12V. If the voltage on each battery is below 1.95V, the battery shall be charged or repaired before troubleshooting resumption.
3. The readings between batteries should not exceed 0.05 volts. If so, the battery shall be properly charged or repaired

Hydrometer test >

1. Test each individual cell of the battery with a hydrometer
2. If any specific gravity indicator is below 1.140, the battery shall be charged.
3. If any reading is 1.265 to 1.285, then the battery is fully charged (please refer to section 2-2-1).
4. The readings between monomers should not exceed 1.020. If so, the battery shall be properly charged or repaired

B. Insulation check of battery case

Any resistance between any point of the wiring in forklift truck and car body should be at least 10000 Ω or higher.

A short circuit in the battery case may cause many faults. Because the battery may have chassis leakage,

A chassis short circuit in the forklift wiring may cause problems. To avoid any problem as caused by the short circuit, the followings shall be attended:

1. Disconnect the battery and discharge the controller.

2. Measure any component connection or wiring that associated with the forklift chassis or wiring connection randomly, and the minimum resistance shall be 10000 Ω.

Any test point with low resistance shall removed from the chassis against any short circuit.

3. The battery shall be always kept clean to minimize the leakage of current into the case.

4. Make sure that all accessories (e.g. horn and lights) are designed to be chassis free (dual wire system)

2-2-4 Maintenance

Battery maintenance and service is essential to maximize the service life of battery and efficient vehicle operation. Regular inspection and maintenance will extend the service life of the battery.

Special attention should be paid to the following rules:

1. The battery shall be always kept clean Being cleaning can prevent corrosion, current leakage and case short circuit. Please tighten all ventilation plugs, clean batteries with water and brush, and then dry with air hose.

2. Distilled water shall be fully refilled to cover the plate before charging, which will ensure a chemical reaction on the entire surface of the plate. After charging, the water shall be added to 12.7mm (0.50in) above the top of the plate. Distilled or mineralfree water is required.

3. Charge properly. The battery should be discharged to 80% of its capacity and then fully charged. Batteries should be charged evenly once a month to ensure that all batteries are fully charged. Correctly battery charging should be identified to prevent low power in the vehicle installation.

4. Low power operation shall be avoided. Low battery power may damage batteries and cause higher-than-normal currents in electrical systems. High current consumption due to low battery power may damage the contactor tip and shorten the service life of the motor brush.

5. The highest temperature of the battery is essential. The electrolyte temperature shall not exceed 55°C (131°F) during operation or charging. Overcharging of the battery will lead to an overheating of the battery, causing the battery bulge and other adverse phenomena. The battery has the longest service life when the electrolyte temperature is maintained at 25 ° C (77°F). Most charging devices are fully automatic, but should be checked regularly to ensure a normal operation.

6. Maintain accurate battery records. Battery tester or voltmeter should be used to read and record the battery index regularly. The specific gravity and voltage of each cell should be checked at least once a month. This inspection should be carried out after a balanced charge. After adding water, the reading should not be taken directly. Maintenance of all batteries should be recorded to identify batteries that are in deficit or wear.

2-2-5 Disassembly and Installation

Warning

Careless use of the battery may result in an electric shock
The safety precautions given in sections 1-4 shall be followed

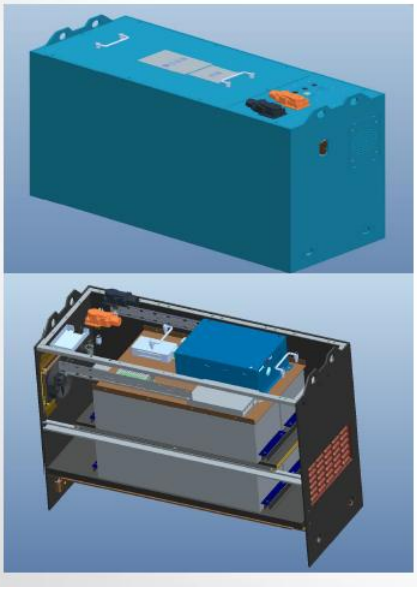
Warning

A short circuit may occur during the removal, transportation, and installation of the battery
Make sure that the battery is covered with insulation material (poly) and that no metal material touches the top of the battery before disassembling, transporting, and installing the battery

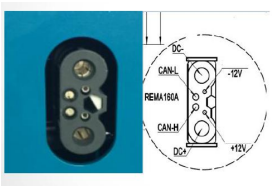
1. Vehicles Parking
2. Drop the fork and tilt the mast forward until the tip of the fork touches the ground.
3. Close key switch
4. Disconnect the battery connector.
5. Position the operating column vertically and move the seat back completely.
6. Open the lock of the fixed seat and battery cover.
7. Lift the seat and battery cover.
8. Keep the key switch open to discharge the power module. Twice for 30 seconds.
   Note: failure to discharge the power module may result in electric shock.
9. Use the hoist to remove the battery.
10 Install the batteries and perform the above steps in reverse order.

2-2-6 Lithium Battery

1 Technical parameters and description of lithium battery



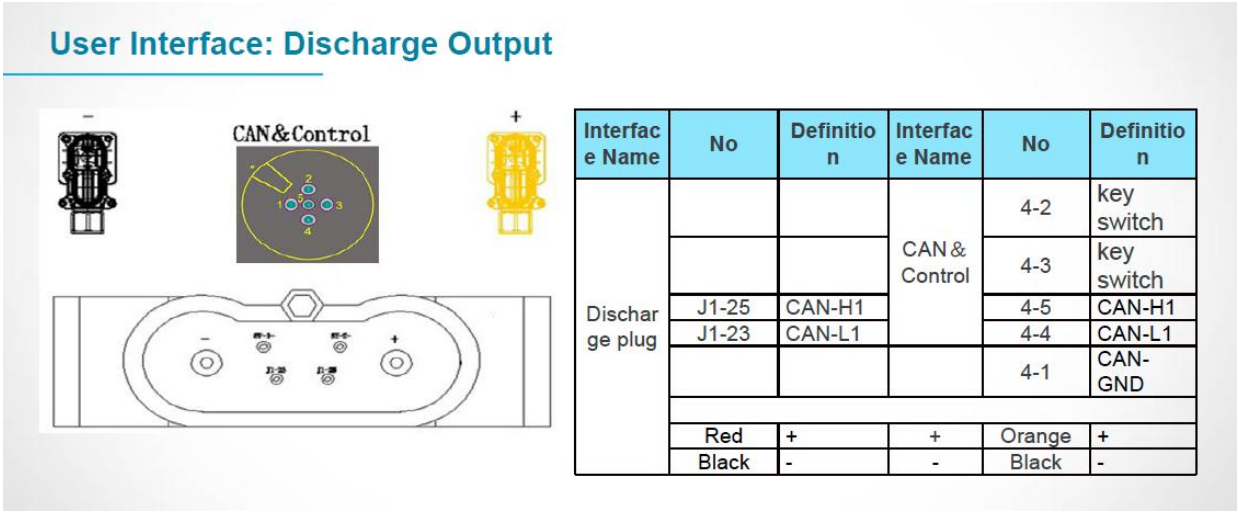
Battery system parameters		
1	Rated voltage	51.2V
2	Rated capacity	300Ah
3	Total voltage range	43.2V ～58.4V
4	MAX. discharging voltage	58.4V
5	Discharging cutoff voltage	43.2V
6	STD. charging current	0.5C，150A
7	STD. discharging current	0.5C，150A 450A MAX, 30S
8	Cycle life	≧3000cycles
9	Dimension	660*179*154mm
10	Total Weight	250±10Kg
11	Cooling method	Built-in cooling fan
12	Operation temperature	Charge: 0℃～45℃
		Discharge: -20℃～55℃
13	Storage condition	-15℃~60℃,30%-50%SOC，Permanent storage: 0℃~35℃
		Humidity: ≤85%RH



Description of lithium battery charging port

Charging input	DC+	Positive pole of Dc power which connects DC power positive pole and battery positive pole
	DC-	Positive pole of Dc power which connects DC power positive pole and battery positive pole
	CAN-L	CAN-H，Charger and vehicle communication connection
	CAN-L	CAN-L，Charger and vehicle communication connection
	-12V	Charger to the 12V negative pole of BMS power supply
	+12V	Charger to the 12V positive pole of BMS power supply

Description of lithium battery discharging port



Interface Name	No	Definition	Interface Name	No	Definition
Discharge plug			CAN & Control	4-2	key switch
				4-3	key switch
	J1-25	CAN-H1		4-5	CAN-H1
	J1-23	CAN-L1		4-4	CAN-L1
				4-1	CAN-GND
	Red	+	+	Orange	+
	Black	-	-	Black	-

Description of lithium battery debugging port

User Interface: Maintenace and Debug

Interface Name	No	Interface	Definition
Debug1	1	4-2	12V+
	2	4-1	B 485
	3	4-4	A 485
	4	4-3	12V-
Debug2	1	4-2	--
	2	4-1	--
	3	4-4	CAN-L 1
	4	4-3	CAN-H 1

Debug 1 is alway used to connect a maintenance LED panel to monitor the battery informations and connect with the surpervior software for update.

Fault analysis and description of lithium battery

Fault repair list of battery pack system					
No.	Fault type	Preliminary estimate	Test method	Failure confirmation	Countermeasure
1	The battery pack shall have no output after starting, and the switch indicator light shall be on	1. Abnormal communication with forklift ; 2.System internal components damaged	1. Check the alarm code on the locomotive display to confirm the specific fault. If it is confirmed as CAN communication problem, the discharge connectors shall be disconnected, and the both ends of the battery pack discharge connectors of CAN communication shall be checked for 120 Ω resistance;	1.If the resistance is measured to be infinite, the the CAN communication wire harness is indicated as disconnected. In this case, the CANH and CAN CAN shall be checked for normal breakover between the discharge connector and the panel communication port, and then the panel communication harness CAN shall be checked for breakover. 2.If there is resistance	1. Replace damaged wiring harness ; 2. Replace damaged BMS

				and is far bigger than 120 Ω, damage may be indicated inside the BMS CAN chip.	
			1.Disconnect the discharge plug and start the battery pack separately to check whether the discharge plug has an output.	If there is an output, the locomotive may have an internal circuit error which will result disability of the battery pack output	Check the locomotive communication and power lines
			1. Remove the battery box cover and high pressure box cover, check whether the fuse is normal (in the case of shutdown, select the lead file of the multimeter and use the meter pen to check the two ends of the fuse. If there is a drop of sound, then it is normal. If there is no sound, then the fuse is damaged.)	Broken fuse	Before replacing the fuse, check whether there is a short circuit between the positive and negative discharge of the locomotive and the battery pack. If there is no short circuit, then replace the fuse; if there is a short circuit, first deal with short circuit fault, and then replace the fuse.
2	The battery pack have no output after starting, and the switch indicator light is not on	1.System internal components damaged ; 2.Insufficient system voltage	1.Select the DC voltage mode of the multimeter, test the total positive and negative voltages at both ends with the meter pen, and check whether the total voltage of the system is normal;	The system voltage is low, and BMS cannot work normally	Charge the battery pack first
			2.Select the lead mode of the multimeter, and check if the communication harness S1_A and the S1_B of the panel have normal lead	Turn on the light and confirm the fault of BMS to replace BMS preliminarily	Replace panel communication harness
			3. After the voltage harness is connected	After pressing the start switch, the	Replace BMS

			normally, press the start switch to check if the BMS is on;	BMS does not turn on the light, and the fault of BMS is preliminarily confirmed	
3	The battery pack cannot be charged. The indicator light of the battery pack is on	1. Abnormal communication with forklift ; 2. System internal components damaged	1. Check if the 12V charging socket harness , GND, CANH and CNAL harness is normal	The conduction is abnormal	Replace the cable harness of the charging socket
			2. Connect the charger to check the fault code of the charger display; switch off to see if there's any loose for charging terminals and terminal jump; check the CAN communication if there are 120 Ω resistance on both ends	If no120 Ω resistance is detected, then the CAN chip is damaged	Replace BMS
4	The battery pack cannot be charged. The indicator light of the battery pack is not on	1.The charger has no 12V auxiliary power output; 2. System internal components are damaged	1. Disconnect the charger and battery pack, and check the charger for 12V auxiliary power output separately after starting up;	1.The charger has no 12V auxiliary power output	Replace the battery charger
			2. Check if the 12V charging socket harness , and GND harness are normal	Wire harness is not working properly	Replace the cable harness of the charging socket
			3. Confirm if the 12V auxiliary power output of the charger is normal, and the wiring harness of the charging socket is normal. Keep the charger on and connect to the battery pack, and then check if the BMS is on.	The BMS does not turn on the light, and the fault of BMS is preliminarily confirmed	Replace BMS
5	The battery pack cannot shut down	1. Car key switch get a short circuit , 2. Internal components of battery pack system are damaged	1. Car key switch get a short circuit , 2. Internal components of battery pack system are damaged	The battery pack can switch the machine normally and the locomotive switch harness is short-circuited	Check the wire harness of forklift switch
			2. After disconnect the battery pack from the forklift and pressing the start switch button on the	The battery pack can switch the machine normally and the locomotive	Replace the start-up switch

			battery pack, the battery pack cannot be shut down normally. After disconnecting the battery box panel and the wire harness on the switch, the battery can be shut down normally	switch harness is short-circuited	
			3. Disconnect the battery pack from the connection to the forklift and the wiring harness on the switch.	BMS fault	Replace BMS

2-3 Emergency Switch

2-3-1 Appearance and Specifications

Item	Specification
Part Number 1010434024	CE4T-10R-01

2-3-2 Function

The emergency switch is used to shut off the current in the electrical system in case of emergency, and thereby stopping the operation of the vehicle. When pressed the key, all DC and AC circuits are open except the speaker circuit.

When the emergency switch is opened, the positive terminal of the battery is disconnected from the key switch, thus cutting off all the load power supplied through the key switch. As a result, all DC loads except the horn will be cut off

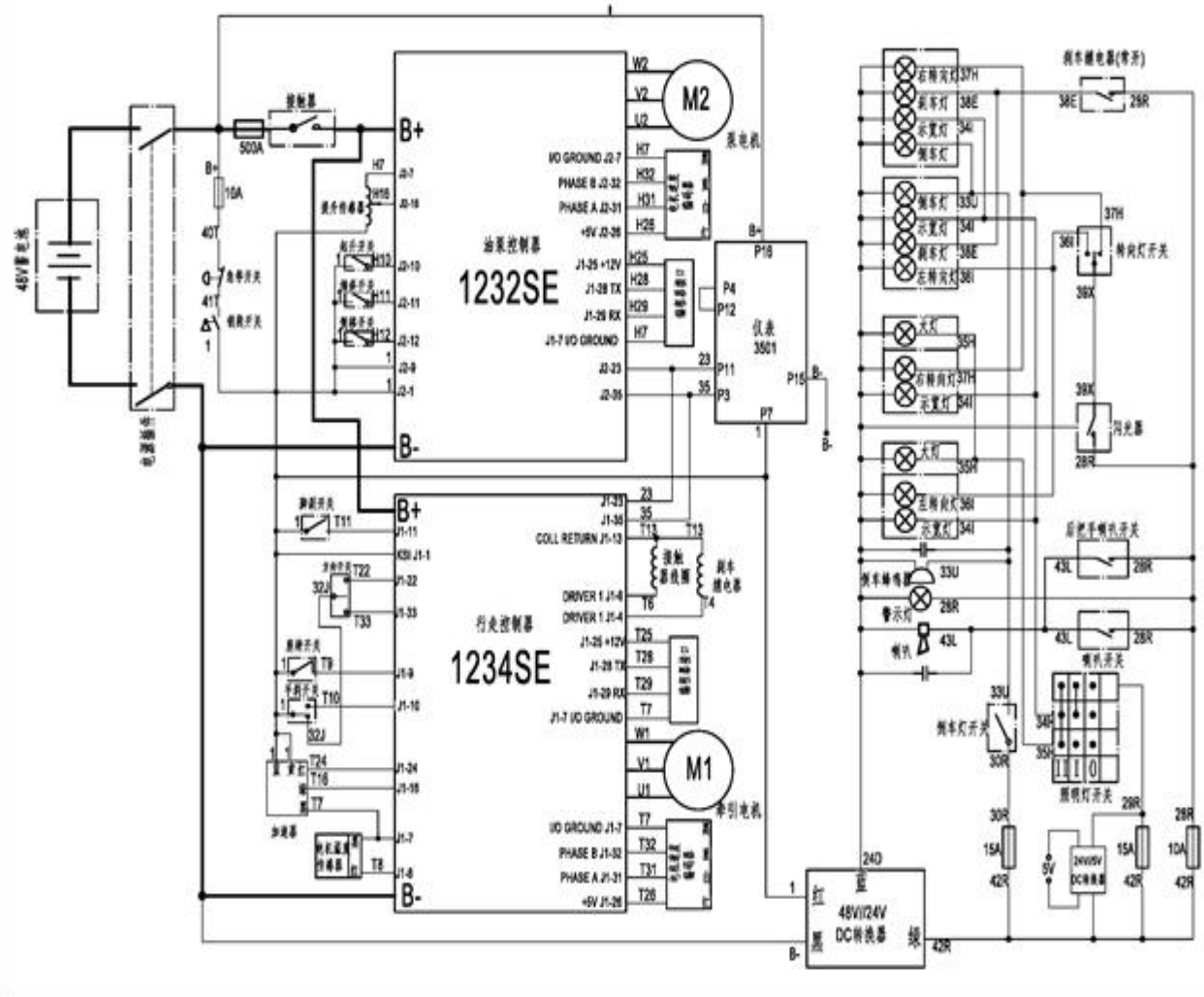
2-4 Controller and Related Equipment

2-4-1 Appearance and Specifications

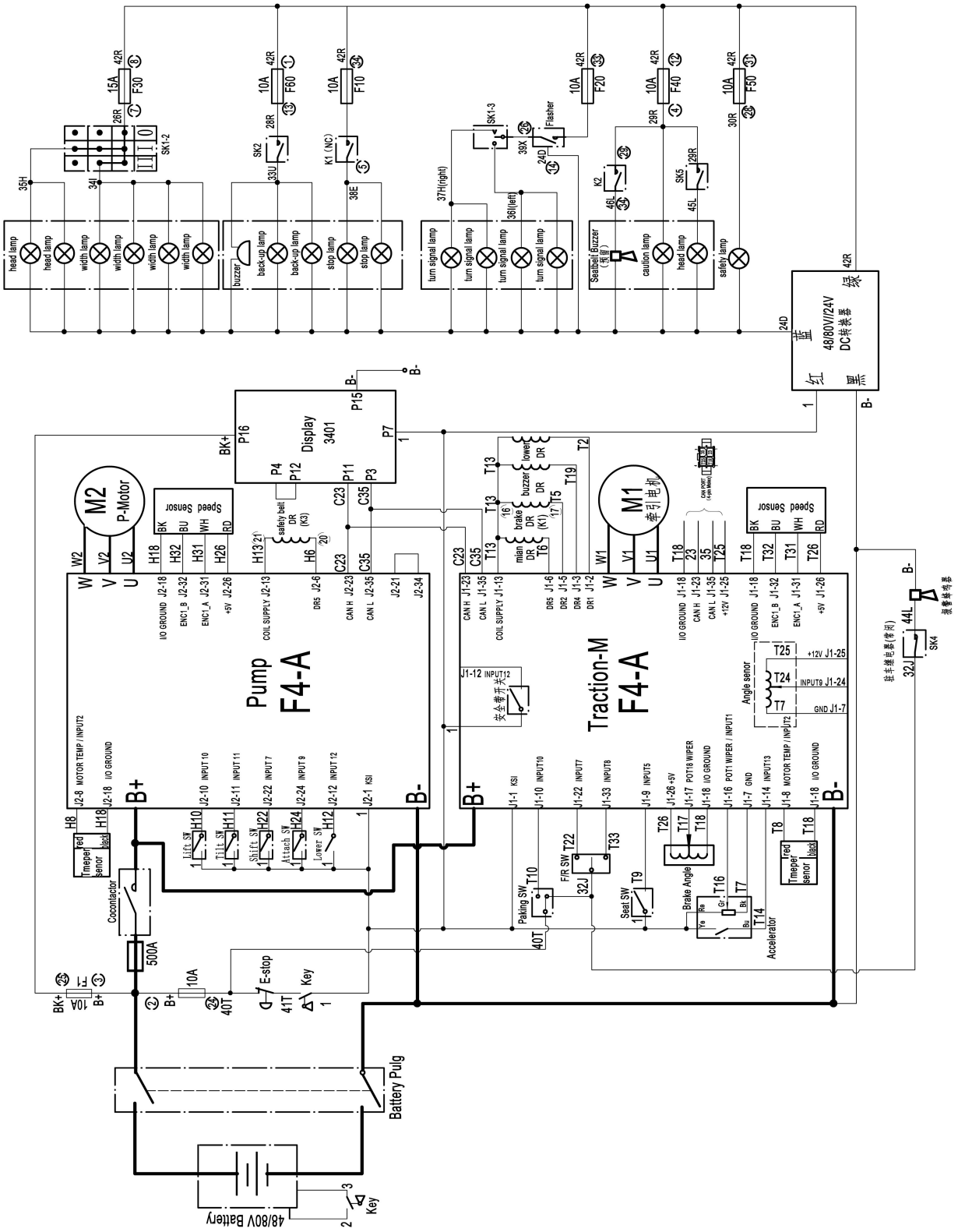
AC variable frequency motor for forklift traction, AC variable frequency motor controller for steering, instrument panel display and AC driver are all products of Curtis company, the world's leading supplier of electric vehicle system. The selected AC variable frequency motor is efficient, durable and basically maintenance free, because it does not have the commutator of DC motor (the commutator will limit the acceleration performance of the vehicle, especially the braking torque at high speed), so its acceleration performance is faster. The controller is a kind of general controller for electric vehicles using CANopen protocol for communication. Through its analog and digital I/O and communication devices, it is very suitable for managing forklift movement, I/O, operation control and information display. It can monitor the discharge of battery pack and has various protection functions. The instrument panel display can display a variety of data, set by factory or user, and input user commands.

2-4-2 Circuits and Functions

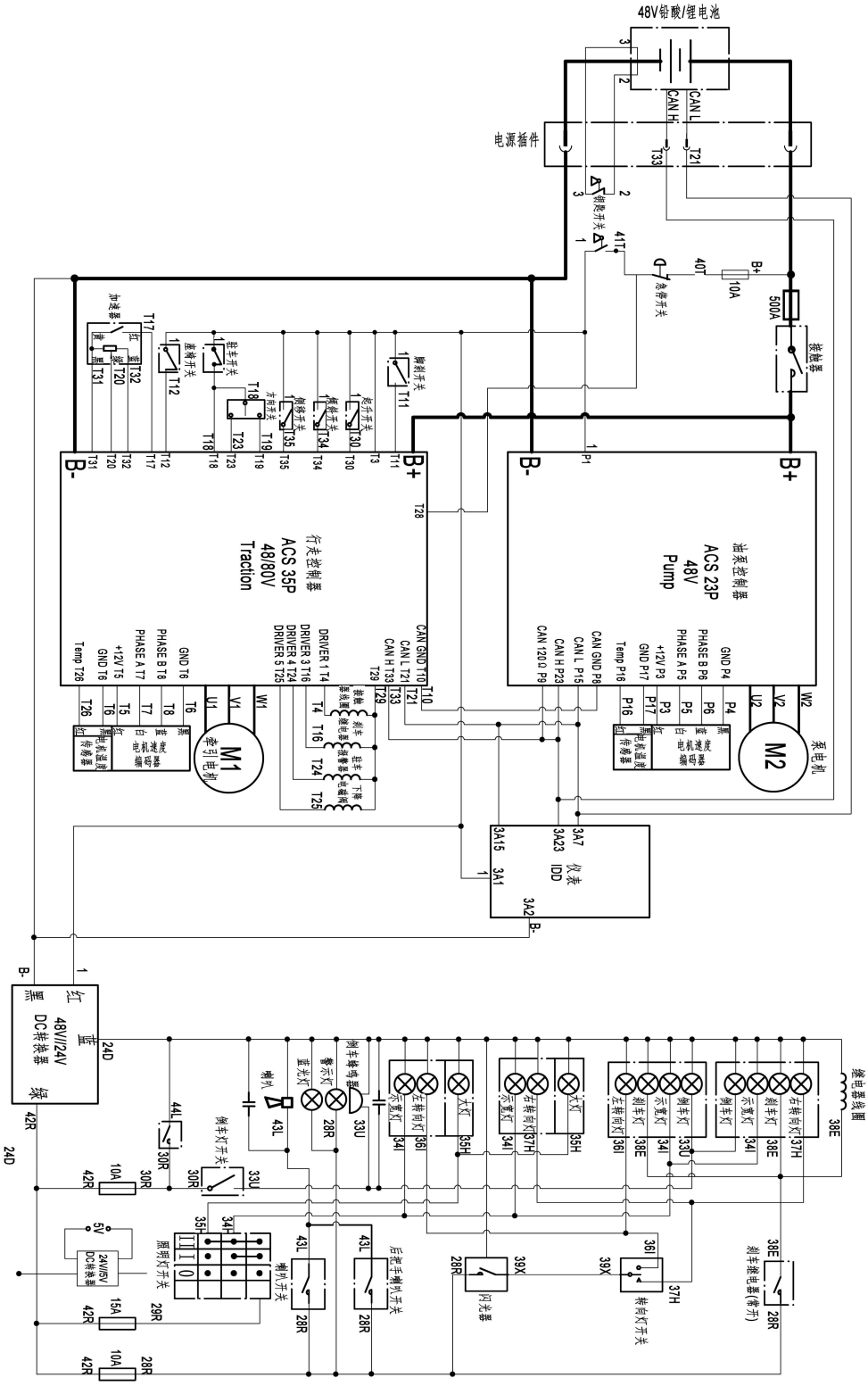
Electrical schematic diagram - Curtis SE system



Electrical schematic diagram - Curtis F series system



Electrical schematic diagram - Inmotion system



Critical Power Supply of Controller

This model is equipped with a drive motor and a pump motor, which are controlled by different controllers.

The forklift is powered by the controllers through key switches and then turned on.

Current to the contactor of the line Power supply of controller

Once the controller is energized, a magnetic coil built into the line contactor will receive power from the driven motor controller. The two contact points, which act like switches, will then touch each other and connect the lines between the battery and the two controllers. Therefore, the controller becomes a three-phase and three-wire AC power supply and is transmitted to the motor through each UVW connections. The line contactor is equipped with 500A fuse to prevent

Line contactor

The two controllers are connected through the following sensors, switches, relays and actuators.

Key switch
Emergency Switch
Forward/revise units
Accelerator
Seat Switch
Brake pedal switch
Parking brake switch
Hydraulic control switch
Horn relay

These devices provide DC power and interact with controllers that activate or receive data based on a number of parameter settings to control the motor.

The two motor controllers are identical to hardware, but each controller is programmed with different types of firmware to achieve different functions.

The safety & high efficiency performance and complete operation function of electric forklift can be realized by properly setting the motor technical parameters and control technical parameters and function values of the controllers.

1. The crawling speed of electric forklift is adjustable. The crawl speed setting function of the controller enables a long-time operation of electric forklift at a low speed.

2. The acceleration rate is adjustable. The acceleration rate refers to the "soft and hard" feeling of accelerator pedal when operating electric forklift. By setting the acceleration rate, the forklift can meet the requirements of

acceleration operation in different working conditions.

3. Plug braking and regenerative braking. The reverse braking signal will be generated when the direction bar is in opposite position, which controls the traction motor to give a braking torque through the motor driver for the purpose of vehicle deceleration. The power level is controlled by the accelerator pedal. Regenerative braking is generated by the controller under the condition that the speed of the vehicle is relatively higher than the speed of the traction motor, of which the braking energy of the vehicle will be converted into electric energy and fed back to the battery. Especially when the electric forklift is on the downhill slope, the regenerative braking to properly reduce the speed of the vehicle on the downhill slope can be achieved through a proper lifting and releasing accelerator foot plate, which thus extends the driving distance of the battery for any single charge.

4. Slope anti-backward slip function. The electric forklift with AC traction motor has the excellent function of staying non-slip on the slope.

5. The maximum driving speed is adjustable. Reasonable setting on maximum driving speed of electric forklift can prevent any overloading of traction motor due to high speed.

6. Static reply switch off. In the event that the seat switch or key switch is disconnected, the control will be turned off and the directional control lever shall be pushed back into the neutral position to restart. If the driver leaves the vehicle and returns at any time, the direction control lever shall be pulled back into the neutral position before restarting. This function may help to avoid any unexpected unsafe operation A time delay of several seconds is provided at the input end of the seat switch to allow instantaneous disconnection of the seat switch against turbulence.

7. Safety protection function If the power component of the controller is damaged during operation, the controller will disconnect the main contactor in the shortest time, and the controller will automatically limit the armature current of the motor upon the temperature over rise of the controller. When the battery voltage is too low, the controller will also stop working to ensure safety.

8. Both traction motor controller and oil pump motor controller are functioned with self-diagnosis. When the lead controller come across a fault during operation, the fault code will be displayed on the display instrument and the controller will stop working automatically for the safety of the operating system.

9. The amount of battery power and accumulated working hours will be indicated in display instrument.

2-4-3 Test

A. Controller

The diode voltage of AC MOSFET circuit inside the controller shall be tested and checked for any burn out damage.

According to the table below, each test item shall be tested repeatedly for more than 3 times.

Item	Multimeter terminals		Range of normal value	
	Red indicating pen	Black indicating pen	Polarity measurement	Resistance measurement
1	B+	U/V/W/B-		1MΩand above
2	B-	U/V/W		1MΩand above
3	U/V/W	B+	0.3-0.6V	
4	B-	U/V/W	0.3-0.6V	

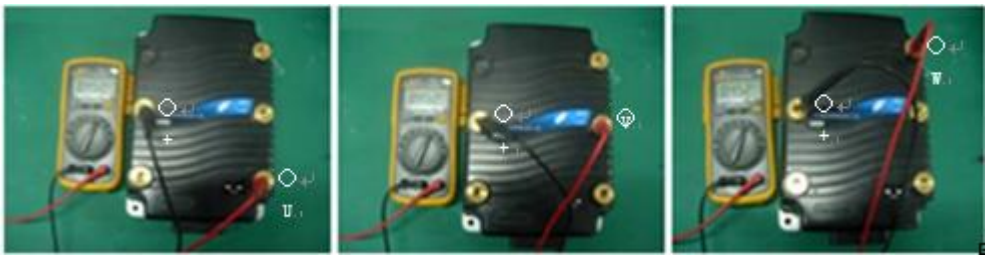
Pull multimeter to Ω mode (resistance). Pull the multimeter to the diode mode (polarity measurement)

1） Remove the cables and wires that connected to the controller, and release all the internal power of capacitor (discharge the B + and B - terminals with 30 Ω resistance).

2） Test the diode voltage (0.3-0.6v) with a multimeter and check if it is normal.

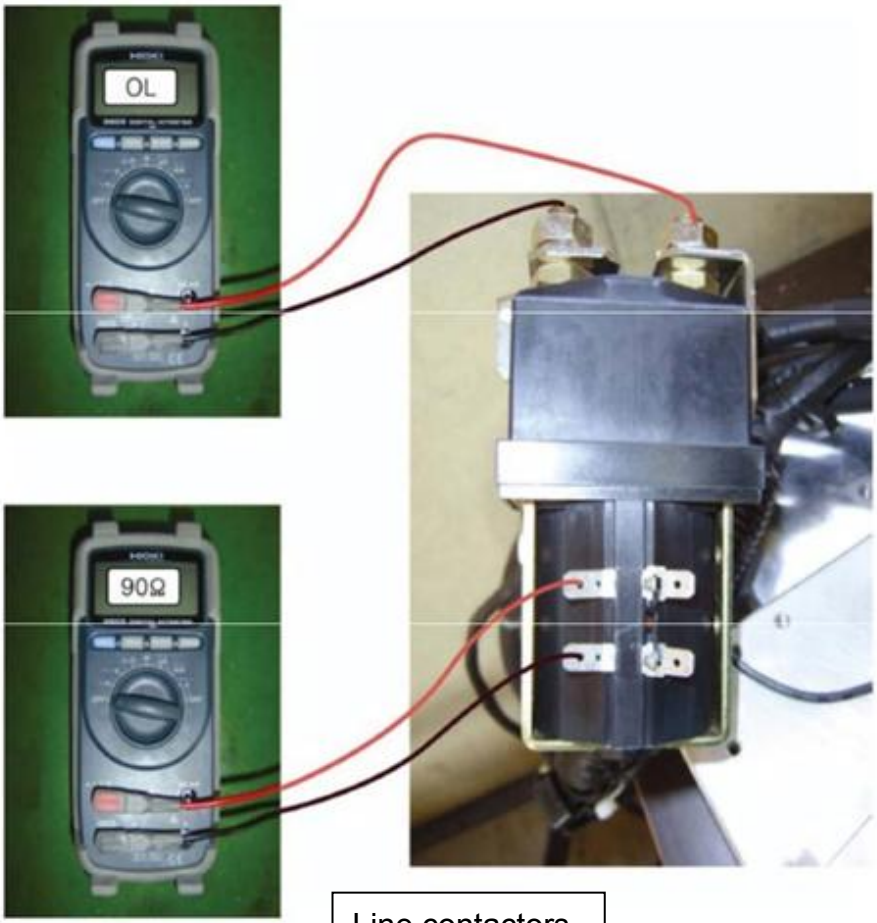
Test1：Read the diode voltage, through which the red wire is B-, the black wires are U, V and W.

Test 2：Read the voltage of the diode to U, V and W, and the black lead to B + with red wires.



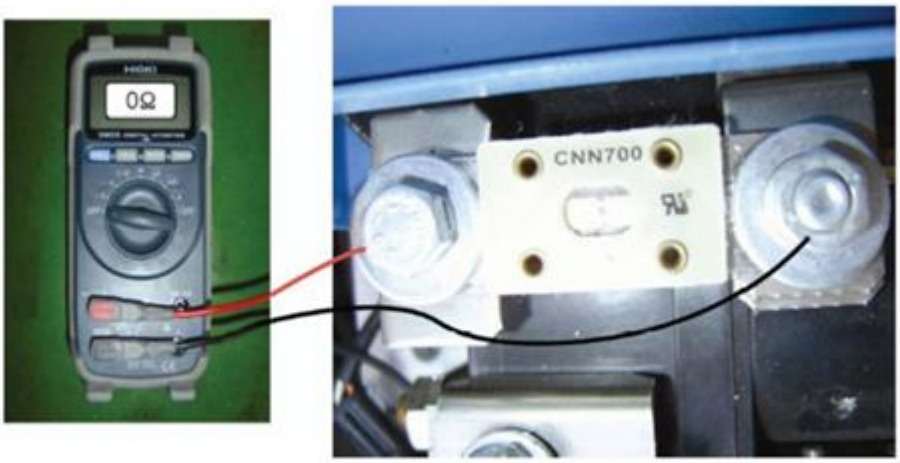
Notes: The multimeter pointers shall not be inverted in use

B. Line contactor and fuse



Line contactors

Figure 2-22



Line fuse

Figure 2-23

For line contactors and line fuses, an ohmmeter shall be connected at the point shown in the figure and shall be tested for the specified value.

2-4-4 Disassembly and Installation

1. Disconnect the battery connector.
2. Keep the key switch open to discharge the power module. Twice for 30 seconds.
3. Close the key switch
4. Remove the cover to enter the drive motor controller and the pump motor controller.

Note：Please remember that the controller contains ESD (electrostatic discharge) sensitive components. Appropriate precautions should be taken when connecting, disconnecting and handling.

1. Disconnect the control harness from the controller connectors
2. Disconnect U, V and W cables.

3. Remove B+ and B- wires from the drive motor controller

4. Loosen and remove the drive motor controller
5. Perform the above steps in reverse order to install the drive motor controller

Disassemble/install pump motor controller

1. Disconnect the control harness from the controller connectors
2. Disconnect U, V and W cables.

3. Remove B+ and B- wires from the drive motor controller

4. Loosen and remove the drive motor controller
5. Perform the above steps in reverse order to install the drive motor controller

Disassembly/installation of line contactor

1. Disconnect the cable from both terminals.
2. Remove the line B+ from the line contactor.
3. Loosen the bracket screw.
4. Remove the line contactor
5. Perform the above steps in reverse order to install the line contactor

Disassembly/installation of line fuse

1. Remove B+x line from line fuse.
2. Remove the line fuse.
3. Perform the above steps in reverse order to install the line fuse

2-5 Miscellaneous Load

2-5-1 Fuse holder

The function and composition

To protect DC load from overcurrent, the fuse box is equipped with the following terminals:

Description	Specification
FU1	15A
FU2	10A
FU3	10A
FU4	10A

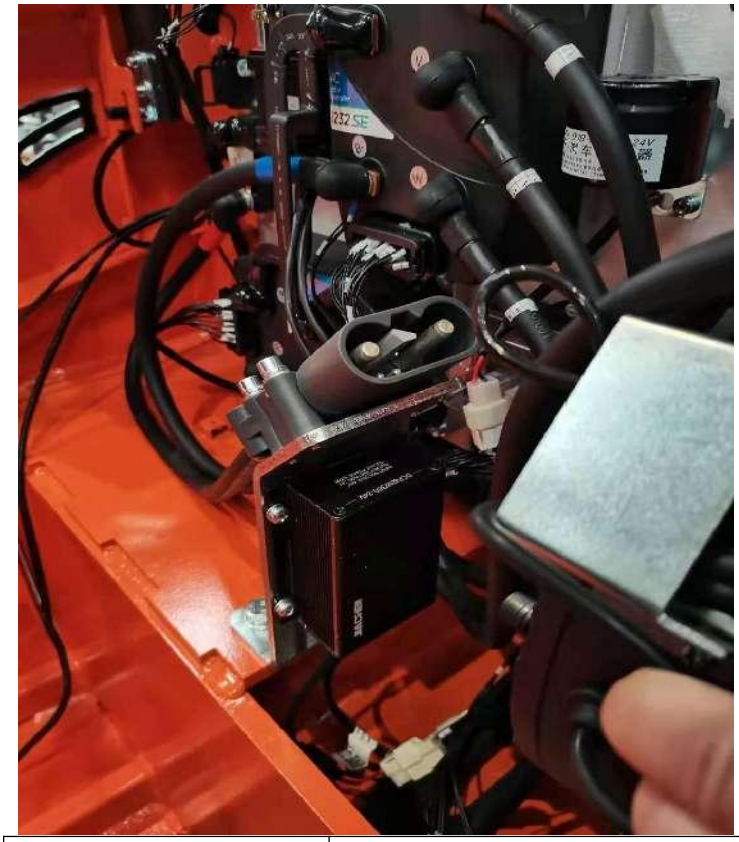
Disassembly and Installation

1. Disconnect the two harness connections from the fuse box.
2. Remove the bolts and washers, and then remove the fuse holder
3. Perform the above steps in reverse order to install the fuse holder

Note: when replacing fuses, new fuses of the same type and specification shall be used to avoid any electrical damage. If the fuse blows out frequently, there may be an electrical fault.

2-5-2 DC-DC Convertor

Appearance and Specifications



Item	Specification
Maximum power	IN 300W
Input voltage	DC 48V
Output voltage	DC 24V

Circuits and Functions

The DC-DC converter power supply (48 V) into a 24 V power supply, which is suitable for various loads.

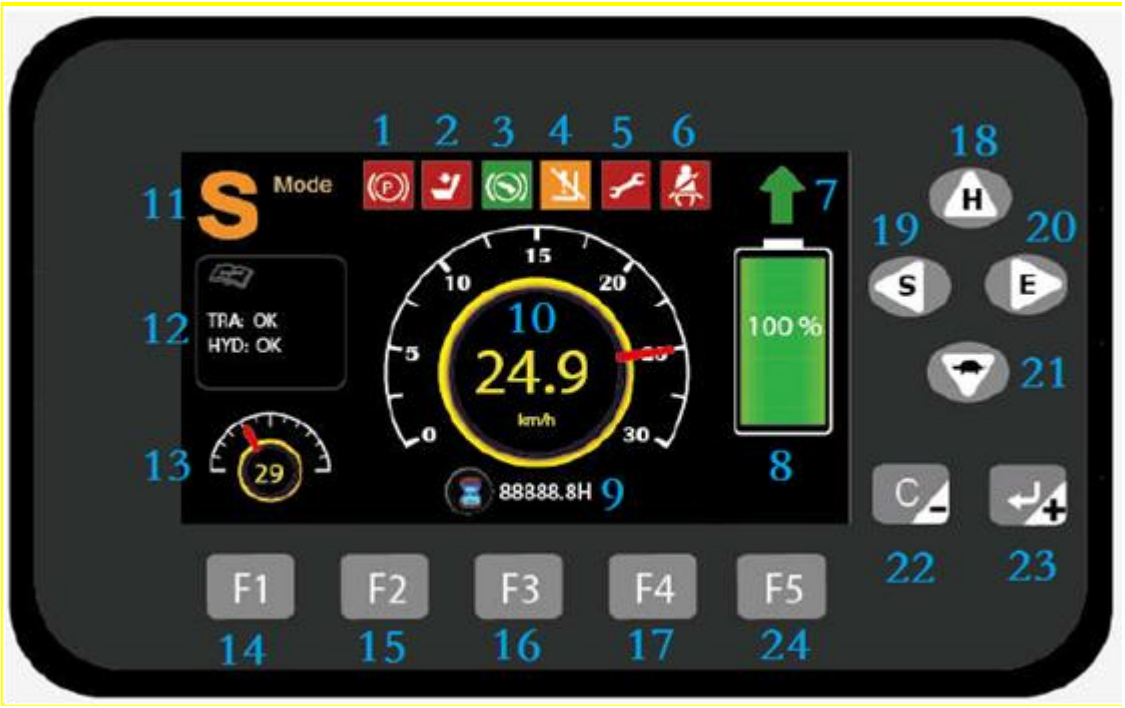
The functions of each terminal are as follows:

1. The INPUT terminal receives power from the battery to activate the DC-DC converter.
2. Collect the OUPUT terminal with green（24V+), which overrides the load supplied from the converter and then passes the fuse box to the load.

The terminal overrides the load supplied from the converter and then passes the fuse box to the load.

2-6 Instrument panel

A new type of combination instrument is adopted to realize auxiliary control function and provide driver's vehicle condition display interface. It consists of control circuit, accumulated time counter (LCD), battery power meter, fault code display and other display circuits. According to the current demand of electric vehicles, this instrument has made a new design in the control circuit and display form, which can provide intuitive vehicle status information for drivers, with compact structure, beautiful appearance, high degree of automation and reliable quality.



1. Parking brake 2. Seat switch 3. Brake pedal switch 4. Lift lock, open when the power is less than 10%
5. Fault prompt 6. Safety belt switch 7. Battery capacity 8. Direction mode: “↑ ” "forward" ; “↓”Back up
9. Battery capacity: green means lead acid; Blue means lithium battery 10. Working hours
11. Speed mode: "H" high tech mode; "S"conventional performance mode; "E "economic model
12. TRA fault: traction fault; HYD fault: pump fault
13. Steering angle: display the tire direction and maintain the function of speed reduction at turns
14-17. Instrument interface menu
18-21. Mode selection key: switch "H", "S" and "E" modes
22. Cancel key/- 23. Confirm key/+

2-7 CURTIS Handheld Programmer

2-7-1 Operation Cautions

The prompt function of the handheld unit is designed for the convenience of vehicle inspection and maintenance, which not allow the adjustment of the controller parameters without the approval of the vehicle manufacturer, so as to avoid vehicle and personal safety accidents.

After modifying the parameters, the handheld unit will automatically save the parameter settings, and the only thing you need to do is just close the key switch and restart.

The CURTIS handheld unit can be connected when the controller is on or off

2-7-2 Process of Vehicle Fault Reading

Please turn on the key switch after connecting the handheld unit to the controller
Check for the faults based on the CURTIS handheld unit menu list……
When running the vehicle, the flashing line of the handheld cursor will prompt English fault content, which can be interpreted by referring to the fault code list

2-7-3 Vehicle signal Detection

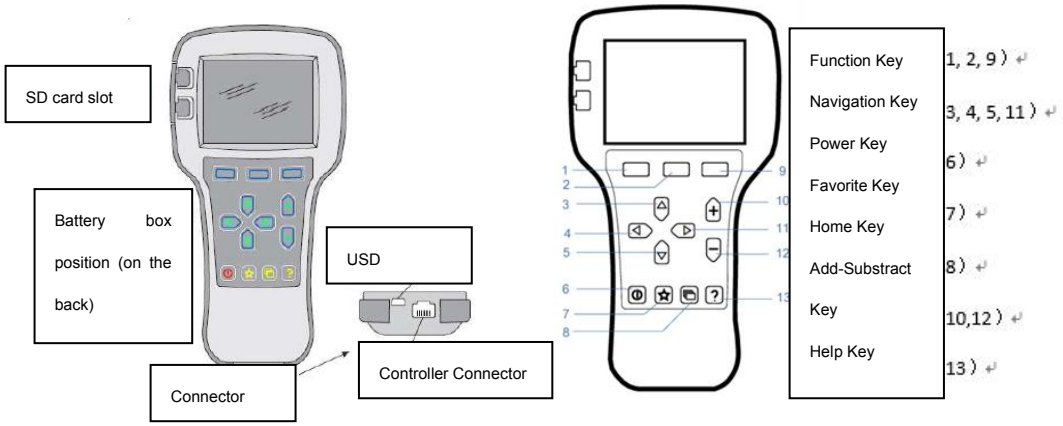
Please turn on the key switch after connecting the handheld unit to the controller
Check for the Monitor based on the CURTIS handheld unit menu list……
Please open the corresponding detection menu subitem according to the need, run the vehicle, and observe the change of handheld value.

2-7-4 Contents of CURTIS Handheld Unit Menu

The Curtis 1313 handheld programmer is used to configure the Curtis electronic control system. The set parameters, real-time monitoring controller data and fault diagnosis may be adjusted and saved trough this programmer

Warning：The control system will affect the performance of vehicle's acceleration, deceleration, hydraulic system and brakes. Hazardous conditions may occur if the vehicle control system is incorrectly programmed or beyond safety limit. Only the vehicle manufacturer or authorized service agent may program the control system

The programmer has two interfaces with a battery box and a memory card slot, of which one is used to communicate with electric control, and the other is used to communicate with PC.



1. Power the programmer

The handheld programmer can be connected to the controller by inserting its connection wire into the programming port of the controller, and will automatically power on and display the control information on the programmer after connecting to the controller.

When the programmer finishes the loading of the controller information, the main menu will

The green circle indicates that the controller is connected

Red flashing indicates that the controller is not connected

Shows programmatic access

1313 battery status

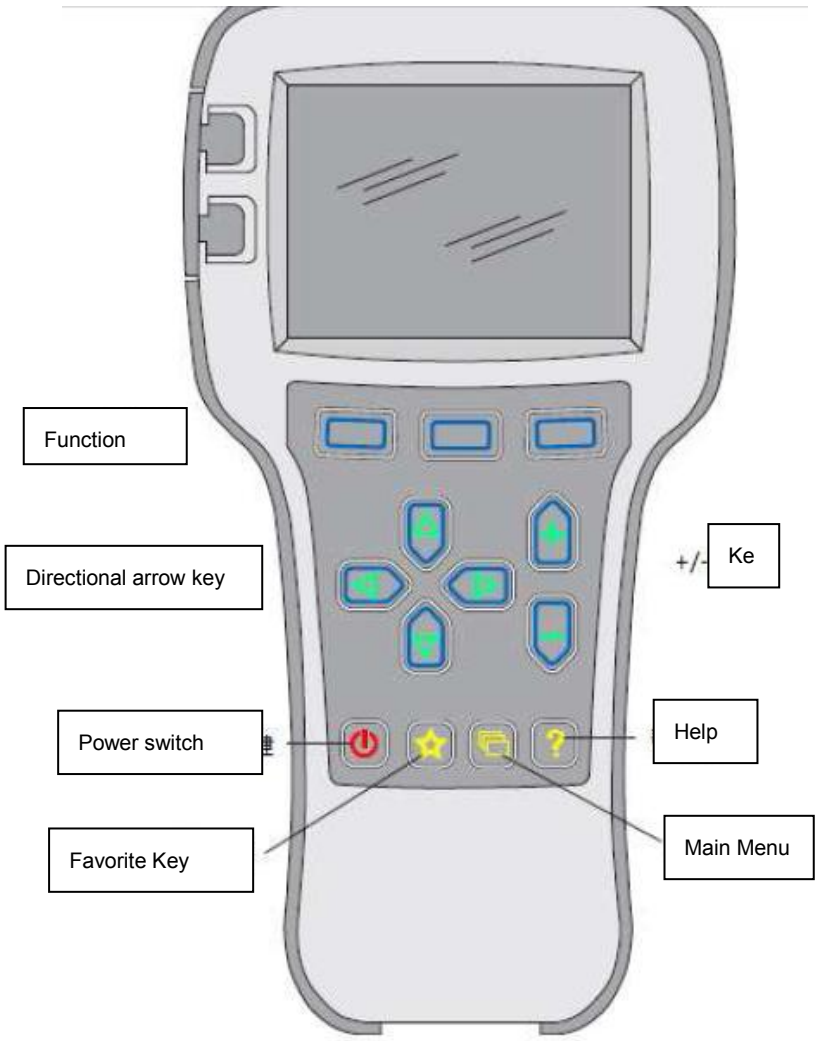
Date and time

Content

Here is the menu interface with 9 independent function

Attachment information bar

Function Key information bar



Function keys

The three keys will be blank because the function of the three keys is based on the specified content. At any given time, the functions of the buttons are displayed on the LCD screen above.

Directional arrow key

The information displayed can be selected by pressing up, down, or left or right through 4 directional keys.

+ / - Button

The parameters can be added or subtracted by the two keys. Meanwhile, "+" refers to "Yes" in the operation system, and "-" refers to "No", which may be used as a scrolling options in some cases

Power switch

When the programmer inserts an already powered controller, it is not necessary for the programmer to be initiated by pressing the power switches, and the programmer will start up automatically. When it is held down for a few seconds, the programmer will prompt turn off confirmation, which shall be answered by selecting "Yes" or "No" of the function keys. When the programmer is turned off, a few seconds of pressing will trigger the restarting of the programmer.

Key of favourite

There are 2 ways to enter the menu of "Favorites" 1. You can enter through the main menu "Favorites"; 2. You can also press this key to enter

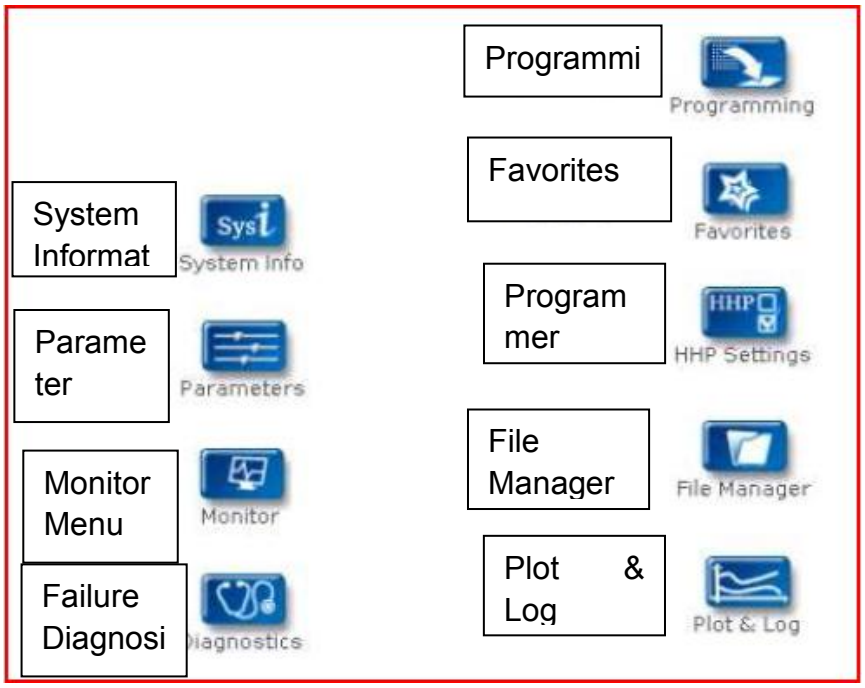
2. Menu structure

The main menu consists of nine submenus, each of which is displayed with a specific icon, and each item of the submenu is arranged in a hierarchy.

Some menus contain one item only, but most menus contain more than one item, and you can access the next level of submenus through each folders. It is possible for you to expand the table through grid options, enter a set of execution commands through dialog options, and return to the next level of menu whichever interface you are in.

All nine submenu names are shown in bold on the main menu and below the icons. When you enter the stepped menu, the name of the submenu or the path you are in are displayed at the top of the screen.

Nine main menus

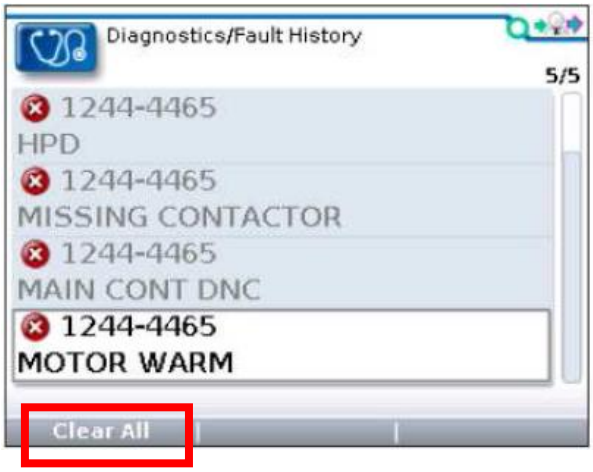


3 Fault diagnosis menu

In the main menu, Select the "Diagnostics" Fault diagnosis icon and press the corresponding function key to enter the Fault diagnosis menu, which includes two folders: "Present Errors" and "Fault History".

Note: the fault caused by a temporary event captured in the circuit is not a real system fault in some cases. And you can determine if the fault really exists by restarting the system and observing the automatic fault indication.

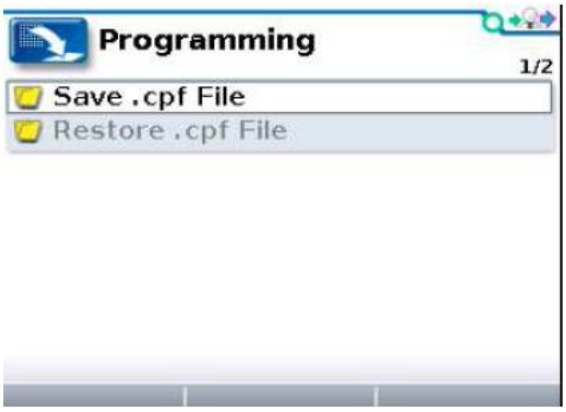
In the history failure folder, the failures listed are all failures encountered after the last history failure was cleared, which can be restarted by clearing the fault content in the entire folder.



"Clear All" is used to Clear the history failure folders. A function key will be highlighted separately if there is a history failure in the history failure folder, and will be grayed out if there is no history failure.

4. Programming edit menu

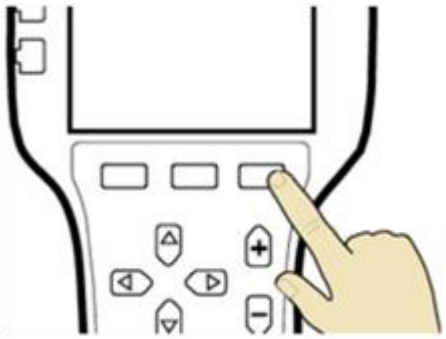
Select the Programming icon in the main menu, and press the function key corresponding to“Select”to enter the menu. Menus may be programmed to store and restore the setting files of parameter(.cpf files)



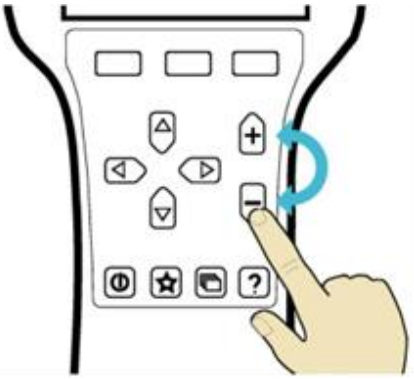
Save.cpf Files
The Save. CPF File function in the program menu may be used to backup current setted parameters. You can save as many.cpf files as you want, and each.cpf file shall be named differently.
Restore.cpf Files
CPF Files to restored may be selected from the earlier saved. CPF Files instead of the

5. Parameter Settings

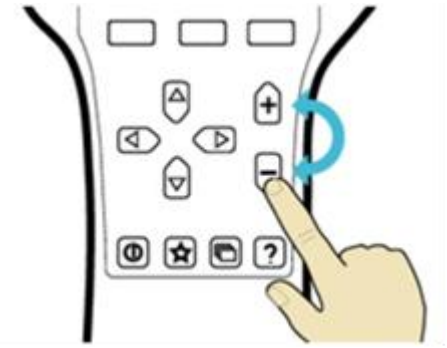
Select "Parameters" from the main page and press "Select" to enter the parameter setting page, in which you can adjust or modify the parameters of the controller.



Parameters can be adjusted or modified in two ways: one is in the parameter list page as shown in the figure below;



The other is through the parameter edit page as shown below



2-8 Troubleshooting to Each Fault Code

A. Fault levels

One of the features of the instrument panel is to show the faults occurring in the vehicle.

B Curtis codes

In addition to the instrument panel and handheld programmer, the driver and pump motor controllers will notify the operator of the current failure with two fault code Leds mounted on each controller and the fingertip extension module, of which the fault indication is called the "Curtis Codes".

Their advantage over other indicators is that the operator can easily identify which controller is in trouble simply by looking at them and the controller's Leds will light up only when a fault is detected. The following table shows the controllers to set warnings for each fault code.

Instructions on how to read the Curtis codes are detailed in section 2-4-3.

Measures for Curtis SE system fault codes

Display codes of programmer	Display codes of instrument	Failure description	Failure causes
Controller Overcurrent	1.2	Controller got Overcurrent	1.Short circuit of motor external U, V or W connections 2.Unmatched motor parameters 3.Controller failure
Current Sensor Fault	1.3	Current sensor failure	1. Motor U, V and W are in a circuit with the vehicle body resulting in leakage 2. Controller failure
Precharge Failed	1.4	Precharging failed	1.The front end of the capacitor is externally loaded which futher disables the capacitor's normal charge.
Controller Severe	1.5	The controller temperature is too	1.The working conditions of the controller is too harsh

Undertemp		high	
Controller Severe Overtemp	1.6		1. The working conditions of the controller is too harsh 2.Vehicle overloaded 3.Wrong installation of controller
Severe Undervoltage	1.7	The voltage is too low	1. Wrong battery parameter setting 2. A non-controller system is consuming power 3.Excessive battery impedance 4. Battery disconnected 5. The fuse is disconnected, or the main contactor is not connected
Severe Overvoltage	1.8	The voltage is too high	1. Wrong battery parameter setting 2. Excessive battery impedance 3. The battery connection disconnected during regenerative braking
Controller Overtemp Cutback	2.2	Performance degradation resulted by excessive controller temperature	1. The working conditions of the controller is too harsh 2.Vehicle overloaded 3.Wrong installation of controller
Undervoltage Cutback	2.3	Performance reduction as leaded by low voltage	1. Low battery 2. Wrong battery parameter setting 3. The non-controller system has run out of power 4. Excessive battery impedance 5. Battery disconnected 6. The fuse or the main contactor is disconnected
Overvoltage Cutback	2.4	Performance reduction as leaded by high voltage	1.The battery connection disconnected during regenerative braking 2. Wrong battery parameter setting 3. Excessive battery impedance 4. When regenerative braking
+5V Supply Failure	2.5	The controller output 5v power failed	1.External load impedance is too low
Digital Out 6 Failure	2.6	Output overcurrent of drive no.6	1.External load impedance is too low
Digital Out 7 Overcurrent	2.7	Output overcurrent of drive no.7	1.External load impedance is too low

Motor Temp Hot Cutback	2.8	Performance degradation as leaded by motor overheating	1. The motor temperature reaches or exceeds the programmed alarm temperature and results in a drop in current output 2. Wrong motor temperature parameter setting 3. If the motor does not use a temperature sensor, the parameters "Tempcompensation" and "Temp cutback" shall be programmed as "OFF".
Motor Temp Sensor Fault2.9	2.9	Motor temperature sensor failure	1. Wrong motor temperature sensor connection 2. If the motor does not use a temperature sensor， the parameter "MotorTemp Sensor Enable" shall be programmed as "OFF"
Coil 1 Driver Open/Short	3.1	The output connection coil of drive 1 has opened or gotten a short circuit	1. the connection load has opened or gotten a short circuit 2. Joint pin soiled 3. Wrong wiring
Main Open/Short	3.1	The main contactor coil has opened or gotten a short circuit	1. the connection load has opened or gotten a short circuit 2. Joint pin soiled 3. Wrong wiring
Coil2 Driver Open/Short3.3	3.2	The output connection coil of drive 2 has opened or gotten a short circuit	1. the connection load has opened or gotten a short circuit 2. Joint pin soiled 3. Wrong wiring
EMBrake Open/Short	3.2	The electromagnetic brake coil has opened or gotten a short circuit	1. the connection load has opened or gotten a short circuit 2. Joint pin soiled 3. Wrong wiring
Coil3 Driver Open/Short	3.3	The output connection coil of drive 3 has opened or gotten a short circuit	1. the connection load has opened or gotten a short circuit 2. Joint pin soiled 3. Wrong wiring
Coil4 Driver Open/Short	3.4	The output connection coil of drive 4 has opened or gotten a short circuit	1. the connection load has opened or gotten a short circuit 2. Joint pin soiled 3. Wrong wiring

PD Open/Short	3.5	The ratio driving has opened or gotten a short circuit	1. the connection load has opened or gotten a short circuit 2. Joint pin soiled 3. Wrong wiring
Encoder Fault	3.6	Encoder failure	1. Motor encoder fault 2. Wrong wiring
Motor Open	3.7	Motor circuit has opened	1. Default phase of motor 2. Wrong wiring
Main Contactor Welded	3.8	Main contactor the has been welded together	1.The contact of the main contactor is welded 2. U or V phase of motor is disconnected or has default phase 3.There is a circuit capacitance connected to terminal B+ Charging status
Main Contactor Did Not Close	3.9	The contactor is not closed	1.The main contactor is not closed 2.The contacts of main contactor may oxidize , melt, or be in an unstable connection 3.The capacitor is being charged by an external device 4.The fuse is off
Throttle Wiper High	4.1	The accelerator's output is too high	1.The output voltage of accelerator potentiometer is too high
Throttle Wiper Low	4.2	The accelerator's output is too low	1.The output voltage of accelerator potentiometer is too low
Pot2 Wiper High	4.3	The output of Pot 2 is too high	1.The output voltage of Pot 2 is too high
Pot2 Wiper Low	4.4	The output of Pot 2 is too low	1.The output voltage of Pot 2 is too low
Pot Low Overcurrent	4.5	Low current of port is too high	1.The port impedance is too low
EEPROM Failure	4.6	EEPROM got a failure	1.Failed to write to EEPROM storage. This may be caused by the VCL writing to EEPROM storage, or CAN BUS, or an error in programming parameters programmed into the controller after adjustment.
HPD/Sequencing Fault	4.7	High pedal protection/operation sequence performance failed	1.Incorrect key start, interlock, incorrect orientation, and incorrect accelerator input sequence. 2. Wiring, switch key, interlock, orientation, or accelerator input failure
Emer Rev HPD	4.7	High pedal protection of emergency reverse	1.The emergency reverse operation has finished, but the accelerator, forward and reverse input and interlock have not been retested

Parameter Change Fault	4.9	Parameter change failed/error	1.To ensure the safety of the vehicle, some specific parameter changes shall become effective after the be restarting with the key switch.
OEM Faults	5.1-6.7	OEM failure （customizeed fault	1.Users can define their own faults for some phenomena and express through the codes of VCL
CAN Communications Fault	5.1	BMS connection communication timeout	
BMS PDO Timeout	5.2	BMS connection communication timeout	
BMS First Level Fault	5.3	The BMS got a First Level Fault	There is a serious fault of lithium battery to be repaired
BMS High temp fault	5.4	BMS reports a high temperature alarm failure	
Battery type mismatch	5.7	Battery type error	
Display Config Fault	6.3	The right motor of the drive got a current deviation	
BMS Overvoltage	6.4	BMS reports an overvoltage fault	
BMS Undervoltage	6.5	BMS reports a low voltage fault	
BMS Low AH	6.5	BMS reports a low capacity failure	
eBMS voltage differnc	6.7	The voltage difference of lithium electric monomer is too large	
VCL Run Time Error	6.8	VCL running time error	1.The VCL codes has over-runed
External Supply Out of Range	6.9	The output of the external power supply is beyond the reasonable range	1. External load in 5V and 12V power current is too large or smaller that 2,or got a error in "CheckingMenu" parameter, e.g. "ExtSupply Max", "ExtSupply Min"
OS General	7.1	Operating system failure	1.Internal controller failure
PDO Timeout	7.2	PDO Timeout	1.The CAN PDO information receiving time has exceeded the time limit of PDO

Stall Detected	7.3	Motor stalling	1. Motor stalling 2. Motor encoder failure 3. Wrong wiring 4. Power failure of input motor encoder
Motor Characterization Fault	8.7	Motor matching failure	1. Code references is presented in the motor matching process: 0=normal 1=The controller has received the encoder signal, but the pulse amount is not defined。Please set the pulse value manually 2=Motor temperature sensor failure 3=Motor high temperature reaction failure 4=Motor overheating reaction failure 5=Motor low temperature reaction failure 6=Low voltage response failure 7=High pressure response failure 8=The controller cannot detect the encoder signal and the channel signal disappears 9=Motor parameters are conditioned beyond the range
Motor Type Fault	8.9	Motor type error	1.The parameter value of motor type is out of range
VLC/OS Mismatch	9.1	VCL/OS cannot be matched	1.The VCL program in the controller does not match the OS program
EM Brake Failed to Set	9.2	The electromagnetic brake setting failed	1.The vehicle still moves after the electromagnetic brake command is conditioned. 2.Electromagnetic braking force is too low
Encoder LOS (Limited Operating Strategy)	9.3	Encoder is restricted by operating state	1. The restricted operating state is activated due to motor stall or encoder failure 2. Wrong wiring 3. The vehicle is stalling
Emer Rev Timeout	9.4	Emergency reverse response timeout	1. Emergency reverse timeout is activated because the EMR timer has expired 2. The emergency reverse switch is always in the position of "On"
Illegal Model Number	9.5	Controller model error	1. Controller model cannot be recognized 2. The hardware and software don't match each other 3. Controller failure

Display	FLASH CODE	Explanation	Cause
Controller Over Current	1.2	Controller Over current	1. External short of phase U, V, or W motor connections. 2. Motor parameters are mistuned. 3. Controller defective.
Current Sensor Fault	1.3	Current Sensor Fault	1) Leakage to vehicle frame from phase U, V, or W (short in motor stator) 2) Controller defective
Precharge Failed	1.4	Precharge Failed	An external load on the capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging
Controller Severe Undertemp	1.5	Controller Severe Undertemp	Controller is operating in an extreme environment
Controller Severe Overtemp	1.6	Controller Severe Overtemp	1. Controller is operating in an extreme environment. 2. Excessive load on vehicle. 3. Improper mounting of controller.
Severe Undervoltage	1.7	Severe Undervoltage	1. Non-controller system drain on battery. 2. Battery resistance too high. 3. Battery disconnected while driving. 4. Blown B+ fuse or main contactor did not close. 5. Battery parameters are misadjusted.

Severe Overvoltage	1.8	Severe Overvoltage	1) Battery menu parameters are misadjusted 2) Battery resistance too high for given regen current 3) Battery disconnected while regen braking
Speed Limit Supervision	1.9	Speed Limit Supervision	1. Motor speed detected that exceeds the limit set by the Max Speed Supervision parameter. 2. Misadjusted Max Speed Supervision parameters. 3. See: Programmer » Application Setup » Max Speed Supervision menu.
Travel Control Supervision	1.10	Travel Control Supervision	1. The vehicle stop state, the detected motor frequency and/or phase current exceed the limit control supervision parameters specified for travel. 2. Improper travel control monitors parameters. 3. See Programmer » Application Settings » Trip Control Supervision menu.
Controller Overtemp Cutback	2.2	Controller Overtemp Cutback	1. Controller is operating in an extreme environment. 2. Excessive load on vehicle. 3. Improper mounting of controller which is preventing controller cooling.
Undervoltage Cutback	2.3	Undervoltage Cutback	1. Batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system-drain on battery. 4. Battery resistance too high.

			5. Battery disconnected while driving. 6. Blown B+ fuse or main contactor did not close.
Overvoltage Cutback	2.4	Overvoltage Cutback	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking.
Ext 5V Supply Failure	2.5	Ext 5V Supply Failure	1. External load impedance on the +5V supply is too low.
Ext 12V Supply Failure	2.6	Ext 12V Supply Failure	Fault Type(s): 1 = 12V Supply’ s voltage is out-of-range 2 = 12V Supply’ s current is out-of-range
Motor Temp Hot Cutback	2.8	Motor Temp Hot Cutback	1. Motor temperature is at or above the programmed Temperature Hot setting—resulting in a reduction of controller drive current. 2. The motor temperature and sensor control parameters are misadjusted. 3. If the motor does not use temperature sensor, the programming parameters "Tempcompensation" and "Temp cutback" must be set to "OFF".

Motor Temp Sensor	2.9	Motor Temp Sensor	1. Motor thermistor is not connected properly. 2. If the motor does not use temperature sensor The programming parameter "MotorTemp Sensor Enable" must be set to "OFF"
MAIN DRIVER	3.1	Main Driver Open/Short	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring.
EM Brake Driver	3.2	EM Brake Coil Open/Short	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring.
Lower Driver Fault	3.5	Proportional drive open/short	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring
Encoder Fault	3.6	Encoder Fault	1. Loss of supervision. 2. Pulse of overcurrent tripping loss. 3. Speed signal pulse loss. 4 . Automatic characterization 5 . Encoder power supply (voltage) fault.
Motor Open	3.7	Motor Open	1. Motor phase is open or lost. 2. Bad crimps or faulty wiring.
Main Contactor Welded	3.8	Main Contactor Welded	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path (such as an external circuit to

			B+) is providing a current to the capacitor bank (B+ connection terminal).
Main Contactor Did Not Close	3.9	Main Contactor Did Not Close	1. Main contactor did not close. 2. Main contactor tips are oxidized,burned, or not making good contact. 3. An external load on the capacitor bank (B+ connection terminal) is preventing the capacitor bank from charging. 4. Blown B+ fuse.
Motor Setup Needed	3.10	Motor Setup Needed	Motor setup is required. Please refer to fault type. Bit1: The current regulator needs to be configured. Bit2: The slip gain test needs to be run. Bit3: The base speed test needs to be run. Bit4: The automated test needs to be run (full motor commissioning).
Throttle Wiper Low	4.2	Throttle Input	1. Throttle voltage exceeded the Analog Low or Analog High parameters for the analog input defined for the throttle input. 2. See Programmer » Controller Setup » Inputs » Analog 1 Type. 3. See Programmer » Controller Setup » Inputs » Configure.

Pot2 Wiper Low	4.4	Brake Input	*Triggered by the respective fault diagnostic associated with the brake input source (assigned analogX input).
EEPROM Failure	4.6	NV Memory Failure	1. Failure to read or write to nonvolatile (NV) memory. 2. Internal controller fault.
HPD/Sequencing Fault	4.7	HPD Sequencing	1. Incorrect sequence in application of Keyswitch, Interlock, Direction,or Throttle. 2. Faulty wiring, crimps, or switches at KSI, Interlock, Direction, or Throttle. 3. Moisture in above-noted digital input switches causing invalid (real) On/Off state. 4. Verify input switch status. See Programmer » System Monitor menu » Hardware Inputs » Switch Status. 5. Verify Throttle. See Programmer » System Monitor menu » Hardware Inputs » Throttle Command.
Emer Rev HPD	4.7	EMER Rev HPD	Emergency Reverse operation has concluded, but the throttle, forward and reverse, and interlock inputs have not been returned to neutral.
Parameter Change Fault	4.9	Parameter Change	While the Interlock was On, a safetybased parameter was changed. Parameters with this property are marked with a [PCF] (Parameter Change Fault) in the Parameter menu listings.

EMR Switch Redundancy	4.10	EMR Switch Redundancy	1. Either or both Emergency Reverse input switches are inoperative,resulting in an invalid state. NO……NC……State On……Off……valid Off……On……valid On……On……invalid Off……Off……invalid 2. Ingress of dirt or moisture in switch(es).
OEM Faults	5.1-6.7	OEM Faults	These faults (and fault actions) can be defined by the User/OEM and are implemented in the application-specific VCL software. See User/OEM documentation.
VCL Run Time Error	6.8	VCL Run Time Error	VCL Run Time Error detected.
PDO Timeout	7.2	PDO Timeout	The time between CAN PDO messages received exceeded the PDO Timeout Period as defined by the Event Timer parameter.
Stall Detected	7.3	Stall Detected	1. Stalled motor. 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder.
Supervisor Fault	7.7	Supervision	1. Data mismatch found during audit 2. Monitor the internal damage of microprocessor

			3. The switch input is allowed to exceed 100ms in the upper and lower range
Supervision Input Check	7.9	Supervision Input Check	Internal controller fault.
PDO Mapping Error	8.2	PDO Mapping Error	1. The PDO Map has too many data bytes assigned or has objects mapped that are not compatible. 2. Adjust PDO Settings. See Programmer » Application Setup » CAN Interface » PDO Setups.
Internal Hardware	8.3	Internal Hardware	Internal controller fault detected.
A1	10.1	Driver 1 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 1 Overcurrent parameter. 5. See Programmer » Controller Setup » Outputs » Driver 1 » Driver 1 Overcurrent.
A2	10.2	Driver 2 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 2 Overcurrent parameter. 5. See Programmer » Controller Setup » Outputs » Driver 2

			» Driver 2 Overcurrent.
A3	10.3	Driver 3 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 3 Overcurrent parameter. 5. See Programmer » Controller Setup » Outputs » Driver 3 » Driver 3 Overcurrent.
A4	10.4	Driver 4 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 4 Overcurrent parameter. 5. See Programmer » Controller Setup » Outputs » Driver 4 » Driver 4 Overcurrent.
A5	10.5	Driver 5 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 5 Overcurrent parameter.

			5. See Programmer » Controller Setup » Outputs » Driver 5 » Driver 5 Overcurrent.
A6	10.6	Driver 6 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 6 Overcurrent parameter. 5. See Programmer » Controller Setup » Outputs » Driver 6 » Driver 6 Overcurrent.
A7	10.7	Driver 7 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 7 Overcurrent parameter. 5. See Programmer » Controller Setup » Outputs » Driver 7 » Driver 7 Overcurrent.
A8	10.8	Driver 8 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 8 Overcurrent parameter.

			5. See Programmer » Controller Setup » Outputs » Driver 8 » Driver 8 Overcurrent.
A9	10.9	Driver 9 Fault	1. Open or short on driver load. 2. Dirty connector pins at controller or contactor coil. 3. Bad connector crimps or faulty wiring. 4. Driver overcurrent, as set by the Driver 9 Overcurrent parameter. 5. See Programmer » Controller Setup » Outputs » Driver 9 » Driver 9 Overcurrent.

Inmotion Programmer Fault Code Table

Code	Explanation	Solution
20	Incorrect start Accelerator pedal switch active before key on	Release pedal switch
21	Incorrect start Forward switch or reverse switch active before key on	Turn off the direction switch
22	Forward switch and reverse switch active at the same time	Direction switch fault
23	Throttle analog value out of range	Throttle fault or analog need to be calibrated
24	Throttle analog fault	
31	Traction controller CAN communication fault	Check CAN wire of controller and display
32	Battery voltage low	Need charge
34	CPU fault	Reset key
36	ERROR Incorrect start Tilt switch active before key on	Reset tilt switch
37	ERROR Incorrect start Side switch active before key on	Reset side switch
38	ERROR Incorrect start Attachment switch active before key on	Reset attachment switch

39	ERROR ERROR Lift switch activated at startup	Reset lift switch
40	ERROR Lift analog value out of range	Lift analog fault or need to be calibrated
43	ERROR Steer analog value out of range	Steer analog fault or need to be calibrated
44	WARNING Traction controller speed protection	Vehicle speed is too high alarm
45	WARNING Traction controller encoder fault	1.Traction controller encoder fault 2.Traction motor speed sensor connection wire is open
81	WARNING Traction controller temperature is low	Traction controller temperature is low alarm
82	WARNING Traction controller temperature is high	Traction controller temperature is high alarm
83	ERROR Traction controller temperature sensor fault	Traction controller temperature sensor fault

84	WARNING Traction motor temperature is low	1.Traction motor temperature is low 2.Traction motor temperature sensor is fault
85	WARNING Traction motor temperature is high	1.Traction motor temperature is high 2.Traction motor temperature sensor is fault
86	ERROR Traction motor temperature sensor fault	1.Traction motor temperature sensor is fault 2.Traction motor temperature sensor connection wire is open
87	ERROR Traction motor encoder fault	1.Traction motor encoder fault 2.Traction motor speed sensor connection wire is open
88	WARNING DC bus voltage of traction controller is high	1.DC bus voltage high 2. The ramp is too steep
89	WARNING DC bus voltage of traction controller is low	Need to charge or check power wiring
90	WARNING The default value of the traction controller is updated	Reset key
91	WARNING Traction drive limit	Battery low vehicle speed limit

97	ERROR Open drain of traction output open or short	Check the wire of open drain of traction output open or short
98	WARNING Traction controller over current or short	Check power wiring
101	ERROR Traction controller short	1.Check power wiring 2.Controller enable before contactor pull
102	ERROR Traction controller temperature is high cut back	Traction controller temperature is high need cool
103	ERROR Traction motor temperature is high cut back	1.Traction motor temperature is high need cool 2.Traction motor temperature sensor fault
104	ERROR Traction controller over current	1.Vehicle overload or Mechanical clamping 2.Traction motor speed sensor fault
105	ERROR Traction controller precharge failed	Replace the pre charge resistance
110	ERROR DC bus voltage of traction controller is low cut back	Battery need charge
111	ERROR	DC bus voltage of traction controller is high cut

	DC bus voltage of traction controller is high cut back	back
112	ERROR () DC bus voltage of traction controller is high cut back(Hardware monitoring)	DC bus voltage of traction controller is high cut back(Hardware monitoring)
114	ERROR Internal power supply error	Traction motor temperature sensor or speed sensor connection wire is open
121	WARNING Pump controller temperature is low	Pump controller temperature is low alarm
122	WARNING Pump controller temperature is high	Pump controller temperature is high
123	ERROR Pump controller temperature sensor fault	Pump controller temperature sensor fault
124	WARNING Pump motor temperature is low	1.Pump motor temperature is low 2.Pump motor temperature sensor fault
125	WARNING Pump motor temperature is high	1.Pump motor temperature is high 2.Pump motor temperature sensor fault
126	ERROR Pump motor temperature sensor fault	1.Pump motor temperature sensor fault 2.Pump motor temperature sensor connection

		wire is open
127	ERROR Pump controller encoder fault	1.Pump motor speed sensor fault 2.Pump motor speed sensor connection wire is open
128	WARNING DC bus voltage of pump controller is high	DC bus voltage of pump controller is high
129	WARNING DC bus voltage of pump controller is low	Check power wiring
130	WARNING The default value of the pump controller is updated	Reset key
132	WARNING Pump drive limit	Battery voltage low need charge
137	ERROR Open drain of pump output open or short	Check the wire of open drain of pump output open or short
138	WARNING Pump controller over current or short	Check power wiring
141	ERROR	

	Pump controller short	
142	ERROR Pump controller temperature is high cut back	
143	ERROR Pump motor temperature is high cutback	Pump motor temperature is high alarm
144	ERROR Pump controller current calibration error	Reset key
145	ERROR Pump controller pre charge failed	Replace the pre charge resistance
147	BMS BMS Cell voltage too high	
148	BMS BMS first fault	
149	BMS BMS second fault	
150	ERROR DC bus voltage of pump controller is low cut back	Low battery power
151	ERROR DC bus voltage of pump controller is high cut back	High battery voltage
152	ERROR () DC bus voltage of pump controller is high cut back (Hardware monitoring)	High battery voltage

153	ERROR Pump controller CPU fault	Reset key
154	ERROR Pump controller speed control fault	Pump controller speed control fault
155	BMS CAN bus Off	BMS CAN
156	BMS BMS temperature protection	
157	BMS BMS over temperature protection	BMS over temperature protection
158	BMS BMS Monomer Overdischarge	Lithium Battery Low Battery Monomer Overdischarge
159	BMS BMS over voltage protection	BMS over voltage protection
163	BMS BMS over current	BMS over current
164	Charge protection	Charge protection
165	Seat switch off after a period of time, the direction of the request to reset	Reset direction switch
168	BMS BMS indicates Limit Current alarm	BMS indicates Limit Current alarm
169	BMS BMS indicates cutoff Current alarm	BMS indicates cutoff Current alarm

170	BMS BMS indicates brake Current alarm	BMS indicates brake Current alarm
171	BMS CAN BMS CAN Error	BMS CAN BMS CAN Error
13	EEPROM KO HPG CONTROLLER EEPROM KO	(HPG) Cycle KSI (HPG DC pump control failure)
30	VMN LOW HPG CONTROLLER BATTERY VOLTAGE LOW	(HPG) HPG CONTROLLER BATTERY VOLTAGE LOW NEED CHARGE
33	NO FULL COND. DC MOTOR VOLTAGE HIGH	(HPG) Motor Voltage High Cycle KSI (HPG DC Pump Control Failure)
49	I=0 EVER 0 DC MOTOR OPERATING CURRENT IS ZERO	(HPG) HPG CONRTOLLER SENSOR FAULT
53	STBY I HIGH HPG CONRTOLLER OVER CURRENT	(HPG) HPG CONRTOLLER OVER CURRENT
62	TH. PROTECTION HPG CONTROLLER TEMPERATURE HIGH	(HPG) HPG CONTROLLER TEMPERATURE HIGH NEED COOL
66	BATTERY LOW HPG CONTROLLER BATTERY LOW	(HPG) HPG CONTROLLER BATTERY LOW NEED CHARGE
74	DRIVER SHORTED	(HPG)

	HPG CONTROLLER DRIVER SHORTED	Pump contactor drive coil short circuit (HPG DC pump control failure)
76	COIL SHORTED HPG CONTROLLER COIL SHORTED	(HPG) Pump contactor drive coil short circuit (HPG DC pump control failure)
78	VACC NOT OK HPG CONTROLLER VACC NOT OK	(HPG) Lifting speed sensor failure or recalibration (HPG DC pump control failure)
79	INCORRECT START HPG CONTROLLER INCORRECT START	(HPG) Operation sequence failure (HPG DC pump control failure)
241	CAN BUS KO CAN HPG CONTROLLER CAN BUS KO	CAN(HPG) CHECK CAN WIRE OPEN AND CAN SPEED RATE
242	BATTERY OVERVOL. HPG CONTROLLER BATTERY OVER VOLTAGE	(HPG) HPG CONTROLLER BATTERY OVER VOLTAGE
243	KEYOFF SHORTED	(HPG) Key switch welded (HPG DC pump control failure)
244	WATCHDOG HPG CONTROLLER WATCHDOG ERROR	(HPG) Cycle KSI (HPG DC pump control failure)
246	WAITING FOR MC HPG CONTROLLER WAITING FOR MAIN CONTACTOR	(HPG) TURN OFF THE PUMP CONCTACTOR PARAMETER
161	CAN	CANCAN

	DISPLAY CAN FAULT	CHECK DISPLAY AND CONTROLLER CAN CONNECTION

3 Drive/Brake system

3-1 overview

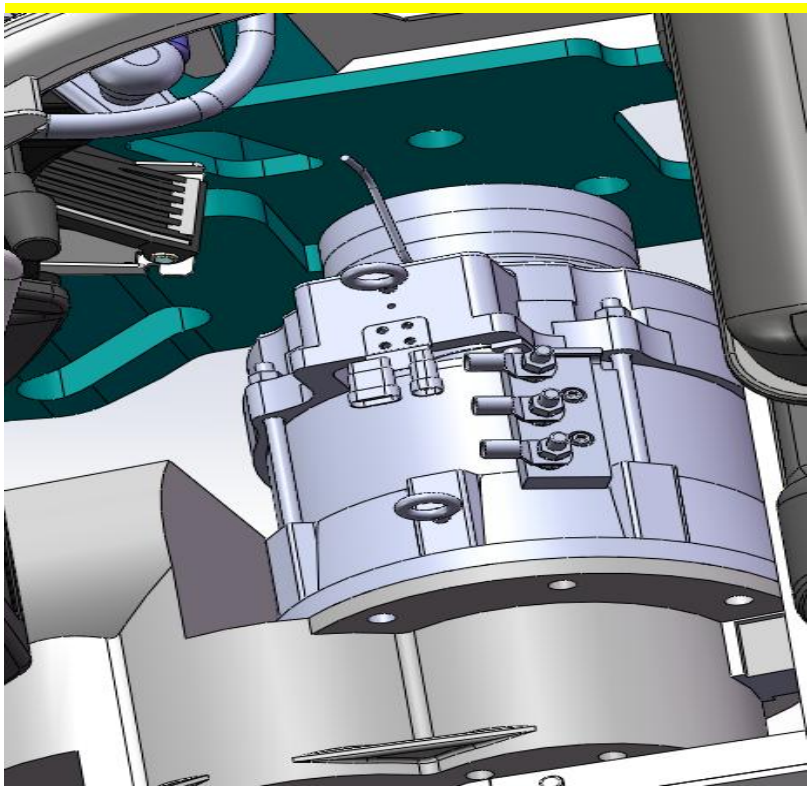
The drive system of the forklift truck is composed of reducer assembly, differential assembly and drive axle. The driving gear of the reducer is directly connected with the walking motor. The walking speed of the forklift increases with the increase of the motor speed. The change of the driving direction is realized by changing the rotating direction of the motor.

Reducer and differential

The gearbox, located between the drive axle and the travelling motor, has two pairs of helical gears that reduce the speed from the output shaft of the travelling motor and increase the torque from the input shaft, which is then transmitted to the differential.

3-2 Drive motor

3-2-1 Appearance and Specifications



TERM	specifications
voltage	48V
power	7kw
current	150A.
speed	2,075 r
Maximum speed	4,500 r
frequency	70 hz

encoder

term	specification
PPR	64 pulses per revolution
connector	4 needle AMP

Thermal sensor

term	specification
Part number	Included in the motor
resistance	603Ω± 3% at 25°C (77°F)
connector	2 needle AMP

Each drive motor is connected to the controller via U, V and W wires. The controller runs the drive motor based on input from multiple switches and sensors as well as internal parameter Settings.

When the following conditions are met, the driving motor runs:

1) The key switch is turned off, providing power to the controller,

2) The operator is seated and the seat switch is turned off.

3) The F/R switch is turned on or the accelerator switch sends a signal to the controller.

3-2-2 Drive motor disassembly/assembly and test

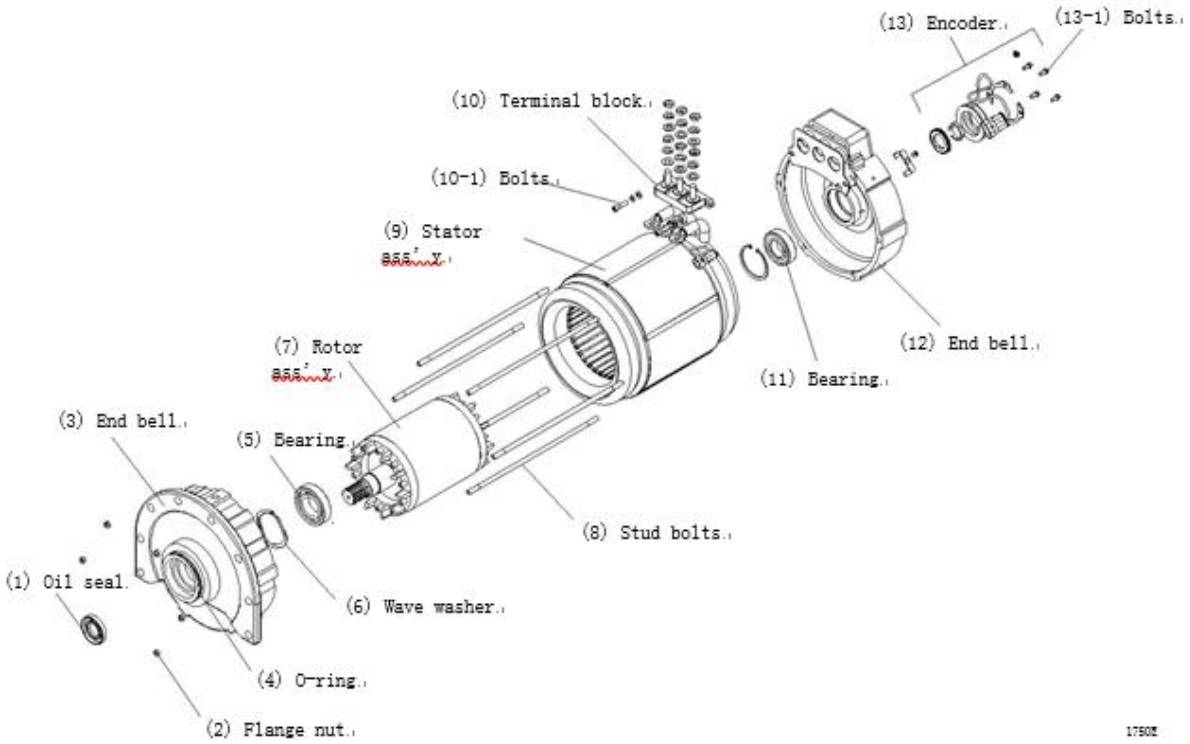


图 3-9

Disassembly/assembly

1.After removing the terminal protector, loosen the screw (10-1) and remove the terminal row (10).

2.Loosen bolts (13-1) and remove encoder (13).

3.Remove the O ring (4) and oil seal (1).

4.Loosen the backing nut (2) and remove the end cover (3).

5.Remove the stator assembly (9) by hand or with a tool.

6.Remove the corrugated washer (6) and bearing (5) from the rotor assembly (5).

7.Remove the bearing (11) and rotor assembly (7) from the end cover (12).

8.It is recommended to use a bearing puller, as shown in the figure.

Follow the above steps in reverse order to assemble the drive motor.

Note: Before reassembling the motor, you can test its components as follows.

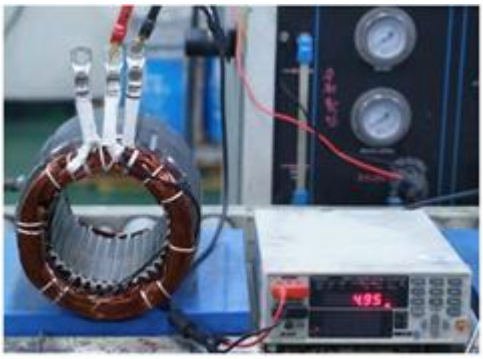
The test of the stator

Use a clean cloth dipped in alcohol to carefully wipe the contaminants on the surface of the stator.

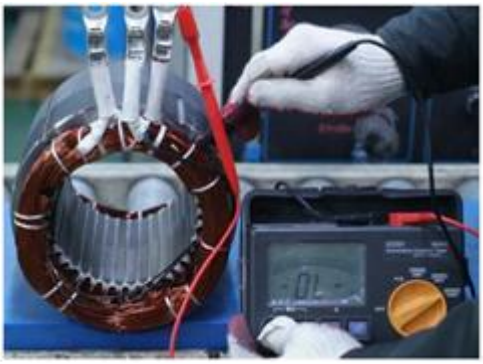
Note: Contaminants in the stator may cause damage to the coil and therefore to the stator itself.

2 Use milliohm meter to measure the resistance of each phase (UV, VW, WU).

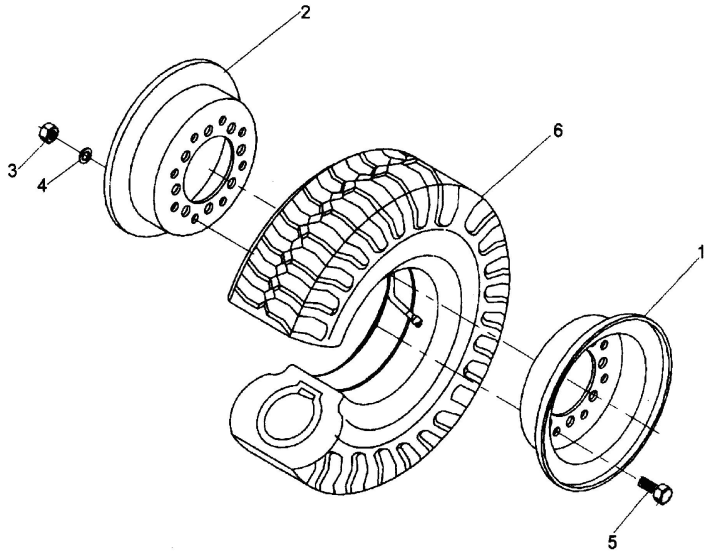
Rated resistance: 0.4Ω



3 Test insulation at 1000 VAC and Min. 10MΩ Use insulation tester.
If there is a problem with the insulation, replace the stator with a new one.



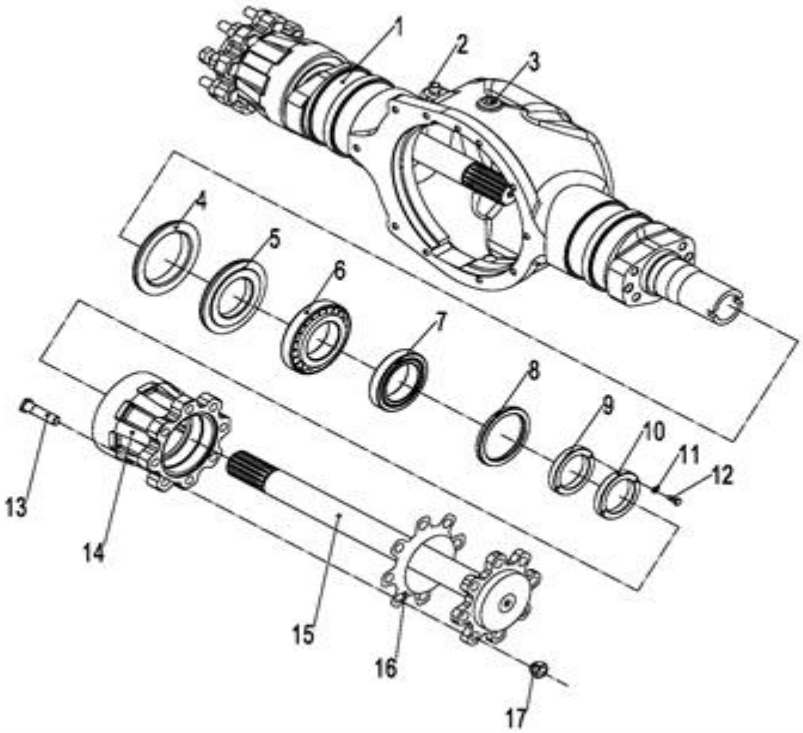
3-2-3 Drive wheel removal/installation



Install the air intake rod and cap on the tire and assemble the rim, noting the following:
Note :
(a) the air stem is at the rim gap and facing outward;
(b) Rim bolt heads should be installed outwards.

3-3 drive axle

3-3-1 Appearance and specifications



1、Bridge shell	2、Ventilation plug assembly	3、Hexagon plug	4、Oil seal SC100X125X12
5、bearing stop ring	6、bearing30213E	7、bearing 32012	8、Skeleton oil seal TC85X100X9
9、nut seat	10、nut seat retaining ring	11、bolt M6X14	12、spring washer GB93-6
13、hub bolt	14、hub	15、half shaft	16、half shaft pad

17、hub bolt

3-3-2 function

Driving function

The drive shaft is responsible for transmitting the output of the drive motor to the wheels, reducing speed and multiplying torque according to the specific gear ratio generated by its internal gear train. This is to make the motor's high speed suitable for driving and obtain enough force to withstand the load of the vehicle and other external conditions.

When the motor shaft rotates, the pinion to which it is connected also rotates, and then the helical gear is rotated and the spline is connected to the pinion. Since a helical gear has several times more teeth than a pinion, the first deceleration occurs between the two gears and a corresponding doubling of torque:

The sun gear meshing with the helical hearing rotates simultaneously with the helical hearing rotation. The rotation of the sun gear causes the three planetary gears to move around the sun gear. Planetary gears, such as those contained in ring gears, maintain their circular motion without becoming out of mesh. The cogs are so named because the way they work together can be compared to the orbits of the planets around the sun.

3-3-3 drive gear oil replacement

Preliminary steps

1) Lift the mast and support it with a support block.

2) Turn off the key switch.

3) Unscrew the level check plug and remove the drain plug to drain the oil.

4) Clean the drain plug and install it.

5) Unscrew the filling plug and fill the oil. Keep the proper oil level by checking the dipping stick.

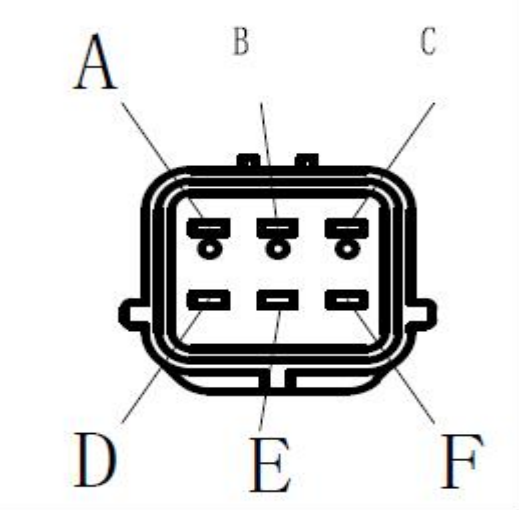
6) Install the oil level check plug and tighten the oil filling plug together.

7) Lift the mast and remove the support block.

3-4 accelerator

3-4-1 Appearance and Specifications

number	definition	color
A	power supply +12V-+80V	red
B	Signal output terminal，0-10V	green
C	Ground cable 1	black
D	CAM（common port）	white
E	Idle switch signal	blue
F	blank	blank



3-4-2 function

Electric vehicles run on the power generated by a drive motor. Therefore, the accelerator that determines the speed of the vehicle is connected to the drive motor controller.

The accelerator is powered from the drive motor controller at 5 V and generates signal A in F and signal B in R. This output determines that the speed of the vehicle is proportional to the Angle at which the accelerator pedal is pressed.

As shown above, the signal A or B sent by the accelerator is communicated by CAN to the controller. In principle, the two signals should have the same value. If their difference exceeds the tolerance, it will be identified as a problem in the electrical system or accelerator, and a fault code will appear on the display.

3-4-3 Removal and installation

Preliminary steps

1 Turn off the key switch.

2 Remove the floor MATS that cover the floor

The procedure

1) Lift the soleplate slightly and perform the following steps:

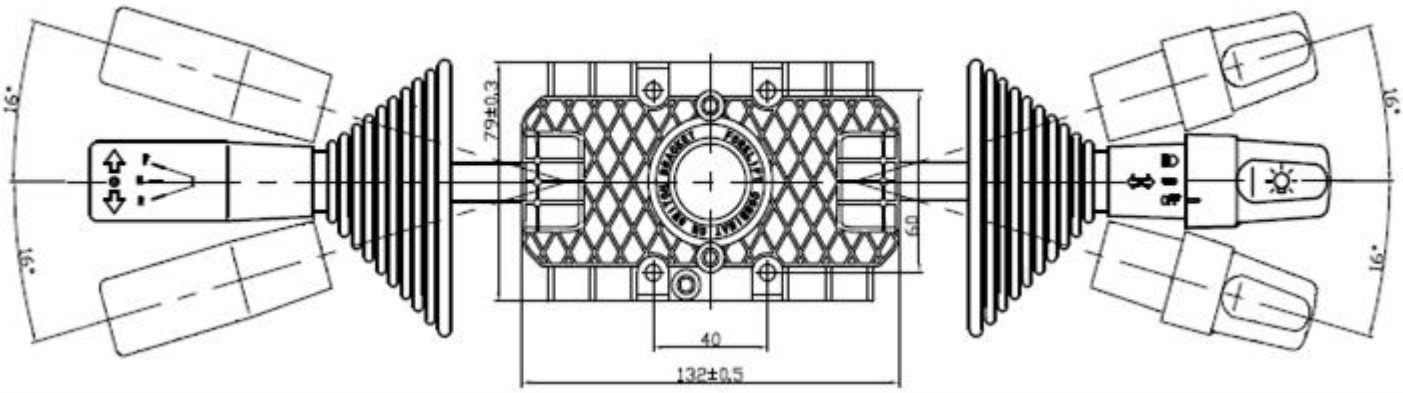
2) Remove the accelerator pedal connector from the main harness.

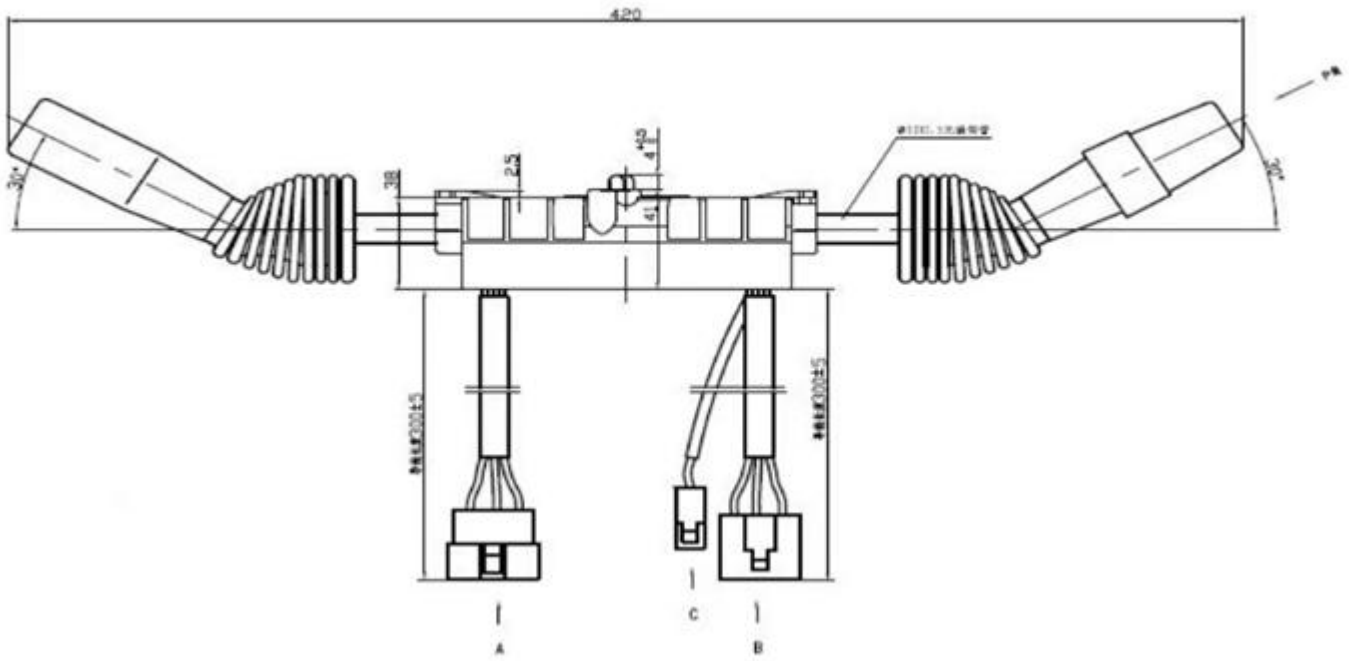
3) Release the three sets of bolts and nuts, and then remove the accelerator.

4) Perform the above steps in reverse order to reinstall the throttle pedal.

3-5 F / R unit

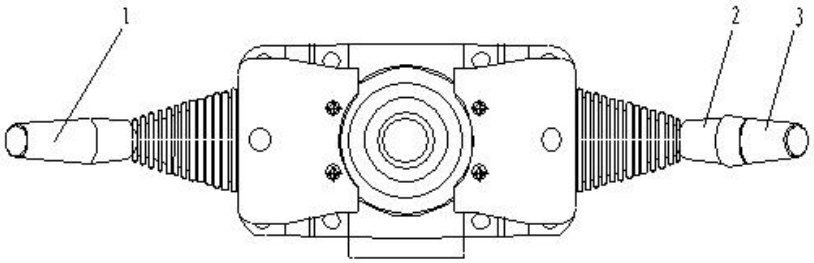
3-5-1 Appearance and Specifications





3-5-2 function

Combination switch is a combination of direction switch, turn signal switch and small or large light switch.



1-F/R direction switch 2- turn signal switch 3- small or large light switch

The direction switch controls the driving direction of the vehicle and transmits the signal to the instrument for display. The handle pushes forward, the handle pulls back, and the middle position is neutral. When the handle is in the reverse position, the backing light and warning light will be on and the backing buzzer will sound.

The turn signal switch indicates the turning direction of the forklift. When the switch handle rotates to the turning

position, the turn signal flashes.

Push forward	The left turn signal is flashing
middle	The median
Draw back	The right turn signal flashes

The switch controls the lighting and extinguishing of the light. This switch has two gears. Rotate to first gear and light up. Rotate to second gear and light up.

gear / light	OFF	The first gear	The second gear
In width modulation	×	○	○
The tail lamp	×	○	○
headlamps	×	×	○

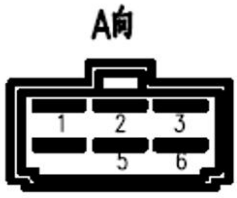
○:light on ×:light off

(4) Rear headlight switch

After the headlight switch is a single file switch, control the light and extinguish after the headlight, pull the starting point after the light, push off the headlight.

The F/R direction switch (forward/backward) is used to enable the operator to select the direction of the vehicle by using a combination switch connected to the F/R.

The F/R orientation switch has A connector (6-pin connector, A-direction) that can interact with multiple devices, as shown below：



DJ7061-6.3-10

Direction Switch	1	3	2	5	6
Connector / Color	Brown	Red	Green	Yellow	Red and blue
Size	0.75	0.75	0.75	0.75	0.75
Length	320	325	320	320	325
Power	60W	+	60W	60W	+
Forward		—			
Stop					
Backward			—	—	

The 6-pin connector pins of the F/R directional switches are connected to the F/R switches to provide a 5V power supply and receive operator requirements through forward, reverse, or undirected switches.

When the switch is in neutral, it sends voltage signals from the forward and reverse terminals.

Connectors in the B and C directions are light switch connectors for the vehicle, as shown below.

Direction Switch		Connector	8	7	9	10	11	12
		Color	Black and yellow	Orange	Grey	Brown	Yellow	Red
		Size	0.75	0.75	0.75	1.0	0.75	1.5
		Length	320	320	325	445	440	445
		Power	60W	60W	+	60W	50W	+
Right				—		—	—	
	▬			—			—	
	OFF			—				
Off						—	—	
	▬						—	
	OFF							
Left			—	—	—	—	—	
	▬		—	—	—		—	
	OFF		—	—	—			

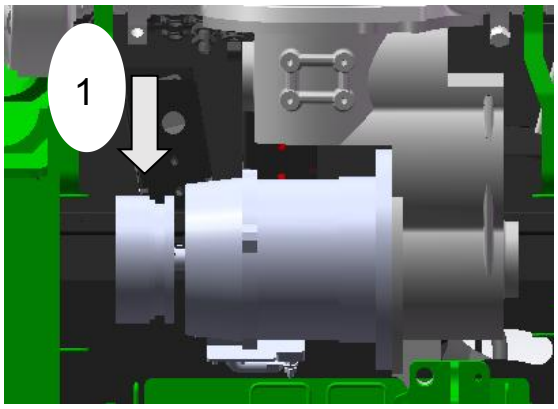
3-6 service braking

3-6-1 overview

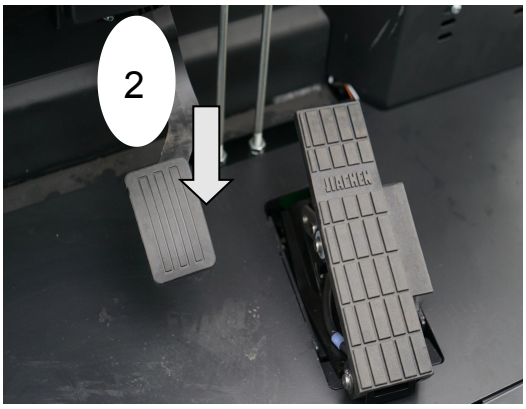
The brake system consists of brake pedal, electromagnetic brake and parking brake switch.

Crane brake

The structure of the driving brake pedal is shown in the figure. When the brake pedal is pressed down, the electromagnetic brake installed on the walking motor is used for braking. The length of braking distance can be adjusted by software.



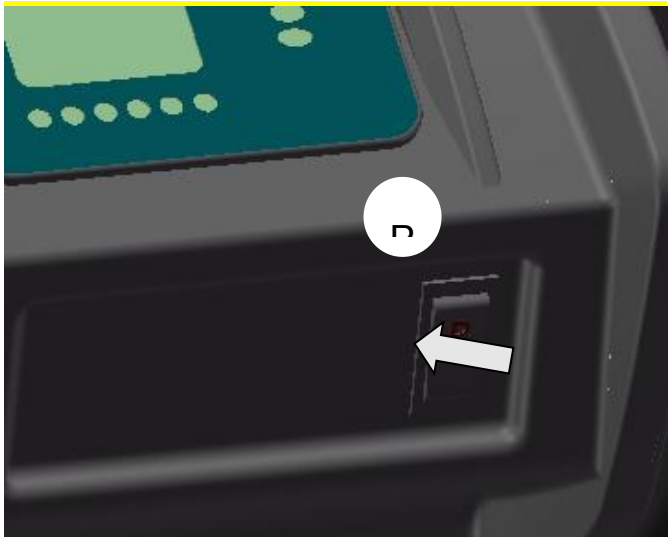
1. Electromagnetic brake



2. Service brake pedal

3-7 Parking Brake

A parking brake switch is installed on the left side of the instrument rack. When the button (P) is pressed, the electromagnetic brake works.



3-7-1 Fault analysis and troubleshooting methods

problem	analyze	solution
Poor braking	1 Braking distance is too long or too short	Adjust the software
	2 Brake overheating	Check brake
	3 There is grease on the surface of the friction plate	Repair or replacement
	4 Impurities are attached to the friction plate	Repair or replacement
The brake is making noise	1 Friction plate surface hardening or impurity attached to it	Repair or replacement
	2 Bolt looseness	Repair or replacement
	3 Incorrect installation	Repair or replacement
	4 Friction plate wear	replace

3-7-2 Maintenance and maintenance

In order to ensure the uninterrupted operation of the electromagnetic brake, it must be regularly maintained and maintained:

1, check the fastening degree of bolts every week, especially to tighten the bolts of the electromagnet, the bolts of the electromagnet and the shell, the bolts of the magnetic yoke, the bolts of the electromagnet coil and the wiring bolts.

2, check the mechanical wear of movable parts every week, and remove the dust, flower hair and dirt on the surface of electromagnet parts.

3. Add lubricant to the movable part of the electromagnetic brake every month.

4. Check the length of armature stroke every month. Because in the process of brake operation, due to the wear of the cutting surface, the armature stroke length will increase. When the armature stroke length does not reach the normal value, it must be adjusted to restore the minimum clearance between the brake surface and the turntable. If the armature stroke length increases above the normal value, the suction may be significantly reduced.

5. If the worn brake surface is replaced, the minimum clearance between the brake surface and the turntable

should be properly adjusted.

3-8 Troubleshooting

3-8-1 Drive motor

problem	Probable cause
Drive motor not working	Switch not closed (battery connector, key switch, seat switch, F/R switch or parking brake switch) : Turn off the switch. If it still does not work, use a voltmeter to test the power supply on the control panel and the current on each switch. However, the service brake switch should be turned on.
	Bad reception. Fuse blown: Check the battery connection. Check the connection of the battery connector. Check fuses, drives and logic. Replace the fuse wire if the fuse is broken. Check the drive motor and control panel for possible fuse failure. Some of the reasons are: Operating under excessive load, current limit is too high
	Low battery power: Check the battery terminal voltage. If it's too low, charge the battery. Check if there is one or more defective cells in all cells. Check the specific gravity of each monomer. The maximum density difference from the highest cell to the lowest cell shall not exceed.020 Sg (specific gravity）
	Incorrect operation of control panel: See "2-3-5 Motor Controller Testing" and "2-7 Diagnosing/Calibration/Handling Faults.”。
Drive motor not working	Encoder failure
Traction cannot be operated during normal operation, but hydraulic operation is normal	Defective brakes cause too much resistance. Heat increases, causing the motor to stop running. Check the brake adjustment.
	There is too much heat in the control panel for the following reasons: Overweight traction load: reduces duty cycle load. Temperature Sensor Failure: Refer to "Section 2-7 on Dashboard. Handle the failure on ". These can cause the drive motor to be obstructed, Control panel malfunction or open drive fuse
Neither traction nor hydraulics will last the entire normal operation period	Vehicles are equipped with batteries that are too small:
	The battery is not fully charged during battery charging: Check if the battery is charged Check if the battery charger is faulty
	The battery replacement interval is too long or the replacement battery cooling time is too short
	The battery has one or more defective individual batteries, resulting in the rated capacity and capacity of the battery below the normal value:
	The drive system is consuming too much battery power due to a drive system failure. Check the brake adjustment. Inspect wheel bearings, axles and other

	mechanical parts for correction to eliminate faults. Switch to tires with less friction
	The hydraulic system consumes too much battery power due to lifting and tilting faults, or the hydraulic conditions of the working cycle are incorrect: Reduce the hydraulic relief valve setting to only used capacity. Replace with a smaller hydraulic pump. Check the mast for restrictions during operation.
	After one shift, the forklift is operating beyond its designed capacity without available power:
The positive electrode (+) or negative electrode (-) of the battery is in direct contact with the forklift frame (body) or the drive motor	The battery is dirty and the electrolyte is on top of the battery and in contact with the frame. Current flows through the battery box, which imposes a voltage on the forklift frame: Clean the battery with baking soda and an aqueous solution.
	Cable connection of battery or control panel in contact with forklift frame: Perform continuity tests and move wire contacts. Remove the wires in sequence until the fault is cleared. The fault will break at the end of the wire
	Dirty motor:
	Wet motor:
The vehicle did not reach its maximum speed	The battery is not fully charged or the battery is poor: Charge the battery. Check the single battery. Replace the single battery if necessary.
	Failure in drive motor, control panel or driveline: Check forklift speed in both directions. If you need to adjust the control panel, do so in accordance with the appropriate section of "Section 2 Electrical Systems". If the drive motor fails, test the motor assembly
Vehicle accelerates slowly	Drive control overheating, temperature sensing switch on. Note: If the temperature is 145°C (293°F), the thermal switch will emit a warning.

3-8-2 drive axle

problem	Probable cause
Noise or vibration in the gearbox	The oil level is incorrect: Satisfy the correct oil level
	Use non-standard oils: Replace the oil with standard oil.
	Damaged or dented gears: Replace the gears.
	Bearing damage: Replace bearings.
	Loose installation bolt: Apply thread glue to the thread of the bolt and re-tighten it to the specified torque.
Installation part leakage	Loose installation bolt: Apply thread glue to the thread of the bolt and re-tighten it to the specified

	torque.
	Installation surface damage: After disassembly, readjust or replace the components.
	O-ring damage: Replace the O-ring.
Hub leakage	Oil seal damage: Replace the oil seal
	O-ring damage: Replace the O-ring
Input shaft leakage	Oil seal damage: Change the oil seal.
	Motor O-ring damage: Replace the motor O ring.
	Motor mounting part or housing damage: Replace components.
Air respirator leaks	Too much oil: Satisfy the correct oil level
	Damaged air respirator: Clean or replace vent holes
	Use non-standard oils:Replace the oil with standard oil.
	Damaged or dented gears: Replace the gears.
	Bearing damage: Replace bearings.
	Loose installation bolt: Apply thread glue to the thread of the bolt and re-tighten it to the specified torque.

3-8-3 running brakes

problem	Probable cause
Uneven braking or rough feeling during braking (flutter)	There is oil or brake fluid on the brake disc.
	Bad contact between steel plate and friction plate.
	Uneven brake disc (uneven)
	Pressure plate bearing loose
	Bad disk and friction disk assembly

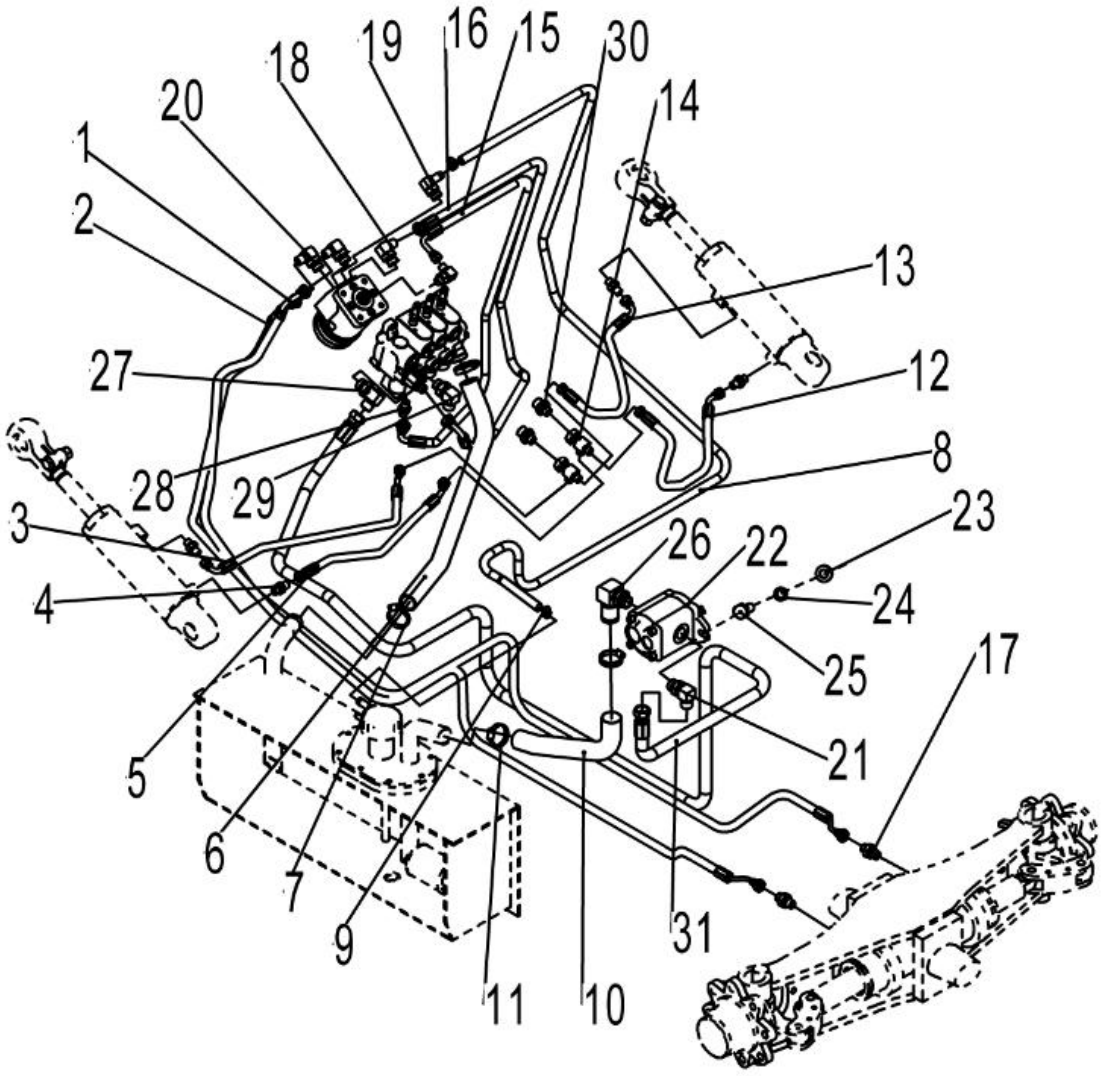
3-8-4 Parking Brake

problem	Probable cause
The brake is not engaged	Parking brake is not adjusted correctly.
	Parking brake cable is not properly adjusted.
	The brake disc is too worn

4 Hydraulic system

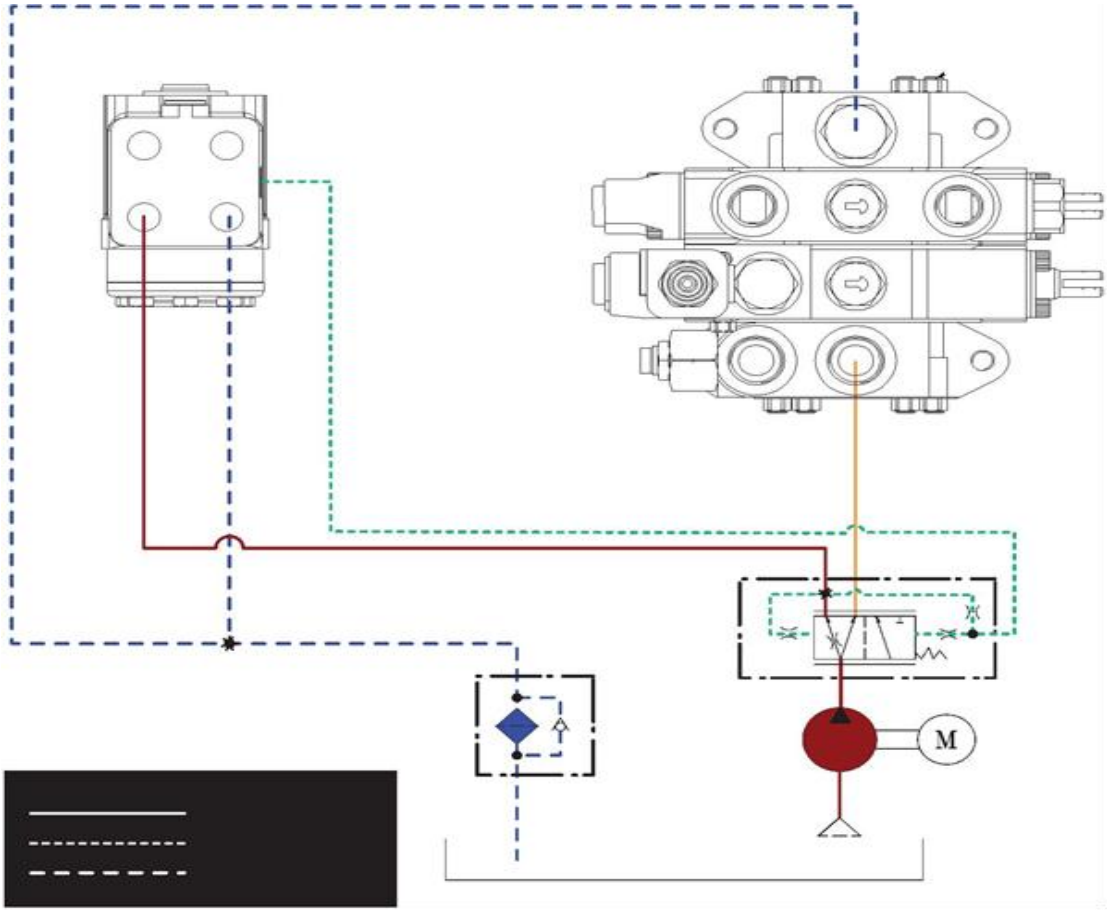
4-1 overview

4-1-1 component



1.Hydraulic pipe assembly	2. Hydraulic pipe assembly	3. Hydraulic pipe assembly	4. Joint
5. Hydraulic pipe assembly	6. Hose (oil return)	7. Throat hoop	8. Oil return hose
9. Throat hoop	10. Rubber hose (oil absorption)	11. Throat hoop	12.Hydraulic pipe assembly
13.Hydraulic pipe assembly	14. Joint (TEE)	15.Hydraulic pipe assembly	16.Hydraulic pipe assembly
17.Connector (straight)	18.Joint(lock bend)	19.Joint (lock bend)	20. Joint (lock bend)
21. Joint (lock bend)	22. Gear pump	23. Gear pump	24. Spring washer
25. Bolts	26. Joint (steering bend)	27.Connector (straight)	28. Joint (lock bend)
29. Joint (lock bend)	30.Connector (straight)	31. Hydraulic pipe assembly	

4-1-2 oil flow



Hydraulic oil circulation

The hydraulic tank stores hydraulic oil, which is fed through the filter to the main hydraulic pump. The main hydraulic pump pressurizes the supply of oil and distributes it through priority valves to different systems throughout the vehicle. Upon receipt of hydraulic oil, these systems perform their functions and then discharge the waste oil to the tank through the return filter.

Hydraulic operating system

The following systems are operated by hydraulic oil circulation:

Lift/auxiliary system: the control valve uses the hydraulic oil supply to control the system.

Steering system: The steering unit uses a hydraulic oil supply to control the system.

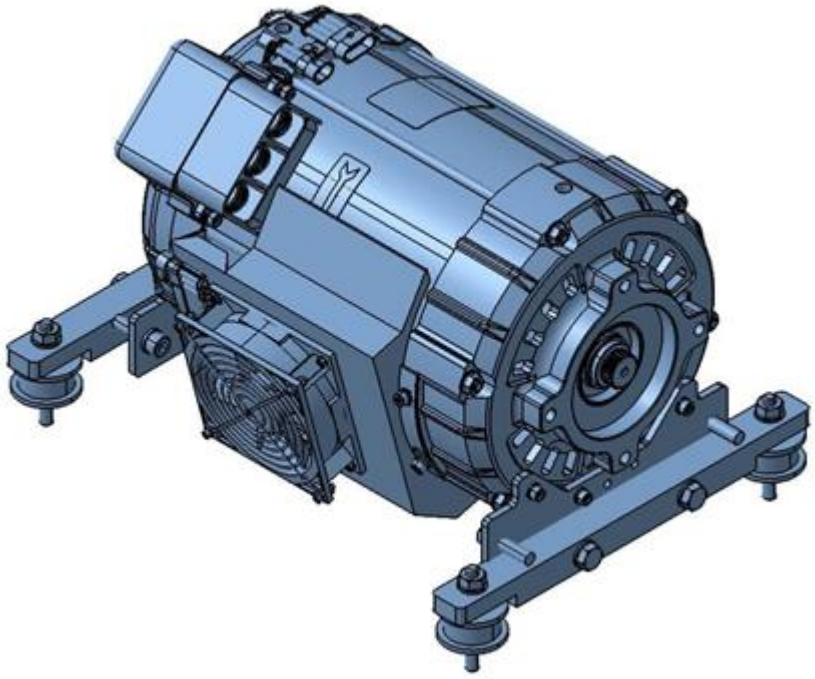
To ensure efficient and safe use of limited hydraulic pressure, priority valves determine which of the two systems will provide the majority of hydraulic oil. When the steering mechanism is not operated, the steering unit supplies only a small amount of hydraulic oil through the orifice, and the control valve is supplied to the rest.

However, once the operator turns the steering wheel, the priority valve receives a guide signal from the steering unit via a load-sensing circuit that causes its spool to move, thereby increasing the hydraulic oil supply to the steering unit.

For more information on the operation of the various components involved in the hydraulic oil cycle, see the following section.

4-2 Pump motor

4-2-1 Appearance and Specifications



term	specification
power	8.6KW
speed	1618rpm
frequency	55.5hz
The insulation level	H

The encoder

term	specification
PPR	64 pulses per revolution.
connector	4 needles AMP

Thermal sensor

term	specification
Part number	Included in the motor
resistance	603Ω ± 3% at 25°C (77°F)
connector	2 needles AMP

4-2-2 function

The pump motor electrically transmits power to the main hydraulic pump in order to pump hydraulic oil to operate the hydraulic system.

The pump motor is connected to the pump motor controller via the U, V and W wires. The controller operates the pump motor based on input from multiple switches and sensors as well as internal parameter Settings.

The pump motor runs when the following conditions are met:
The key switch is off.
Operator seated, close the seat switch.
One of the hydraulic control switches, the F/R switch or the accelerator switch, sends a signal to the controller. Turn the F/R switch to forward or reverse transfer to trigger the pump motor to run in idling state for 6 seconds. Then it goes into PP mode to stop running, except in six seconds
The clock sends a signal from the accelerator. To restart the pump motor, the operator should return the F/R switch to neutral and then switch it forward or backward, or move one of the hydraulic levers to open the appropriate switch.

Motor speed detection (encoder operation)

The pump motor is equipped with an encoder that acts as a speed sensor for the motor.
The controller analyzes the amplitude of the pulse to calculate the speed of the motor. The smaller the amplitude, the higher the speed of the motor.

Like other sensors, the encoder also generates A main signal (signal A) and A reference signal (signal B) through two hole sensors. The order of the resulting signals varies according to the direction of rotation.

Overheat protection (heat sensor operation)
Pump motors are equipped with heat sensors to prevent overheating. Once the motor is heated to 145°C (293 °F), the overheating alarm is activated and the motor has limited operating performance.

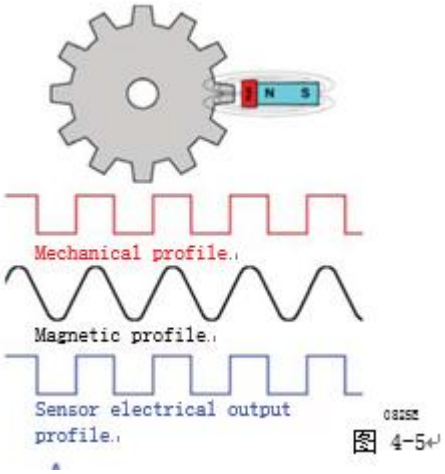


图 4-5

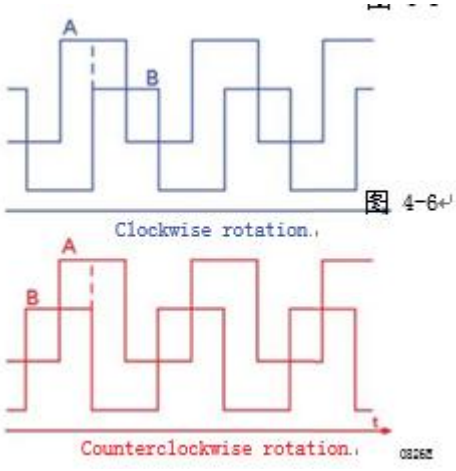


图 4-6

4-2-3 Removal/installation of pump motor and main hydraulic pump

1. Disconnect cables from UVW terminals.
2. Disconnect the encoder cable and thermal sensor cable from the main beam.

3. Disconnect hose from hydraulic pump.
4. Disconnect suction hose from hydraulic pump to priority valve.

5. Support the pump motor with the belt and remove the motor.
6. Remove the bolts, washers and hydraulic pump from the hydraulic motor.
7. Install the pump motor in reverse order.

4-2-4 Pump motor disassembly/assembly and testing

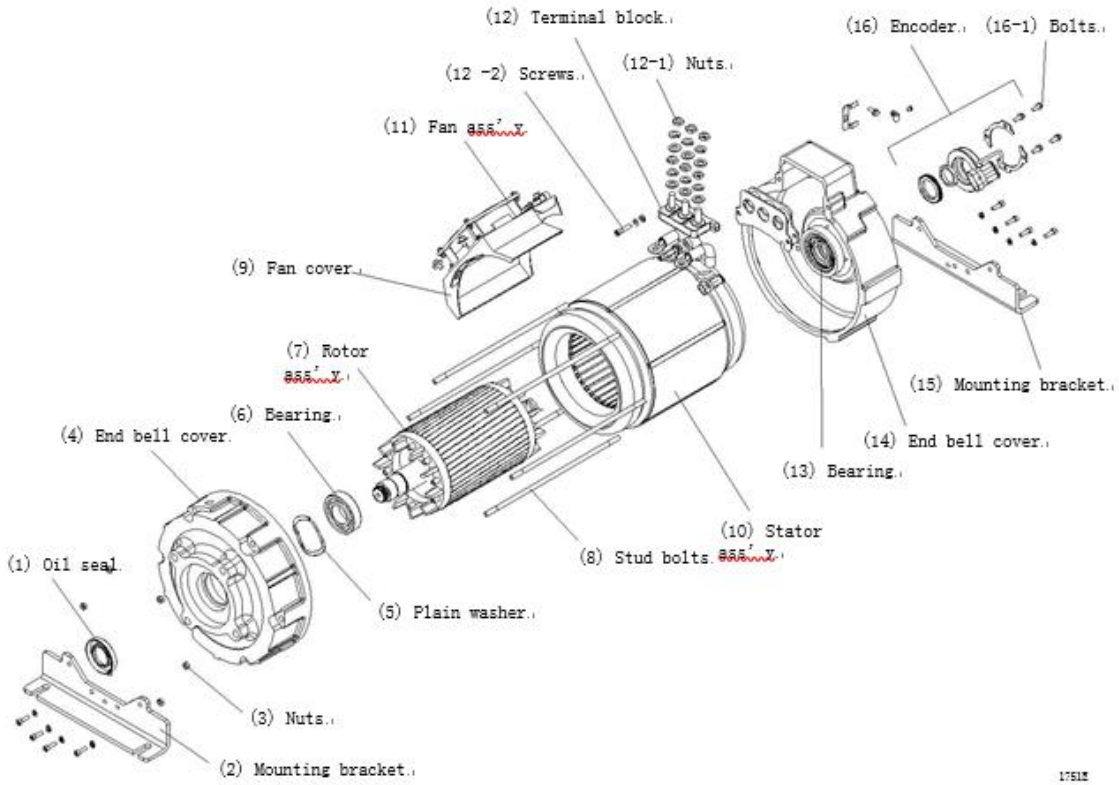


图 4-8

Disassembly/assembly

1. After removing the terminal protector, loosen the nut (12-1) and remove the terminal bar (12).
2. Loosen the bolts (16-1) and remove the encoder (16).
3. Loosen nut (3) and remove stud (6).
4. Remove the front bell jar (4) and the rear bell jar (14).
5. Remove the stator assembly by hand or with tools (10).
6. Remove flat washer (5), bearing (6) and rotor assembly (7) from rear bell jar (14).
   A manual puller is recommended.
7. Follow the steps above in reverse order to assemble the pump motor.

The test of the stator

1. Use a clean cloth dipped in alcohol to carefully wipe the contaminants on the stator surface.

Note: Contaminants in the stator may cause damage to the coil and therefore to the stator itself.

2. Use a milliohm meter to measure the resistance of each phase (UV, VW, WU).

Rated resistance: 0.4Ω

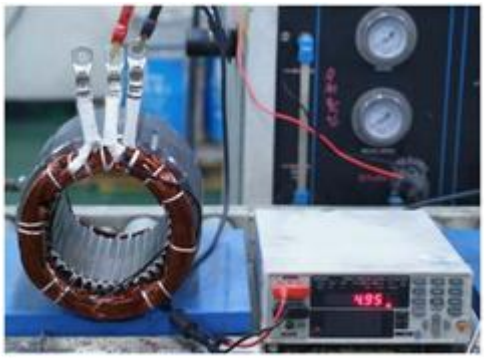


图 4-10

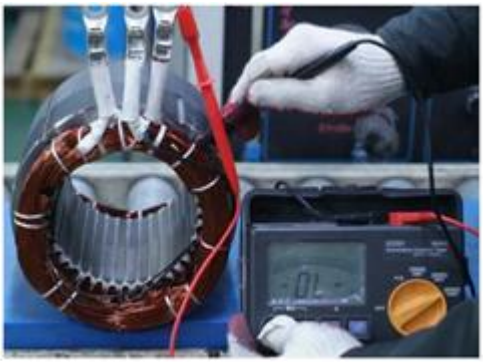
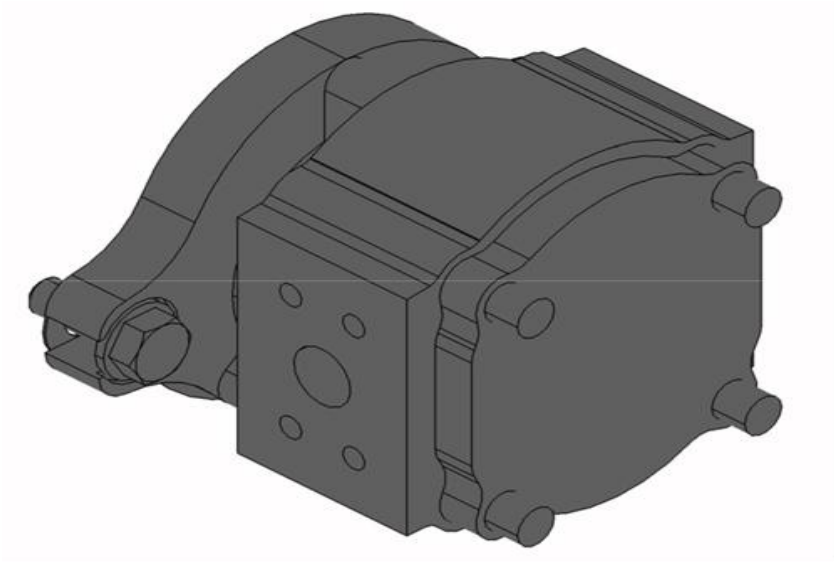


图 4-11

4-3 main hydraulic pump

4-3-1 Appearance and Specifications



term	specification
shift	32.1 ml/L
The pump rotation	CW

4-3-2 function

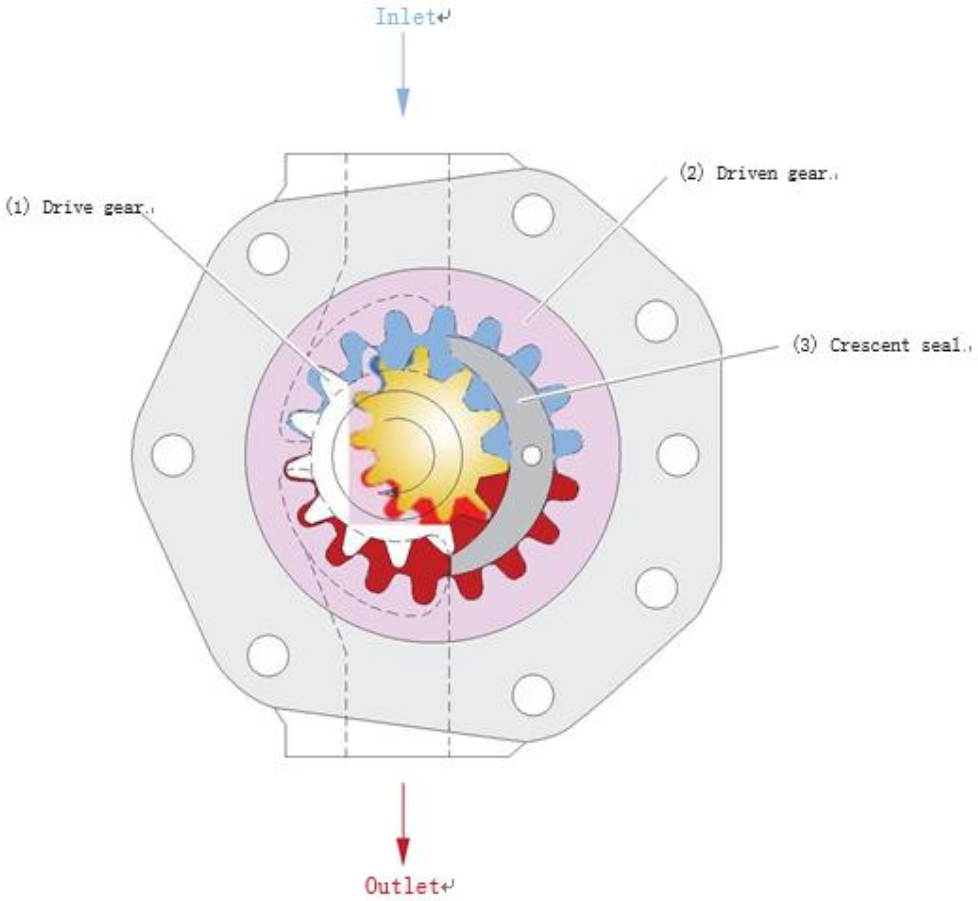


图 4-13

This model uses an internal gear pump as its main hydraulic pump.
Internal gear pump includes driven gear (2) [outer gear] and drive gear (1)
[Inner Gear], as shown in the figure. Of or relating to the area where the drive and driven gears engage
The volume increases as they rotate and absorb oil.
Then place the suction oil cage in both gear grooves and crescent seals (3)
(the bright area in the figure) and decreases with the volume of the gear meshing area
And taken to the exit.
The high pressure chamber (discharge) and low pressure chamber (suction) are composed of crescent seals (3)
Seal. In theory, the internal gear pump than the external gear pump has a smaller pulsation.

4-3-3 Disassembly and assembly

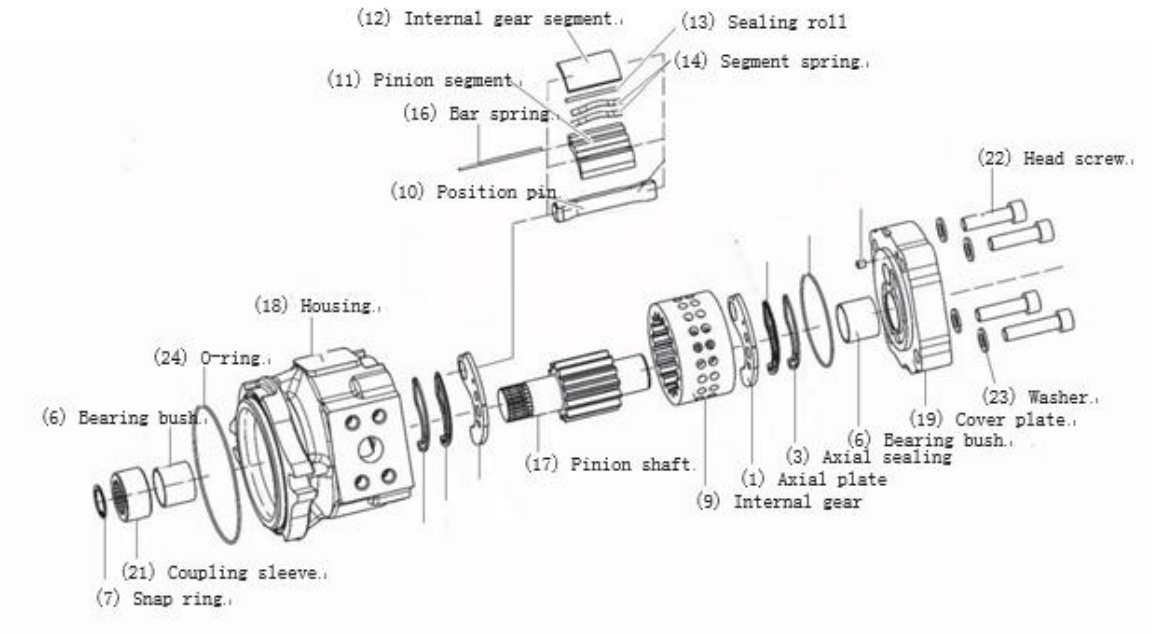


图 4-14

Disassembly

1. Loosen and remove the 4 screws (position 22) on the cover plate (position 19).
2. Carefully remove cover plate (position 9) from housing (position 18).
3. Remove shaft plate II (2), pinion shaft (17), rod spring (16),Section (11,12),sectional springs(14,15) and sealing rolls (13).

Note the position of the pinion shaft (17), which may be positioned through Pin (10) locked, as shown.

4. Remove the inner gear (9) and rotate the locating pin (10) approximately 90°. After this, pull out the locating pin（10）。
5. Remove shaft plate I（1）

Below are the spare ring (4) and the axial seal (3).

Parts

1. Ensure that the axial seal (3) and the left support ring (4) are machined The groove is intact. Shaft plate I The slot of (1) must be as shown in the figure Look up.
2. Install the locating pin (10) first, as shown in the figure. And then put it inside The gear (9) and the locating pin (10) are rotated about 90°

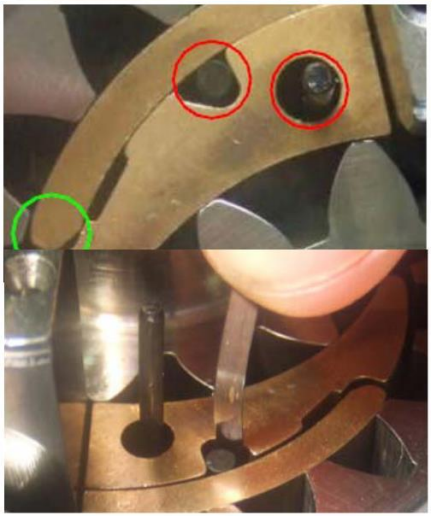
3. Install the pinion shaft
(17) and make sure it is not pinned
(10) Blocking, as shown in the figure.

4. Install pinion gear segment
(11) and inner gear segment
(12). To ensure that the belt
There are two beveled sides of the inner gear segment
(12) shown in the pinion
Top of wheel segment
(11) (green marked).

5. Place the sealing roller (13) and the rod spring
(16). Rod spring
(16) is fixed in the shell
(18) through the shaft plate I (1)

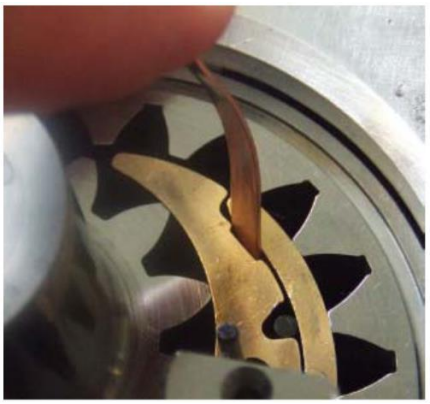
6. The section spring II (15) is placed so that the two bows are pressed against the sealing roll
, as shown in the figure.

7. To press against the inner gear segment with the bow piece（12）same way instal



8. the axillare II（2）Install close to housing, otherwise possible
Can damage the cover plate（19）the bearing bushing（6）。
The hydraulic system

9. Check the green O-ring (20) and check the position on the cover plate (19)
Buy. Install the flexible axial seal (3) first, then the right side
Ring (5). Cover the axial seal (3) and the right side with grease
It is helpful to use the ring (5), which makes assembly easier.
Direct selling must be located in cover plate (19) or housing (18)。



10. Measure the clearance between cover plate (19) and housing (18).

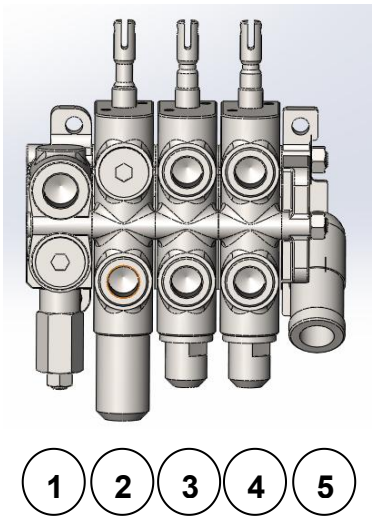
If clearance is greater than 0.6 mm (0.024 in.), axial plate
Or the seal may slip and remove the pump again!

11. Tighten 4 screws with 50 N·m (37 lb·ft).

Note: if the pump is properly assembled, the pinion shaft should be capable of manual rotation.

4-4 multi-way valve

4-4-1 Appearance and specifications



1. The relief valve
2. The lifting
3. The tilt
4. The fittings
5. Return oil mouth

Figure 2-15 Multi-way valve contour drawing

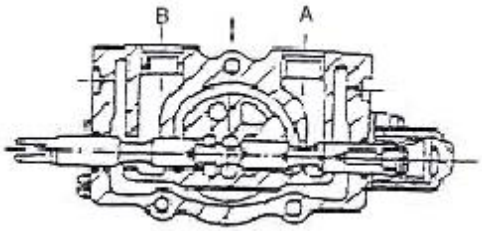
(1) Operation of the slide valve (take the inclined slide valve as an example)

(a) Neutral position (Fig. 2-16)

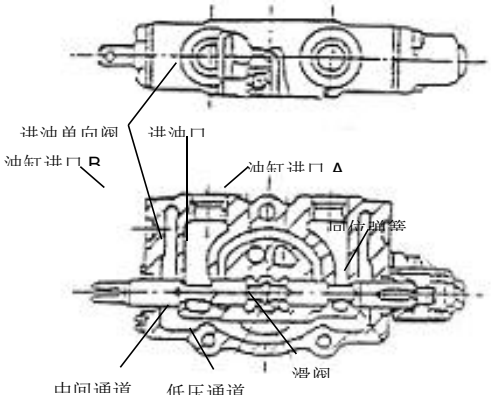
At this point, the high pressure oil discharged from the oil pump returns to the tank through a neutral position.

(b) Push in the slide valve (Fig. 2-17)

At this time close the middle channel, the oil from the oil inlet to open the one-way valve to flow to the cylinder interface B, from the cylinder interface A to the oil tank through the low pressure channel, with the help of the return spring, can make the slide valve back to the neutral position.



2-16



2-17

(c) Pull-out slide valve (Fig. 2-17)

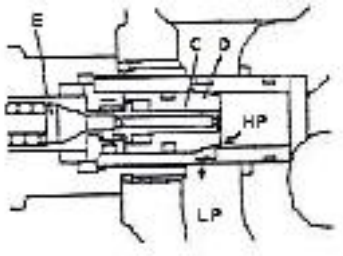
When the neutral position is closed, the oil from the oil inlet opens the check valve and flows to the cylinder interface A, and the oil from the cylinder interface B flows to the tank through the low pressure channel. With the help of the return spring, the slide valve can return to the neutral position.

(2) Action of safety relief valve (Figure 2-18)

A relief valve is installed between the "HP" interface of the oil pump and the low pressure channel "LP". Through the lifting valve "C" oil acting on the diameter "A" and "B" on the different area, so the check valve "K"

and the relief lifting valve "D" are falling on the seat. The pressure set in the pump "HP" path is applied to the spring of the guide valve and the check valve "E" opens. Oil flows into the low pressure "LP" side through the through-hole around the valve.

As soon as the guide valve "E" opens, the pressure inside the valve "C" drops and both the valve "E" and the valve "C" fall on the seat. The flow at the rear of the flow valve "D" is closed and, as a result, the pressure on the inner part is reduced. The pressure on the side and inside of the "HP" passage of the oil pump is unbalanced. Under the action of pressure difference, the valve "D" opens and the oil flows directly into the low-pressure circuit "LP".



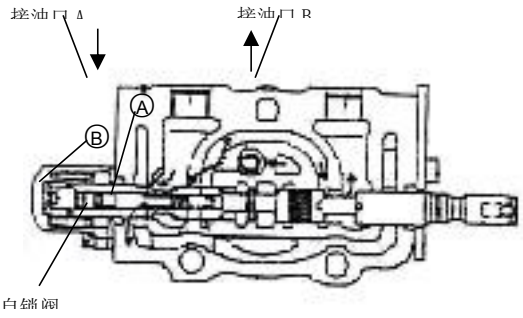
2-18

(3) the action of tilting the self-locking valve

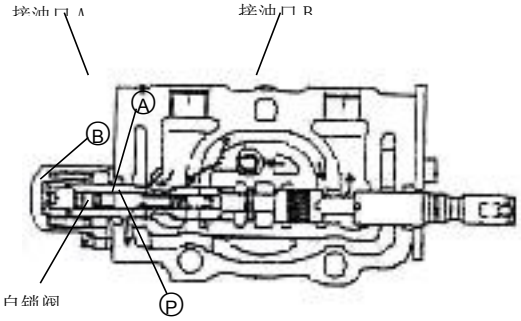
The inclined cylinder valve plate is equipped with inclined self-locking valve. When negative pressure is generated in the cylinder, it can prevent the mast from falling suddenly. At the same time, it can prevent danger when the tilting valve stem is misoperated. When the forklift motor stops working, the mast can not be tilted forward even if the joystick is pushed sharply. When the spool is pulled out, the flow of oil is the same as that in Figure 2-18, and the mast is in a backward leaning state.

(a) When the spool is pushed in (the pump is working), the oil from the independent pump passes through the interface "B" to the inclined cylinder, and the oil returned from the cylinder acts on the piston through the oil port A. The oil returns to the oil tank through the upper holes A and B of the spool to the low oil channel. As shown in figure 2-19

(b) When the spool is pushed in (the pump is not working), no oil enters the cylinder interface "B", so that the pressure of part P will not rise. Therefore, the piston does not move, the oil from the cylinder interface "A" cannot return to the tank, and the cylinder does not move. As shown in figure 2-20



2-19

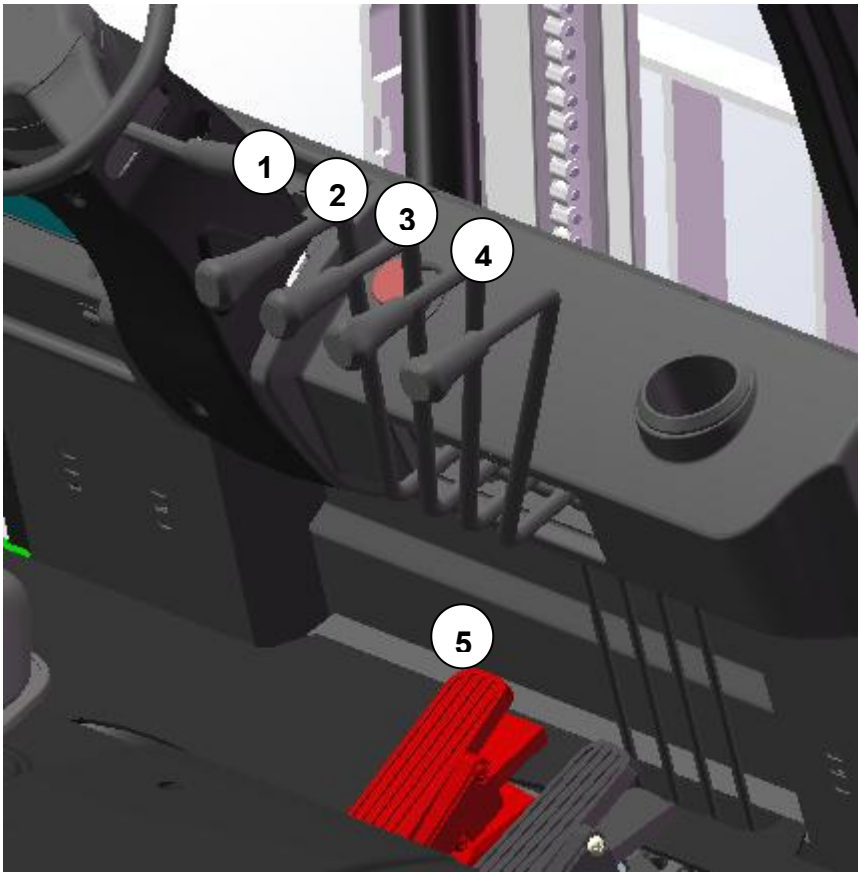


2-20

(4) Multi-way valve operation Figure 2-21

The multi-way valve is operated by a joystick, all of which are mounted on a connecting shaft, which is fixed to the car body by a bracket,

The joystick operates the slide valve through the connecting rod.



1. Lifting lever 2. Tilting lever 3. It belongs to joystick 1
4. Adopt a joystick 2 5 .Connecting rod

2-21 Multi-way valve operation

(5) Relief valve pressure adjustment

The set pressure of the relief valve is 13.5/16.8MPa；

⚠ **The pressure of the safety valve has been set by the manufacturer, and the user is not allowed to adjust it by himself.**

6.4 Lifting cylinder and lifting chain are shown in Fig. 2-22.

Lifting cylinder is single acting piston type, which is composed of cylinder block, piston rod, piston and cylinder head. In this series of forklifts, two lifting cylinders are installed behind the outer mast, the bottom of which is fixed on the lifting cylinder support of the outer mast with pins and bolts, and the top of the cylinder (that is, the top of the piston rod) is connected with the cross beam of the outer mast. The right lifting cylinder has a built-in speed limiting valve.

The piston is fixed on the piston rod with elastic steel wire, and the piston outer ring is provided with an oil seal and a support ring.

At the bottom of the cylinder is equipped with a cut-off valve, such as the mast rise, the sudden rupture of the high pressure pipe can play a role in safety protection.

Steel-backed bearings and oil seals are installed on the cylinder head to support the piston rod and prevent dust from entering.

4-4-2 multi-way valve removal/installation

1. Remove the multi-way valve connecting oil pipe

2. Remove the microswitch

3. Pull out the operation rod to connect the pin shaft
4. Remove the multi-way valve fixing bolts

4-5 Troubleshooting

4-5-1 pump motor

The fault phenomenon	Probable cause
Hydraulic pump motor is not working.	Bad connection or blown fuse. Check the battery connection. Check the key fuse. Check whether the motor of the hydraulic pump may cause the fuse to blow.
	Key switch, seat switch or line contactor is not closed. Close the seat and key switch. Use a multimeter to check the power flow through the seat switch, key switch, line contactor coil and line contactor. The key switch, seat switch and line connector must be turned off for the power steering function to operate.
	Not enough voltage. Recharge or replace batteries. Check if there is one or more defective cell in all cells. Check the specific gravity of each cell. The maximum density difference from the highest cell to the lowest cell shall not exceed 0.020 Sg (specific gravity). Check that the cable terminals fit tightly with the battery terminals and control panel connectors. Check whether the internal wires of the cable are broken.
	Hoisting and drive systems are not operating correctly.
When the battery does not continue to work properly Between.	The batteries mounted on the forklift trucks are too small. Study and question the use of forklifts under their full operating conditions, select and purchase the appropriate battery capacity to know the working hours.
	The battery is not fully charged during battery charging operation. Check that the batteries are evenly charged (charge all the batteries to the same weight). Check the battery charger for defects.
	The battery charge interval is too long or the charging battery cooling time is too short. Reduces battery operation duration. Extend the battery cooling time before charging before putting it into use.
	The battery has one or more defective battery cells, which may result in lower rated capacity and battery capability. Test and find defective cells. Replace defective batteries. The battery units are connected in series. A bad battery results in high power in series with other batteries Resistance. As the battery resistance increases, this reduces the speed of the motor. This can happen when other batteries are almost fully charged.
	Hydraulic systems consume too much battery power because the lifting and tilting devices or hydraulic controls are not correct for the operating cycle. Reduce the hydraulic relief valve setting to the capacity required for the application. Replace with a smaller hydraulic pump (if available). Check for mast restrictions during operation. Remove the quick disconnect connection and install the connector with low oil flow resistance.

	Check defective hydraulic control valves, pilot relief valves. Remove any restrictions in the hydraulic circuit. Check removable hydraulic accessories for limitations. Check sliding parts, bearing wear, hinge bindings, and necessary parts for the correct amount of lubrication.
	Hydraulic pump motor overheating. If the motor temperature reaches 155°C (311°F) Controllers do overheat to warn and reduce performance.
The hydraulic speed of the forklift is very slow	Pump motor control circuit overheating. If the temperature of the power unit reaches 100°C (212°F), the controller will experience overheating warnings and degraded performance.

4-5-2 The main hydraulic pump

fault phenomenon	Probable cause
Noise in the pump.	Low oil level
	The oil is too thick, ie too viscous
	Pump inlet line limited
	The worn parts in the pump.
	Oil is very dirty.
	Air leaks into the inlet line.
The oil temperature is too high.	Low oil level
	The oil passage is restricted.
	The relief valve is set too low.
	The oil is too thin.
	There is air leakage in the system.
	There is too much wear on the pump.
	The system is operating under too much pressure. The relief valve is set too high. Restrictions in flow control valves, check valves and oil lines.
Leakage at pump shaft seal.	The shaft seal is worn.
	Internal wear of pump body.
	Operating the oil level too low in the tank can cause suction on the seals.
	During installation, the seal is cut at the shoulder of the pump or keyway.
	Sealing lip is dry and hardened by heat.
The pump can't move fluid.	The oil content in the tank is low.
	Pump inlet line limited.
	There e is a leak in the pump inlet line. Loose bolts. Defects in bay suction line.
	The viscosity of the oil is wrong.
	There is too much wear on the pump.
	Pump shaft failure
	Pump bolts do not have the correct torque.

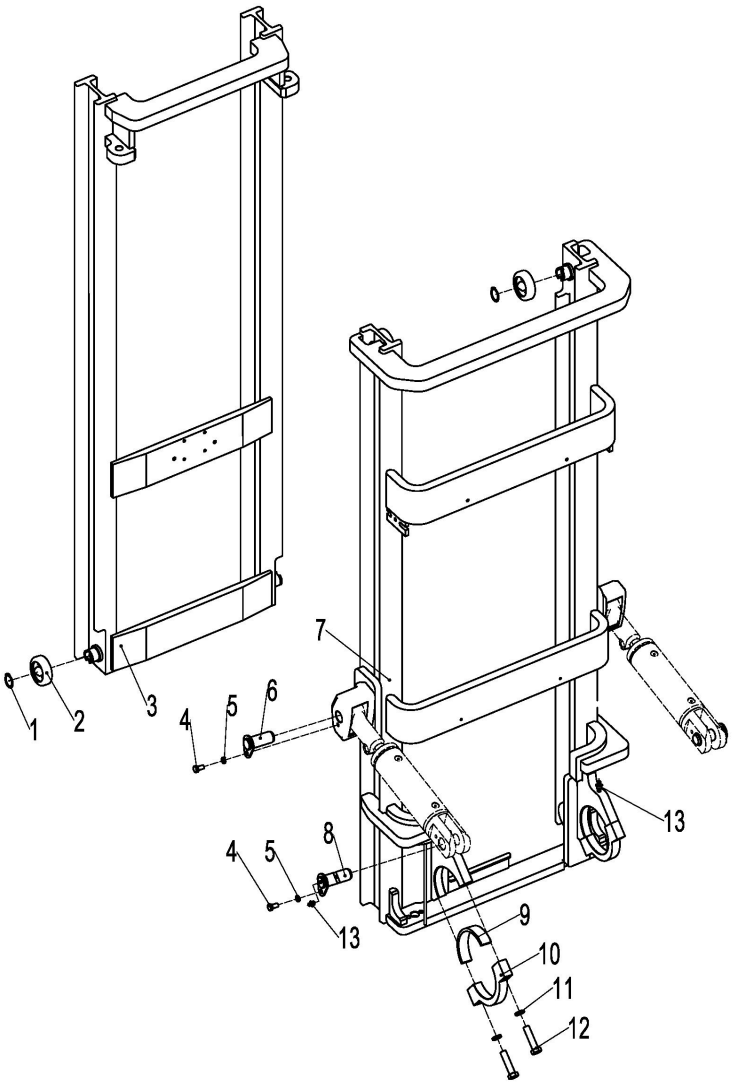
5 .Lifting system

5-1 overview

The lifting system is a two-stage roller vertical lifting and contracting system, which is composed of inner and outer masts and cargo forks.

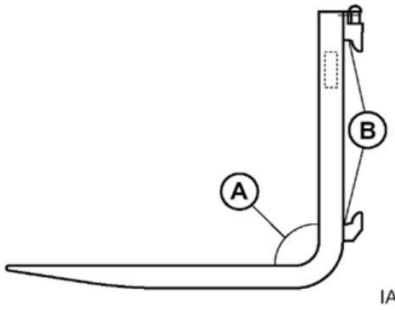
The inner and outer masts are welding parts. The bottom of the outer mast is mounted on the drive axle with support.

The middle part of the outer mast is connected with the frame through the tilting cylinder, and it can tilt forward and backward under the action of the tilting cylinder.



1. Elastic stop for shaft
2. Composite roller
3. Inner mast
4. Bolts
5. Spring washer
6. With trunnion
7. Outer mast
8. With trunnion
9. Bearing bush
10. Cover
11. Spring washer
12. Bolts
13. Oil cup

5-2 Fork service



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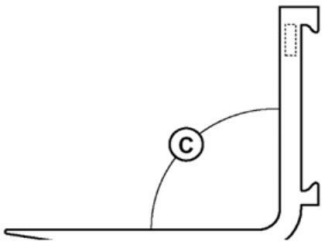
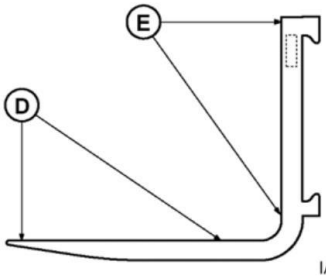
A. Fork Check
Forks should be inspected at least once every 12 months. If the forklift is made in multiple shifts or heavy duty
For industrial use, it should be checked once every six months.

1. Check the forks carefully for cracks. Particular attention should be paid to the heel
(A), all welding areas and mounting brackets (B). Check the hang
The fork on the hook forklift is used on the top and bottom of the fork Hook.
The fork with the crack should be replaced



2. Check the Angle between the upper surface of the fork blade and the front surface of the fork handle.

If the Angle (C) exceeds 93 degrees or deviates more than 90 degrees
Forks should be discontinued if the original Angle exceeds 3 degrees, such as some specials
The special application is shown in the fork.



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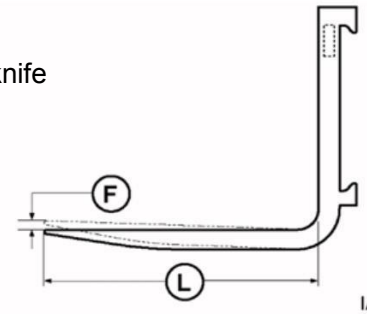
3. Inspect the upper surface of the blade (D) and the front surface of the shank (E) with a straight edge
The straightness of.

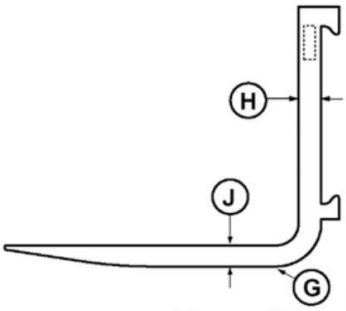
If the deviation in straightness exceeds 0.5% of the blade length and/or the knife
The height of the handle is 5 mm / 1000 mm (0.18 "/ 3"),
The front fork should be discontinued.



IA1O4095

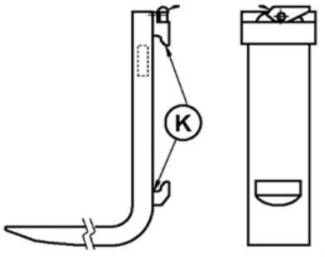
4. When mounting on the fork rack, check the connection
between one fork tip and another height difference.
Differences in the height of the fork tips may result in uneven loads
Support and cause problems entering the load.

The maximum recommended difference in fork tip height (F) is 6.5 mm. for pallet forks
Meter (0.25 in) and fully tapered fork 3 mm (0.125 in)
Inch). The maximum height of the fork tip between two or more forks
Perhaps the difference is 3% of the leaf length (L).



IA1O4096

If the difference in fork tip height exceeds the maximum allowable difference, then
Switch to a fork or two.



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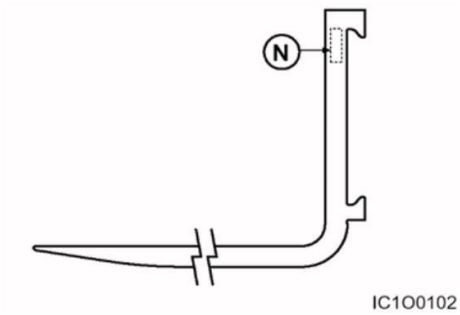
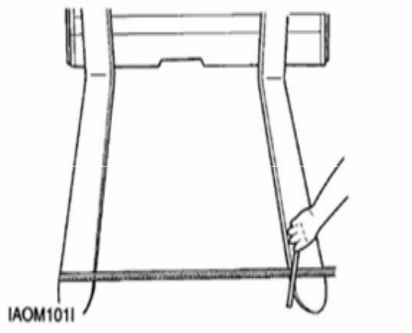


5. Check whether the front fork blade (J) and shank (H) are worn, especially
Notice the following (G). If the thickness is reduced to 90% of the original thickness
Or smaller, the front fork should be replaced.

Fork blade length may also be reduced by wear, especially in
Tapered fork and press plate.
If the blade length no longer fits the expectation
Then the fork will be replaced from the maintenance.



6. Check the fork frame (K) for wear, extrusion and other local deformation.
This can cause excessive lateral swing of the forks. On the hook fork
Large gaps may cause them to fall off the carrier.
Forks showing clear signs of damage should be discontinued.

Check the locator lock and other fork fixtures to make sure they are in place
And it's working.

The hook fork uses the spring pin (M) located in the top hook to engage the notch in the top bracket bar to hold the fork in place.

When adjusting the front fork spacing, prevent the fork from sliding out of the end of the slide frame through the block. These stop blocks are located at both ends of the slide frame and the bottom fork hook
In the path of. In some cases a load backrest extension may be used instead of a stop block.

The shaft mounting fork may be used to either side of the fork using a sleeve or gasket on the shaft. They can also use U-bolts, pins or similar devices,
The fork is engaged through the top structure of the bracket.

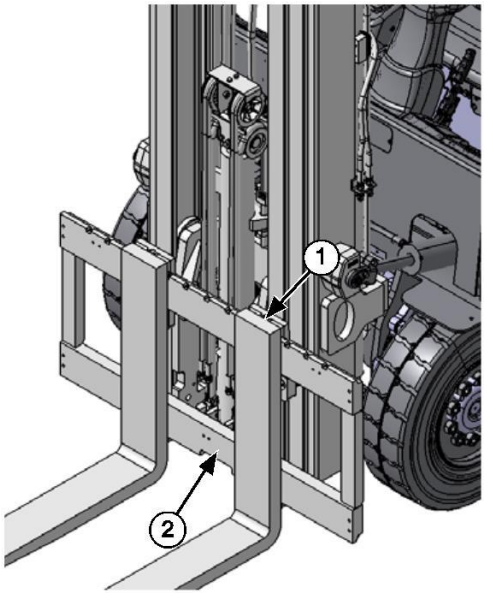
8. Check that the cross (N) is legible. Update the markup as needed to maintain legibility.

9. Lift the mast and operate the tilt control lever until the top surface of the fork is parallel to the floor. Place two straight bars of the same width as the bracket across the fork.

10. Measure the distance from the bottom of each bottom of the two rods to the floor. For fully tapered and polished (FTP) forks, the forks must be parallel to within 3 mm (.12 in.) and the full length of all other forks must be 6.4 mm (.25 in.).

11. Place a fork (tip one-third) under a clamp that does not move. Then carefully operate the tilt controller until the back of the truck is just lifted off the floor. Perform the same procedure with the second fork. Repeat step 9.

B. Fork removal/installation



1. Completely lower forks.
2. Unlock the latch at area (1).
3. Slide fork into the center groove (2) and remove it.
4. Follow these steps in reverse order to install the front fork.

Note: During the disassembly process, check forks and forks and replace them if they may be damaged. Any part that is broken or excessively rusted.

5-3 Side shifter service

A. Standard side shifter and cylinder removal/installation

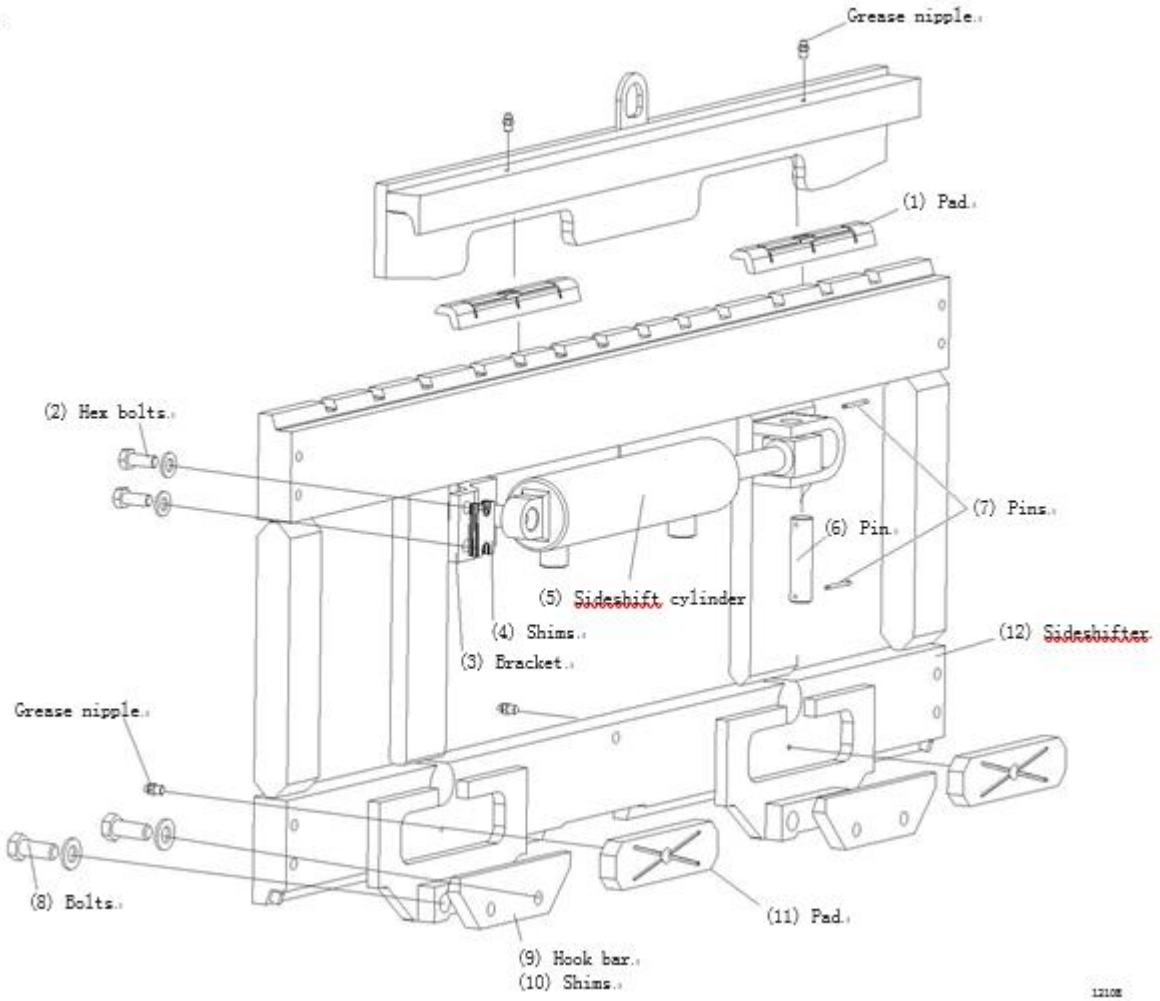


图 5-46

Preliminary steps

1. Lift the bracket and place a block under it.
2. Lower the bracket to the wooden block and then fix the crane on the load backrest.
3. Remove the fork
4. Eliminate hydraulic pressure by moving the lever back and forth several times by closing the key

Residual pressure in the system

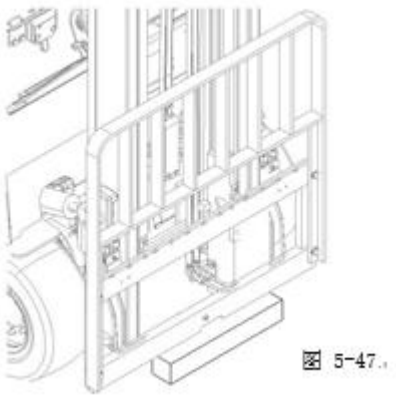


图 5-47

procedure

1. Provide corresponding marks for the hoses and ports of the side moving cylinder as reference for assembly.
2. Disconnect the hose from the side transfer cylinder, then plug and cover the hose and end. Get the pan ready to grab anything from the hose and cylinder
Oil flowing out of ports.
3. Remove the hex bolt and gasket, then remove the gasket. Apply thread glue to hexagon bolts during installation. During installation, adjust the thickness of the gasket so that the clearance between the bracket and the cylinder is a minimum of 1.5 mm (0.06 in).
4. Slide the shifter out of the bracket. When installing, check whether the clearance between the bracket and the side-shifter matches. If this is not the case, the hook bar must be cushioned with gaskets on each side. They can be removed by removing the bolts and gaskets. After installation, lubricate all gaskets by injecting grease through their respective nozzle.
5. After removing the pin, pull out the split pin and remove the side shifting cylinder.
6. Follow the above steps in reverse order to install the side shifter body and side shifter cylinder.

5-4 The chain service

A. Chain wear inspection
To check for chain wear, you must first find the chain spacing
1. The lifting bracket is sufficient to exert tension on the lifting chain.
2. Place the resting pointer of the chain wear gauge on the top pin of the link.
3. Place the sliding pointer on the lower pin of the chain link.
4. Be sure to line both Pointers in the same position on both pins to get an accurate reading.
5. Fix the sliding pointer in place and read the scale on the meter to find the chain pitch.
After finding the chain spacing, start the wear check:
1. Place the sliding pointer on one of the three squares at the bottom of the meter scale. ascension
2. Place the window of the pointer square of the chain spacing found above
3. Fix the measuring instrument on the other side of the lift chain again so that the fixed pointer rests on the top pin of one of the chain links.
4. With the pointer resting the entire length of the lifting chain, move and slide the pointer until it is aligned with the top pin of the other link so that the window of the pointer remains on the correct square found in Step 2.
5. If the chain wears too much, replace the lifting chain

B. Chain tension check

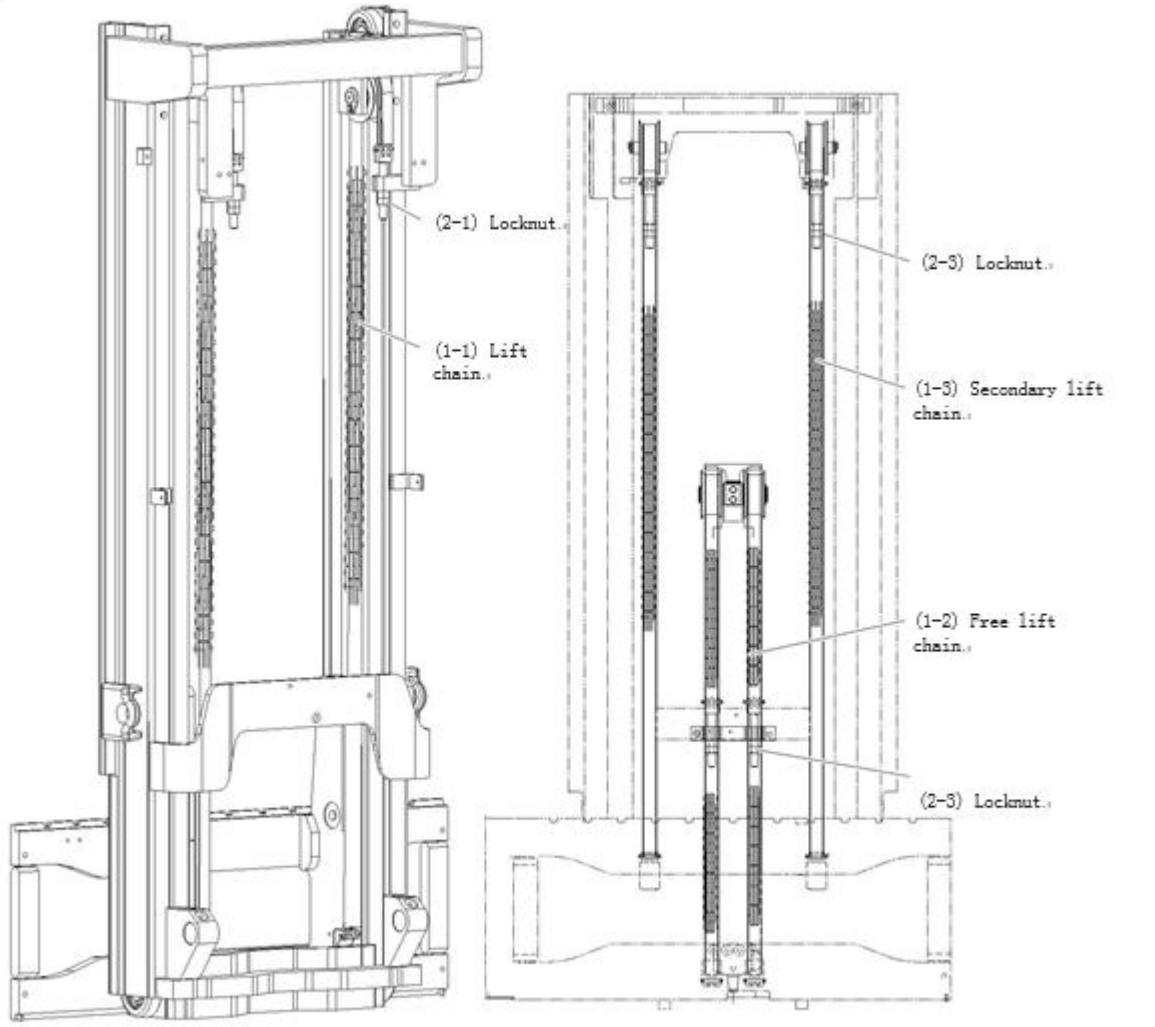


图 5-52

For safe operation, the tension of each pair of chains on the mast shall be the same.

The chain of STD

1. Lift the bracket and place the weight on the fork.
2. Gently push the two lifting chains with your hands to check the tension.

If their tension is lopsided, follow the tone below

Whole procedure operation.

3. As the bracket rises, the block is located below.
4. Lower the bracket onto the block to release tension from the chain.
5. Tighten or loosen the lock nuts (2-1) on both sides of the bracket to increase or decrease chain tension as required.
6. After adjustment, place the thread glue on the thread of the lock nut (2-1).

Chain for FFL/FFT

1. Perform the same operation for the STD on the free lift chain (1-2) and adjust it using the lock nut (2-2).
2. After completely lifting the slide frame, further lift the mast and apply tension to the second lifting chain (1-3).
3. Gently press the two auxiliary lifting chains (1-3) with your hand to check the tension.

If their tension is unbalanced, follow the following adjustment procedure.

4. With the internal department frame rising, the position of the block below.
5. Lower the inner frame onto the block to release tension from the chain.
6. Tighten or loosen the lock nuts (2-3) on both sides of the bracket to increase or reduce the chain tension as needed.
7. After the adjustment, put the thread glue on the thread of the lock nut (2-3).

C.Chain removal/installation

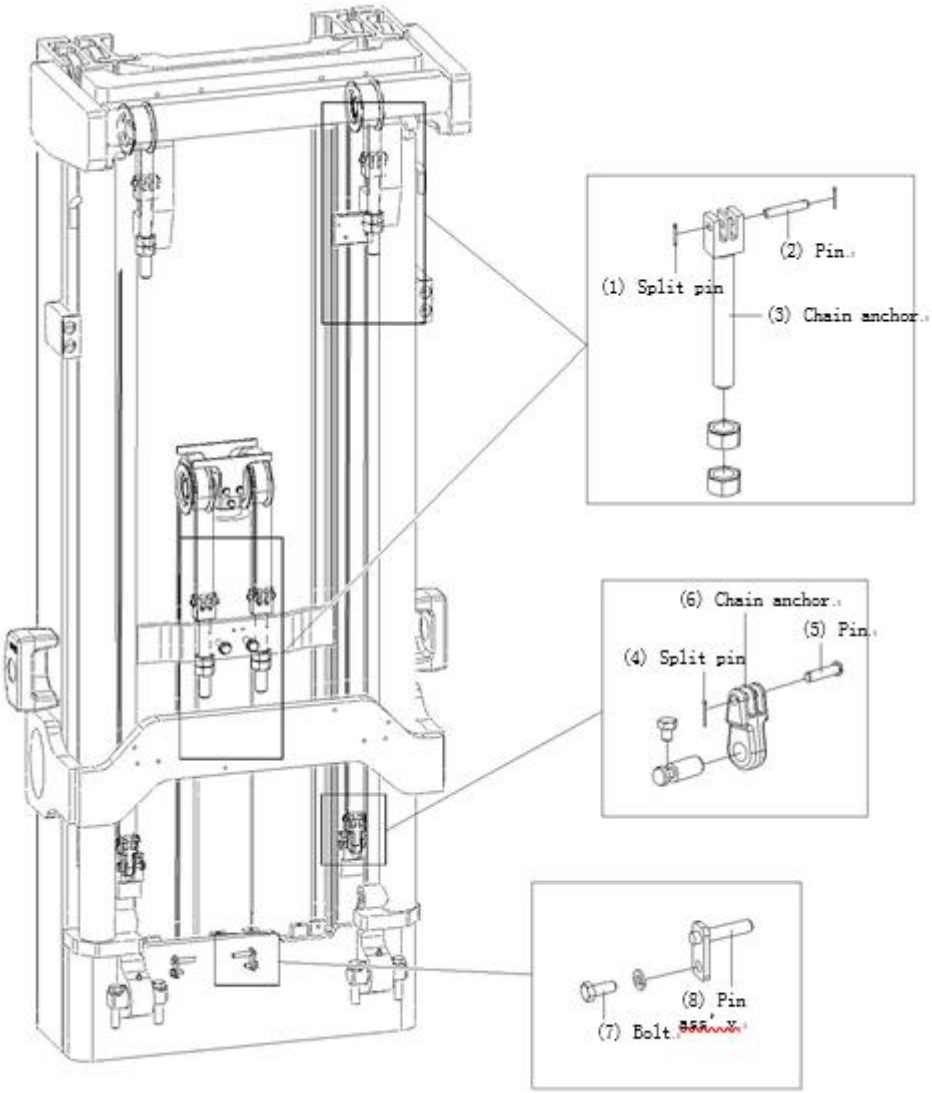


图 5-54

Level 2 / Standard Portal Frame Chain Removal/Installation

1. Lift the cart and place blocks under it.
2. Lower the bracket onto the block in order to release tension from the lifting chain.
3. After removing the split pin (1), pull out the split pin (2) and remove the chain from the chain anchorage member (3).
4. After removing the split pin (4), pull out the split pin (5) and remove the chain from the chain anchor (6).
5. Install the lift chain in reverse order.
6. Check that the chain has the correct tension.

Disassembly/installation of main lifting chain (for FFL/FFT)

1. Lift the cart and place blocks under it.
2. Lower the bracket onto the block to release tension from the main lifting chain.
3. After removing the split pin (1), pull out the split pin (2) and remove the chain from the chain anchorage member (3).
4. Remove the bolt (7) and washer and remove the pin (8).
5. Follow these steps in reverse order to install the main lifting chain.
6. Check that the chain has the correct tension.

5-5 tilting cylinder service

A. Tilted cylinder alignment

Danger!

The mast can fall over and squeeze, causing serious injury. After adjustment, make sure the piston rod is firmly mounted in the U-clip

Note: Misaligned cylinders will create additional stress in the mast assembly and mast hinge areas. To ensure the tilting cylinder is aligned, follow these steps:

Follow these steps:

Preliminary steps

Before starting the adjustment, check to see if:

1. The two oil cylinders stop evenly at the rear end and tilt forward;

2 Two oil cylinders are evenly telescopic;

3. There is no distortion on both sides of the mast;

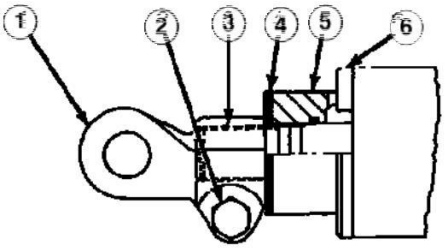
4 When tilting completely forward and backward, the tilt Angle of the mast falls within the specification range on the forklift nameplate (measure them using tilt indicator or protractor)

5 When fully extended, the length difference between the cylinder rods is within 3.18 mm (0.125 in).

If you do not meet any of the criteria, follow the steps below to adjust

The alignment of the inclined cylinder.

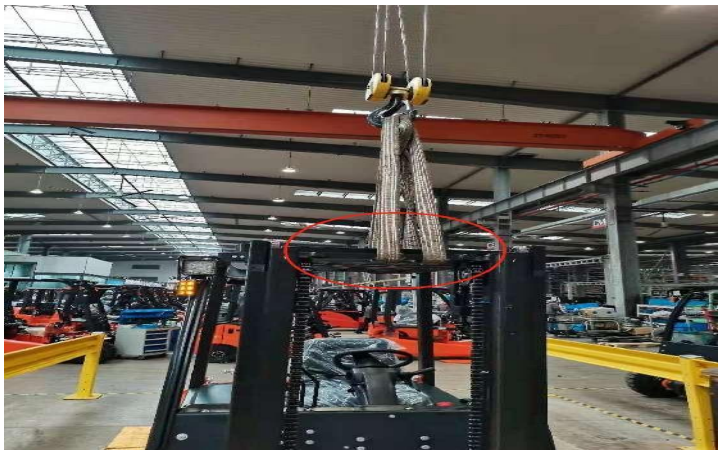
Procedure



1. Tilt the mast completely forward.
2. Loosen the nut (2) that holds the cylinder rod in the U clip (1).
3. Screw the rod out or into the U-clamp to reach the correct length of the two cylinders.
For tilting cylinders with the tilting back limit group option, you need to move the gasket (5) before adjusting the rod.
4. Install nut (2) and tighten it to 95±15 N·m (70±10lb·ft) of torque.
Perform the following steps only if the tilt cylinder on the vehicle contains the tilt limit group option.
5. Tilt the mast completely back.
6. Install gasket (4) so that there is no gap between gasket (5) and head (6).

B. Integral disassembly/installation of inclined cylinder

1. Secure the mast with sling.



2. Remove the inclined cylinder oil pipe.

3. Pull out the fixed pin shaft on the mast and the frame to remove the oil cylinder.

4. Install the inclined cylinder in reverse order.

D. Tilting cylinder disassembly/assembly

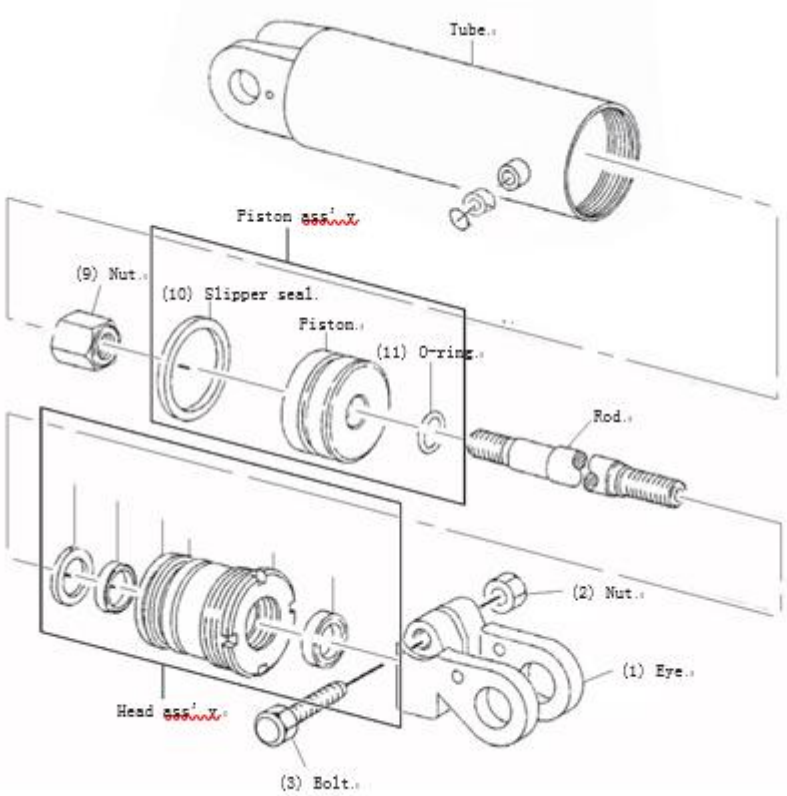
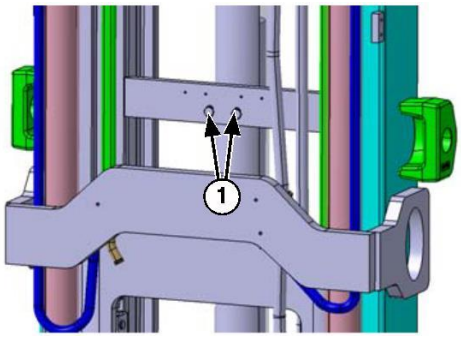


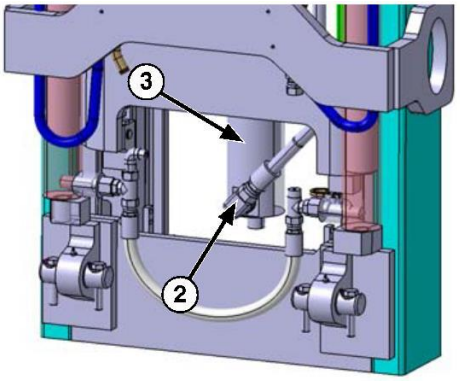
图 5-60

Tools required: claw wrench

1. Place the inclined cylinder in the vise, then remove the rod assembly using a claw wrench.
Mounting torque: 270±30 N·m (200±22 lb·ft)
2. Loosen the nut (2) and bolt (3) and remove the eye (1).
Mounting torque: 95±15 N·m (70±11 lb·ft)
3. Remove the buttocks from the head.
4. Remove sealing ring (4).
Install with lips facing head.
5. Remove the U-shaped cup (5).
6. Remove the O-ring (6).
Install the support ring contact side so bent.



7. Remove the spare ring (7).
8. Remove the dustproof sealing ring (8).
Install with lips facing head.
9. Remove nut (9).
Mounting torque: 402±29 N·m (297±21 lb·ft)
10. Remove piston assembly.
11. Remove the sealing ring of the slippers (10).
12. Remove the O-ring (11).
13. Follow these steps in reverse order to assemble the inclined cylinder.



Note: After the assembly of the tilt cylinder is complete, be sure to reseal the ports with the dust cover and plug。

5-6 Main Lifting Cylinder Service

A. Overall disassembly/installation

of the main lifting cylinder

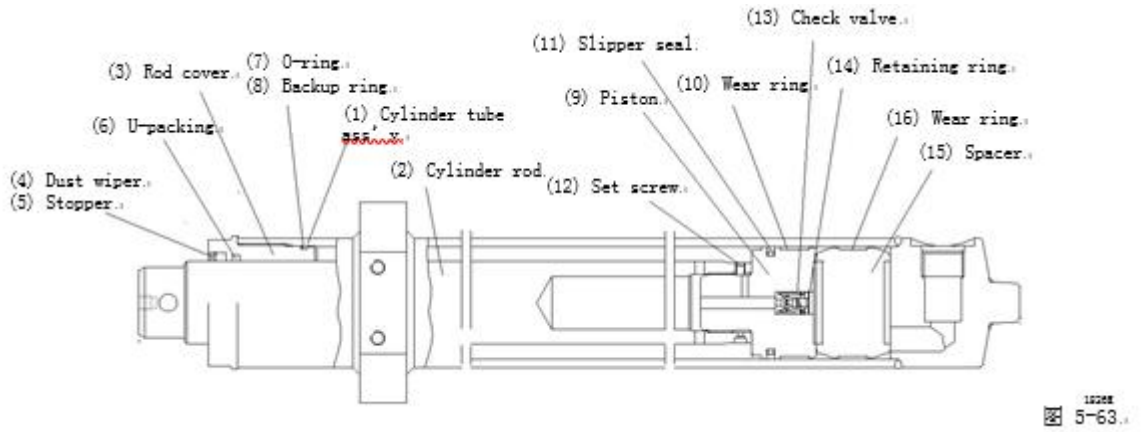
Preliminary steps

1. Remove bracket chain.
2. Remove bracket and keep all remnants
There's a complete release of stress.
3. Fix the elevator on the master cylinder.
Prepare a pan of oil.

procedure

1. Remove bolts (1).
2. Disconnect the hydraulic hose (2)
3. Remove the main lifting cylinder (3).
4. Install the inclined cylinder in reverse order.

B. Disassembly/assembly of main lifting cylinder



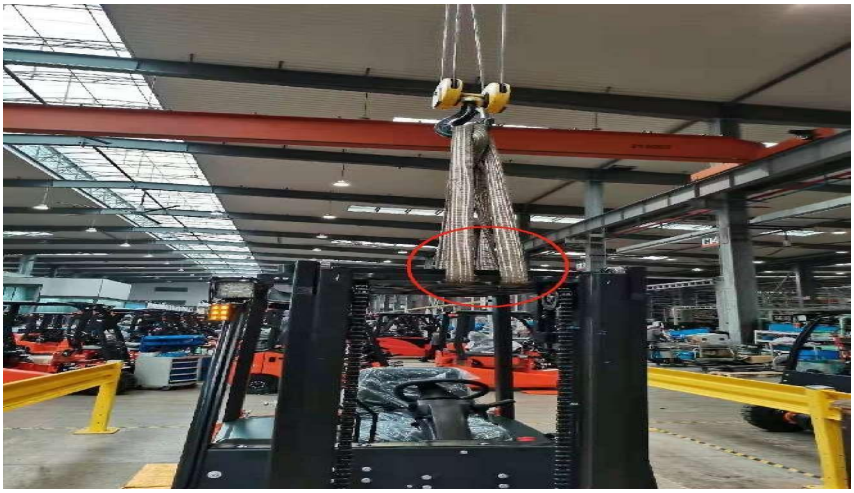
Tools required: claw wrench

1. Remove the lever cover (10) with a claw wrench.
2. Remove the O-ring (7) and support ring (8) from the outside diameter of the rod cover (3), and remove the dust collector (4), plug (4) and U-ring (6) from the inside. To install, install the U-shaped gasket (6) with the lip edge facing outwards. Check the condition of dust collector (4).
3. Fix the cylinder tube assembly (1) in the vise and remove the cylinder rod (2).
4. Loosen the setting screw (12).
5. Unscrew piston (9)
6. Remove sliding seal ring (15) and wear ring (10) from the outer diameter of piston (9) and remove stop ring (14) and check valve (13) from the inside.
7. Remove the wear ring (16) and gasket (15).
8. Check the condition of the seals and replace the damaged or worn seals.
9. Follow these steps in reverse order to assemble the main lift cylinder.

Note: After completing cylinder assembly, be sure to reseal the ports with a dust cover.

5-7 mast assembly disassembly

1. Eliminate hydraulic pressure by moving the lever back and forth several times by closing the key Residual pressure in the system
2. Remove the fork.
3. Fix the sling on the mast and tighten the sling with the crane.



4.Remove the hoisting connecting oil pipe

5.Remove the inclined pin bolt connecting the mast and pull out the pin shaft

6.Remove mast and front axle retaining block

7 .It is advisable to lower the mast

5-8 troubleshooting

fault phenomenon	Probable cause
The hydraulic system does not lift the load.	The existence of air leakage, so that air into the hydraulic pump inlet side of the hydraulic system
	The relief valve opens at low oil pressure.
	Too much wear on the hydraulic pump
	The load is not correct (too heavy).
	mast is not aligned with other lifting parts and cannot move freely.
	There is not enough lubricant for moving mast parts.
	Bracket or mast bracket roller (bearing) worn, do not move (stuck)
Lifting cylinder extends too slowly.	Insufficient fuel supply for lifting cylinder.
	Bad seal of lifting cylinder
	mast is not aligned with other lifting parts and cannot move freely.
	There is not enough lubricant for moving mast parts.
	Bracket or mast bracket roller (bearing) worn and not moving (stuck)
mast does not move smoothly	Air in a hydraulic system.
	Relief valve stem may be defective.
	There is not enough lubricant for moving mast parts
	Loading rollers (bearings) are defective or not properly adjusted.
The mast will not be lowered completely or at all.	Lifting spool (lifting lock) is damaged and contaminated
	Lifting cylinder damaged or bent.
	The load roller is defective (bearing) or not properly adjusted.
	There is not enough lubricant in the moving frame area.
masts do not tilt correctly or move too slowly。	The existence of air leakage, so that air into the hydraulic pump inlet side of the hydraulic system.
	The relief valve opens at low oil pressure.
	Too much wear on the hydraulic pump.
	The internal valve of the tilt spool is stuck.
	Control valve tilt spool is limited
	The piston rod is damaged or failed on the inclined cylinder.
Forks are not lowered correctly.	The lifting spool in the multi-way valve has limitations caused by foreign bodies and cannot be operated freely.
	Lifting cylinder flow control valve has a limit.
	There is a limit to the excess flow protector on the lifting cylinder.
	Air in a hydraulic system.
	mast is not aligned with other lifting parts and cannot move freely.
	The transport chain needs to be adjusted.
	There is not enough lubricant for moving mast parts.
	Forks or mast roller (bearing) worn, do not move (stuck).
Lifting or tilting cylinders cannot be maintained Position of valve control lever in middle position.	The spool cannot hold in position because the spring of the spool is weak or damaged.
	Control valve leakage caused by spool wear.
	Bad check valve or flow control valve in control valve.
	Cylinder line or piston seal ring leakage.
	There is strange thing in the control valve.

6 Steering system

6-1 overview

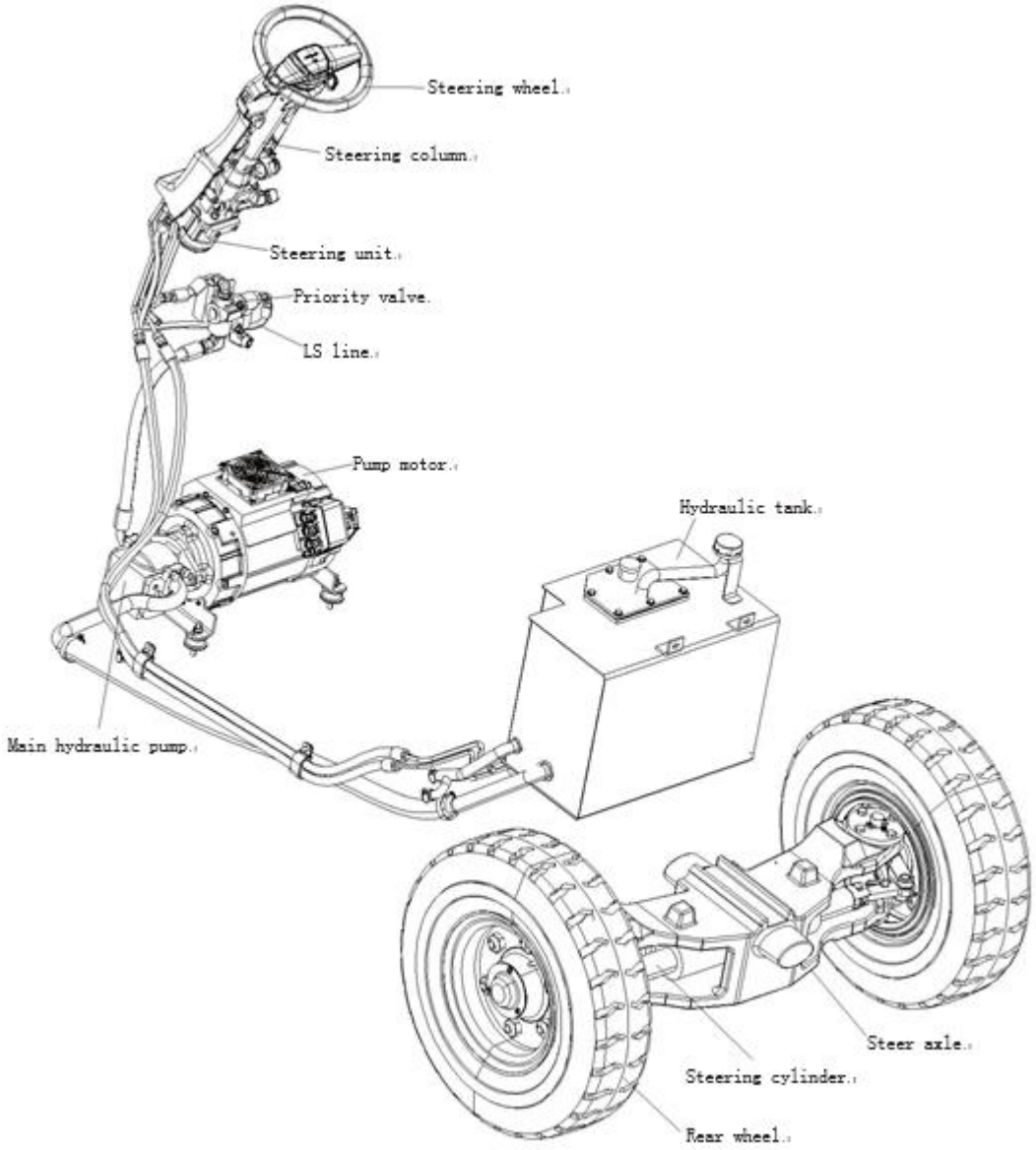


图 6-1

The steering system is a set of devices used to turn a vehicle to the left or right. In this model, the steering system is hydraulically operated and consists of a control group and an actuator group:

The control group determines the speed and direction of steering and supplies hydraulic oil to the operation group accordingly. This group includes the steering wheel and steering device. The operation group will transfer hydraulic power from the control section to mechanical power through hydraulic oil to steer the rear wheels. The set consists of a steering cylinder, a steering shaft and two rear wheel assemblies. [Section 6-3] Unlike cars, forklifts use the rear wheels as steering wheels because their priority is not speed but to ensure a wider steering Angle in narrow places.

6-2 function

A. Steering control mechanism

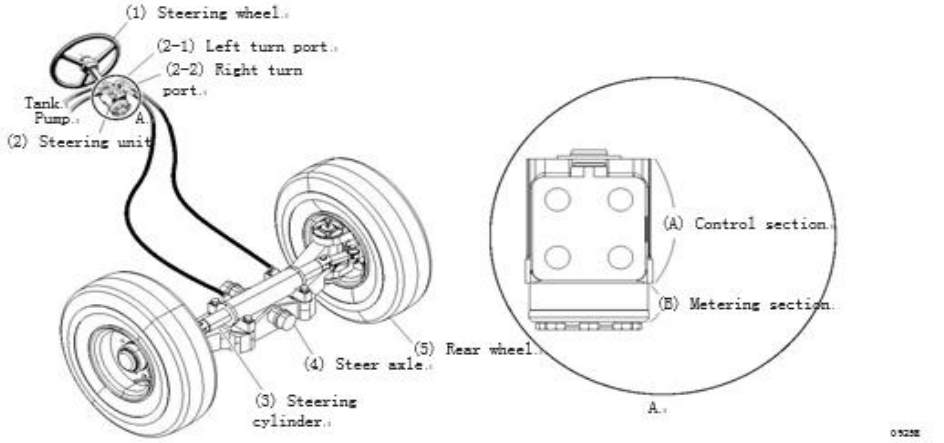


图 6-4

Once the steering wheel (1) is rotated, the spool in the steering unit (2) is also rotated by the steering wheel column splined between them. Turn the spool to the steering device to adjust the amount of oil discharged into the steering cylinder by the following means:

1• The control section (A), depending on the direction of steering wheel rotation, determines which side of the steering chamber distributes the oil and then transfers the oil supply from the hydraulic pump to the metering section (B). Once through the metering section (B), the oil returns to the control section (A) to leave through the left turn (2-1) or the right turn (2-2), depending on the direction of the steering wheel.

2• The metering section (B) is used as a small pump to control the amount of oil delivered to the steering cylinder by the device. The vehicle's steering Angle increases proportionately to the amount of oil sent to the steering cylinder, which is determined by the speed of the steering wheel. The oil discharged from the left port (2-1) flows to the right of the steering cylinder (3), pushes the cylinder left and turns the rear wheels (5) left. The oil discharged from the right port (2-2) flows in reverse and causes the rear wheel (5) to turn to the right. For more information on the different operations of cylinders and wheels.

B. The neutral position

When the steering wheel is in neutral, the oil groove of the spool and the oil hole of the sleeve are not aligned with each other, so the oil reaching the sleeve cannot enter the spool, or the steering cylinder. Therefore, since the rear wheels can neither turn left nor right, the vehicle goes straight ahead. Because all the pump oil traveling along the LS line is discharged when the spool is in neutral, the priority valve is difficult to be pushed by the LS pressure on its spring side, so it is opened by the pump oil pressure. As a result, most of the pump oil is delivered to the control valve, while the steering unit only supplies some low-pressure oil. This small supply causes the check valve to weaken its push at the inlet, so that only a small amount of pumped oil reaches the steering unit through the valve. This volume fills the steering device so that it can respond quickly to the steering wheel.

C. turn left

When the steering wheel is turning

When the spool is splined to the steering wheel, turn the steering wheel to rotate the spool and its meshing pin and drive. The sleeve is also engaged with the pin, but the diameter of the pin hole in the sleeve is greater than the diameter of the pin itself; Therefore, after the spool begins to rotate for some time, the sleeve will not rotate. Therefore, the oil holes and oil grooves are now not aligned with each other at the neutral point, and the oil sleeve outside the pump flows into the spool, bringing two changes. First, when the spool becomes full, it no longer discharges the LS (load sensing) line inflow, so the pressure increases throughout the LS line, closing the priority valve. Here, most of the pump oil is directed to the steering unit, where access to the control valve is blocked. The high pressure oil then overcomes the resistance of the check valve spring in the inlet and enters the steering. Second, the increased pressure oil enters the spool and then flows through the channel into the metering section. Spline driven, the gear rotor in the metering section rotates with the steering wheel to pump oil in. The pumped oil is discharged through the oil circuit to the left port and then to the right chamber of the steering cylinder. The oil entering the right chamber pushes the piston to the left, making the vehicle turn left. The steering speed increases in proportion to the amount of oil expelled and the pumping speed, which is determined by the speed of the steering wheel. As the steering wheel turns, pressure oil from the pump flows through this channel, increasing the steering Angle until the steering cylinder reaches its limit.

When the steering wheel is stationary

Once the operator stops turning the steering wheel, the spool, pin, drive and stator also stop turning, and the centering spring returns the spool and sleeve to their original position. Then, the pilot signal sent to the priority valve via the load sensing line stops and only a small amount of pressurized oil is supplied. Even this small amount cannot enter the spool, and the oil in the spool cannot enter the metering section through the channel. The oil in the metering section is also not pumped out to the left port because the steering wheel is no longer turning. Therefore, all the oil flow stops and the steering Angle of the wheel remains the same.

D. turn right

When the steering wheel is stationary

When the spool is splined to the steering wheel, turn the steering wheel to rotate the spool and its meshing pin and drive. The sleeve is also engaged with the pin, but the diameter of the pin hole in the sleeve is greater than the diameter of the pin itself; Therefore, the sleeve does not rotate after the spool begins to rotate for some time. Therefore, the oil holes and oil grooves are now not aligned with each other at the neutral point, and the oil sleeve outside the pump flows into the spool, bringing two changes. First, when the spool becomes full, it no longer discharges the LS (load sensing) line inflow, so the pressure increases throughout the LS line, closing the priority valve. Here, most of the pump oil is directed to the steering unit, where access to the control valve is blocked. The high pressure oil then overcomes the resistance of the check valve spring in the inlet and enters the steering. Second, the increased pressure oil enters the spool and then flows through the channel into the metering section. Spline driven, the gear rotor in the metering section rotates with the steering wheel to pump oil in. The pumped oil is then discharged through the oil channel to the right port and then to the left chamber of the steering cylinder. The oil entering the left chamber pushes the piston to the right, turning the vehicle to the right. The steering speed increases in proportion to the amount of oil expelled and the pumping speed, which is

determined by the speed of the steering wheel. As the steering wheel turns, pressure oil from the pump flows through this channel, increasing the steering Angle until the steering cylinder reaches its limit.

When the steering wheel is stationary

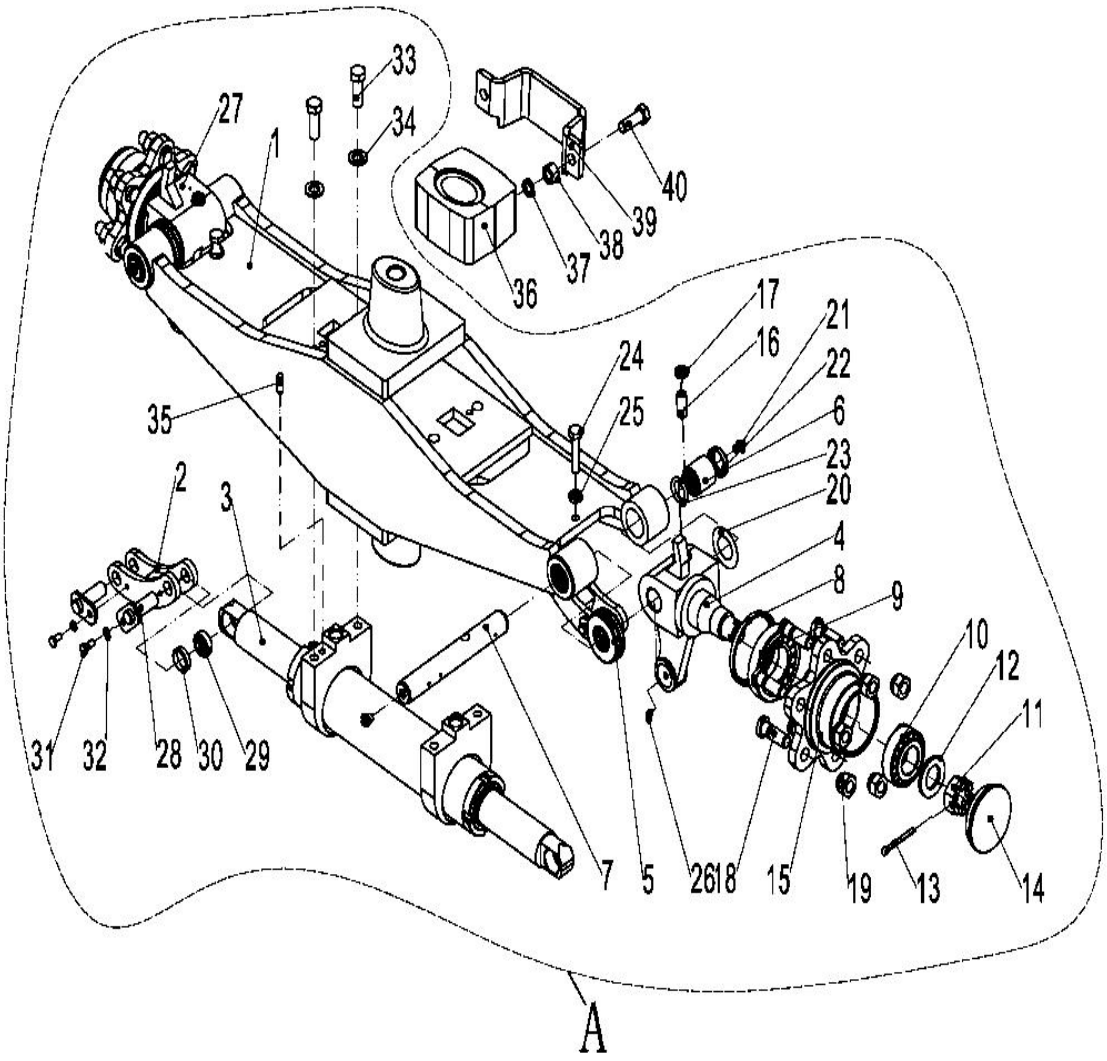
Once the operator stops turning the steering wheel, the spool, pin, drive and stator also stop turning, and the centering spring returns the spool and sleeve to their original position. Then, the pilot signal sent to the priority valve via the load sensing line stops and only a small amount of pressurized oil is supplied. Even this small amount cannot enter the spool, and the oil in the spool cannot enter the metering section through the channel. Measurement of

The oil is not being pumped to the right port because the steering wheel is no longer turning. Therefore, all the oil flow stops and the steering Angle of the wheel remains the same.

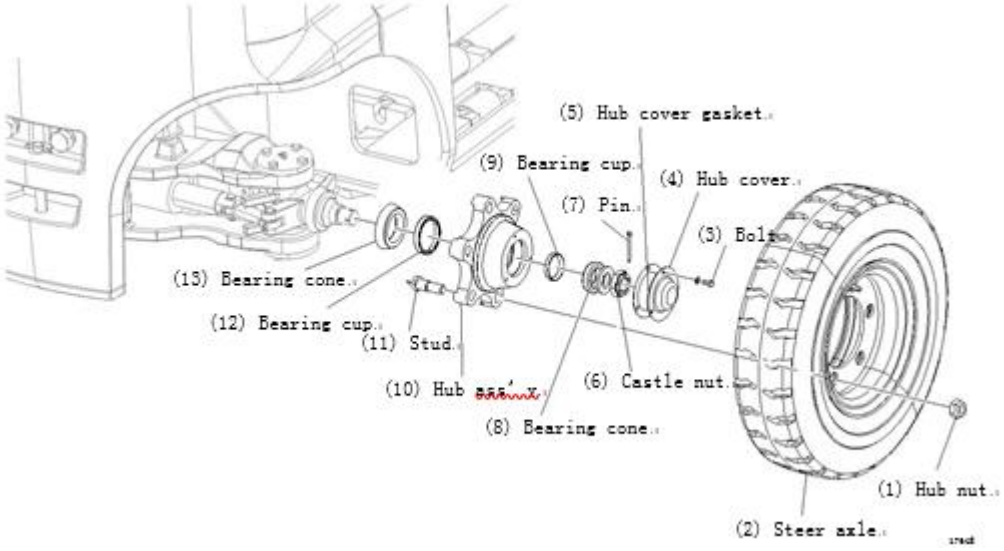
6-3 Steering axle

The steering axle is a welded structure with box cross section (as shown in the figure below), which is composed of steering axle body, steering cylinder, connecting rod, steering knuckle, steering wheel and other parts. The steering trapezoid adopts the crank slider mechanism, and the steering knuckle is driven by the cylinder piston rod through the connecting rod to make the steering wheel offset, so as to realize the steering. The steering axle is fixed to the tailstock at the rear of the frame by the front and rear pins through the fixing plate, that is, the damping pad, with bolts, so that the axle can swing around the pin shaft. There is a steering knuckle on the left and right sides of the steering axle. The rear wheel hub is installed on the steering knuckle shaft with two tapered roller bearings. The wheel is fixed to the wheel hub through the rim. Oil seal is installed inside the bearing to keep the grease in the hub and steering knuckle cavity

6-3-1 Appearance and specification



6-3-2 Rear wheel and hub removal / installation / adjustment



Tools needed: floor jack and torque wrench

Preliminary steps

1. Raise the rear of the vehicle with floor jack and support it with wooden block.

Rear wheel removal / installation

1. Loosen six hub nuts (1).
2. Remove the rear wheel (2).
3. Follow the above steps in reverse order to install the wheel.

Rear hub removal / installation

1. Remove three bolts (3), then remove hub cover (4) and hub cover washer (5).
2. Remove the pin (7), then the nut (6) and washer.

During installation, when turning the wheel, slowly tighten the castle nut (6) to 200 ± 10N·m（148 ± 7lb·ft）。completely

Loosen the castle nut (4) and then tighten again to a torque of 45-55 n · m (33-41 LB · ft).

3. Remove the bearing cone (8).
4. Delete hub Ass'y (10).
5. Remove the bearing covers (9, 12) from both sides of the hub assembly (10).

During installation, use multipurpose grease to lubricate the contact surface of the cup.

6. Clean the hub assembly (10) and make sure it is free of grease.

During installation, fully lubricate the interior of the hub assembly (10).

7. Remove the bearing cone (13) from the knuckle.
8. Follow the above steps in reverse order to install the hub.

6-3-3 Rear axle removal / installation

Tools needed: floor jack

Preliminary steps

1. Lift the rear of the vehicle and support it with wooden blocks.

Make sure that the stop is under the frame, not under the axle, so that the vehicle may keep lifting even after the floor jack.

2. Remove the two rear wheels.

procedure

1. Disconnect the hydraulic hose from the two tanks.
2. Remove four bolts and washers.

Installation torque: 240 ± 40 N·m（177 ± 30 lb·ft）

3. Use floor jack to pull out steering shaft (3). The steering axle weighs about 184 kg (405 lb).
4. Follow the above steps in reverse order to install the steering shaft.

6-3-4 Link rod and steering cylinder removal / installation

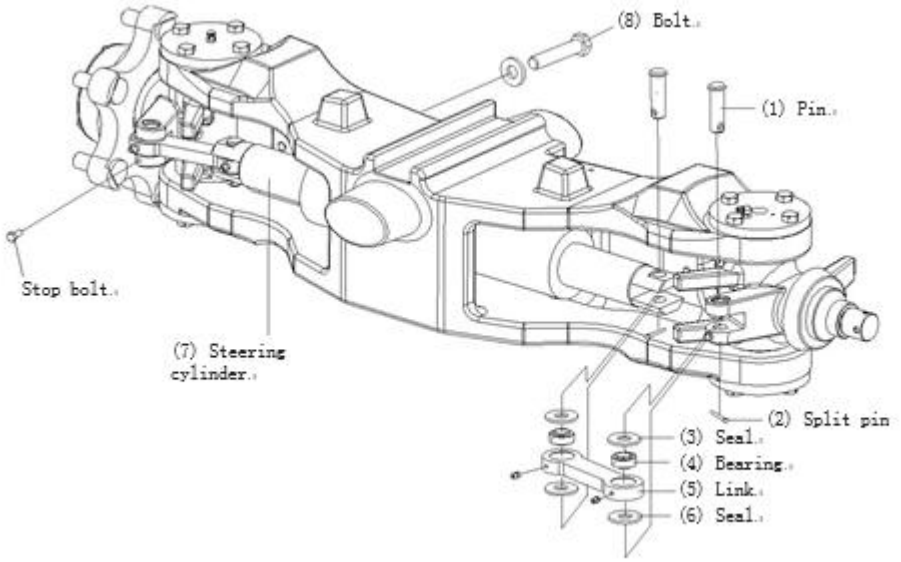


图 6-32

Preliminary steps

1. Remove the steering shaft.

Link bar removal / installation

1. Loosen the bolt (2) at the shaft end.
2. Pull out the pin (1).
3. Remove the seal (3), bearing (4) and seal (6).
4. Repeat steps 1-3 at the knuckle end.
5. Perform the above steps in reverse order to install the link components.

Lubricate the pin (1), both sides of the seal (3, 6) and the bearing (4).

Steering cylinder removal / installation

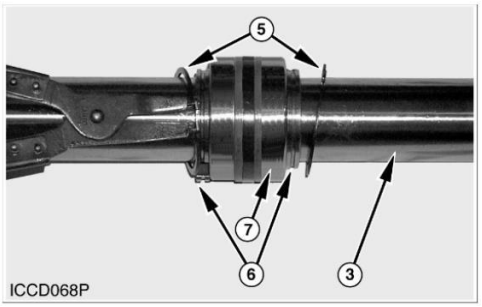
1. Remove the pin (1) from the LH and Rh shaft ends.
2. Remove the four bolts (8) and washers, and then remove the steering cylinder.
3. Follow the above steps in reverse order to install the steering cylinder.

6-3-5 Disassembly / assembly of steering cylinder

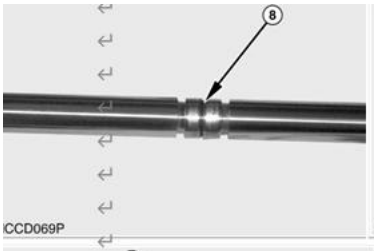
Preliminary steps

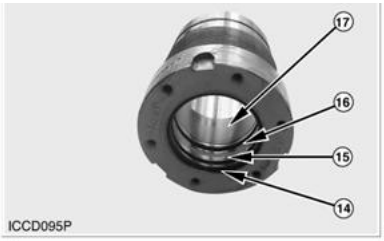
1. remove the steering cylinder.

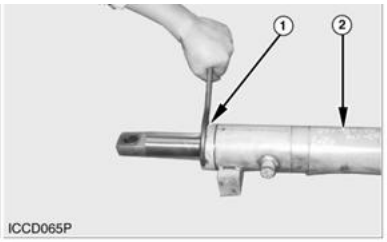
procedure

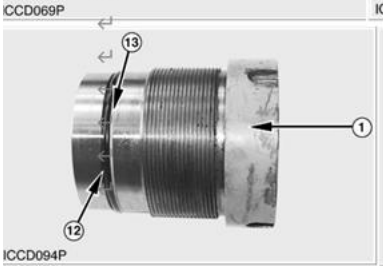


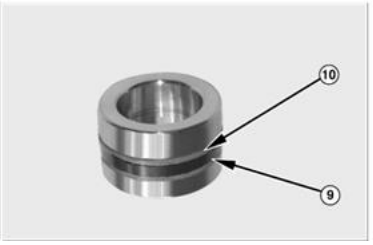
1. put the steering cylinder into the vice.
2. use a spanner to loosen the beginning (1) from the pipe (2).
3. remove the rod assembly (3) from the tube (2).
4. remove the retaining ring (5) from each side of the piston (7) with a pliers and ring (6), and the piston (7) will fix the piston in the proper position on the rod (3).
5. remove the piston (7) from the piston rod (3).
6. remove the O-ring seal (8) from the rod.
7. Remove seal ring (9) and backup seal ring (10) from piston.
8. Loosen the head at the other end of the pipe.
9. Remove O-ring (12) and backup ring from each head (1)
10. Remove the scratch seal (14), support ring (15), u-gasket (16) and Du bushing (17) from the hole of each ram.
11. Follow the above steps in reverse order to install the steering cylinder.

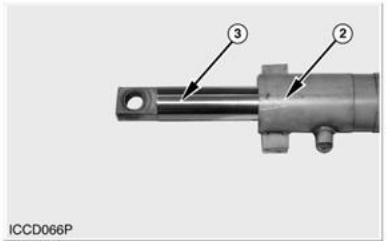












6-3-6 Removal / installation of knuckle, kingpin and bearing

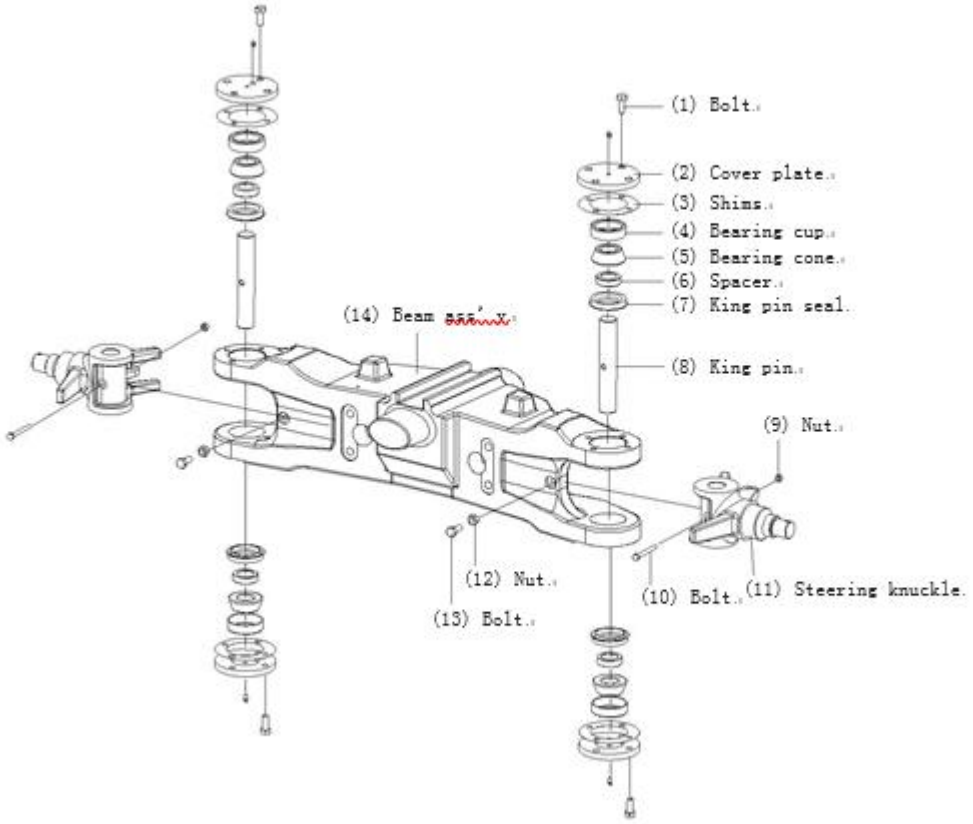


图 6-40

Tool needed: feeler gauge

Preliminary steps

1. remove the rear wheel and hub.
2. delete the link component.

Disassembly / assembly

1. remove the bolts (1), cover plate (2) and gasket (3) from the top and bottom of beam assembly (14).

Perform the above steps in the reverse order for installation.

Note: a steering angle sensor is installed at the top of the right steering knuckle. Be careful not to damage it.

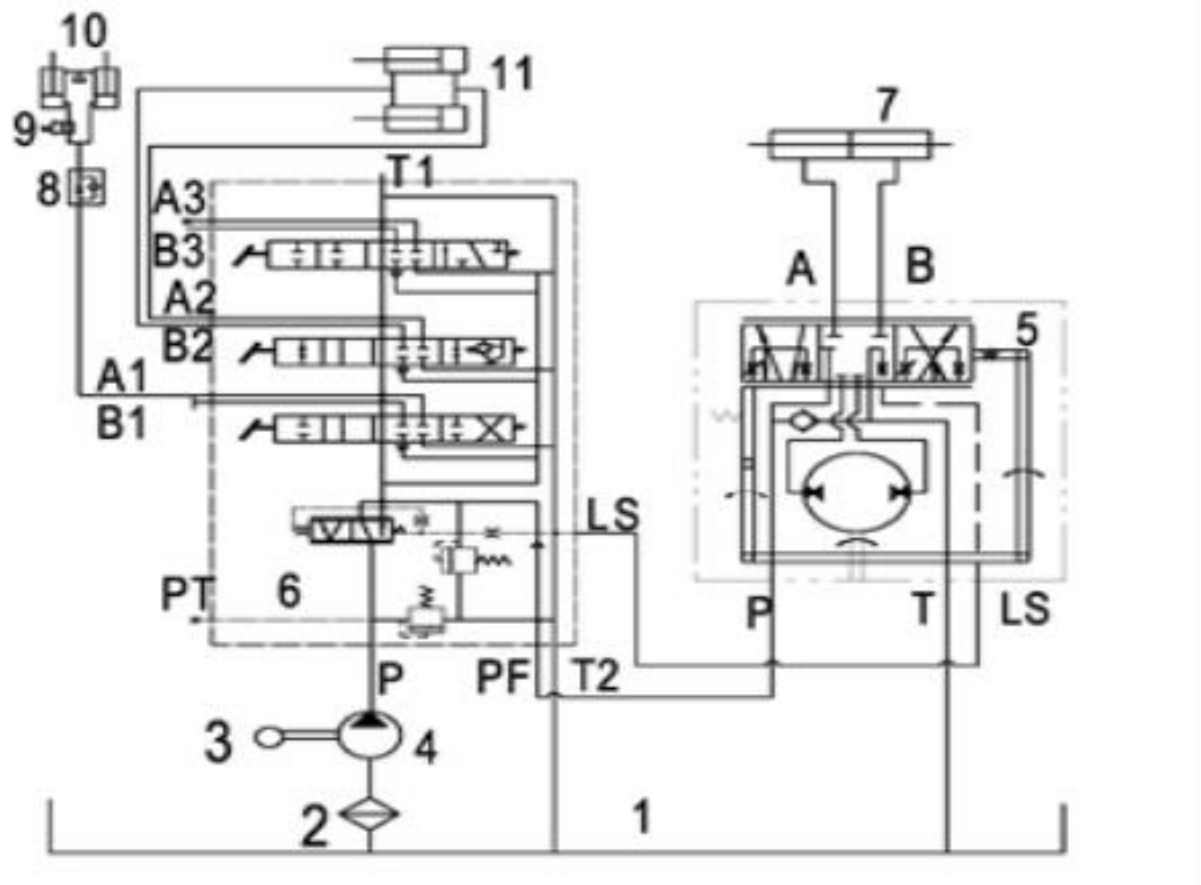
2. Remove the nut (9) and the bolt (10).
3. Pull out kingpin (8) and remove steering knuckle (11).
4. Remove the gasket (6), bearing cup (4) and bearing cone (5) from the steering knuckle (10).
5. Follow the above steps in reverse order, install the knuckle, kingpin and bearing. Lubricate the seals in the kingpin (8), bearings (4-5) and knuckle (10).

6-4 Troubleshooting

problem	Peobable cause
It takes too much force to turn the steering wheel	The priority valve (if equipped) releases the pressure oil at a low setting
	The oil pressure of the pump is low and the pump is worn.
	The steering cover is too tight
	The steering column is not aligned with the steering gear.
	Priority valve spool is held in one position.
	The steering gear does not need lubrication.
	The liquid level in the hydraulic supply tank is low.
The steering wheel did not return to the center position correctly.	The steering gear cover is too tight.
	The steering column is not aligned correctly.
	The spool in the steering gear is limited.
	The priority valve check valve allows lifting and tilting hydraulic oil to affect the hydraulic circuit.
The pump leaks oil.	Loose hose connection.
	Poor shaft seal
The oil pressure is low.	The oil level is low
	The priority valve (if equipped) relief valve spring is weak.
	The relief valve (priority valve) will not move from the open position.
	Oil leakage inside or outside the system.
	The pump is broken.
The pump makes noise when the steering wheel is turned, and Can't move smoothly	Air in the steering hydraulic circuit.
	The pump is too worn.
	The oil pipe connection on the inlet side of the pump is loose.
	The viscosity of the oil is wrong.
	The oil level in the hydraulic tank is very low.
	The oil level in the tank is very low.
	There is air in the steering system.
	Incorrect pump operation.
	Dirt in the steering system
	Incorrect steering gear operation.
	Limit of steering shaft connecting rod.
	The steering cylinder has worn parts.
The oil temperature is too high.	The viscosity of the oil is wrong.
	Air is mixed with oil.
	The relief valve is set too high (priority valve).
	There are restrictions in the return line.

7 schematic diagram

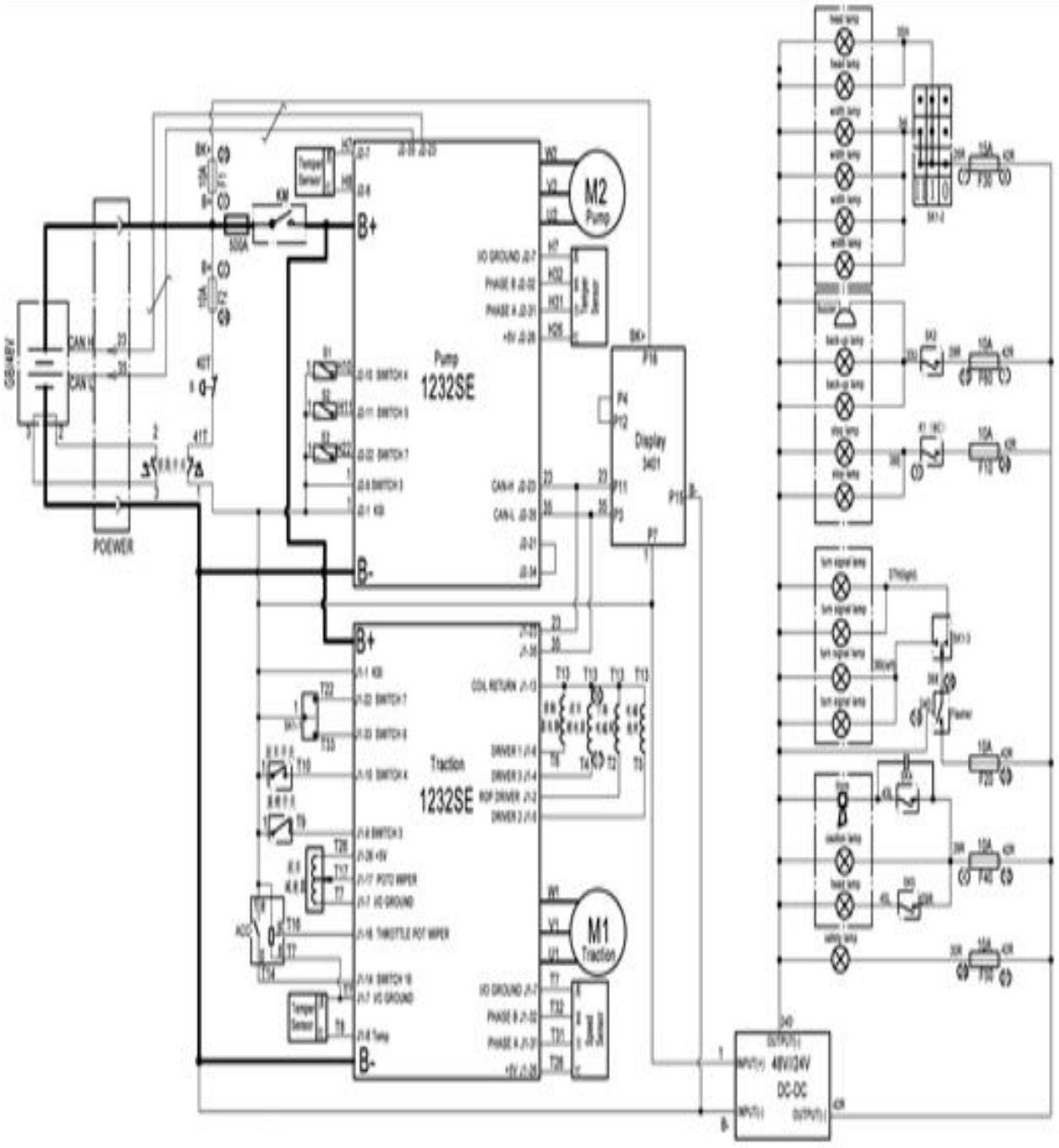
7-1 hydraulic schematic diagram

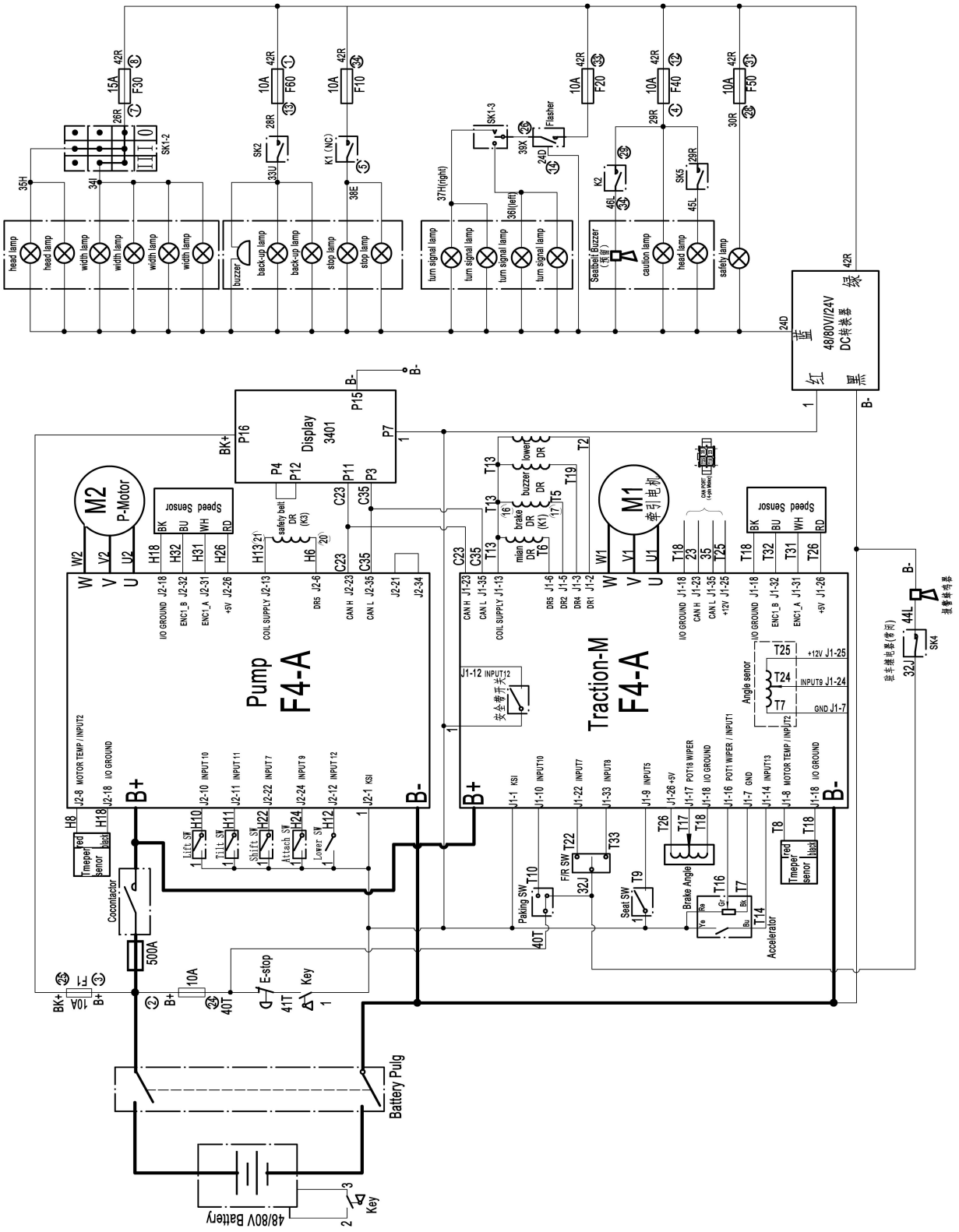


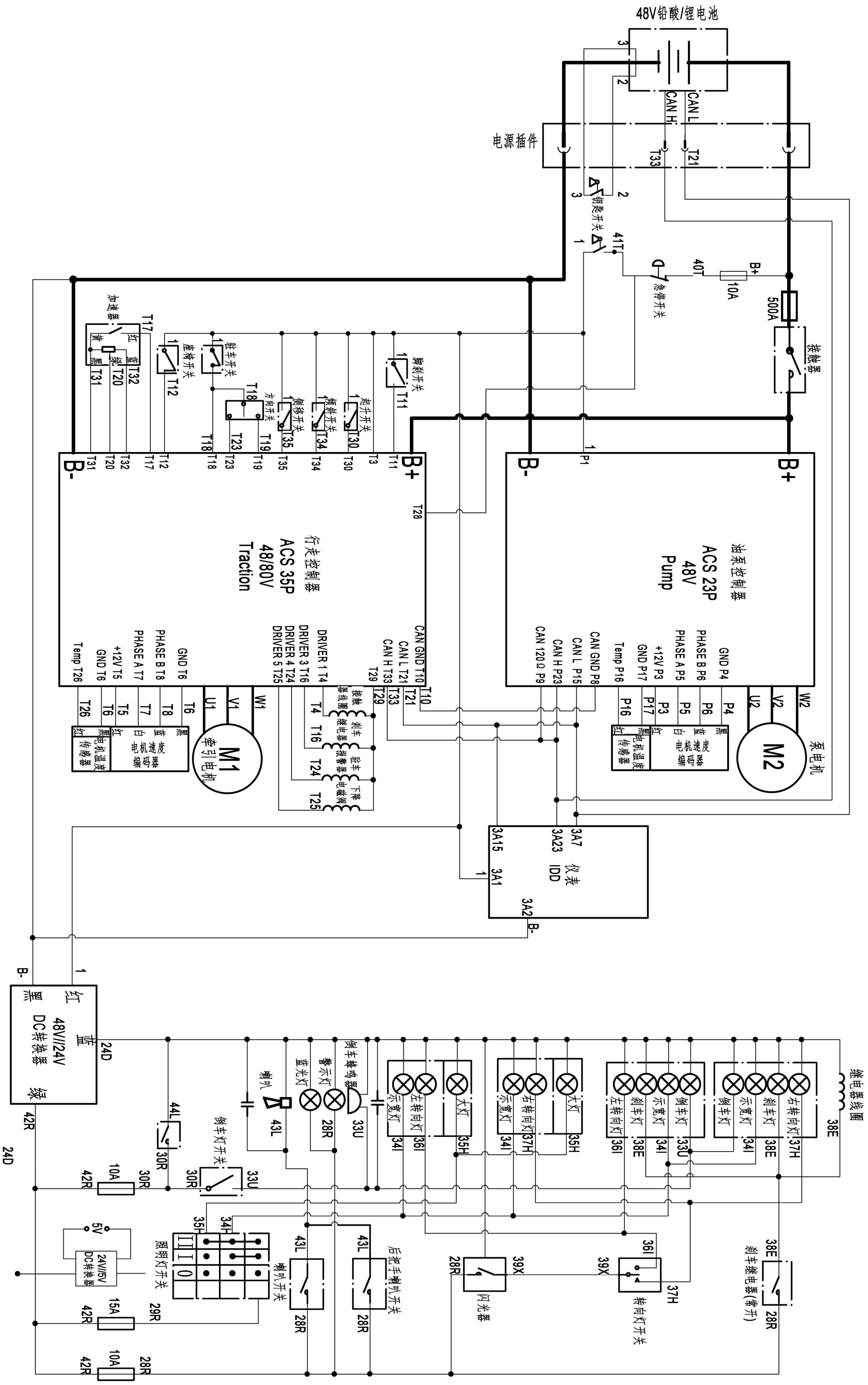
1.hydraulic oil tank	2.suction filter	3.pump motor	4.gear pump
5.Steering gear	6.multi way valve	7.steering cylinder	8. Speed Limit Valve
9.shut-off valve	10.lifting cylinder	11.Tilt Cylinder	

7-2 Schematic Diagram

Curtis SE series




Pump F4-A
Traction-M F4-A
Display 3401
M2 P-Motor
M1 牵引电机
48/80V//24V DC转换器
Speed Sensor
Battery Pulg
48/80V Battery
Key
E-stop
Cocontactor
500A
Brake Angle
Accelerator
Seat SW
Parking SW
F/R SW
Angle senor
Seatbelt Buzzer
head lamp
width lamp
back-up lamp
stop lamp
turn signal lamp
caution lamp
safety lamp
buzzer
Flasher


48V铅酸/锂电池
电源插件
CAN H
CAN L
T33
T21
500A
10A
B+
B-
ACS 35P
48/80V
Traction
ACS 23P
48V
Pump
M1
M2
24D
42R
28R
10A
15A
29R
30R

8 battery charger

8-1 Lead acid charger

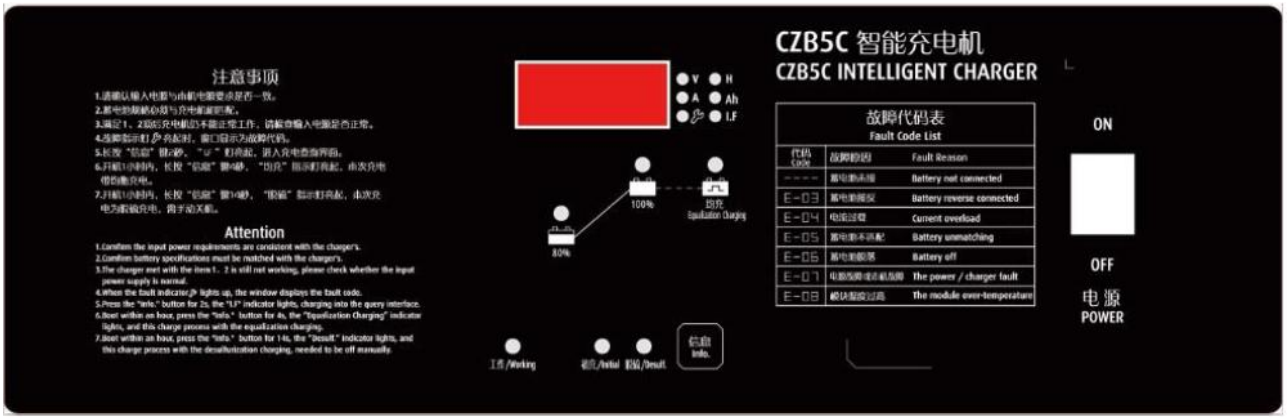
8-1-1 Introduction of lead acid charger

This model adopts intelligent charger

Normal working conditions:

1) Altitude not more than one kilometer
2) The surrounding medium temperature is not higher than 40 ℃ and not less than -10 ℃
3) Relative humidity of air shall not be greater than 85% (when the medium temperature is 20 ± 5 ℃)
4) No conductive dust, no explosion hazard environment
5) Environment free of corrosive metal and insulation gases and vapors
6) Where there is no rain or snow
7) Where the vertical plane is inclined not more than 5 degrees and there is no violent vibration and impact

8-1-2 control panel description



1) Power switch - used to turn on or off the grid power
2) Information window (LED screen) - display various charging parameters, fault code information, etc
3) Information content indicator light - when each light is on, the corresponding information window will display the information of the corresponding content
4) Information key——

a) During the charging process, the charging voltage, charging time, charging current and charging capacity are automatically displayed in turn. Click the "information" key to switch the display content directly;

b) Press the "info" key 4S to set the manual equalizing charging function

c) Press the "information" key for 10s to set the initial charging function

d) Press "information" key 15s to set desulfurization charging function

e) Press "information" key 6S to cancel the functions of manual equalization charging, initial charging and desulfurization charging

f) Press the "information" key 8s to cancel / resume the automatic equalizing charging function

g) Press the "information" key 2s to enter the query interface

5) Charging status indicator——Work indicator: on, indicating the charger is charging "80%" indicator: on indicating the charging battery exceeds 80%

a) “ 100% "indicator light: the light is on, indicating that the charger is fully charged and the battery is sufficient

b) “ "Equalizing charging" indicator light: the light is on, indicating that equalizing charging will be carried out this time; The light is flashing, indicating that charging is in progress

c) “ "Initial charging" indicator light: it is on together with the working indicator light, indicating that the charger is in initial charging

d) “ Desulfurization "indicator light: the light is on, indicating that the charger is in desulfurization charging

8-1-3 Common faults of lead acid charger

number	Fault code	cause	method
1	----	The battery has not been connected or the contact after connection is bad	Connect the battery and make sure the connection is reliable
2	E-03	The positive and negative polarity of the battery are reversed	Correctly connect the battery polarity
3	E-04	Charging current overcurrent, sudden change of grid power supply or short circuit damage of rectified module of charger	Check whether the power supply of the power grid is normal; Replace the rectifier module
4	E-05	Battery specifications do not match (average cell voltage is less than 1.5V or battery capacity is too large) or battery fault	Check whether the capacity and voltage of the charged battery match the specification of the charger; Replace with a matching battery; Replacement of faulty batteries
5	E-06	In the process of charging, the charging cable falls off, and the battery disconnects from the charger	Check the connection points in the charging circuit, clear the oxide layer, to ensure that the contact of each point is good
6	E-07	Power failure: Low power supply, power failure or damaged input fuse Charger fault: no current output of the charger, rectifier module or control panel damaged	Check the input voltage and restore the normal power supply Replace failed fuses Replace the faulty rectifier module Replace the damaged control panel
7	E-08	The fan is damaged or the ambient temperature is too high, causing the temperature of the module in the machine to be too high	Replace the damaged fan Check whether the vent of the charger is blocked Improve the working environment of the charger
Note: When the " " indicator light on the panel is on, the fault code will be displayed in the information window			

8-2 lithium electric charger

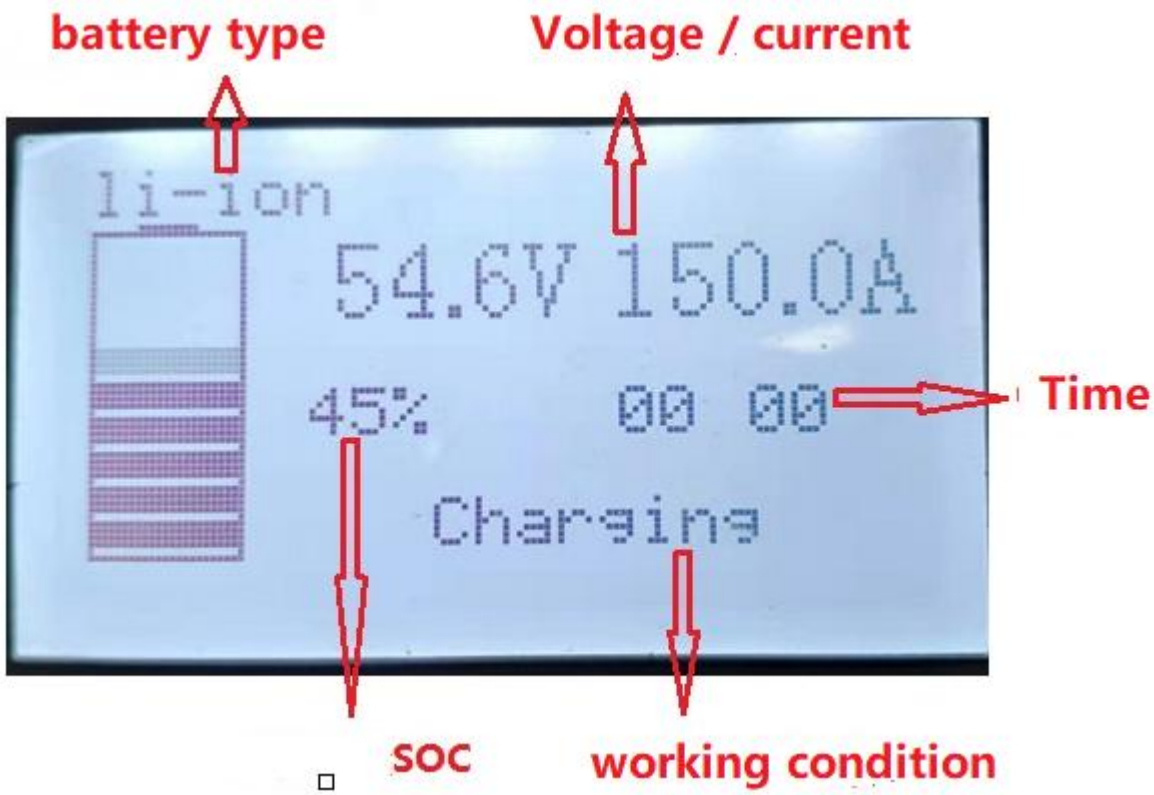
8-2-1 lithium charger introduction

Antwep ADY6111 charger, this charger is a kind of high efficiency, fast, small volume, adjustable current, CAN communication floor charging equipment. The charger adopts three-phase AC 380V voltage input, and the maximum output power is 9KW. It adopts forced air cooling mode, and has functions of input overvoltage, undervoltage, output overvoltage, undervoltage, overcurrent, output short circuit and fan fault protection. It also meets RoHS and CE requirements

8-2-2 Technical parameters of lithium battery charger

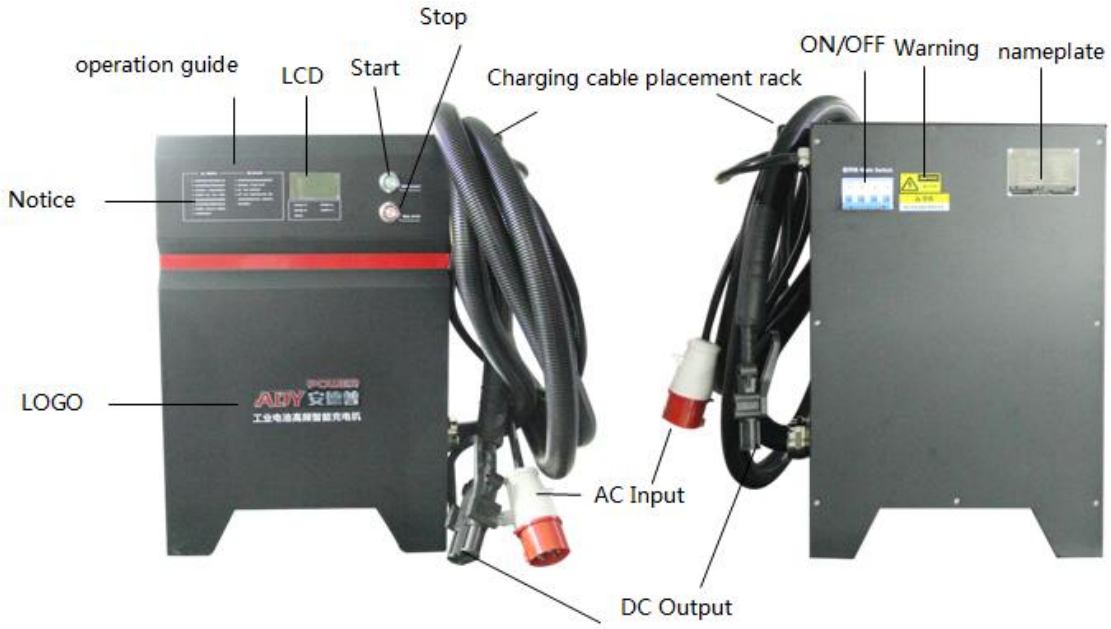
term	parameter	note
AC input：		
Rated input voltage	380Vac	L1+L2+L3+PE
Input voltage range	±7%	/
Input line length	2.5M	Three phase four wire cable
frequency range	47-63 Hz	/
Input current	≤63A Max	175Vac
power factor	≥0.98	Rated load
DC output：		
Rated output voltage	48V	/
Output voltage range	38-60V	Adjustable by communication
Rated output current	150A	Lithium battery charging mode
	65A	Charging mode of lead acid battery
output power	9000W	Maximum output power
Output voltage of auxiliary power supply	12V	Optional to power BMS
Output current of auxiliary power supply	2A	Optional to power BMS
Output cable and connector:		
Output connector	REMA 160A Public plug in	With lead acid battery output port
Output line length	2.5M	/
Output cable specification CH1	50	mm²
Output cable specification CH2	25	mm²
Transmission：		
Transmission way	CAN	Transmission with battery BMS
Transmission agreement	《BMS charging protocol nl-cd01》	Transmission protocol with battery BMS

8-2-3 lithium battery charger panel description



State of charge	description
Self-checking	Check the condition of lithium battery, whether it can be charged in the next step
Ready	Entering charging preparation
Charging	Charging
Finish	Charging complete
Shutting down	End the charging and turn off the main power switch
Input abnormal	The input voltage of the charger is too high or too low, exceeding the charging rating requirements
Connect bat	The output plug of charger is not connected with lithium battery, but the communication is normal

Note: the above fault codes should be sent by BMS before they can be displayed. If there is no battery of BMS, some fault codes will not be displayed.



8-2-4 lithium battery charger maintenance

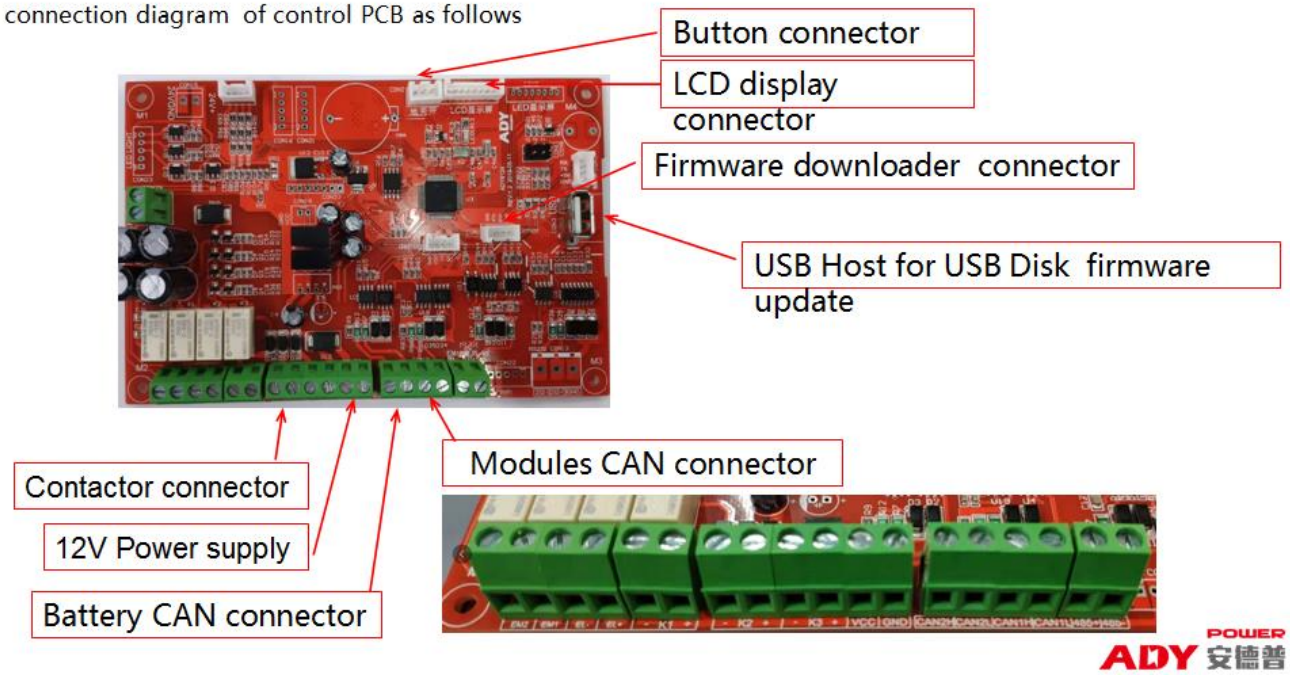
1. In daily use, pay attention to clean the dust screen on both sides of the charger, especially the LCD display error status E04 of the charger

2. Pay attention to the use environment of the charger, and try to avoid using the charger in high temperature, high humidity and other harsh environments

8-2-5 troubleshooting

Fault phenomenon	Fault explanation
No electricity	Check whether the AC input is connected correctly and whether the air switch is on
Can't charge	Check that the DC rema connector is properly connected to the battery or check the charger status on the LCD
Low output voltage during charging	Check whether the CAN bus of the module is correctly connected to the control PCB, otherwise please contact the manufacturer for after-sales service support
Low output current during charging	Check whether the CAN bus of the module is correctly connected to the control PCB, otherwise please contact the manufacturer for after-sales service support

connection diagram of control PCB as follows



Fault code	Code fault analysis
E01	The output voltage of the charger exceeds the preset value. Restarting the charger is normal operation. If not, check the output voltage of the charger or contact the manufacturer for after-sales support
E02	The output current of the charger exceeds the preset value. Restarting the charger is normal operation. If not, check the output current of the charger or contact the manufacturer for after-sales support
E03	Charger internal module communication failure, please check whether the communication bus between internal module and control PCB is connected normally. Or check whether the module works normally
E04	Over temperature protection of charger. Check whether the dust screen is covered by dust or other substances, thus affecting the heat dissipation of the charger
EB1	The received battery is overvoltage from the battery BMS. Check the BMS for troubleshooting
EB2	The over-current of the battery is received from the lithium battery BMS. Check the BMS for troubleshooting
EB3	Communication failure between charger and BMS. The charger lost the message from BMS. Check if BMS of battery works normally, CANbus communication line is well connected between charger and battery
EB4	The temperature of the received battery is higher than that of the battery BMS. Check the BMS for troubleshooting

Maintenance Record Table

No	Date	Maintenance	Recorder