

**NIRI II**

**NOBLELIFT**

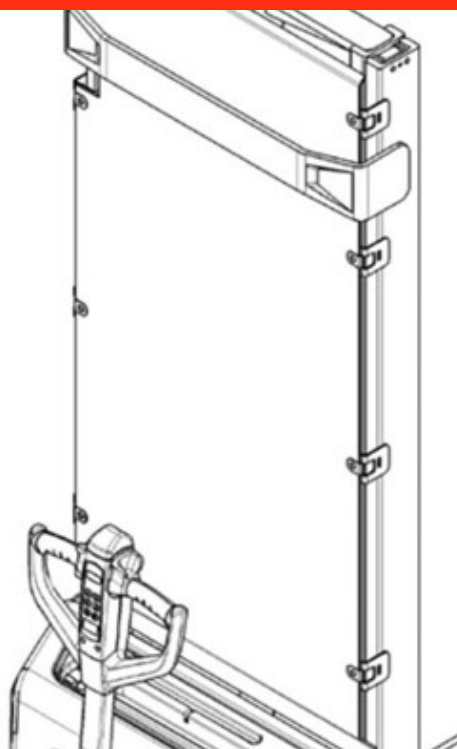


## Service & Maintenance Manual

### Electric Pallet Truck

PSL-type Stacker (PS E12B / PS E12N)

1



#### **WARNING**

**Do not use the pallet truck before reading and understanding these operating instructions.**

#### **NOTE:**

- Please check the designation of your present type at the last page of this document as well as on the ID-plate.
- Keep for future reference.

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## 1-1 How to use this manual

### 1-1-1 Build this manual

This service manual provides information service engineers and technicians required for vehicle maintenance; it does not contain vehicle operating instructions.

The introductory part of this manual provides an overview of the functions of the vehicle, with particular attention to its different components. You can find each part in the main body of this manual, which provides more specific and detailed information, including schematic diagrams of vehicle components, working methods, inspection contents, repair procedures, and data and information required for repair and maintenance.

To help readers quickly and easily find the services and training information they need, these chapters are based on The different systems included in the vehicle are classified (see the table below).

section	title
1	general
2	electronic system
3	Drive/brake system
4	Hydraulic system
5	Lift/Tilt/Assist System
6	steering system
7	Schematic diagram
8	other
9	Charger

### 1-1-2 Warning label definition

This manual uses the following three warning labels: "Danger", "Warning" and "Caution". Each label is designed to show the reader the severity and nature of the potential hazards, the consequences, and preventive measures to prevent the hazards. You will find these labels throughout this manual. Make sure you pay attention to them carefully, as they are included for your safety.



Danger

This sign represents a situation that could result in serious injury if not avoided.



Warning

This sign represents a situation that could result in serious injury if not avoided.

## 1-2 vocabulary

The following are the terms and descriptions used in this service manual

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 a 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.

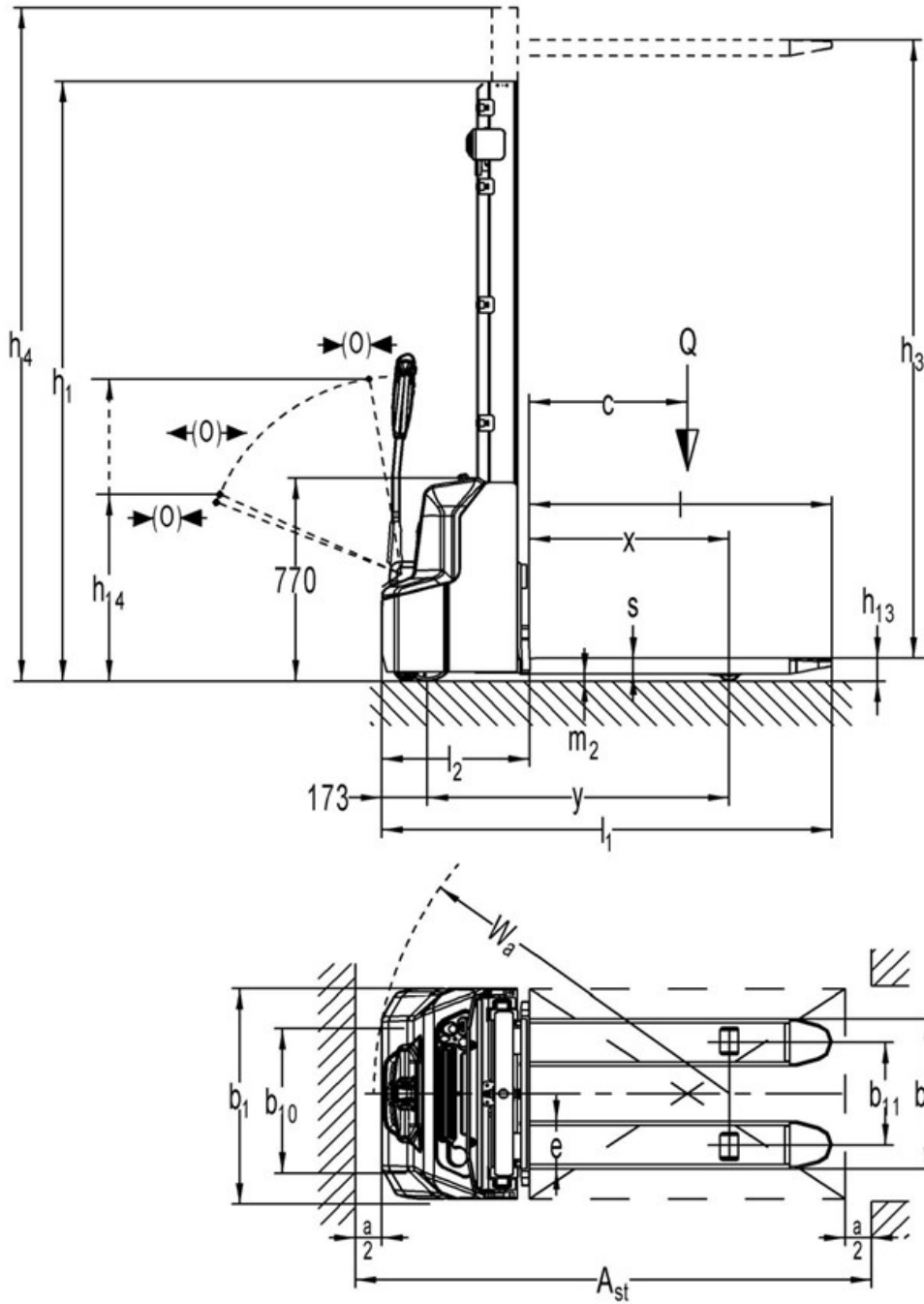
Digital Signal	A signal in which the element can be either of two different values, e.g. high voltage and low voltage.
Diode	A semiconductor device that allows current to flow from the anode to the cathode in one direction
Directional Valve	A valve that directs the flow of oil according to the position of the valve element.
Instrument	An electrical device that converts voltage input into an 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 ( $\Omega$ )	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
Jockey 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



## Type sheet for industrial truck acc. to VDI 2198

Type sheet for industrial truck acc. to VDI 2198				
General data	1.2	Manufacturer`s type designation		PS E12N
				3600
	1.3	Power (battery ,diesel, petrol, gas, manual)		Battery
	1.4	Operator type		Pedestrian
	1.5	Load Capacity / rated load	Q(t)	1.2
	1.6	Load centre distance	c(mm)	600
	1.8	Load distance ,centre of drive axle to fork	x(mm)	760
	1.9	Wheelbase	Y(mm)	1147
Weight	2.1	Service weight	kg	585
	2.2	Axle loading, laden front/rear	kg	560 / 1225
	2.3	Axle loading, unladen front/rear	kg	440 / 145
Tires, chassis	3.1	Tires		Polyurethane (PU)
	3.2	Tire size, front	Ø x w (mm)	Φ210 x 70
	3.3	Tire size, rear	Ø x w (mm)	Φ84 x 93
	3.4	Additional wheels(dimensions)	Ø x w (mm)	Φ100 x 50
	3.5	Wheels, number front/rear (incl. drive wheels)		1x + 1 / 2
	3.6	Track, front	b <sub>10</sub> (mm)	550
	3.7	Track, rear	b <sub>11</sub> (mm)	400 / 515
Dimensions	4.2	Lowered mast height	h <sub>1</sub> (mm)	2280
	4.3	Free Lift height	h <sub>2</sub> (mm)	-
	4.4	Lift height	h <sub>3</sub> (mm)	3514
	4.5	Extended mast height	h <sub>4</sub> (mm)	4037
	4.9	Height of tiller in drive position	h <sub>14</sub> (mm)	710 / 1150
	4.15	Height, lowered	h <sub>13</sub> (mm)	86
	4.19	Overall length	l <sub>1</sub> (mm)	1710
	4.20	Length to face of forks	l <sub>2</sub> (mm)	560
	4.21	Overall width	b <sub>1</sub> (mm)	800
	4.22	Fork dimensions	s/e/l (mm)	60 / 180 / 1150
	4.25	Width across forks	b <sub>5</sub> (mm)	570 / 685
	4.32	Ground clearance, centre of wheelbase	m <sub>2</sub> (mm)	26
	4.33	Aisle width for pallets 1000X1200	Ast (mm)	2197
	4.34	Aisle width for pallets 800X1200	Ast (mm)	2145
4.35	Turning radius	Wa (mm)	1350	
Perfor mance	5.1	Travel speed, laden/ unladen	Km/h	4.5 / 4.7
	5.2	Lift speed, laden/ unladen	m/s	0.12 / 0.19
	5.3	Lowering speed, laden/ unladen	m/s	0.13 / 0.11

	5.8	Max. gradeability, laden/ unladen	%	5 / 10	
	5.10	Service brake		Electromagnetic	
Electric	6.1	Drive motor rating S2 60min	kW	0.65	
	6.2	Lift motor rating at S3 7.5%	kW	2.2	
	6.3	Battery acc. to DIN 43531/35/36 A, B, C, no		no	
	6.4	Battery voltage, nominal capacity	V/Ah		24 / 60
	6.5	Battery weight	kg		19
	6.6	Energy consumption acc: to VDI	Kwh/h	0.8	
Other	8.1	Type of drive control		AC- speed control	
	8.4	Sound level at driver's ear acc. to	dB(A)	<70	

Type	Lowered mast height h1(mm)	Free Lift height h2(mm)	Lift height h3(mm)	Extended mast height h4(mm)
One stage mast	1930	1514	1514	1930
	2330	1914	1914	2330
Two stage mast	1930	-	2814	3337
	2080	-	3114	3637
	2280	-	3514	4037

## 1-4 Safety notice

The safety section includes the following subsections: general, personal safety, maintenance safety, compressed air hazards, hydraulic oil hazards, mechanical hazards, electrical hazards, and fire and burn hazards. Under each heading are listed the precautions you should take to ensure that you stay safe while working on the vehicle.

Readers are responsible for reading thoroughly, understanding and implementing all the following preventive measures. Please also note that the safety instructions listed below are not only for the safety of the reader, but also for the people around him. Therefore, for your own personal safety and the safety of those around you, please read the following instructions carefully:

### **General safety instructions**

Be familiar with the safety instructions immediately visible on the vehicle. These include warning signs, stickers, engravings, etc. Before operating, lubricating or repairing the vehicle, please write down and read them (see the section "Description of Safety Devices and Warning Labels" in the "Operation Manual").

Ensure that all safety rules, regulations and instructions are followed when performing maintenance. Please pay special attention to the danger warnings in this manual, which will inform you of potentially dangerous situations.

Do not assume that you can perform the steps outlined in this manual based on your previous maintenance experience with similar models. Different models have different weights and specifications, so close attention should be paid to avoid dangerous situations, injuries and/or component damage.

### **Personal safety**

Do not operate or maintain the vehicle without authorization or training. Do not operate or maintain the vehicle after drinking alcohol or drugs that damage your judgment.

If you have any diseases or conditions that restrict physical activity, do not operate or maintain the vehicle.

### **Work clothes**

If you are wearing loose clothes or your hair is very long and it is not handled in a safe state, please do not operate the vehicle or perform maintenance. Both may be caught by moving parts and cause serious injury.

Wear proper protective equipment when you are performing maintenance tasks. Protective equipment may include hard hats, glasses/visors, ear protectors, gloves and protective shoes.

Wear a mask when polishing the car body, and wear an air breathing device when spraying paint.

Wear welder's gloves, welding mask/goggles, apron and other suitable welding clothing when welding.

## Maintain safety

### Pre-maintenance

Ensure that the vehicle is in a clean, open environment and not affected by traffic and other people.

Ensure that the vehicle is parked safely and that the vehicle does not move suddenly. Place wooden props in front of and behind the wheels and make sure the parking brake is properly engaged.

Ensure that the vehicle is empty and unoccupied, the fork is lowered, all hydraulic controllers are in the neutral position, and the key is switched to OFF. Before servicing or repairing the vehicle, attach a "no operation" or similar warning label to the start switch or control 器上。 On the device.

Make sure the tool is in good condition.

### Installation and removal

Before installing the vehicle, make sure that the working environment is clean, tidy and dry.

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

Use these steps and grab the handle to install or remove parts. When you cannot use these steps, use ladders, scaffolds, work platforms or cranes to safely perform maintenance operations。

### Hoist

Check the weight of each component before removal. Some parts of this vehicle are very heavy and may cause serious injury.

When removing any components, use proper lifting procedures

To avoid back injuries, use a hoist when lifting parts weighing 23 kg (50 lb) or more. Ensure that all chains, hooks, slings, etc. are in good condition and have the correct capacity. Make sure that the hook is positioned correctly. During the lifting operation, the eye bolts should not be loaded sideways.

### Assembly/disassembly

Ensure that the assembly/disassembly work site is kept clean, tidy and dry, and keep hand tools clean.

When tightening/loosening bolts and nuts, please use a wrench of appropriate size and always pull it toward your body. Using the wrong wrench size or pushing away from the body to loosen/tighten the bolts or nuts may cause accidents due to the sliding of the handle.

If two or more people are working, use signs or signals to communicate so that the work is done in an agile way, as if the work was done by one person.

Reinstall all fasteners using the same parts. If you need to replace any fasteners, please use high-quality fasteners and be careful not to use metric system fasteners mixed with imperial fasteners。

### Compressed air hazards

When cleaning, please wear a protective mask, protective clothing and protective shoes. When cleaning, the maximum air pressure must be lower than 205 kPa (30 psi).

## Hydraulic oil hazards

Please carefully follow the instructions below to carry out safety tips on hydraulic system maintenance.

De-oiling under pressure, even if the pinhole size leaks, it can penetrate body tissues, causing serious injury and possibly death. Wear gloves, goggles, and make sure your arms and legs are completely covered. Release all pressure from the hydraulic system before disconnecting or removing any pipes, fittings or related items, and wait for the system to cool down when it is just running.

Do not touch the pressurized hose with your hands, and do not bend or hit the hose.

Never use your hands to check the pinhole for leaks; this is the most common method of oil injection related injuries! Use cardboard or other solid surfaces instead.

When removing the filler cap, vents and plugs, put a rag on the port to prevent being sprayed or splashed by liquid under pressure.

Prepare a container to catch any hydraulic fluid that may flow out of the hose/port.

Make sure that all raised components are properly locked.

When reinstalling the lines, make sure to tighten them to the correct torque.

Ensure that all clamps and guards are installed correctly to avoid vibration or friction with other parts during operation.

## Mechanical hazard

If any rotating parts are damaged and any other parts are touched during operation, do not operate the machine. Before reuse, check the balance of any damaged or altered high-speed rotating parts.

When working under the vehicle, properly support the equipment and installation components. Don't expect the hydraulic cylinder to remain installed. If the moving lever or the hydraulic line breaks, any accessories may fall.

Upon impact, debris or other debris will fly away from the object. Before striking an object, make sure that flying debris will not harm anyone.

## Electrical hazard

Do not damage the wiring during the disassembly operation. When reinstalling the wiring, please ensure that the installation method is correct.

Do not connect the wiring to lines containing oil.

When checking, charging or servicing the battery, do not smoke or expose the battery to sparks or flames. Keep chains and metal tools away from the top of the battery.

Electrolyte is an acid that may cause personal injury if it comes in contact with skin or eyes.

## Risk of fire and burns

To avoid burns, please pay attention to the hot parts on the machine just stopped and the hot oil in the pipes and tanks.

All hydraulic fluids, most lubricants and some coolant mixtures are flammable. If the pipe is loose or damaged, a fire may occur.

Store all hydraulic oil and lubricants in appropriately labeled containers away from



unauthorized personnel.

Store all oily wipes or other flammable materials in a protective container in a safe place.

Do not weld or flame cut pipes or pipes that contain flammable fuel. Before welding or flame cutting, clean them thoroughly with a non-flammable solvent.

Remove all residual flammable materials from the vehicle.

## 1-5 maintenance

The following describes the key items and replaceable parts to be checked during maintenance intervals.

**Note:** Except for the daily inspection by the vehicle driver, all maintenance and repairs should be carried out by qualified and authorized engineers.

**Note:** Careless handling of waste oil will not only harm the environment but also human health. Waste oil should always be placed in a container and disposed of by authorized personnel at designated locations.

### Check if necessary

item	Inspection standards and methods
Gear rack roller	Measure the distance from the bottom of the inner main frame to the bottom of the carriage bearing, Make the inner door frame upright, and then adjust the extrusion of the roller.
Power module	Before touching any electrical components, the power module must be fully discharged.
Fuse box	Check whether the fuse has any removed components and replace it if necessary. 10 A: Key switch 150 A: main fuse
Wheel bolts	Check whether the wheel bolts and nuts are fixed as follows: Drive tightening torque: 50 Nm
Drive axle gear box	Check the gearbox for lubricating oil Refill the lubricating oil into the plug opening to check the housing level.

### Check every 10 service hours or once a day

item	Inspection standards and methods
Walk around	Check for loose parts and fasteners. Check whether the indicator on the dashboard is abnormal. Check whether the horn and other alarms are operating normally. Check whether the mast and lifting chain are worn out, and whether the pins/rollers are abnormal. Check the shelf, front fork and accessories for damage and abnormality. Check whether the tires, valves and wheels are abnormal.

	Check the hydraulic system for oil leakage and damage. Check whether the drive is leaking.
Door frame	Lubricate the beam where the rollers are located.
Tires	Check the tires for wear, cuts, grooves and contamination.

Check every 500 service hours or 3 months

item	Inspection standards and methods
Crosshead roller	Check whether the crosshead roller guard and retainer are damaged.
Doorframe, chain	Check whether the lifting cylinder is operating normally. Check whether the fork is operating normally. Use a brush to lubricate all chains and check whether their anchor points are abnormal.
Steering shaft	Lubrication of steering shaft accessories.
control panel	Clean the control panel. Maximum allowable air pressure: 205 kPa (29.7 psi)
accelerator	Check the tightness of the accelerator switch mounting bracket, and repair as needed. Check for loose wiring and fix it if necessary.
Hydraulic oil	Check the hydraulic oil level and refill as needed.

Check every 1,000 service hours or 6 months

item	Inspection standards and methods
Drive and hydraulic pump motor	Remove dust and check the area of the drive motor and electrical components. Maximum allowable air pressure: 205 kPa (29.7 psi)
Hydraulic return filter	Replace the oil return filter in the hydraulic oil tank.
Tires	Check tires for wear, cuts, grooves, contamination, etc. Check the wheel components for cracks, wear, damage, corrosion, etc. Standard torque of driving wheel: 50 N·m
Lifting chain	Perform lifting chain wear test by measuring the wear of chain links and pins.

Check every 2,000 service hours or once a year

item	Inspection standards and methods
Hydraulic system	Replace hydraulic oil and filter.
Basic maintenance	Under normal circumstances, regular inspections are carried out at least every 12 months. If you work for a long time or under a heavy load, perform regular inspections for 6 months. If you find any of the following conditions, please replace: Healing of cracks on forks, welding, brackets, etc.

## 1-6 lubricating oil

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

### 1-6-1 Lubricant specifications

The following lubricants are recommended for chains and connecting rods:

item	specification
1	DIN 51825 Standard grease

### 1-6-2 Hydraulic oil (HYDO)

The hydraulic oil should have anti-wear, anti-foam, anti-rust and anti-oxidant additives for heavy-duty use as stated by the petroleum supplier. The ISO viscosity grade is usually No. 32.

Note: The correct hydraulic oil should be used to achieve the maximum service life and performance of hydraulic system components. It is recommended to use the above hydraulic oils in most hydraulic and hydraulic systems.

If the hydraulic oil becomes turbid, it means that water or air has entered the system. Water or air in the system will cause the pump to malfunction. Drain all hydraulic oil, re-tighten all hydraulic suction pipe clamps, then clean and refill the system.

## 1-7 Disassembly/assembly instructions

The disassembly/assembly part includes the following subsections: preparations before disassembly, inspection and testing before disassembly, precautions during disassembly, precautions after disassembly, precautions during assembly, handling of general parts, and hydraulic pipeline accessories. Precautions to be taken to perform disassembly/assembly work correctly are listed under each heading.

### Preparation before disassembly

Remove dust and pollutants from the vehicle before sending it to a repair center. Dust or contaminants entering the repair center may stain the components and enter them to cause damage.

Electric vehicles operate based on electrical systems. Do not let any water enter the system.

To avoid unnecessary disassembly work, prepare the necessary tools, place the boxes for the parts, and give priority to ensuring the cleanliness of the site

### Check and test before disassembly

Before starting disassembly, be sure to record any problems. This prevents unnecessary disassembly, loss of replacement parts, and repeated failures caused by the same problem.

To prevent malfunction, please record the malfunction and the parts required for replacement.

**Also make sure to check and record the following information:**

- Vehicle model, serial number and business hours
- The reason why the vehicle needs to be disassembled
- Check the symptom, location and cause of the malfunction.  
(If necessary, reproduce the same failure).
- Check if any parts are inappropriate.
- Check for damage or loose parts.
- If possible, check the maintenance of the vehicle.

## **Precautions when disassembling**

### **Disassemble**

Determine the assembly method of the parts (front/rear, left/right and top/bottom connection) to determine the disassembly sequence.

Before starting to disassemble the parts, pay attention to the connection points of the parts and mark them with arrows to avoid incorrect placement of the parts during assembly.

Use the right tools to delete specific parts.

If you have not removed any parts, even the mounting bolts and nuts, do not use excessive force. Check and find the reason.

Put the disassembled parts on one side in the order of disassembly, and put labels or marks on the parts with similar appearance.

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

### **Check and test during disassembly**

Sometimes the cause of the failure will be discovered during the disassembly process. Therefore, it is very important to carefully check the condition of the friction surface and the contact parts.

During the disassembly process, measure and record the gap, deformation, projection and other factors that may cause the failure.

### **Keep the gap**

Ensure that the installed gaskets and washers produce the required specified clearance value

### **Remove press parts**

Remove any dents or marks caused by hammering and polishing the area.

If you loose any press-fitted parts, please determine and eliminate the cause to avoid problems during the assembly process.

### **Disassemble the bearing**

Do not use force to disassemble the bearing, but use a bearing puller.

## Precautions after disassembly

### clean

Clean the disassembled parts and keep them away from contaminants.

Pay special attention to removing contaminants from the oil pipeline or component pipeline.

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

Kerosene or neutral anhydride diesel oil is suitable for cleaning the viscous oil in the bearing.

When using hazardous chemical cleaners, please be careful not to contact your skin or eyes. Use designated containers to dispose of used oil at designated locations.

### dust-proof

Use a dust cover to place the cleaned parts in a place free of dust and contaminants, and block the ends of all pipes.

Before installing again, any parts you may store must be rust-proof.

## Precautions during assembly

### Parts installation

Keep all parts clean before assembly. Check the surface for defects and repair as needed. Make sure not to smear or rub the surface on any part, otherwise the service life of the part may be shortened.

Before starting the assembly, use a cleaning agent to remove the rust inhibitor from the components.

Before starting the assembly, determine the mark that will assemble the parts together.

Use press-fit tools to assemble bearings, bushings and oil seals, and use designated tools to process specific parts.

Before press-fitting parts, lubricate their surfaces with lubricating oil.

### Tighten the bolts and nuts

To ensure the even torque of the bolts and nuts, tighten them in the order shown in Figure 1-19, and then tighten the other side on the other side. This method is called the "template method" and it gradually repeats loosening and tightening to ensure uniform contact.

Use the wires, split pins, lock washers or other parts shown in Figure 1-20 to fix bolts, nuts or other important fasteners that cannot be visually inspected.

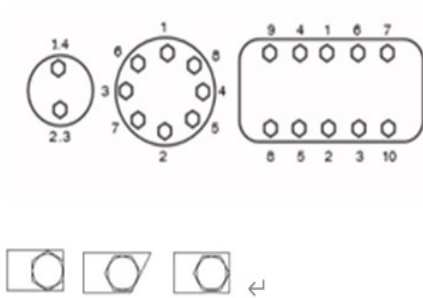


图 1-19

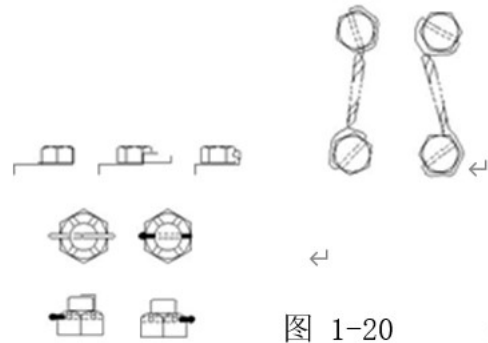


图 1-20

### Check during assembly

In each step of the assembly process, check and record each part number.

### Reassemble the gasket

Install gaskets and washers in the same positions as before, and then check if the gap is correct.

### Assembly adjustment link

If there is no need to adjust, please assemble them to the same length as before.

### Assemble press parts

Repair scratches and dents as needed, and keep parts clean before insertion. Note that press-fit parts that are not sufficiently tightened may loosen.

### Assemble the key and keyway

Check whether the keyway and key are loose and whether they are in contact with the key head. If the key head touches the keyway, remove the remaining part of the key head.

### Handling general parts

#### Handling packaging

Packaging, gaskets and copper packaging should be replaced as directed. After using the adhesive, please assemble the gasket specified in this service manual. When applying adhesive to the gasket, please pay attention to the following:

Thoroughly remove the old adhesive, scratches, dust, paint and grease on the surface of the gasket.

Apply a suitable sealant evenly on both sides of the gasket and wait a few minutes until it is dry.

Once the sealant is dry to the touch, it won't stick to your hands, assemble the parts.

Soak the leather packaging in oil before use.

#### Handle O-ring

Remember to check the condition of the O-ring. Do not use O-rings that have hardened.

Only use the O-ring specified in the parts list. For example, O-rings used for engine oil are made of special materials, such as silicone rubber, and are resistant to heat and aging. In this case, installing different types of O-rings may cause serious damage to the system and its components.

Lubricate the O-ring to avoid scratching its surface during installation. Silicone rubber O-rings are easily damaged, so be careful not to stretch them excessively.

## Deal with the oil seal

Prevent the oil seal from collecting dust, especially dust on the lips, and make sure that there is no hardening or scratching.

Evenly lubricate the lip surface opposite to the oil seal.

Check whether the surface of the shaft where the oil seal is installed is contaminated, rusted or scratched, and then apply grease or lubricant so that the oil seal can be installed easily.

Check the surface of the oil seal lip for scratches. If there are scratches, replace the oil seal.

When inserting the oil seal, use guides and clamps to avoid damage to the oil seal.

After inserting the oil seal, check the inclination (inclination tolerance: 0.2 mm/100 mm, diameter 0.008 inch/3.937 inch).

When applying adhesive to the oil seal, make sure that no adhesive is in contact with the lip surface. Before inserting another seal, completely remove residual adhesive on the rails and clamp.

## Handling the bearings

To assemble the bearing correctly and avoid damage to the bearing, please pay attention to the following:

Thoroughly remove dust and other contaminants that may shorten the life of the bearing. Keep the bearing package until it is installed.

Do not rotate the bearing excessively in order to clean the purifier by blowing in compressed air. Ensure that the oil seal ring is installed in the correct direction.

### **Please pay attention to the following when installing the bearing:**

Neither the outer ring was hit with a hammer to install it, nor the inner ring was hit to insert the outer ring. Hammering like this can cause damage to the bearing track.

When you insert the inner ring of the bearing with a reasonable tolerance, use a clamp and apply pressure to the inner ring. When performing hot insertion with a press-in tolerance, heat the bearing to 120°C (248°F). However, please note that excessive heating will reduce the hardness of the bearing surface.

When you insert a non-split bearing with an inner ring and an outer ring with a reasonable tolerance, use a clamp while pressing the inner ring and the outer ring at the same time.

## Handling the retaining ring

When removing or installing the fixing ring, please use a pair of right ring pliers, being careful not to put too much pressure on the fixing ring.

After installing the fixing ring, check whether the fixing ring is inserted correctly.

Assembly of accessories with straight thread and O-ring seal (suitable for different applications)

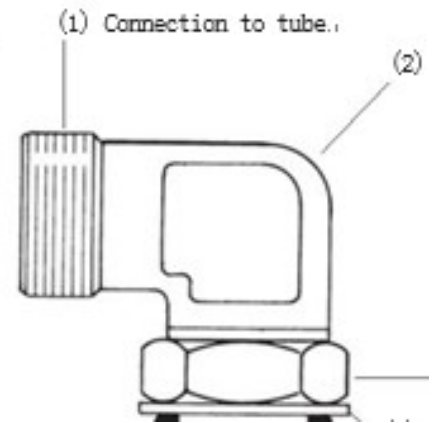
1. Seal the lock nut (3), support washer (4) and O-ring. Place the piece (5) as far as possible on the main body (2) of the accessory.
2. Turn the joint to the part it uses until the support washer (4) just touched the surface of the part.
3. To place the joint assembly in the correct position place the joint body (2). Rotate outward (counterclockwise) up to 359°.
4. Tighten the lock nut (3) to the correct diagram of the accessory used. The torque shown.
5. If the shape of the pipe end of the fitting body is shown in Figure 1-25 (elbow or Straight body), put the sleeve on the tube before connecting the tube to the end.

**Note:** If the connector is a connector (direct connector), the hexagon on the body replaces the lock nut. To install this type of connector, tighten the hex connector to the surface of the part it enters. Tighten other accessory types

**High-load (shear casing) pipe fittings:** After the pipe passes through the nut and contacts the pipe shoulder in the fitting body, turn the nut with a wrench until you feel a slight decrease in torque.

**High-sealing fittings:** Place the nut and sleeve on the pipe with the short and heavy end of the sleeve facing the end of the pipe. Place the end of the pipe against the counterbore in the main body of the fitting and tighten it until the nut is above the last thread on the main body. Just remove the accessory and install it again, and the remaining space will be used.

**Flexible fittings:** Put the nut and sleeve on the pipe, and push the pipe into the counterbore of the fitting body as much as possible. Tighten the nut until it touches the hexagonal part of the connector body.





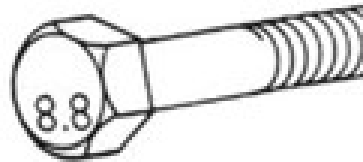
## 1-8 Standard torque

### 1-8-1 Standard torque of bolts and nuts

Be careful to avoid mixing metric and imperial size fasteners. Mismatch or incorrect The fasteners may cause vehicle damage or malfunction, or may cause personal injury. If necessary, exceptions to these torques can be given in the service manual.

Before installing any hardware, make sure that the components are in a near new state. Screw. The bolt and nut threads must not be worn or damaged. The hardware must be free of rust and corrosion. Use non-corrosive cleaners to clean the hardware and apply engine oil to the threads and bearings Surface. If you want to use thread glue or other compounds, do not use engine oil. After loosening the fasteners, keep them in good condition and only reuse them under delicate conditions. When replacing a new one, be sure to select fasteners of the same size and grade.

Generally, you can identify it based on the number marked on the head (such as 8.8 or 10.9) The strength of the bolt is shown in Figure 1-30. The following table lists standard bolts and nuts. The standard torque, and the tapered bolt shown in Figure 1-31.



Standard bolt.

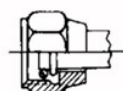
For metric fasten

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↵

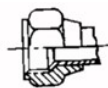
## For British fasteners

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 torque for fastening accessories



o-rings



45 ° flare

1-36<sup>4)</sup>

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 <sup>4)</sup> / 8-18 <sup>4)</sup>	18 ± 4 <sup>4)</sup>	13 ± 3 <sup>4)</sup>	30 ± 3 <sup>4)</sup>	22 ± 2 <sup>4)</sup>	23 ± 3 <sup>4)</sup>	17 ± 2 <sup>4)</sup>
3 <sup>4)</sup> / 4-16 <sup>4)</sup>	37 ± 4 <sup>4)</sup>	27 ± 3 <sup>4)</sup>	52 ± 5 <sup>4)</sup>	38 ± 4 <sup>4)</sup>	33 ± 4 <sup>4)</sup>	24 ± 3 <sup>4)</sup>
7 <sup>4)</sup> / 8-14 <sup>4)</sup>	40 ± 4 <sup>4)</sup>	30 ± 3 <sup>4)</sup>	60 ± 7 <sup>4)</sup>	44 ± 5 <sup>4)</sup>	38 ± 4 <sup>4)</sup>	28 ± 3 <sup>4)</sup>
1 <sup>4)</sup> / 16-14 <sup>4)</sup>	45 ± 5 <sup>4)</sup>	33 ± 4 <sup>4)</sup>	75 ± 8 <sup>4)</sup>	55 ± 6 <sup>4)</sup>	50 ± 5 <sup>4)</sup>	37 ± 4 <sup>4)</sup>

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

### Hose clamp - belt type

Clamp width	New hose torque	Torque for re-tightening
7.9 mm <sup>4)</sup> (0.312 in <sup>4)</sup> )	0.9 ± 0.2 N · m <sup>4)</sup> (8 ± 2 lb · in <sup>4)</sup> )	0.7 ± 0.2 N · m (6 <sup>4)</sup> ± 2 lb · in <sup>4)</sup> )
10.5 mm <sup>4)</sup> (0.531 in <sup>4)</sup> )	4.5 ± 0.5 N · m <sup>4)</sup> (40 ± 5 lb · in <sup>4)</sup> )	3.0 ± 0.5 N · m (25 <sup>4)</sup> ± 5 lb · in <sup>4)</sup> )
10.9 mm <sup>4)</sup> (0.625 in <sup>4)</sup> )	7.5 ± 0.5 N · m <sup>4)</sup> (65 ± 5 lb · in <sup>4)</sup> )	4.5 ± 0.5 N · m (40 <sup>4)</sup> ± 5 lb · in <sup>4)</sup> )



图 1-33<sup>4)</sup>

## 37° bell and straight threaded O - ring accessories

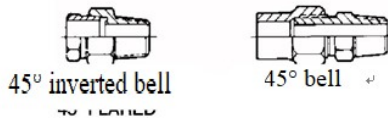


Pic 1-34

图 1-34

37°C 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 <sup>±</sup>	0.125 <sup>±</sup>	5/16 <sup>±</sup>	5.0 ± 1.5 <sup>±</sup>	4 ± 1 <sup>±</sup>	
4+76 <sup>±</sup>	0.188 <sup>±</sup>	3/8 <sup>±</sup>	11.0 ± 1.5 <sup>±</sup>	8 ± 1 <sup>±</sup>	
6+35 <sup>±</sup>	0.250 <sup>±</sup>	7/16 <sup>±</sup>	16 ± 2 <sup>±</sup>	12 ± 1 <sup>±</sup>	
7+94 <sup>±</sup>	0.312 <sup>±</sup>	1/2 <sup>±</sup>	20 ± 5 <sup>±</sup>	15 ± 4 <sup>±</sup>	
9+52 <sup>±</sup>	0.375 <sup>±</sup>	9/16 <sup>±</sup>	25 ± 5 <sup>±</sup>	18 ± 4 <sup>±</sup>	
9+52 <sup>±</sup>	0.375 <sup>±</sup>	5/8 <sup>±</sup>	35 ± 5 <sup>±</sup>	26 ± 4 <sup>±</sup>	
12.70 <sup>±</sup>	0.500 <sup>±</sup>	3/4 <sup>±</sup>	50 ± 7 <sup>±</sup>	37 ± 5 <sup>±</sup>	
15.88 <sup>±</sup>	0.625 <sup>±</sup>	7/8 <sup>±</sup>	65 ± 7 <sup>±</sup>	48 ± 5 <sup>±</sup>	
19.05 <sup>±</sup>	0.750 <sup>±</sup>	1-1 / 16 <sup>±</sup>	100 ± 10 <sup>±</sup>	75 ± 7 <sup>±</sup>	
22.22 <sup>±</sup>	0.875 <sup>±</sup>	1-3 / 16 <sup>±</sup>	120 ± 10 <sup>±</sup>	90 ± 7 <sup>±</sup>	
25.40 <sup>±</sup>	1.000 <sup>±</sup>	1-5 / 16 <sup>±</sup>	135 ± 15 <sup>±</sup>	100 ± 11 <sup>±</sup>	
31.75 <sup>±</sup>	1.250 <sup>±</sup>	1-5 / 8 <sup>±</sup>	180 ± 15 <sup>±</sup>	135 ± 11 <sup>±</sup>	
38.10 <sup>±</sup>	1.500 <sup>±</sup>	1-7 / 8 <sup>±</sup>	225 ± 15 <sup>±</sup>	165 ± 11 <sup>±</sup>	
50.80 <sup>±</sup>	2.000 <sup>±</sup>	2-1 / 2 <sup>±</sup>	320 ± 30 <sup>±</sup>	240 ± 22 <sup>±</sup>	

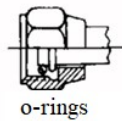
## 45° bell shape and 45° inverted bell fittings



| 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 <sup>±</sup>	0.125 <sup>±</sup>	5/16 <sup>±</sup>	5.0 ± 1.5 <sup>±</sup>	4 ± 1 <sup>±</sup>	
4+76 <sup>±</sup>	0.188 <sup>±</sup>	3/8 <sup>±</sup>	8.0 ± 1.5 <sup>±</sup>	6 ± 1 <sup>±</sup>	
6+35 <sup>±</sup>	0.250 <sup>±</sup>	7/16 <sup>±</sup>	11 ± 2 <sup>±</sup>	8 ± 1 <sup>±</sup>	
7+94 <sup>±</sup>	0.312 <sup>±</sup>	1/2 <sup>±</sup>	17 ± 3 <sup>±</sup>	13 ± 2 <sup>±</sup>	
9+52 <sup>±</sup>	0.375 <sup>±</sup>	5/8 <sup>±</sup>	30 ± 3 <sup>±</sup>	22 ± 4 <sup>±</sup>	
11.11 <sup>±</sup>	0.438 <sup>±</sup>	11/16 <sup>±</sup>	30 ± 3 <sup>±</sup>	22 ± 2 <sup>±</sup>	
12.70 <sup>±</sup>	0.500 <sup>±</sup>	3/4 <sup>±</sup>	38 ± 4 <sup>±</sup>	28 ± 3 <sup>±</sup>	
15.88 <sup>±</sup>	0.625 <sup>±</sup>	7/8 <sup>±</sup>	50 ± 5 <sup>±</sup>	37 ± 4 <sup>±</sup>	
19.05 <sup>±</sup>	0.750 <sup>±</sup>	1-1 / 16 <sup>±</sup>	90 ± 8 <sup>±</sup>	65 ± 6 <sup>±</sup>	
22.22 <sup>±</sup>	0.875 <sup>±</sup>	1-1 / 4 <sup>±</sup>	100 ± 10 <sup>±</sup>	75 ± 7 <sup>±</sup>	

## Thread fittings for air conditioning and conical pipes



1-36<sup>+</sup>

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 <sup>+</sup> / 8-18 <sup>+</sup>	18 ± 4 <sup>+</sup>	13 ± 3 <sup>+</sup>	30 ± 3 <sup>+</sup>	22 ± 2 <sup>+</sup>	23 ± 3 <sup>+</sup>	17 ± 2 <sup>+</sup>
3 <sup>+</sup> / 4-16 <sup>+</sup>	37 ± 4 <sup>+</sup>	27 ± 3 <sup>+</sup>	52 ± 5 <sup>+</sup>	38 ± 4 <sup>+</sup>	33 ± 4 <sup>+</sup>	24 ± 3 <sup>+</sup>
7 <sup>+</sup> / 8-14 <sup>+</sup>	40 ± 4 <sup>+</sup>	30 ± 3 <sup>+</sup>	60 ± 7 <sup>+</sup>	44 ± 5 <sup>+</sup>	38 ± 4 <sup>+</sup>	28 ± 3 <sup>+</sup>
1+1 / 16-14 <sup>+</sup>	45 ± 5 <sup>+</sup>	33 ± 4 <sup>+</sup>	75 ± 8 <sup>+</sup>	55 ± 6 <sup>+</sup>	50 ± 5 <sup>+</sup>	37 ± 4 <sup>+</sup>

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

## 2 electronic system

### 2-1 Overview

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

- 1 The battery powers the electrical system.
- 2 Press the power switch in an emergency to turn off all DC and AC circuits.
- 3 Motors, controllers and related equipment provide the necessary drive and pump power for the vehicle based on their interaction with sensors, switches, relays and actuators and many parameter settings.
- 4 When the load is powered by a current higher than the limit, the fuse protects all DC loads from overcurrent by cutting off the power of the load.
- 5 Other DC loads activated by direct operator demand work independently of the controller. First, they are not controlled by the controller, nor are they the purpose of sending signals. However, they may interact with them in some configurations. These loads include light sets and speakers.
- 6 The handle display instrument monitors the vehicle to inform the user of its status. [Section 2-6]
- 7 The handheld programmer provides various functions such as diagnosis and parameter modification.

## 2-1-1 Communication protocol

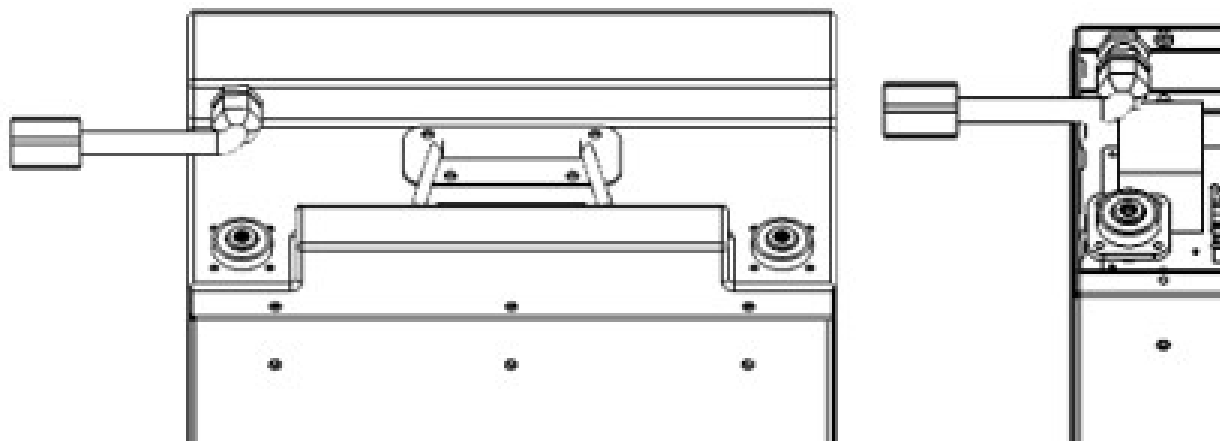
In order to enable all electrical equipment of the vehicle and provide users with diagnostic and parameter calibration functions, data needs to be shared between these controllers and instruments. For this, CAN (Controller Area Network) is used as the standard protocol.

Note: For information on how to install the app to check the condition of the vehicle and perform parameter calibration via CAN communication, please refer to section 2-7.

This CAN communication effectively overcomes the shortcomings of the UART (Universal Asynchronous Receiver/Transmitter) system based on point-to-point communication that was widely used in the past. Due to the one-to-one communication between each device, the UART system is limited in the number of available communication devices and wiring and in improving vehicle performance.

## 2-2 lithium battery

### 2-2-1 Appearance and specifications



ITEM	parameter	Remarks	
Specification	24V60Ah	8-LFP-60-EV-NOB	
Nominal voltage	25.6V		
Rated Capacity	60Ah	0.5C Discharge	
reference weight	approximately 16.5kg		
Discharge	Maximum continuous discharge current	100A	
	Maximum pulse discharge current	150A	No more than 10 seconds
	Discharge cut-off voltage	≥22V	
Discharge	Standard charging current	20A	
	Maximum charging current	30C	
	Charging voltage	28~28.8V	
Internal resistance	Less than 20mΩ	Between the positive and negative poles	
Charging temperature	5~45℃		
Discharge temperature	-20~60℃		
Storage temperature range	-20~50℃		
BMS parameter	Overcharge protection voltage	Single section 3.9V±0.03V	
	Over discharge protection voltage	Single section 2.5V±0.3V	
	Overcurrent protection current	120A	
	Short circuit protection current	200A	fuse 200A

	Charge control	CAN bus control
--	----------------	-----------------

## 2-2-2 Analysis and explanation of lithium battery fault

Battery pack system fault repair table					
Number	fault types	preliminary judgment	Detection method	Failure to confirm	The measures
1	No output after the battery pack is started and the switch indicator is on	1. Abnormal communication with the vehicle; 2. Internal components of the system are damaged	1, check the monitor screen of a vehicle alarm code, and confirm the specific fault, if confirmed as the CAN communication, disconnect the discharge connectors, measurement on both ends of the battery pack discharge connectors CAN communication if there are 120 Ω resistance;	1. When the resistance is infinite, it indicates that CAN communication wiring harness is disconnected. Firstly, measure whether CANH and CANL are on normally between discharge connector and panel communication port, and then measure whether CAN of panel communication wiring harness is on; 2, there is resistance, but is far larger than 120 Ω, damage may be inside the BMS CAN chip	1. Replace the damaged wiring harness; 2. Replace the battery
			1. Disconnect the discharge plug, start the battery pack separately, and check whether the discharge plug has output;	If there is output, there may be an error in the locomotive internal circuit, resulting in the battery pack unable to output	Check locomotive communication and power lines
2	No output after the battery pack is started, the switch indicator	1. Internal components of the system are damaged; 2. The system	1. Select the DC voltage range of the multimeter, measure the total positive and negative voltages at both ends with a stylus, and check whether the	The system voltage is low and BMS cannot work normally	Charge the battery pack first



	light is not on	voltage is insufficient	total voltage of the system is normal; 2. Use the multimeter conducting file to measure whether the two wiring harnesses of the panel communication wire harness are normal conducting	Wire harness failed when both ends of wire harness failed to conduct properly	Replace the battery
3	The battery pack cannot be charged. The switch indicator is on	1. Abnormal communication with the vehicle; 2. Internal components of the system are damaged	1. Measure whether the wiring harness of charging socket 12V, GND, CANH and CNAL is in normal conduction	The conduction is not normal	Check the charging harness
			2, connect the charger, to check the charger shows fault code, off to see if there's any loose for charging port terminals, terminal, back measurement CAN communication if there are 120 Ω resistance on both ends	Did not measure to 120 Ω resistance, CAN damage the chip	Replace the battery
4	The battery pack won't charge and the switch indicator isn't on	1. The charger has no 12V auxiliary power output; 2. Internal components of the system are damaged	1. Disconnect the charger from the battery pack and separately measure whether there is 12V auxiliary power output after the charger is started up;	The charger has no 12V auxiliary power output	Replace the charger
			2. Measure whether the wiring harness of charging socket 12V and GND is in normal conduction	Wire harness not conducting properly	Replace the charging socket wiring harness

## 2-2-3 Removal and installation of lithium battery

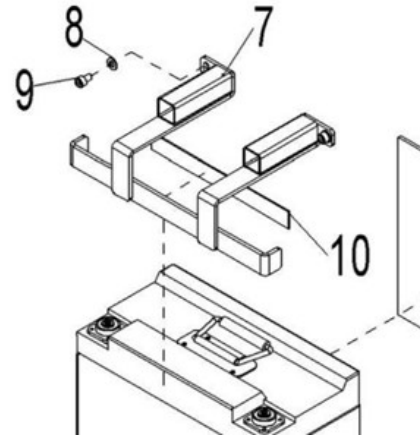
### Preliminary steps

- 1 Park the vehicle safely and remove the cover.
- 2 Turn off the key switch.

### Program

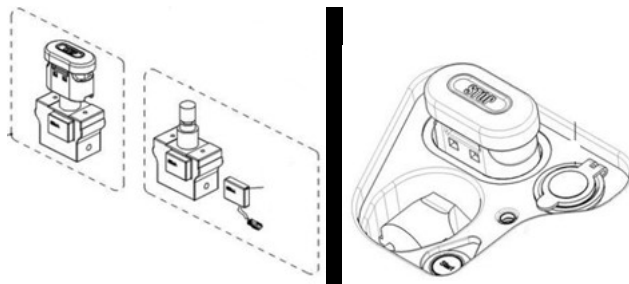
- 1 Remove screw (9) and remove battery mounting plate (7)
- 2 Disconnect the battery control cable
- 3 Remove the positive and negative screws of the battery and remove the battery power cord.
- 4 Remove the battery.

Follow the steps above to install the battery in reverse order.



## 2-3 Emergency switch

### 2-3-1 Appearance and Specifications



ITEM	Specifications
Part number 920200100007	ZDK32-350-1

### 2-3-2 function

The emergency stop switch is used to stop the operation of the vehicle by cutting off the current in the electrical system in an emergency. When pressed, all DC and AC circuits are open.

The DC circuit is open

Once the emergency stop switch is turned on, the battery's positive terminal and the key switch are disconnected, thereby cutting off power to all loads supplied by the key switch. As a result, all DC loads will be cut off.

### Detection

#### A) Mechanical properties

Press the red button down with the palm of your hand. The palm can obviously feel a reliable

pause point locked. When pulling up, there is also a reliable sense of suction.

## B) Electrical properties

Put the digital multimeter in on-off gear, and connect the two meter pens on the metal terminals on both sides of the emergency stop switch. When the emergency stop switch is not pressed down, the multimeter buzzer will call (that is, it is in the on-off state). When the emergency stop switch is pressed down, the multimeter buzzer does not ring (that is, it is in the disconnected state).

Connect the two meter pens to the two metal terminals of the micro switch on the emergency stop switch. When the emergency stop switch is not pressed down, the multimeter buzzer will be called (that is, it is in the on state). When the emergency stop switch is pressed down and locked, the multimeter buzzer does not ring (that is, the switch is in the disconnected state).

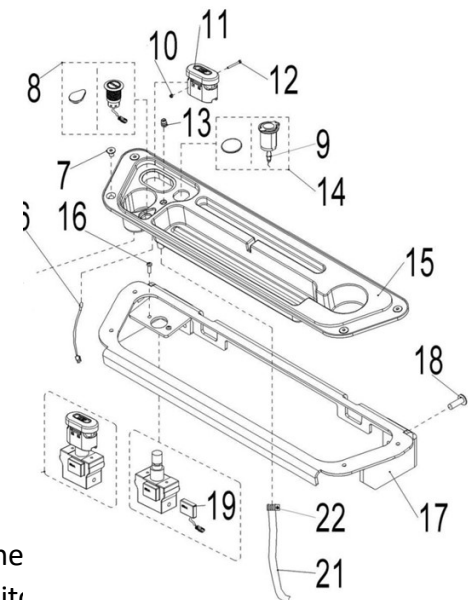
## Removal and installation

### Preliminary steps

- 1 Park the vehicle safely and remove the cover.
- 2 Turn off the key switch.
- 3 Disconnect the battery connector.

### Program

- 1 Disconnect the button switch (8) and the USB power cable.
  - 2 Remove the emergency stop switch cap screw (12) and remove the emergency stop switch cap (11).
  - 3 Remove instrument panel screw (7) and remove instrument panel (15).
  - 4 Remove the power cord on both sides of the emergency stop switch.
  - 5 Disconnect the connection line for the microswitch (19)
  - 6 Remove the fixing screw (16) of the emergency stop switch to remove the
- Perform the above steps in reverse order to install the emergency stop switch.



## 2-4 Controller and associated equipment

### 2-4-1 appearance



- Logical part plug-in: 14 core Molex Mini-Fit Jr., P/N 39-01-2140**
- Electromagnetic brake plug: 2 core Molex Mini-Fit Jr., P/N 39-01-2020;**
- Handheld programming port plug-in: 4 core Molex Mini-Fit Jr., P/N 39-01-2040;**
- Power part plug-in: AMP The plug-in, P/N 12076SL02**

### 2-4-2 Features

The controller is connected through the following sensors, switches, relays and actuators.

- Key switch
- switch
- accelerator
- Handle proximity switch
- Emergency reverse switch
- Hydraulic control switch

These devices provide DC power and interact with the controller. The controller activates or receives data from them based on many parameter settings to control the motor。

By correctly setting the various motor technical parameters and control technical parameters and function values of the controller, the safe and efficient work performance and complete operating functions of electric vehicles can be realized。

1、 The crawling speed of electric vehicles can be adjusted. Through the crawl speed setting function of the controller, the electric vehicle can run for a long time at low speed。

2、 The acceleration rate can be adjusted. The acceleration rate is the "soft and hard" feeling of the accelerator pedal when operating an electric vehicle. By setting the acceleration rate, the vehicle can meet the requirements of acceleration operation under different working conditions.。

3、 The maximum travel speed can be adjusted. Reasonable setting of the maximum travel speed of electric vehicles can prevent the traction motor from overloading due to excessive vehicle speed。

4、 Safety protection function. If the power element of the controller is damaged during the operation of the vehicle, the controller will disconnect the main contactor in the shortest time; when the controller temperature rises too high, the controller will automatically limit the armature current of the motor; when the battery voltage is too high When low, the controller will stop working to ensure safety。

5、 The motor controller has a self-diagnosis function. During the working process of the controller, once a fault occurs, the fault code will be displayed on the handle display instrument, and the controller will automatically stop working to ensure the safety of the operating system。

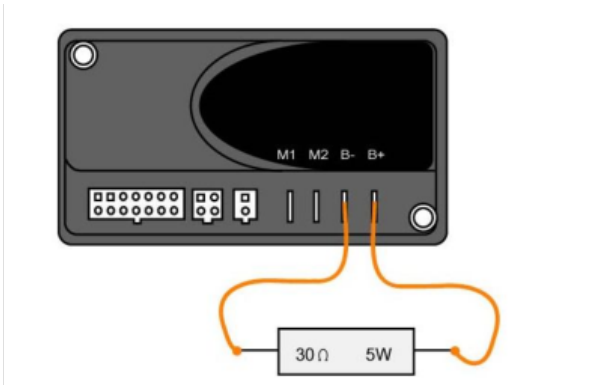
6、 The handle display meter will display the battery power and accumulated working hours。

## 2-4-3 test

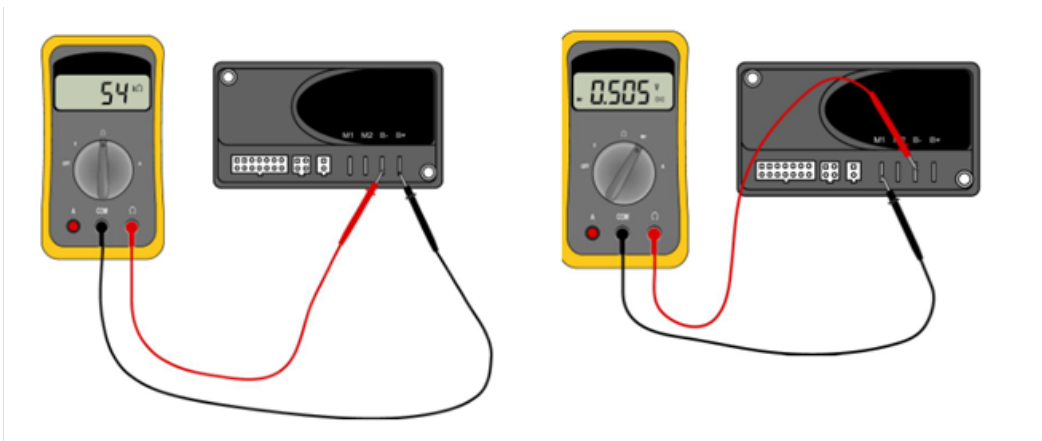
### A. Controller

Measure the diode voltage of the AC MOSFET circuit inside the controller to check whether it is burned or damaged.

Remove the cables and wiring harness connected to the controller, and completely discharge the internal capacitor power (discharge the B+ and B- terminals with a resistance of 30Ω/5W).



Use a multimeter to measure according to the table below and check whether it is normal. Each test item must be tested repeatedly for more than 3 times。



ITEM	Multimeter terminal		Normal range	
	Red test lead	Black test lead	Polar value determination	Resistance measurement
1	B+	B-		40KΩ 以上
2	B+	M2		80KΩ 以上
3	B+	M1		80KΩ 以上
4	M1	M2		60KΩ 以上
5	B-	M2	0.3-0.6V	
6	B-	M1	0.3-0.6V	

Pull the multimeter to the Ω position (determination of resistance value) Pull the multimeter to the diode position (determination of polarity value)

## 2-4-4 Removal and installation

Access control panel

- 1 Lower casing to enter drive motor controller.
- 2 Close the key switch and emergency stop switch。
- 3 Disconnect the battery。
- 4 Leave the key switch on to make the power module discharge. Two 30 seconds。
- 5 Turn off key switch。

Note: Remember that the controller contains AN ESD (electrostatic discharge) sensitive component.

Appropriate precautions should be taken when connecting, disconnecting and handling。

Drive motor controller removed/installed

Note: Remember that the controller contains AN ESD (electrostatic discharge) sensitive component.

Appropriate precautions should be taken when connecting, disconnecting and handling

- 1.Disconnect the control harness from the connector port of the controller.
- 2.Disconnect the B+,B-,M1 and M2 cables.
3. Release and remove the controller.
- 4.Perform the above steps in reverse order to install the drive motor controller。

## 2-5 Miscellaneous load

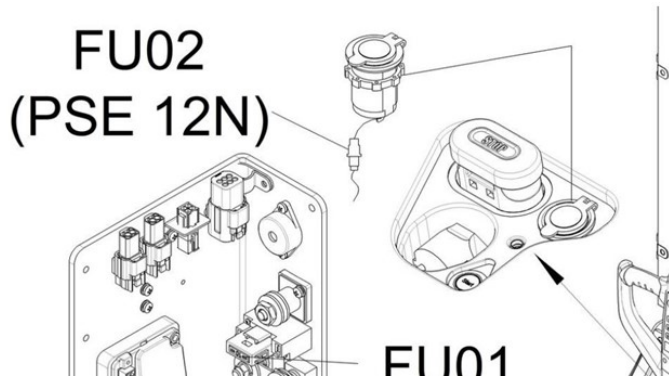
### 2-5-1 fuse

A. Function and composition

To protect dc loads from overcurrent, fuses are equipped with the following specifications:

name	specifications
------	----------------

FU1	60A
FU2	150A
FU01	10A
FU02	1.5A



## A. Remove and install

### Preliminary steps

1. Remove the shell to get inside the vehicle
2. Close the key switch and emergency stop switch.
3. Disconnect the battery connector.

### program

- 1 Open the fuse cover to take out the fuse (FU01).
- 2 Remove bolts and washers, then remove fuses (FU1 and FU2)
3. Unscrew the fuse box to take out the fuse (FU02)
4. Do the above steps in reverse order to install the fuse box.

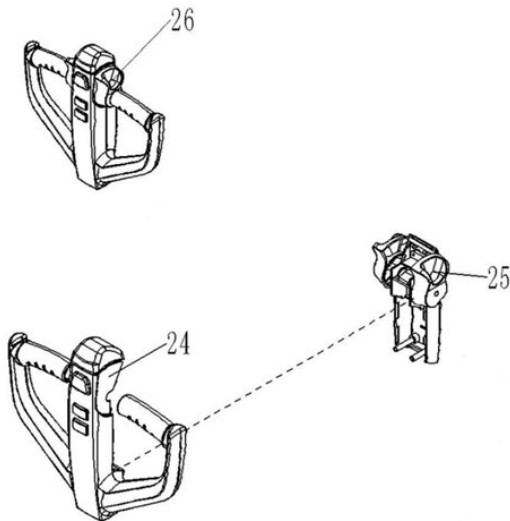
Note: When replacing a fuse, a new fuse of the same type and specification must be used to prevent electrical damage. If fuses are blown frequently, there may be an electrical fault.

## 2-5-2 horn

The speaker is directly powered by a battery. It is used to sound an alarm to warn people nearby.

## 2-6 Handle the head

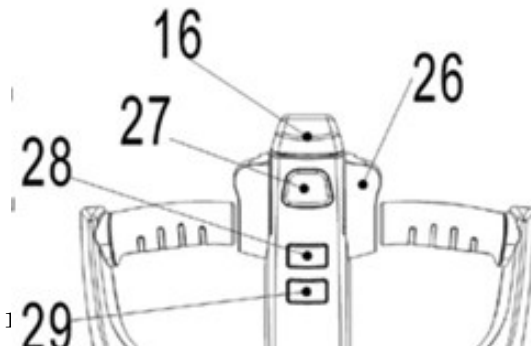
### 2-6-1 appearance



### 2-6-2 function

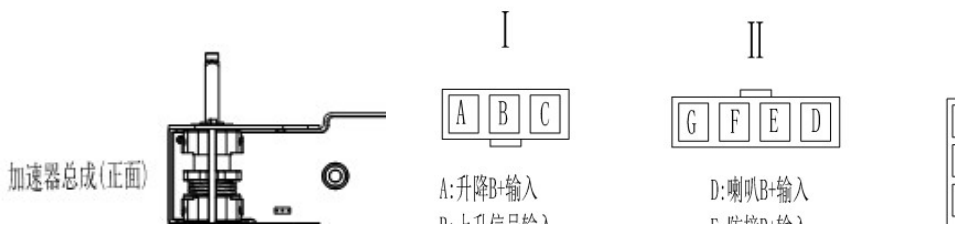
Handle head through up and down button, belly switch, turtle speed button, Accelerators and combination locks fight with controllers to control some of the vehicle's actions.

- A Combination lock (18)
- A Up and down (28,29)
- B Belly switch (16)
- C accelerator (26)
- D Turtle speed switch (30)
- E Horn switch (27)



### 2-6-3 Handle head detection

1 a multimeter is used to measure the III 1  
Nominal resistance:120.0Ω



Use a multimeter to measure the on and off of belly switch and horn switch. If the CAN resistance is not correct, please replace the handle.



## 2-6-4 Removal and installation

### Preliminary steps

- 1 Remove the shell to access the vehicle interior
- 2 Turn off the key switch and emergency stop switch.

### program

1. Remove the fixing screw of the lower cover of the handle and disconnect the cable to remove the lower cover of the handle (25)
  - 2 Remove the handle upper cover fixing screw to remove the handle upper cover (24)
- Perform the above steps in reverse order to install the handle head assembly (26).

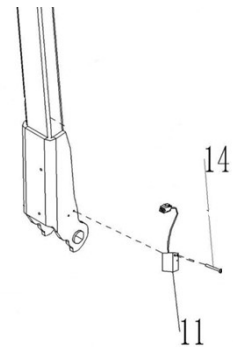
## 2-6-5 Handle proximity switch removed and installed

### Preliminary steps

- 1 Safe parking。
- 2 Close the key switch and emergency stop switch。

### program

- 1 Press down the handle to disconnect the harness of the proximity switch。
  - 2 Remove the retaining screw (14) of the proximity switch and remove the proximity switch.
- Follow the steps above in reverse order to install the handle proximity switch (11).



## 2-6-6 Handle air spring removed and installed

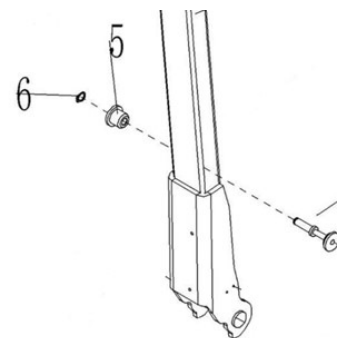
### Preliminary steps

- 1 Safe parking。
- 2 Close the key switch and emergency stop switch。

### Program

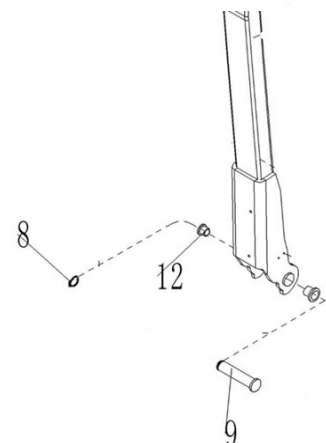
- 1 Press down the handle to disconnect the proximity switch from the handle harness。
- 2 Remove the fixing screw at the lower end of the air spring (10)。
- 3 Remove the fixed shaft retainer (6) and the fixed shaft (4) to remove the air spring (7).

Install the handle air spring in reverse order.



## 2-6-7 Handle removed and installed

### Preliminary steps



1 Safe parking。

2 Close the key switch and emergency stop switch。

Program

1 Press down the handle to disconnect the proximity switch from the handle harness。

2.Remove the fixing screw (10) at the lower end of the air spring.

3.Remove pin retainer (8) and pin shaft (9) to remove handle

Follow the steps above to install handles in reverse order.

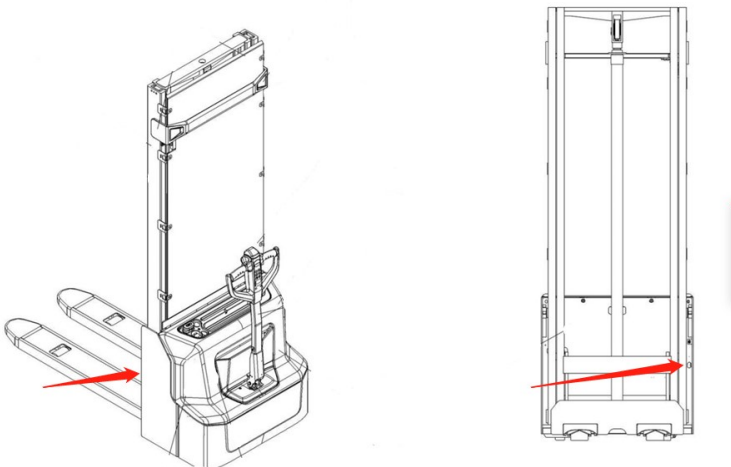
## 2-7 CURTIS Handheld programmer

### 2-7-1 Operation precautions and connection to the vehicle controller:

The attention function of the handheld unit is to facilitate vehicle inspection and maintenance. It is not allowed to adjust the controller parameters without the approval of the vehicle manufacturer to avoid vehicle and personal safety accidents.

After the handheld unit modifies the parameters, it will be automatically saved, just turn off the key switch and restart it.

The CURTIS handheld unit can be connected when the controller is powered on or off. The connection port of the handheld unit is shown in the figure below:



### 2-7-2 Vehicle fault reading process

After connecting the handheld unit to the controller, turn on the key switch

According to the CURTIS handheld unit menu list, find: Faults...

When running the vehicle, the English fault content will appear when the cursor is flashing, please refer to the fault code table for interpretation

## 2-7-3 Vehicle signal detection

After connecting the handheld unit to the controller, turn on the key switch

According to the menu list of the CURTIS handheld unit, find: Monitor...

If necessary, open the corresponding sub-item of the detection menu, run the vehicle, and observe the change of the handheld value.

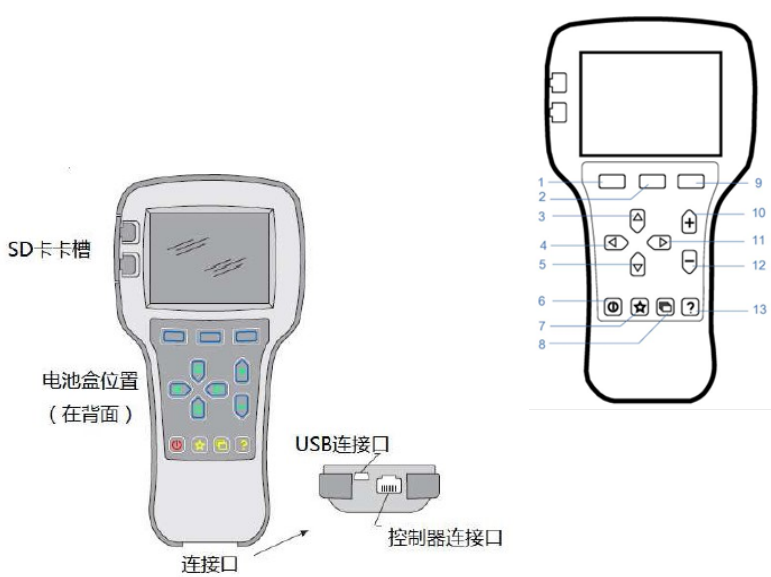
## 2-7-4 CURTIS Handheld unit menu content

Curtis 1313 handheld programmer is used to configure the Curtis electronic control system. Through this programmer, you can adjust and save the set parameters, real-time monitoring of controller data and fault diagnosis



**Warning:** The control system will affect the acceleration rate, deceleration rate, hydraulic system and brakes of the vehicle. If the vehicle control system is programmed incorrectly or exceeds safety, a dangerous situation will occur. Only the vehicle manufacturer or an authorized service agent can program the control system

The programmer has 2 interfaces, one is used to communicate with the electronic control, the other is used to communicate with the PC, the programmer has a battery box and a memory card slot

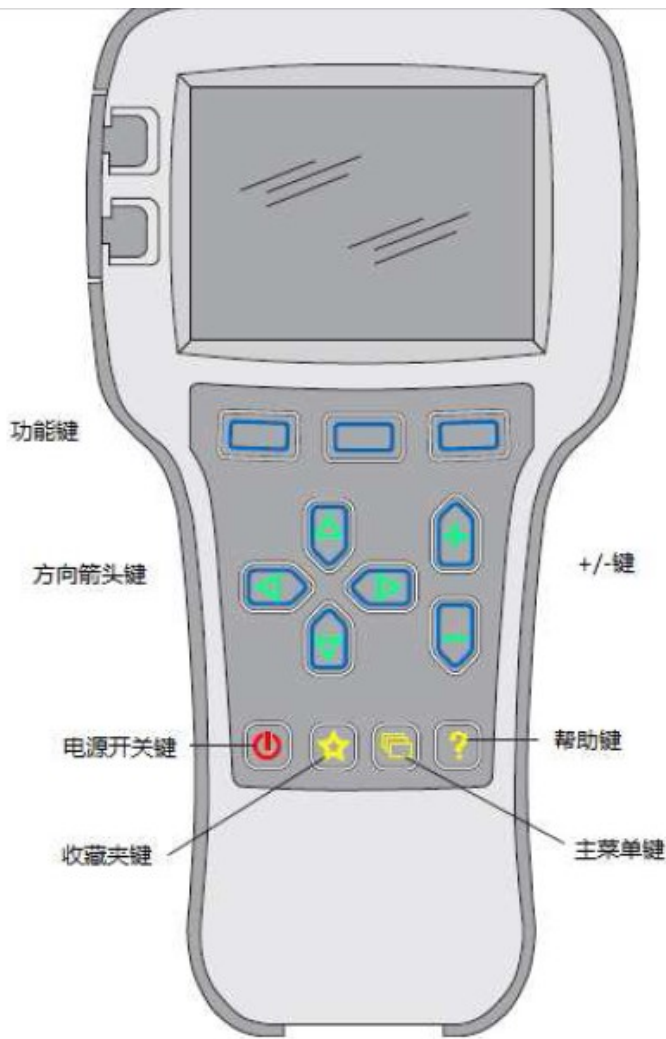


- 功能键 (1, 2, 9)
- 导航键 (3, 4, 5)
- 电源键 (6) ↵
- 收藏键 (7) ↵
- 首页键 (8) ↵

## 1 Power on the programmer

Insert the cable of the handheld programmer into the programming port of the controller to connect to the controller. After connecting to the controller, the handheld programmer will automatically power on and display the control information on the programmer.





## Function keys

Since the functions of these three buttons are determined according to the specified content, these three buttons are blank. At any specific time, the function of the button will be displayed on the upper LCD screen.

## Arrow keys

The displayed information can be selected up, down, left, and right through the 4 direction buttons.

## +/- button

The parameters can be added or subtracted through these 2 keys. At the same time, "+" can mean "Yes" in operation, and "-" can mean "No". In some cases, it can also be used as a scrolling option.

## Power button

When the programmer is inserted into a power-on controller, the programmer does not have to press the power button to use it, the programmer will automatically turn on. After pressing and holding for a few seconds, the programmer will prompt whether it needs to be closed. You can decide whether to shut down by selecting "Yes" and "No" represented by the function keys. After closing the programmer, press for a few seconds, the programmer will restart.

## Favorite button

There are two ways to enter the favorites menu, you can enter through "Favorites" in the main menu, or you can press this key to enter

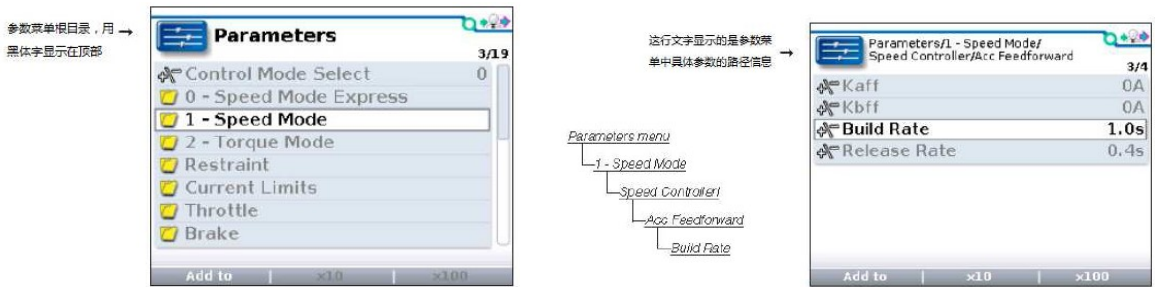
## 2 Menu structure

The main menu consists of nine sub-menus, each of which is displayed with a specific icon, and each item in the sub-menu is arranged hierarchically.

Some menus only contain one item of information, but most menus contain multiple pieces of information. You can enter the next submenu by opening each folder. Expand the table through the grid options, and enter a group of execution commands through the dialog box options. No matter which interface, you can use the left direction button to return to the previous menu.

The names of all nine sub-menus are displayed in bold on the main menu and displayed below the icons. When entering the stepped menu, the name of the submenu or the path you are on will be

displayed at the top of the screen。

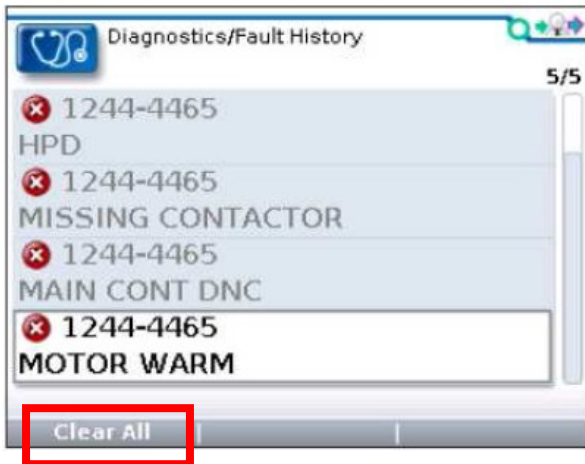


Nine menus

### 3 Fault diagnosis menu

In the main menu, select the "Diagnostics" fault diagnosis icon and press the corresponding function key of Select to enter the fault diagnosis menu. The fault diagnosis menu includes 2 folders: "Present Errors" current fault and "Fault History" Note: Sometimes the fault caused by the temporary event captured in the circuit is not a system fault. You can confirm whether the fault really exists by restarting the system and observing whether the fault will disappear automatically.

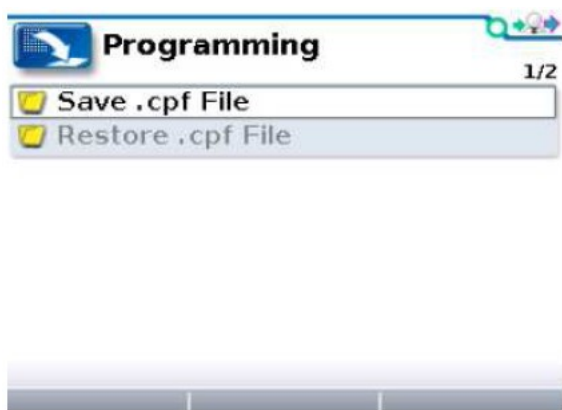
In the historical fault folder, the listed faults are all the faults encountered after clearing the last historical fault. By clearing the fault content in the entire folder, the historical fault can be recorded again。



"Clear All" is used to clear the historical fault folder. A function key will only be highlighted when there is a historical fault in the historical fault folder, and will be grayed out when there is no historical fault.

#### 4 Programming edit menu

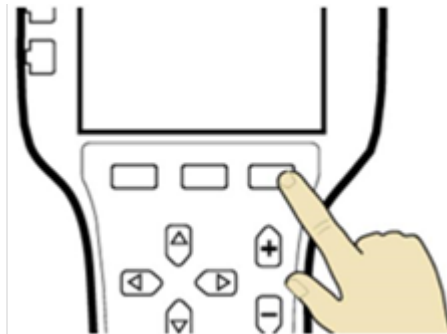
In the main menu, select the "Programming" programming icon and press the function key corresponding to "Select" to enter the menu. The parameter setting file (.cpf file) can be stored and restored through the programming menu



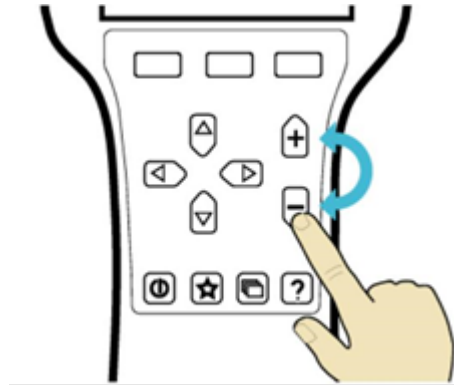
Save.cpf File (Save .cpf file)  
 Use the save .cpf file function in the programming menu to back up the currently set parameters. You can save as many .cpf files as you need, and you need to name each .cpf file a different name  
 Restore.cpf File (restore .cpf file)  
 Restore.cpf File can select the previously saved .cpf file to replace the current controller's .cpf file. When the entire data recovery process is completed, a dialog box will pop up on the screen to request the system to be restarted.

#### 5 parameter settings

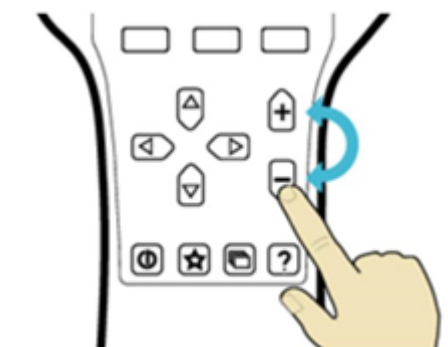
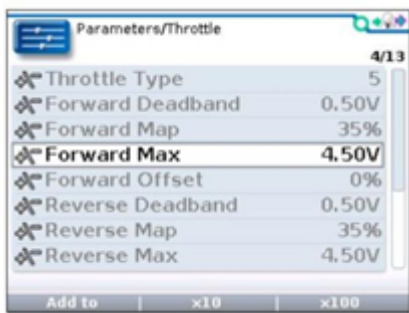
Select "Parameters" in the homepage and press "Select" to enter the parameter setting page, you can adjust or modify the parameters of the controller.



There are two ways to adjust or modify parameters, one is in the parameter list page, see the figure below



The other is to enter the parameter editing page, see the figure below






## 2-8 Troubleshooting for each fault code

Fault code measures

Fault code	Fault name	cause of issue	Source of failure <span style="float: right; border: 1px solid black; border-radius: 50%; padding: 2px;">49</span>
0	LOW_BDI	low power	1212C-2503 Controller
1	PUMP_SRO_FAULT	The lifting or lowering switch acts before the key switch	1212C-2503 Controller
2	SRO_FAULT	The operation sequence of direction, interlock and key switch is wrong	1212C-2503 Controller
3	HPD_FAULT	Interlock, accelerator operation sequence is wrong; or after emergency reverse action, accelerator does not return to center	1212C-2503 Controller
4	WIRING_FAULT	Accelerator problem	1212C-2503 Controller
5	THROTTLE_FAULT	Accelerator wiring problem	1212C-2503 Controller
6	PRECHARGE_FAULT	Controller problem	1212C-2503 Controller
7	MAIN_DRIVER_FAULT	Internal main contactor problem	1212C-2503 Controller
8	MAIN_RELAY_WELDED	Electric control internal contactor adhesion	1212C-2503 Controller
9	MAIN_RELAY_DNC	The electronic control internal contactor is not closed	1212C-2503 Controller
10	BRAKE_OFF_FAULT	The internal drive of the electromagnetic brake is open or the coil is short-circuited	1212C-2503 Controller
11	MOTOR_OVER_TEMPERATURE	Motor over temperature	1212C-2503 Controller
12	BATTERY_DISCONNECT_FAULT	Battery cable connection problem	1212C-2503 Controller
13	BRAKE_ON_FAULT	The internal drive of the electromagnetic brake is short-circuited or the coil is open	1212C-2503 Controller
14	CURRENT_SENSE_FAULT	Electric control problem	1212C-2503 Controller
15	HARDWARE_FAULT	Electronic control fails or the motor reacts incorrectly	1212C-2503 Controller
16	SOFTWARE_FAULT	Electric control problem	1212C-2503 Controller
17	PARAMETER_CHANGE_FAULT	Parameter change failure	1212C-2503 Controller
18	MOTOR_SHORT	Motor short circuit	1212C-2503 Controller
19	MOTOR_OPEN	Motor open	1212C-2503 Controller
20	CONTROLLER_OVERCURRENT	Electronic control overcurrent	1212C-2503 Controller
21	MOTOR_TEMP_HOT_CUTBACK	Motor over temperature cut off	1212C-2503 Controller

22	CONTROLLER_OVERTEMP_CUTBACK	Controller over temperature cut off	1212C-2503 Controller
23	CONTROLLER_UNDERTEMP	Electronically controlled low temperature	1212C-2503 Controller
24	CONTROLLER_SEVERE_OVERTEMP	Severe electric control over temperature	1212C-2503 Controller
25	OVERVOLTAGE_CUTBACK	Overvoltage cut off	1212C-2503 Controller
26	SEVERE_OVERVOLTAGE	Severe overpressure	1212C-2503 Controller
27	UNDERVOLTAGE_CUTBACK	Low pressure cut off	1212C-2503 Controller
28	SEVERE_UNDERVOLTAGE	Severe low pressure	1212C-2503 Controller
29	PARAMETER_FAULT	Electronic control failure or parameter setting error	1212C-2503 Controller
30	GAGE_PDO_TIMEOUT	Instrument communication timeout	1212C-2503 Controller
32	PDO_TIMEOUT	Handle communication timeout	1212C-2503 Controller
33	LIFT_DRIVER_FAULT	Drive 1 (J1-3) failure	1212C-2503 Controller
34	LOWER_DRIVER_FAULT	Drive 2 (J1-11) failure	1212C-2503 Controller
36	BMS_PDO_TIMEOUT	BMS communication timeout	1212C-2503 Controller
37	EMR_SEQUENCING_FAULT	Emergency reverse switch action before power on	1212C-2503 Controller
38	TILLER_HANDSHAKE_FAILED	Handshake between the handle and the electronic control fails	1212C-2503 Controller
39	COAST_SRO_FAULT	The upright walking switch is activated before the key switch or the interlock is switched from On to Off when the upright walking switch is closed.	1212C-2503 Controller
40	PUSH_SRO_FAULT	Carry out the action before switch on	1212C-2503 Controller
80	Mode fault	Handle turtle speed button failure	
81	Lift fault	Up button malfunction	
82	Lower fault	Down button malfunction	
83	BMS Communication Outage	Lithium battery communication timeout	
90	Over Voltage	Battery voltage is too high	
91	Over Discharge	Battery over discharge	
92	Communication Outage	Battery communication timeout	

93	Under Voltage	Battery voltage is too low	
94	Over Current	Battery overcurrent	
95	Over Temperature Protect	The battery temperature is too high	
96	Temperature Protect	Battery temperature is too high	

## 3 Drive/brake system

### 3-1 Overview

#### 3-1-1 Component

The drive/brake system includes the following:

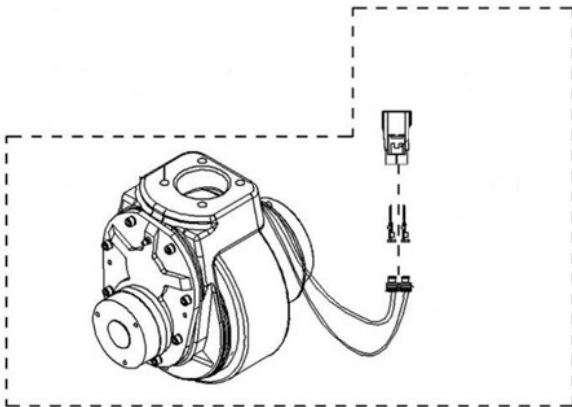
1 The drive motor controlled by the controller transmits the rotational force to the drive shaft (electricity → mechanical power).

2 The drive shaft converts the rotational force transmitted from the drive motor into torque and speed suitable for driving through its gear set, and sends them to the corresponding wheels (mechanical power). They also include service brakes, which use a controller to control electromagnetic brakes to generate braking power (friction).

3 The accelerator sends a CAN number to the drive motor controller to accelerate the motor (CAN signal).

### 3-2 Drive assembly

#### 3-2-1 appearance



#### 3-2-2 How does this work

On the electric side, the driving motors rotate their drive wheels so that the vehicle can move forward/backward

Controlled by the controller

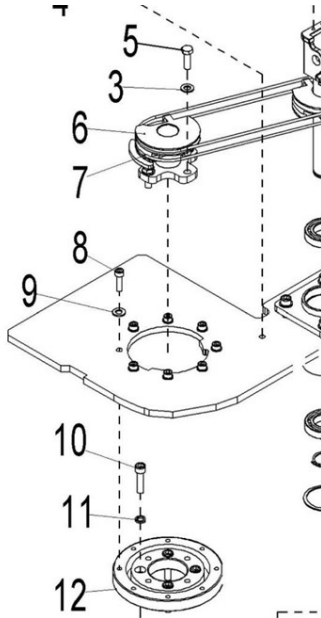
Each drive motor is connected to the controller via M1 and M2 lines. The controller runs the drive motor based on input from multiple switches and sensors and internal parameter Settings.

When the following conditions are met, the drive motor operates:

1. Open the key and emergency stop switch to supply power to the controller.

2. Move the handle to the operating area.
- 3 determine the driving direction,
- 4 Twist the accelerator on the handle

## Removal/assembly of drive assembly



### Preliminary steps

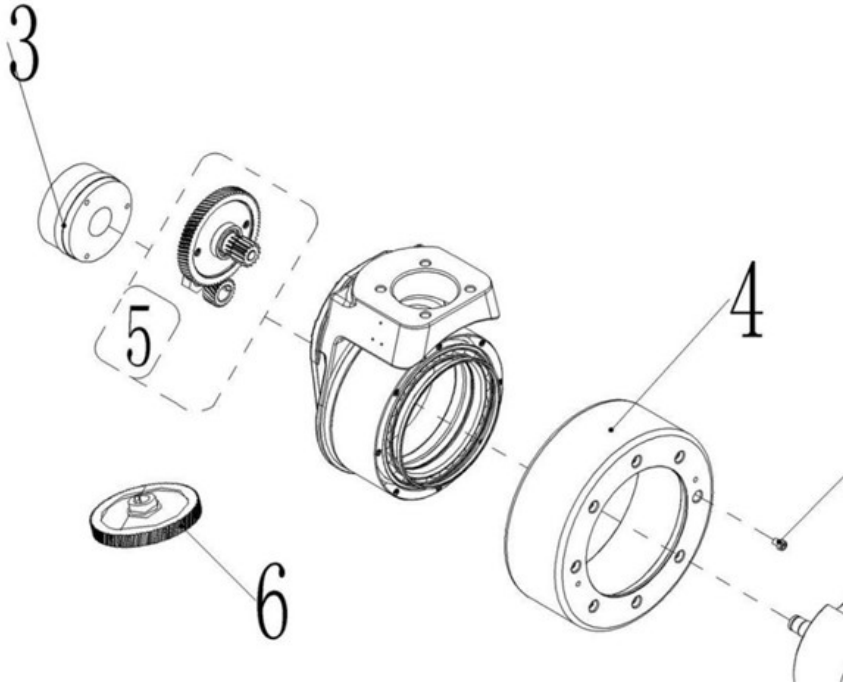
1. Safely park the vehicle and remove the shell
2. Close key and emergency stop switch.
3. Disconnect the battery connector.

### program

1. Remove steering wire rope assembly (7).
- 2 remove the steering shaft screw (5) and remove the steering shaft (6)
3. Lift the whole vehicle with the weight of 585KG.
4. Disconnect the connecting terminals of the driving motor and the electromagnetic brake, and put the vehicle into a stop.
5. Remove the fixing screw (8) of the drive assembly and lift the whole vehicle to remove the drive assembly.
6. Remove the slewing support fixing screw (10) to remove the slewing support and connecting plate (13)

Follow the steps in reverse order to install the drive assembly

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



### Disassembly/assembly

1. Remove the fixing screw of the electromagnetic brake and remove the electromagnetic brake (3)
2. Remove the electromagnetic brake gear.
3. Remove the drive housing screw and remove the housing.
4. Loosen and exit the motor fixing screw.
5. Set up the motor in the air and press the motor downward.

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

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

### motor test

1. The resistance between M1 and M2 is measured using a milliohmmeter.

Nominal resistance:  $0.4 \Omega$

2. Test insulation at 1000 Vac and Min.  $10 \text{ m} \Omega$  use insulation tester.

If there is a problem with insulation, please replace it with a new motor.

### Carbon brush removal/assembly

1. Remove the carbon brush housing fixing screw
2. Remove the brush holder assembly.
3. Remove the fixing screws of the brush and brush holder.
4. Press the spring upward and take out the carbon brush.

Assemble the brush holder assembly by following the steps in reverse order.

## 3-2-4 Drive wheel removal/installation

### Preliminary steps

1. Safely park the vehicle and remove the shell
2. Close key and emergency stop switch.
3. Disconnect the battery connector.

### program

1. Use the crane to lift the vehicle safely.
2. Disconnect the connection line of the drive motor.
3. Loosen and exit the driving wheel fixing screw (9)

4. Push out the drive wheel with screws.

Perform the above steps in reverse order to assemble the drive wheels.

## 3-3 Service braking system

### 3-3-1 Overview

The brake system is composed of a drive controller, an electromagnetic coil and a brake disc, and the brake is an expansion spring compression type.

### 3-3-2 How does this work

In terms of electric power, the drive controller controls the pull-in of the electromagnetic brake so that the vehicle can brake

Controlled by the controller

Each electromagnetic brake is connected to the controller through a wire. The controller operates the electromagnetic brake closing and closing time according to the input from multiple switches and sensors and internal parameter settings.

When the following conditions are met, the electromagnetic brake is engaged:

- 1 Turn on the key and the emergency stop switch to supply power to the controller,
- 2 Move the handle to the operating area,
- 3 The electromagnetic brake is engaged,

### 3-3-3 test

- 1 Use a milliohm meter to measure the resistance between the electromagnetic brakes.

Rated resistance:  $0.4\Omega$

- 2 Test the insulation at 1000 Vac and Min.  $10M\Omega$  uses an insulation tester.

If there is a problem with the insulation, replace the electromagnetic brake with a new one.

## 3-3-4 Removal/installation of electromagnetic brake

### Preliminary steps

- 1 Park the vehicle safely and remove the shell
- 2 Turn off the key and emergency stop switch.
- 3 Disconnect the battery connector.

### program

- 1 Use a hoist to lift the vehicle safely.
  - 2 Disconnect the connecting wire of the electromagnetic brake.
  - 3 Loosen and remove the electromagnetic brake fixing screws
  - 4 Take out the electromagnetic brake and related components.
- Perform the above steps in reverse order to assemble the electromagnetic brake.

## 3-4 Troubleshooting

### 3-4-1 Drive motor

The problem	Probable cause
The drive motor is not working	Switch not off (battery connector, key switch, handle access switch, accelerator) : Turn off 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.
	Bad signal. Fuse blown: Check the battery connection. Check the connection of the battery connector. Check fuses, drives and logic. Replace the retaining wire if it fuses. Check the drive motor and control panel for possible fuses. Some of the reasons are: Operating under excessive load, the current limit is too high
	Low battery voltage: Check the battery terminal voltage. If it's too low, charge the battery.
The drive motor is not working	Excessive wear on carbon brushes(Spring press to the lowest level of carbon brush)。
Traction does not operate during normal operation, but hydraulic operation is normal	A defective brake caused excessive resistance. The increased heat causes the motor to stop running. Check brake adjustment。
	Heavy traction load: Reduces duty cycle load.



<p>Neither traction nor hydraulics will last throughout the normal operating period</p>	<p>The vehicle has too small a battery:</p> <p>Battery is not fully charged during battery charging: Check that the battery is charged Check the battery charger for faults.</p> <p>The battery replacement interval is too long or the battery cooling time is too short.</p> <p>The battery has one or more defective single cells, resulting in a lower than normal capacity and capability rating:</p> <p>Due to the failure of the drive system, the drive system consumes too much battery power. Check brake adjustment. Check wheel bearings, axles, and other mechanical components for correction and troubleshooting purposes. Switch to tires with less friction</p> <p>Due to lifting failure, the hydraulic system consumes too much battery power, or the working cycle hydraulic conditions are incorrect Check whether the gantry is restricted during operation.</p> <p>After a shift, the vehicle's capacity exceeds its designed capacity and has no available power:</p>
<p>The positive (+) or negative (-) electrodes of the battery are in direct contact with the frame (body) of the vehicle or the drive motor</p>	<p>Wiring of the battery or control panel in contact with the frame of the vehicle: Conduct continuity tests and move wire contacts. Remove the wires in sequence until the fault is cleared. The fault will disconnect at the end of the wire</p> <p>Dirty motor: Please clean the toner in time</p> <p>Wet motor: Motor gets damp</p>
<p>The vehicle did not reach its maximum speed</p>	<p>Battery is not fully charged or battery power is poor: Charge the battery.</p> <p>Failure in the drive motor, control panel or transmission system: Check the vehicle speed and steering speed limit proximity switch in both directions .Check the degree of traffic in both directions. If you need to adjust the control panel, do so according to the corresponding section of Section 2 Electrical</p>

	Systems. If the drive motor fails, test the motor assembly
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## 3-4-2 Driving box

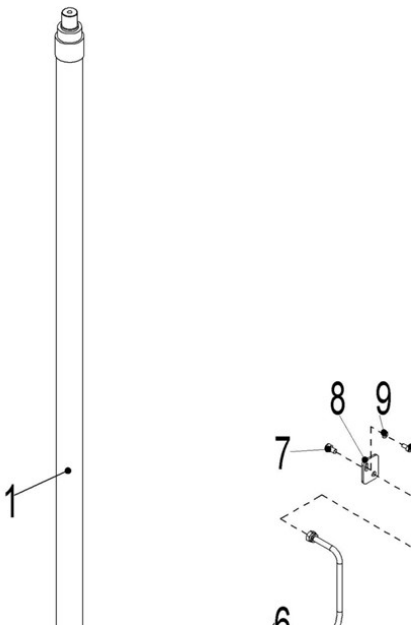
The problem	Probable cause
Noise or vibration in the gearbox	No lubricating oil: Meet the correct amount of lubricant
	Use non-standard oils: Replace oil with standard oil.
	Gear damaged or dented: Replace gear。
	Bearing damage: Replace the bearing。
	Loose mounting bolts: Apply thread glue to the thread of the bolt and retighten it to the specified torque.
Noise or vibration in a brake panel	Use non-standard friction materials: Replace friction material with standard material。
	Friction wear: Replace friction plate。
Installation part leakage	Loose mounting bolts: Apply thread glue to the thread of the bolt and retighten it to the specified torque.

## 4 The hydraulic system

### 4-1 overview

The hydraulic system is composed of working oil pump, lifting cylinder and pipeline. Hydraulic oil is supplied by a pump directly connected to the motor. The pump sends the hydraulic pump to the cylinder.

#### 4-1-1 component



The hydraulic system uses pressurized hydraulic oil from the main hydraulic pump to operate the lifting cylinders and draw out the oil discharged from these cylinders.

1 The pump motor controlled by the controller drives the main hydraulic pump. [Section 4-2]

2 The main hydraulic pump uses the rotational force output from the motor to pressurize the oil in the hydraulic oil tank and deliver the oil to the lifting cylinder. [Section 4-3]

3 The hydraulic oil tank stores the hydraulic oil returned from the lifting cylinder. The stored oil is sucked by the main hydraulic pump for reuse. [Section 4-5]

#### Hydraulic oil circulation

The hydraulic oil tank stores hydraulic oil, which is supplied to the main hydraulic pump through a filter. The main hydraulic pump pressurizes the supplied oil and sends it to the lifting cylinder. When hydraulic oil is received, these systems perform their functions and then drain the waste oil to the tank through a return filter.

## 4-2 Pump station assembly

### 4-2-1 Appearance and specifications



item	specification
power	0.8KW
speed	1618rpm
frequency	55.5hz
Insulation level	H

### 4-2-2 test

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

The pump motor is connected to the controller through a motor contactor. The controller operates the pump motor contactor based on inputs from multiple switches and sensors and internal parameter settings.

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

- The key emergency stop switch is turned off.
- The limit switch and the up button are closed.
- Pump motor contactor suction

Pump motor contactor detection:

For the pump motor contactor, according to the figure,  
And check if it measures the specified value.



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

Note: When assembling and disassembling the hydraulic pump, do not apply any pressure to the motor

### **⚠ Danger**

Pressurized hydraulic fluid can cause severe burns and may even result in amputation.

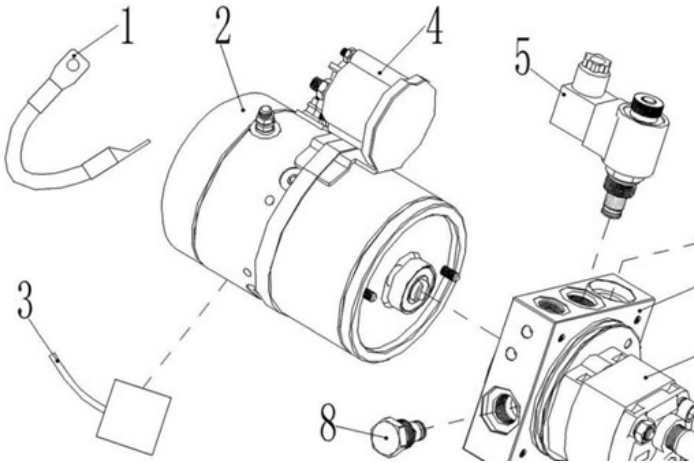
Before performing the following steps, make sure that the pressure has been released from the system.

### **Program**

1. Disconnect the cable from the motor B- and pump motor contactor terminals.
2. Disconnect the wiring harness of the pump motor contactor and the lowering solenoid valve.
3. Disconnect the hose from the hydraulic pump.
4. Remove the fixing screws of the pump station assembly, and take out the pump station assembly.
5. Follow the above steps in reverse order to install the pump motor.
6. Fill the hydraulic oil tank according to the specifications given in section 1-6.

The pressure of the safety valve has been adjusted before leaving the factory, and users are not allowed to adjust and disassemble at will.

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



### Disassembly/assembly

1. Disconnect the connection of the pump motor contactor and remove the contactor.
  2. Loosen the fixing screws of the pump motor and pump.
  3. Remove the motor from the vertical pump station upwards.
  4. Perform the above steps in reverse order to assemble the pump motor.
- Note: Before reassembling the motor, you can test its parts as follows。

### Motor test

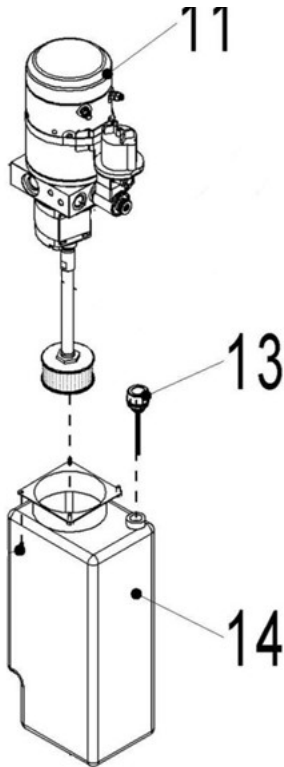
- 1 Use a milliohm meter to measure the resistance between the electromagnetic brakes.  
Rated resistance:  $0.4\Omega$
  - 2 Test the insulation at 1000 Vac and Min.  $10M\Omega$  uses an insulation tester.
- If there is a problem with the insulation, please replace the pump motor with a new one

### Pump motor carbon brush disassembly/assembly

- 1 Remove the fixing screws of the carbon brush housing
  - 2 Remove the carbon brush holder assembly.
  - 3 Remove the fixing screws of the carbon brush and the carbon brush holder.
  - 4 Squeeze the leaf spring upward and take out the carbon brush.
- Perform the above steps in reverse order to assemble the carbon brush holder assembly.

## 4-3 Hydraulic oil tank and filter

### 4-3-1 appearance



### 4-3-2 Replacement of hydraulic fluid and filter

#### Preliminary steps

1. When the fork reaches the top, press the drop button several times to eliminate residual pressure in the hydraulic system
2. Open the case and disconnect the battery.
3. Prepare an oil pan.

#### Program

1. Remove the pump station assembly (see 4-2-3 for details).
2. Remove the 4 fixing screws of the fuel tank and pump station.
3. Loosen the fastening screw of the fuel tank.
4. The hydraulic oil can be poured out after pulling up the pump station.
5. Replace the filter as needed.

Perform the above steps in reverse order to assemble the fuel tank and filter.

## 4-4 troubleshooting

### 4-4-1 Pump motor

Failure phenomenon	possible reason
<p>The hydraulic pump motor does not work</p> <p>◦</p>	<p>Poor connection or blown fuse. Check the battery connection. Check the key fuse. Check whether the hydraulic pump motor may cause the fuse to blow.</p>
	<p>The key switch, upper limit switch, and line contactor are not closed. Turn off the key switch. Use a multimeter to check the power flow through the key switch, line contactor coil and line contactor. The key switch must be turned off.</p>
	<p>The voltage is not enough. Charge the battery or replace the battery. Check whether the cable terminals are tightly matched with the battery terminals and the control panel connector. Check whether the wires inside the cable are broken.</p>
	<p>Incorrect operation of lifting and drive systems.</p>
<p>When the battery will not continue to work normally between.</p>	<p>The battery installed in the vehicle is too small. Research and question the usage of the vehicle under its full working conditions, select and purchase the appropriate battery capacity to understand the working time.</p>
	<p>During the battery charging operation, the battery is not fully charged.</p>
	<p>The hydraulic system consumes excessive battery power due to incorrect lifting or hydraulic control for the working cycle.</p>
	<p>The hydraulic pump motor is overheated. If the motor temperature reaches 155°C (311°F)</p>



## 4-4-2 Hydraulic pump

The fault phenomenon	possible reason
Pump noise。	Oil level is low。
	The oil is very thick (too viscous)
	Pump inlet line is limited。
	Worn parts in the pump.
	Oil is very dirty。
	Air leaked into the inlet line。
The oil temperature is too high。	Oil level is low。
	The oil duct is restricted。
	The oil is too thin。
	There is a leak in the system。
	There is too much wear and tear on the pump。
	The system operates under too much pressure。
The pump shaft seal is leaking。	The shaft seal has worn away。
	Internal wear of pump body。
	Operating at too low an oil level in the tank can cause suction on the seals。
	During installation, seal the shoulder cut in the pump or keyway。
	Seal lips are dry and hardened by heat。
The pump is unable to move fluid。	The oil content in the tank is low。
	Pump inlet line is limited。
	There e is a leak in the pump inlet line. Loose bolts.
	Defects in inlet line of bay。
	The viscosity of the oil is wrong。
	There is too much wear and tear on the pump。
	Pump shaft failure
	The pump bolt does not have the correct torque。

## 5 Lifting system

### 5-1 Overview

#### 5-1-1 Component

The lifting system is powered by the main hydraulic pump.

Fork: Two fork-shaped objects to support the load

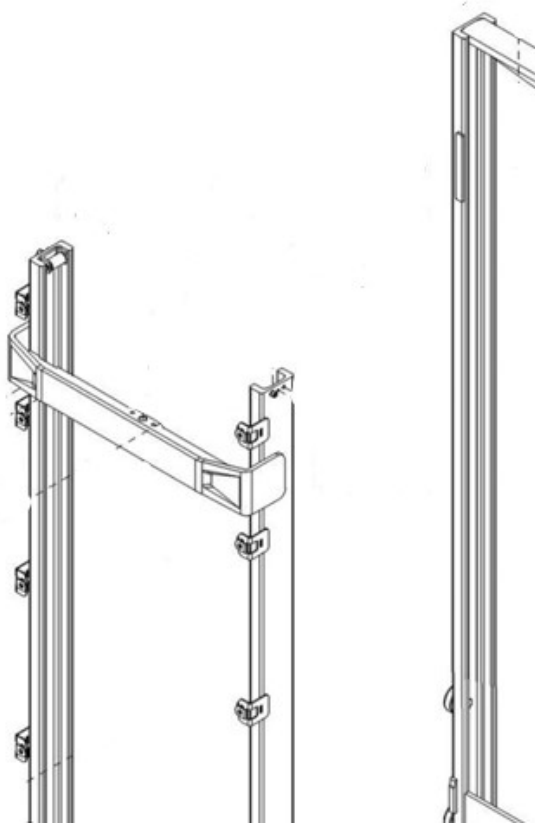
Chain: the part that lifts the bracket and mast

Lifting cylinder: single-acting cylinder pulls back the chain of the bracket

Mast: the vertical structure at the front of the forklift, which extends and retracts to lift and lower the load

## 5-2 Door frame

### 5-2-1 appearance



#### A. Lifting of doorframe

The gantry assembly USES two gantries and a single acting oil cylinder to lift the load. Rollers mounted on the inside and outside of the cargo fork and door frame, respectively, facilitate these up/down movements.

#### Oil cylinder

After receiving the hydraulic oil from the pump station, the rod of the cylinder extends and pushes up the internal frame. At the same time, the fork is also pulled by the lifting chain, which is connected to the outer door frame to lift with the chain.

reduce

If the operator holds down the drop button, the oil output from the cylinder will begin to flow to the tank through gravity.

When the oil is discharged, the cylinder rod and the attached internal frame will retract. As the inner

gantry descends, the tension of the lifting chain relaxes and the fork follows.

## 5-2-2 Pallet fork

### A Fork inspection

The forks should be inspected at least every 12 months. If the vehicle is used in multiple shifts or heavy operations, it should be inspected every six months.

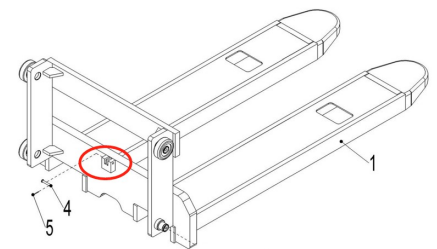
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1. Check carefully for cracks in the fork. Special attention should be paid to the heel part, all welding areas and mounting brackets. Fork with cracks should be replaced
2. Check the angle between the upper surface of the fork blade and the front surface of the fork handle.

If the angle exceeds 93 degrees or deviates more than 3 degrees from the original angle other than 90 degrees, the fork should be stopped.

### B chain tension adjustment

1. Fill 10cm-thick sleepers under the forks and lower the forks completely.
2. Disconnect the chain and fork.
3. Slowly raise the main frame to make the fork frame separate from the main frame and take out the fork.
4. Perform the above steps in reverse order to install the fork.



Note: During the disassembly process, check the fork and fork frame, and replace any parts that may be damaged, cracked or excessively rusted.

## 5-2-3 Chain

### A. Chain wear check

To check the chain wear, you must first find the chain spacing

1. Lift the bracket enough to apply tension on the lifting chain.
2. Place the stationary pointer of the chain wear gauge on the upper pin of the chain link.
3. Place the sliding pointer on the lower pin of the chain link.
4. Make sure to line up the two pointers at the same position on the two 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 distance, start the wear check:

1. Place the sliding pointer on one of the three boxes at the bottom of the meter scale.
2. Place the pointer window on the square containing the chain spacing found above
3. Fix the measuring instrument on the other side of the lifting chain again so that the fixed pointer rests on the upper pin of one of the chain links.
4. Lean the entire length of the indicator on the lifting chain and move the sliding pointer until it

aligns with the upper pin of the other link, keeping the pointer window on the correct square found in step 2.

5. If the chain is too worn, replace the lifting chain

## B. Chain tension check

1. Lower the forks to the lowest level.

2. Gently push the lifting chain by hand to check the tension.

If it does not feel tight, please follow the adjustment below

The entire program operation.

3. Raise the fork and place a 10cm-thick sleeper under it.

4. Lower the fork onto the sleeper block to release tension from the chain.

5. Tighten or loosen the lock nut at the junction of the chain and the main frame to increase or decrease the chain tension as needed.

6. After the adjustment is complete, put the thread glue on the threads of the lock nut.

## Lifting chain removal/installation

1. Raise the fork and place sleepers under it.

2. Lower the forks onto the sleepers to release tension from the main lifting chain.

3. After removing the cotter pin (5), pull out the cotter pin (4) and remove the chain from the chain anchor.

4. Remove the bolts and washers connecting the chain and the main frame, and then take out the chain.

5. Perform the above steps in reverse order to install the main lifting chain.

6. Check that the chain has the correct tension.

## 5-2-4 Lifting cylinder

### Cylinder removal/installation

1. Raise the fork and place sleepers under it.

2. Lower the forks onto the sleepers to release tension from the main lifting chain.

3. Remove the chain

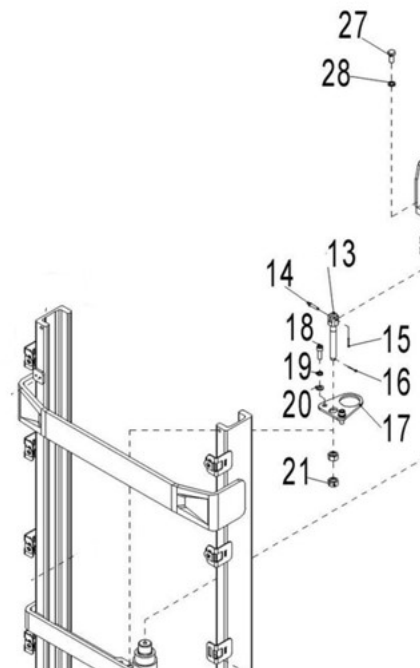
4. Disconnect the oil pipe connected to the oil cylinder.

5. Remove the relevant components of the sprocket (24)

6. Remove the cylinder fixing plate (17).

7. Take out the cylinder upwards

Perform the above steps in reverse order to install the cylinder.



## 5-3 Troubleshooting

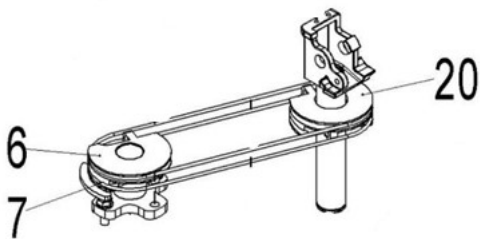
Failure phenomenon	possible reason
The hydraulic system does not lift the load。	There is a leak, allowing air to enter the hydraulic system on the inlet side of the hydraulic pump
	The emergency lowering valve is opened manually.
	The hydraulic pump is too worn 多
	Incorrect load (too heavy)。
	The mast is not aligned with other lifting parts and cannot move freely。
	There is not enough lubricant in the moving mast。
	Bracket or mast rollers (bearings) are worn, do not move (stuck)
Lifting cylinder extension is too slow。	Insufficient oil supply to lift cylinder。
	Poor sealing of lifting cylinder
	The mast is not aligned with other lifting parts and cannot move freely。
	There is not enough lubricant in the moving mast。
	Bracket or mast rollers (bearings) are worn and not moving (stuck)
The mast will not be lowered completely or not at all.	Damaged and contaminated drop spool
	Damaged or bent lifting cylinder。
	The load roller is defective (bearing) or not adjusted correctly。
	There is not enough lubricant on the moving mast。
The fork is not lowered correctly.	Air in hydraulic system。
	The mast is not aligned with other lifting parts and cannot move freely.
	The transportation chain needs to be adjusted.
	There is not enough lubricant in the moving mast。
	The fork or mast roller (bearing) is worn, do not move (stuck)。

## 6 steering system

### 6-1 Overview

The steering system is a set of devices that steer the vehicle left or right. In this vehicle model, the steering system is mechanically structured and consists of a handle rotation shaft (20) and a drive rotation shaft (6), which are connected by a steel wire chain (7).

#### 6-1-1 appearance



#### 6-1-2 How does this work

##### A. Steering control mechanism

Once the handle steering shaft (20) rotates, the drive steering shaft (6) is connected to the handle steering shaft with a wire rope (7). The wire rope is divided into two upper and lower wires to connect them.

##### B. Neutral position

When the steering shaft of the handle is in neutral, the wire rope connecting them is in a non-stressed state.

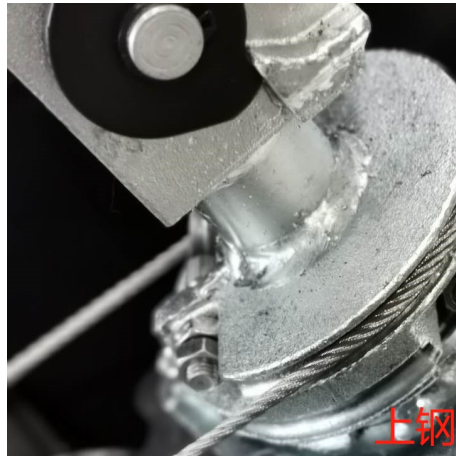
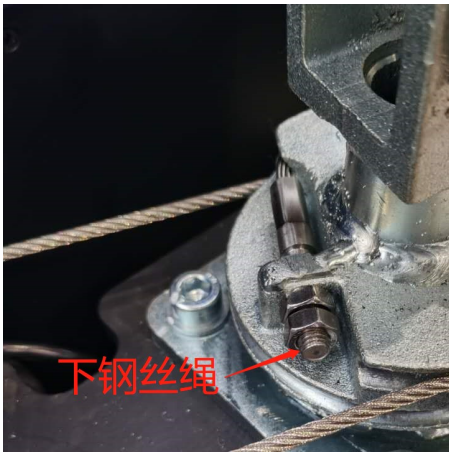
##### C. Turn left

When the steering shaft of the handle rotates, the lower wire rope connecting them rotates, and at the same time, the steering shaft is driven to rotate. If the rotation is not synchronized, please tighten the lower wire rope.

##### D. Turn right

When the steering shaft of the handle rotates, the upper wire rope connecting them rotates, and at the same time, the steering shaft is driven to rotate. If the rotation is not synchronized, please tighten the upper wire rope.

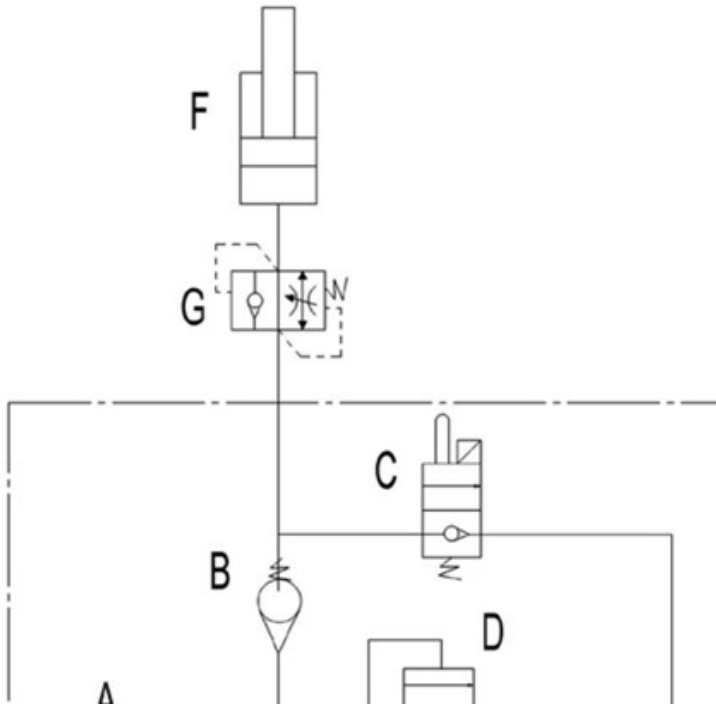
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## 7 Schematic diagram

### 7-1 Hydraulic schematic



number	Codename	name	number	Codename	name
1	A	Hydraulic power unit (motor and oil pump)	5	E	Throttle valve
2	B	Check valve	6	F	Cylinder
3	C	Solenoid valve	7	G	Safety valve
4	D	The overflow valve			



number	Code name	Name	number	Code name	name	number	Code name	name
1	B	The handle	7	MP	oil pump motor	13	SU	Height limiting microswitch
2	Et	The controller	8	MT	Traction motor	14	SB	button switch
3	FU	fuse	9	SA	Interlock switch	15	U	charger
4	GB	battery	10	SC	Lifting wire speed switch	16	USB	USB
5	HA	horn	11	SH	Turning reduction switch	17	YB	Electromagnetic brake
6	KMP	Oil pump contactor	12	SM	Dc power switch	18	YV	Descending solenoid valve

## 8 Charger

### 8-1 Lithium battery charger

#### 8-1-1 Lithium battery charger introduction

WT2425ZMB type charger, this charger is an efficient, fast, small-sized, floor-standing charging device with CAN communication. The charger adopts two-phase AC 220V voltage input and adopts forced air cooling. It has input over-voltage, under-voltage, output over-voltage, under-voltage, over-current, output short-circuit, fan failure protection functions, and meets RoHS and CE requirements

#### 8-1-2 Technical parameters of lithium battery charger

Input voltage (VAC)	Input Current (A)	Power factor	Overall efficiency	Rated output voltage (V)	Rated output current (A)
220±15% VAC	≤9	≥0.9	≥93%	24±0.5	25±0.5

- A、 Input to the chassis Withstand voltage AC2000V , Leakage current <20mA;
- B、 Output to case Withstand voltage AC1000V, Leakage current <20mA;
- C、 Input to output Withstand voltage AC2000V , Leakage current <20mA;
- D、 Insulation resistance test, The input is not less than 20MΩ/DC 500V.

## 8-1-3 Lithium battery charger indicator light description

Indicator label		
No-load indication	Traffic lights flash alternately	
Battery indicator	<p>Red light flashes one second apart, battery power &lt;80%;</p> <p>yellow light flashes one second apart, battery power &gt;80%;</p> <p>green light flashes one second apart, battery power 100%</p>	
error indication	Overvoltage (flow) fault	Red, green, red - - -
	The ambient temperature is too high or too low	Red, green, red and green - -
	The charger is overheated	Green and red - - - -
	Output undervoltage	Red, green, - - -
	Input ac abnormal	Input ac abnormal
	Comprehensive error	Green, red, green, - - -
Full shutdown indication	Green light normally on	

## 8-1-4 Lithium battery charger maintenance

1. In daily use, pay attention to cleaning the dust on the charger. After charging, put the power cord in place.
2. Pay attention to the use environment of the charger, try to avoid using the charger in harsh environments such as high temperature and high humidity

## 8-1-5 Troubleshooting

Failure phenomenon	Failure explanation
No electricity	Check whether the AC input is properly connected and whether the power cord is damaged.
Can not be charged	Check if the B+ and B- wires of the charger are well connected
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

### Charger removal/installation

- 1 Remove the cover to access the drive motor controller.
  - 2 Turn off the key switch and emergency stop switch.
  - 3 Disconnect the charger AC power cord
  - 4 Disconnect the charger control harness
  - 5 Disconnect charger B+ and B-
  - 6 Remove the fixing screws of the charger and take out the charger.
- Perform the above steps in reverse order to install the charger.