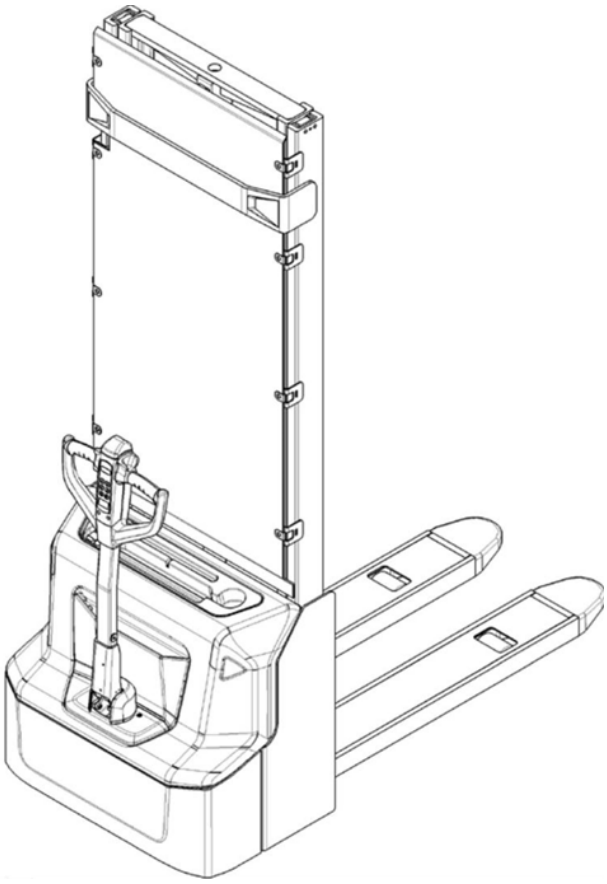
12ES-XB, XN

Electric Pallet Truck

Service Manual



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1 Overview

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.

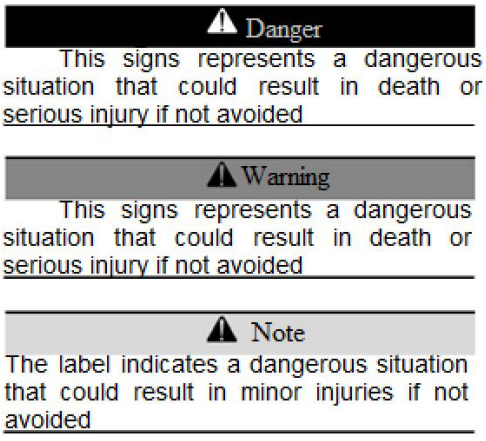
The introductory part of this manual provides an overview of the functions of the vehicle, with particular attention to its different components. You can find each part in the main body of this manual, which provides more specific and detailed information, including schematic diagrams of vehicle components, 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	Hydraulic 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.



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.
Bus bar	A re-conducting conductor that wired to other smaller conductors
Communication Modes	CAN (Controller Area Network) is the standard for communication among microcontrollers and/or devices.
Condenser	A device for short-time electrical energy storage.
Goods Holder	A supporting structure on which a fork is mounted
Check Valve	A valve that allows oil to flow in one direction rather than in the other
Circuit	A path along which current can travel from the positive (+) side of the source to the negative (-) side. This can be obtained with wires and electrical components.
Connector	A part of a wire assembly or harness wired to another wire assembly or harness to for an easier Disassembly and Assembly operation.
Co-contactor	A switch, relay, or part of a contactor that opens or closes a circuit
Components of Co-contactor	An electrical element consisting of an electromagnetic coil and a set of heavy contact tips, which controls current flow through the coil, create a magnetic field, and close or open contact tips
Coil of Co-contactor	An electromagnet used to open or close contact tips in a contactor component.
Control Valve	A valve unit includes multiple directional blocks, each of which has a corresponding actuator
Counterweight	The weight mounted on the back of the forklift to ensure a stable status, especially when lifting heavy loads
Current Limiting	The maximum permissible armature current of the stopped drive motor during the pulse.
Oil Cylinder	A container that maintains pressurized oil and converts hydraulic power into rectilinear motion
DC-DC Convertor	A device that converts a high-voltage DC onto a low-voltage DC.
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 over large 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.
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
Mast	The front vertical structure of the forklift extends and retracts to lift and lower the load.
Master Cylinder	The hydraulic cylinder which is responsible for the start-up of the driving brake
Needle Valve	A valve to lower the backstay manually when the lifting lever is not available.
Normal State	A term used with switches or relays. Their "normal state" means that they are not under any control of stress, temperature, pressure or electricity.
Ohm（Ω）	A resistance unit. The resistance will be such that one volt shall push one ampere of current through it only.
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).
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.

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.
Short Circuit	An unwanted electrical connection between two or more components.
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
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

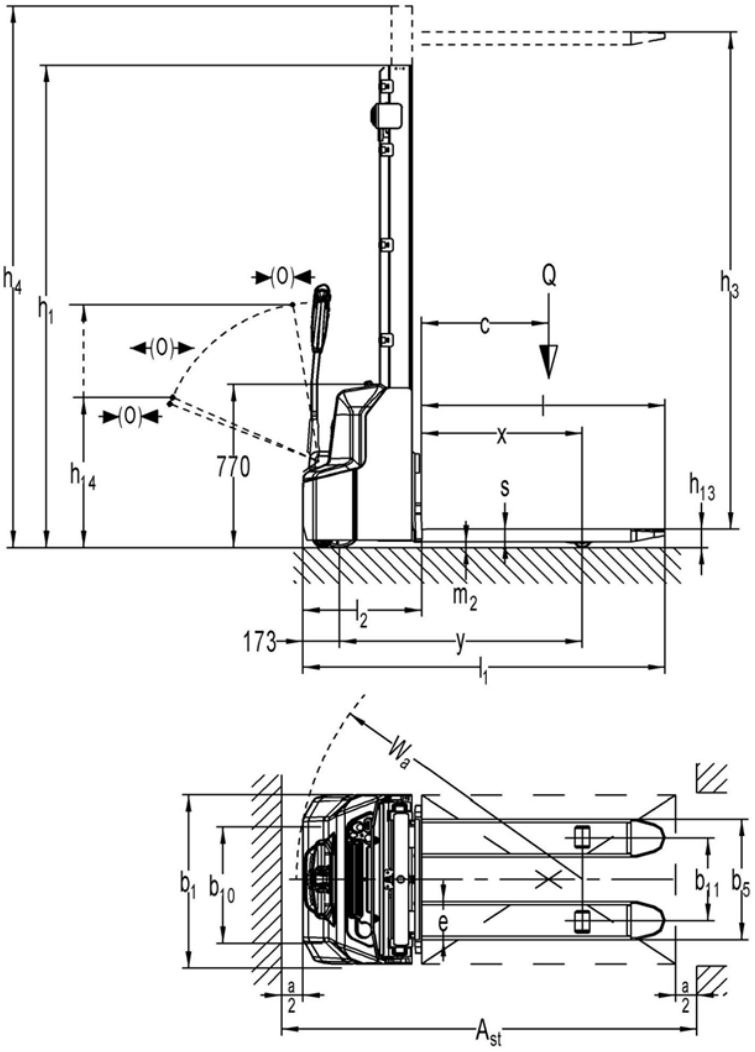


Table 1:Main technical data of the standard version

Type sheet for industrial truck acc. to VDI 2198						
Distinguishing mark	1.2	Manufacturer`s type designation		12ES-XN	12ES-XB	12ES-XN(EN1175:2020)
	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 center distance	c(mm)	600		
	1.8	Load distance ,center of drive axle to fork	x(mm)	760	710	
	1.9	Wheelbase	Y(mm)	1147	1097	
Weight	2.1	Service weight	kg	585	650	620
	2.2	Axle loading, laden front/rear	kg	560 / 1225	530/ 1320	520/ 1300
	2.3	Axle loading, unladen(front/rear)	kg	440 / 145	450 / 200	440 / 180
Tires, chassis	3.1	Tires		Polyurethane (PU)		
	3.2	Tire size, front	∅ x w (mm)	Φ210 x 70	Φ210 x 75	
	3.3	Tire size, rear	∅ x w (mm)	Φ84 x 93		
	3.4	Additional wheels(dimensions)	∅ x w (mm)	Φ100 x 50		
	3.5	Wheels, number front/rear(x=driven wheels)		1x + 1 / 2		
	3.6	Track, front	b10 (mm)	550		
	3.7	Track, rear	b11 (mm)	400 / 515		
Dimensions	4.2	Lowered mast height	h1 (mm)	2280		
	4.3	Free Lift height	h2 (mm)	-		
	4.4	Lift height	h3 (mm)	3514		
	4.5	Extended mast height	h4 (mm)	4037		
	4.9	Height of tiller in drive position min./ max.	h14 (mm)	710 / 1150		
	4.15	Height, lowered	h13 (mm)	86	90	

	4.19	Overall length	l1 (mm)	1710		
	4.20	Length to face of forks	l2 (mm)	560		
	4.21	Overall width	b1 (mm)	800		
	4.22	Fork dimensions	s/e/l (mm)	60 / 180 / 1150		
	4.25	Distance between fork-arms	b5 (mm)	570 / 685		
	4.32	Ground clearance, center of wheelbase	m2 (mm)	26	24	
	4.33	Aisle width for pallets 1000X1200 crossways	Ast (mm)	2197	2167	
	4.34	Aisle width for pallets 800X1200 lengthways	Ast (mm)	2145	2133	
	4.35	Turning radius	Wa (mm)	1350	1300	
Performance data	5.1	Travel speed, laden/ unladen	Km/h	4.5 / 4.7	4.2 / 4.5	
	5.2	Lift speed, laden/ unladen	m/s	0.12 / 0.19	0.11 / 0.14	
	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		
Electrical Engine-	6.1	Drive motor rating S2 60min	kW	0.65		
	6.2	Lift motor rating at S3 10%	kW	2.2		
	6.3	Battery acc. to DIN 43531/35/36 A, B, C, no		no		
	6.4	Battery voltage, nominal capacity K5	V/Ah	24 / 60	2 x 12 / 85[1)]	24 / 60
	6.5	Battery weight	kg	19	2 x 27[2)]	17
	6.6	Energy consumption acc: to VDI cycle	Kwh/ h	0.8	0.6	
Additional data	8.1	Type of drive control		AC-speed control	DC	
	8.4	Sound level at driver`s ear acc. to EN 12053	dB(A)	<70		

1) Optional：2x12V/106Ah

2) 2x12V/106Ah : 2 x 34kg

12ES-XB/N

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

12ES-XB/N(EN1175:2020)

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	1780	-	2514	3037
	1930	-	2814	3337
	2080	-	3114	3637
	2280	-	3514	4037

1-4 Overview of Main Components

12ES-XB/XN (EN1175:2020)

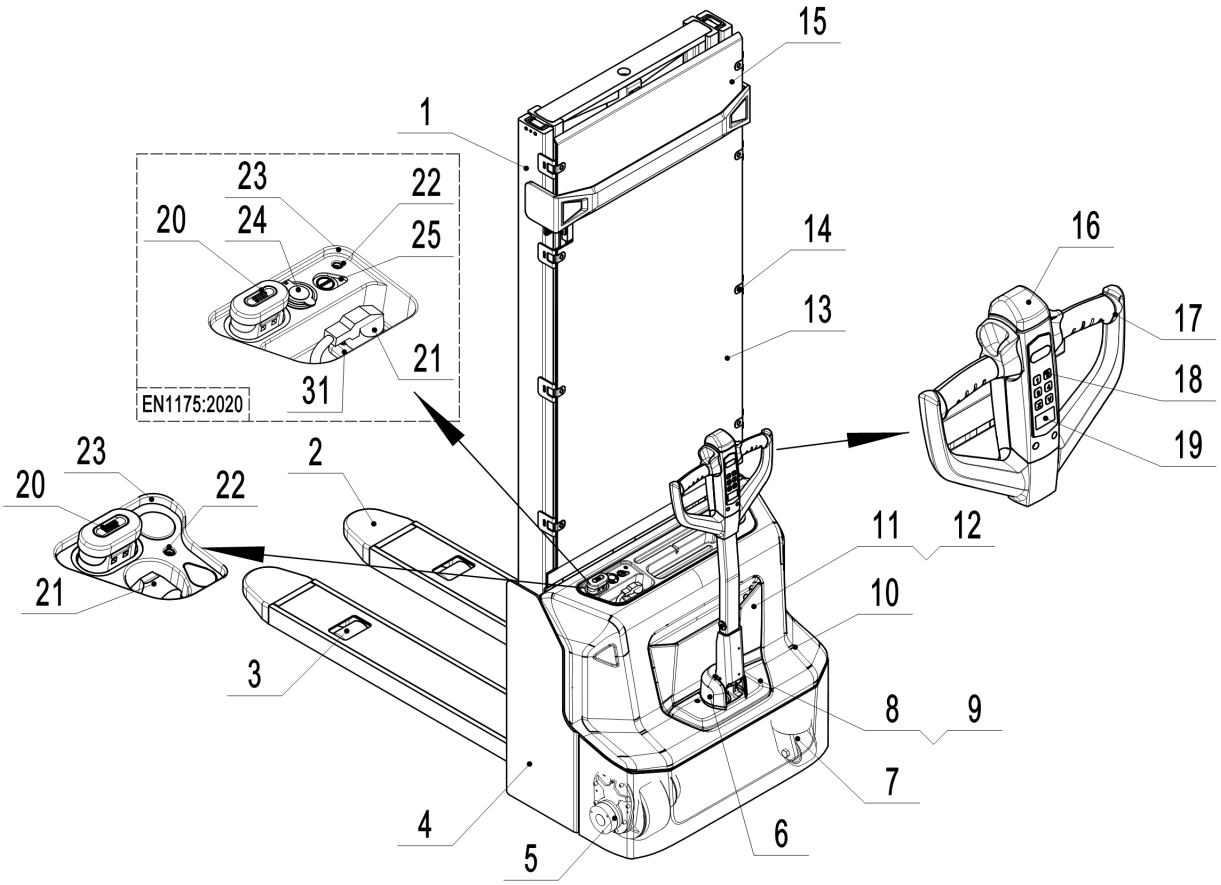


Fig.1: Overview of main components

1.Mast assembly	11.Panel (folder)	21.Charging spring line
2.Pallet frame assembly	12.Bottom cover (folder)	22.Charging indicator
3.Load-bearing wheel assembly	13.Protection plate	23.Instrument panel
4.Body assembly	14.Spring clips	24.USB power supply (12ES-XN,XB)
5.Drive wheel assembly	15.Protective plate	25.Push button switch (12ES-XN,XB)
6.Protective cover (handle)	16.Belly switch	31.Socket (12ES-XB, XN EN1175:2020)
7.Balance wheel assembly	17.Handle	
8.Lower panel 1 (handle)	18.Combination lock	
9.Lower panel 2 (handle)	19.Power meter	
10.Housing	20.Emergency stop switch	

1-5 Cautions

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 14 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.

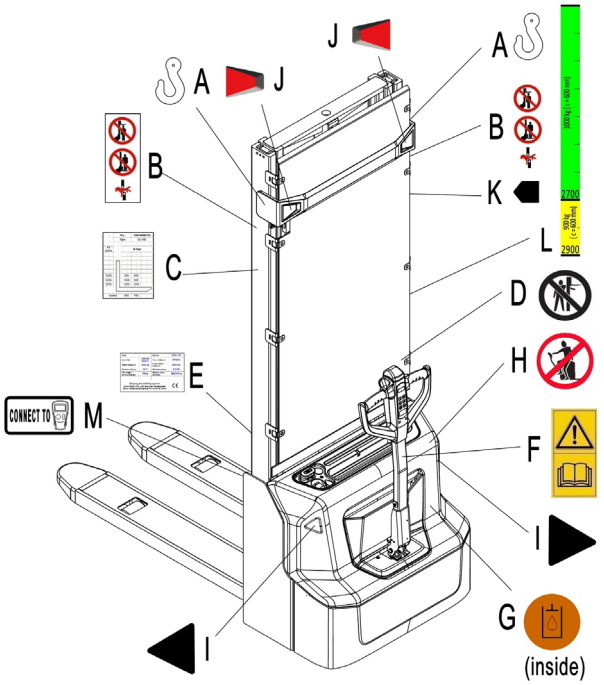
Personal safety

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.

Description of safety devices and warning labels

A Hanger label
B Warning label
C Load Curve Patch
D Prohibit arm sticker
E nameplate
F Read this note label
G Refill Label
H Prohibit Multiplication of Coordinate Sticks
I Warning Label
J Warning Poster
K Height Indicator
L Height Ruler



This stacker crane has a key emergency stop switch (20) that stops all lifting, lowering and driving functions and also disables the electromagnetic brake. After checking the functions of the controller, unplug this switch to operate this stacker crane. Before operation, manually enter the code to start the vehicle.
If you do not operate the stacker, to prevent unauthorized use, press the emergency stop switch (20) or press the "X" button on the combination lock panel.
This stacker is equipped with a belly switch (16) that allows the vehicle to move away from the operator when the vehicle is moving toward the operator by touching the belly switch within the operating range of the handle.
Also follow the instructions shown on the label and replace it promptly if it is damaged or missing.

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.

Table 2: Test Data

Model	12ES-XB/ 3600	12ES-XN/ 3600
Packing weight [kg]	680	650
Lifting height [mm]	3600	3600

After receipt of our new stacking truck or when a re-adjustment is required, please proceed with the following steps before operating the vehicle (for the first time):

- Check that all parts are included and not damaged
- Installation and charging of batteries (refer to 2-2-3)
- Conduct routine and machine function checks

Lifting/ transportation

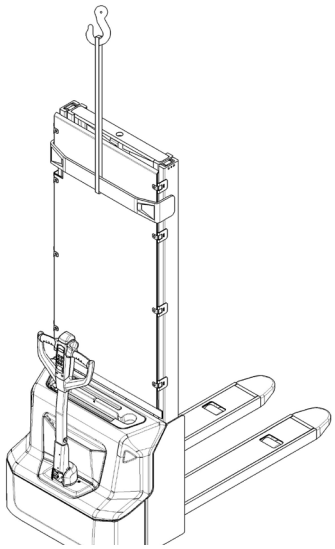


Fig 3: lifting with crane

Check the weight of each component before removing it. Some components of this vehicle are very heavy and may cause serious injury.

Use proper lifting procedures when removing any component

To avoid back injuries, use a hoist when lifting components weighing 23 kg (50lbs) or more. Make sure all chains, hooks, slings, etc. are in good condition and of the correct capacity. Make sure that the hooks are properly positioned. The eyebolt should not be loaded sideways during the lifting operation.

Stacking trucks need to be securely fastened to trucks or trucks during transportation.

Lower the forks and park the vehicle safely.

As shown in Fig. 4, a special strap for hoisting is used to fix the body, fork and mast, and the other side is fixed to the transport vehicle.

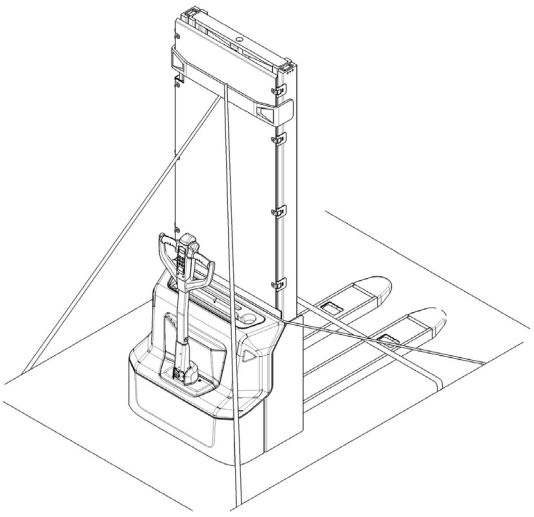


Fig. 4：Fixing point

Storage/decommissioning

For storage, remove the load, lower the truck to the lowest position, grease all in this handbook mentioned greasing points (regular inspection), and eventually protect the truck against corrosion and dust. Remove the batteries and jack the truck safely, so that there will be no flattening after storage.

For final decommissioning hand the truck to a designated recycling company. Oil, batteries and electric components must be recycled due to legal regulations.

1-6 maintenance

Maintenance security

Pre-maintenance

Ensure that the vehicle is in a clean, open environment and free from traffic and other people.
Make sure the vehicle is parked safely and that it does not move suddenly. Place wooden props in front and behind the wheels and make sure the parking brake is properly engaged.
Make sure the vehicle is empty and unoccupied, the forks are lowered, all hydraulic controls are in neutral, and the key is switched to OFF. Attach a "do not operate" or similar warning label to the starter switch or control before servicing or repairing the vehicle.
Make sure the tools are in good condition.
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 mast 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.
mast	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.
Mast, 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 month

Item	Inspection standards and methods
Drive and hydraulic pump motor	Dust and inspect the drive motor and electrical parts area. Maximum allowable air pressure: 205 kpa (29.7 psi)
Hydraulic oil return filter	Replace the oil return filter in the hydraulic oil tank.
Tires	Inspect tires for wear, cuts, grooves, contaminants, etc. Check wheel parts for cracks, wear, damage, corrosion, etc. Drive wheel standard torque: 50 N-m
Lifting chain	Performing a lift chain wear test by measuring the wear of 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.

1-7 lubricating oil

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

1-7-1 Lubricant specifications

The following lubricants are recommended for chains and connecting rods:

Item	Specification
1	DIN 51825 Standard grease

1-7-2 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.

Lubricating point

Lubricate marked points according to maintenance list. The required grease specification is: DIN 51825 standard grease.

1.Load bearing wheel bearing
2.Mast
3.Chain
4.Steering bearing
5.Gear box
6.Balance wheel bearing

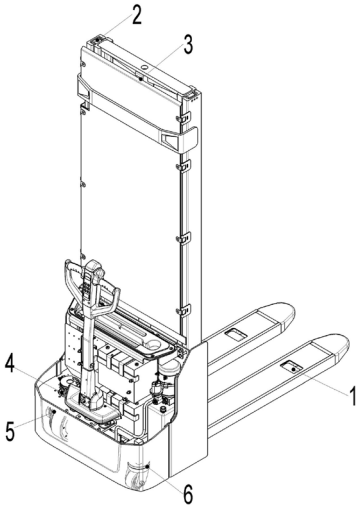


Fig. 5：Lubricating point

Check and refill the hydraulic oil

Hydraulic oil type recommended according to temperature is:

Environment temperature	–5℃~25℃	>25℃
Type	HVLP 32, DIN 51524	HLP 46, DIN 51524
Viscosity	28.8-35.2	41.4-47
Amount	5L (depends on specific model)	

Waste material like oil, used batteries or other must be probably disposed and recycled according to the national regulations and if necessary brought to a recycling company.

Fuel Tank

The oil level in the oil tank should be between min and max marks with fully lowered forks. If necessary add oil at the filling point.

1-8 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 o

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. 21

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

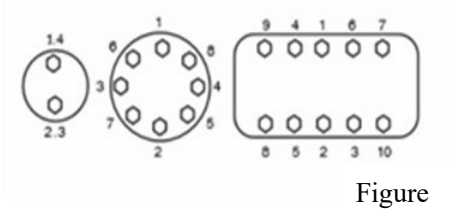


Figure 1-19

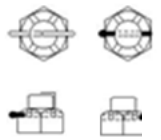


Figure 1-20

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/00 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 o

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 (248e 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.

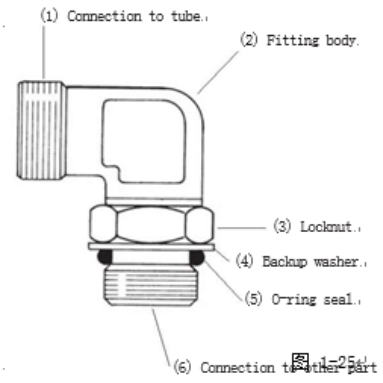


图 1-25

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 counter bore 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 counter bore of the fitting body as much as possible. Tighten the nut until it touches the hexagonal part of the connector body.

1-9 Standard torque

1-9-1 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.

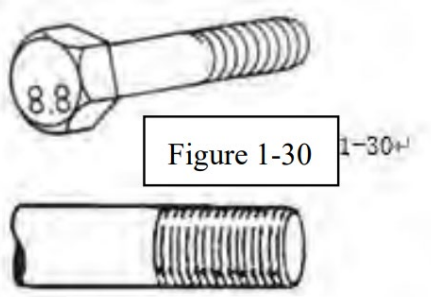


Figure 1-30 1-30

Standard bolt

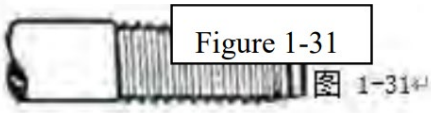


Figure 1-31 图 1-31

Taperlock stud

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

1-9-2 Standard torque for fastening accessories

Standard torques for O-ring surface seal fittings

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

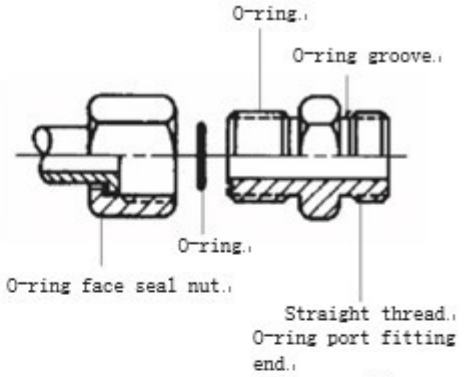


图 1-32

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

Hose clamp - belt type

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

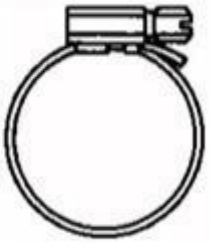


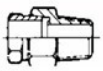
图 1-33

37° bell and straight threaded O - ring accessories

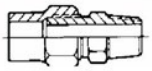
Pic 1-34

37℃ bell and straight threaded O - ring accessories（Sealing accessories for O - ring surface are excluded）				
Nominal pipe external diameter		Thread diameter（in）	Standard torque	
Metric	Inch	Inch	(N·M)	Ponds/Feet
3-18	0.125	5/16	5.0±1.5	4±1
4-76	0.188	3/8	11.0±1.5	8±1
6-35	0.250	7/16	16±2	12±1
7-94	0.312	1/2	20±5	15±4
9-52	0.375	9/16	25±5	18±4
9-62	0.375	5/8	35±5	26±4
12.70	0.500	3/4	50±7	37±5
15.88	0.625	7/8	65±7	48±5
19.05	0.750	1-1 / 16	100±10	75±7
22.22	0.875	1-3 / 16	120±10	90±7
25.40	1.000	1-5 / 16	135±15	100±11
31.75	1.250	1-5 / 8	180±15	135±11
38.10	1.500	1-7 / 8	225±15	165±11
50.80	2.000	2-1 / 2	320±30	240±22

45° bell shape and 45° inverted bell fittings



45° inverted bell



45° bell

1-35

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

Thread fittings for air conditioning and conical pipes

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

2 Electronic System

2-1 Overview

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

1. The battery supplies the power to the electrical system [Section 2-2]

2. The emergency switches may be pressed in emergency to turn off all DC and AC circuits [Section 2-3]

3.Motors, controllers, and associated equipment are providing the necessary drive and pump power to the vehicle based on their interactions with sensors, switches, relays, actuators, as well as various parameter settings. [Section 2-4]

4. When the load is supplied at a current above the limit, the fuse will protect all DC loads from over-current by cutting off the load's power supply. [Section 2-5-1]

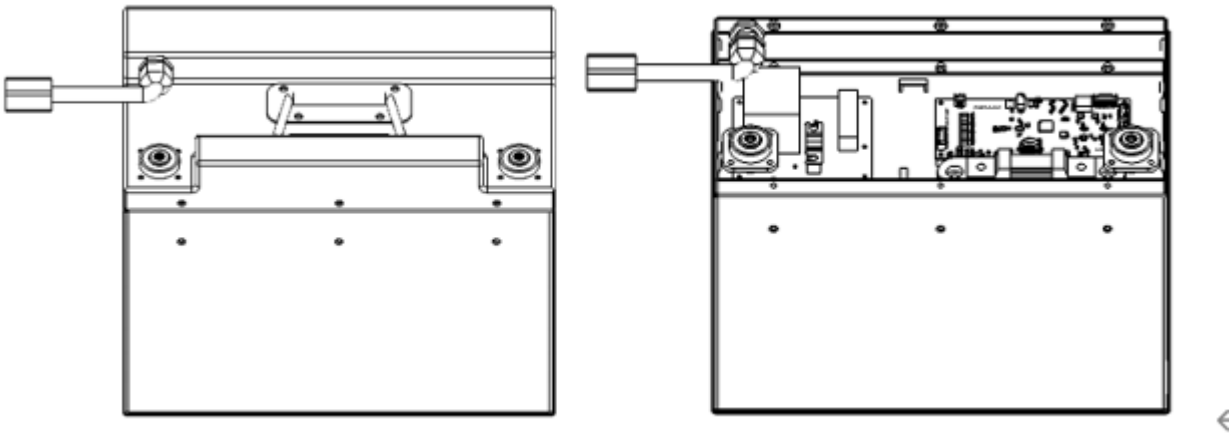
5.Other DC loads that activated by the operator's direct requirements will work independently of the controller. First, such DC loads not regulated by controllers and are not the purpose of controllers' signals. However, they may interact with controllers in some configuration. Such loads include light sets and horns. [Section 2-5-3 to 2-5-5]

6.The display board monitors the vehicle, informs the user of its condition and provides basic functions for mode setting, diagnosis and calibration [Sections 2-6]

7. The handheld console provides the same functions as the instrument board, but more detailed [sections 2-7]

2-2 Battery (Lead-acid)

2-2-1 Appearance and Specifications



Item		Parameters	Remark
Specifications		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	30A	
	Charging voltage	28~28.8V	
Internal resistance		Less than 20mQ	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	Failure to confirm	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 Q resistance;	1.When the resistance is infinite, it indicates that CAN communication wiring harness is disconnected. Firstly, measure whether CAN Hand CAN L 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 0, damage may be inside the BMS CAN chip	1.Replace the damaged wiring harness; 2.Replace the battery
			1.Disconnect the	If there is output,	Check locomotive

			discharge plug, start the battery pack separately, and check whether the discharge plug has output;	there may be an error in the locomotive internal circuit, resulting in the battery pack unable to output	communication and power lines
2	No output after the battery pack is started, the switch indicator light is not on	1. Internal components of the system are damaged; 2.The system voltage is insufficient	1.Select the DC voltage range of the multi meter, measure the total positive and negative voltages at both ends with a stylus, and check whether the total voltage of the system is normal;	The system voltage is low and BMS cannot work normally	Charge the battery pack first
			2.Use the multi meter 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 Q resistance on both ends	Did not measure to 120 Q 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 Precautions (Lithium battery)

a). Charging requirements:

The battery has a built-in protection system, when the system is over-discharged, the internal MOS will cut off the output, showing a high resistance state (OD), then the charger needs to charge to activate. The maximum charging voltage of the charger is limited to 28.8V, two-stage constant voltage charging, charging cut-off current 0.3~0.5A.

b). Cautions:

1) The battery is not allowed to be charged below 0℃, otherwise it will seriously cause battery performance degradation and even safety incidents.

2) The battery is not allowed to be charged at low temperature, and should not be used at low temperature (cold storage or outdoor in winter), especially in places where the ambient temperature changes drastically, the battery will produce condensation water droplets inside the battery, the water droplets will break the battery internal electronic devices, resulting in unpredictable hidden problems. After taking out from the cold environment, the battery should be placed at room temperature for at least 4 hours before use.

3) The battery protection level is IP54, you can't use water to rinse the battery directly, you can use a cloth dipped in water to wipe, but not dipped in water to wipe the charge and discharge port.

4) The battery should not be used in the marine salt spray environment, nor in the humid environment for a long time (aquatic market, cold storage, ice factory, bathroom, acid factory, etc.).

5) When the lithium battery pack is not used for a long time, please do not store it in a fully charged state, try to store it in a semi-charged state (the battery voltage is around 26V) and store it in a cool place.

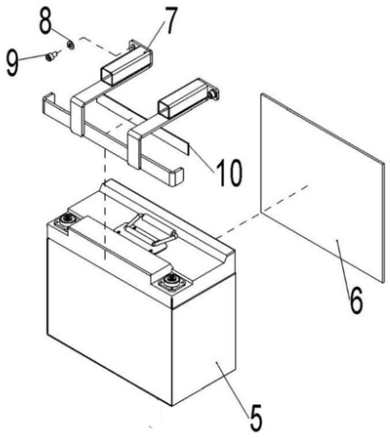
2-2-4 Removal and installation of lithium battery

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
Emergency Switch

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 o

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

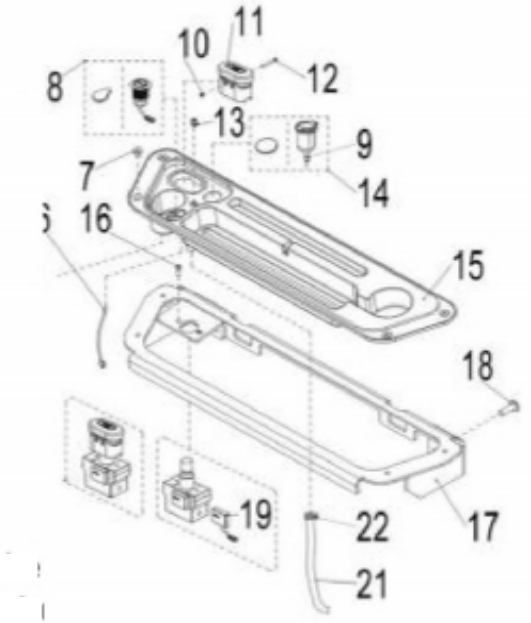
A) Mechanical properties

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 multi meter 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 multi meter buzzer will call (that is, it is in the on-off state). When the emergency stop switch is pressed down, the multi meter 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 multi meter buzzer will be called (that is, it is in the on state). When the emergency stop switch is pressed down and locked, the multi meter buzzer does not ring (that is, the switch 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 multi meter buzzer will be called (that is, it is in the on state). When the emergency stop switch is pressed down and locked, the multi meter 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 o

5 Disconnect the connection line for the micro switch (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

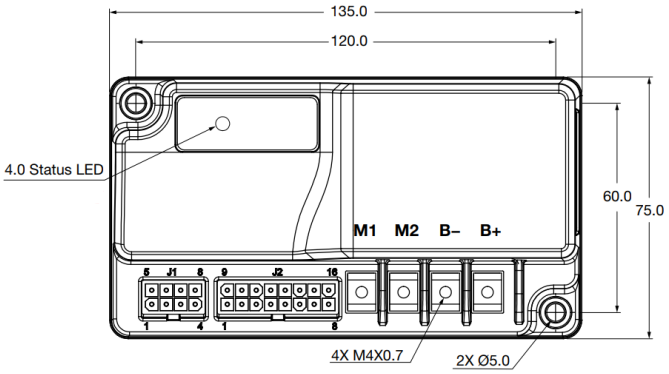
2-4 Controller and associated equipment

2-4-1 appearance

a.Controller Curtis 1212C

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

b. Curtis **controller 1212e(EN1175)**



Docking connectors：
8 core Molex Mini-Fit Jr.
16 core Molex Mini-Fit Jr.

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 o

l. 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 o

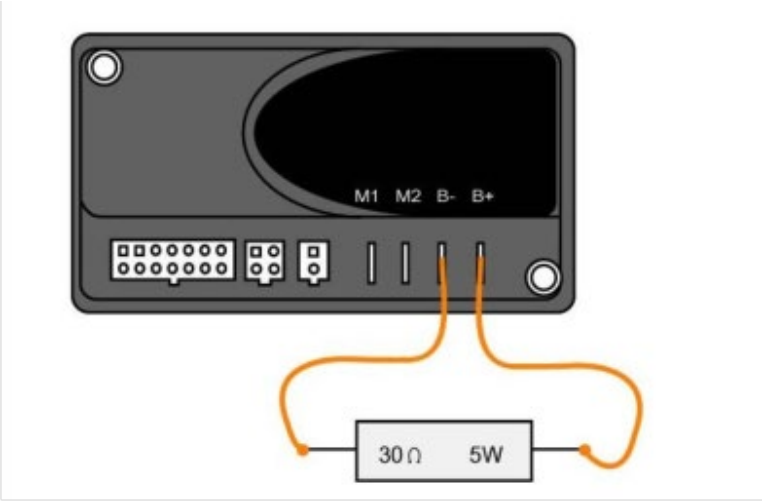
6. The handle display meter will display the battery power and accumulated working hours.

2-4-3 test

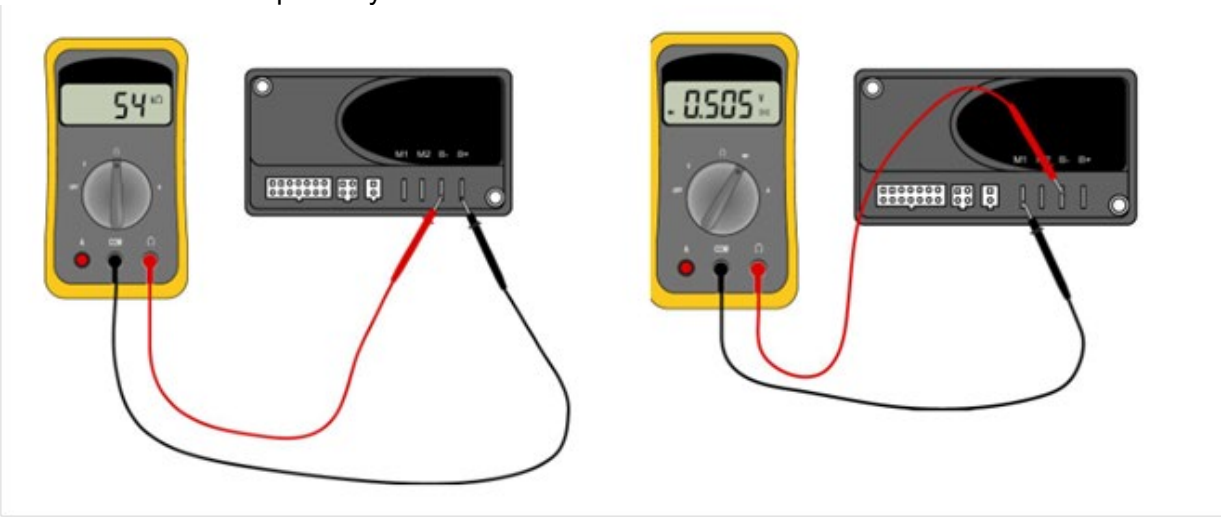
A. Controller

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 30Q/5W).



Use a multi meter 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	Multi meter terminal		Normal range	
	Red test lead	Black test lead	Polar value determination	Resistance measurement
1	B+	B-		40KΩ+
2	B+	M2		80KΩ+
3	B+	M1		80KΩ+
4	M1	M2		60KΩ+
5	B-	M2	0.3-0.6V	
6	B-	M1	0.3-0.6V	

Pull the multi meter to the Q position (determination of resistance value) Pull the multi meter 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 betaken when connecting, disconnecting and handlingo 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

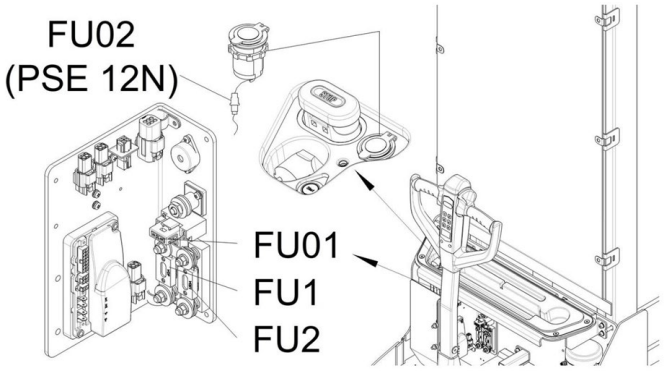
2-5 Miscellaneous load

2-5-1 fuse

A. Function and composition

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

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



B. 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,

procedure

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.

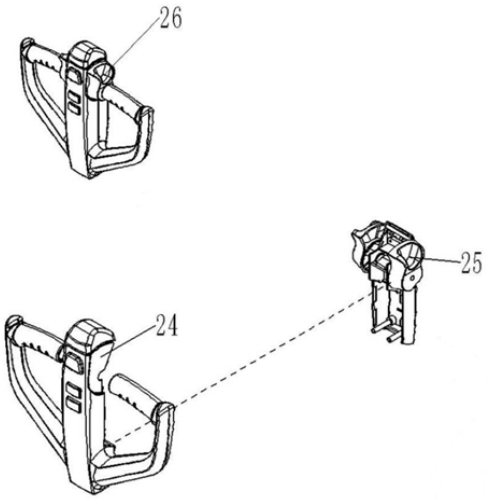
Note: When replacing a fuse, a new fuse of the same type and specification must be used to prevent electrical damage. If fuses are blown frequently, there may be an electrical fault.

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 Tiller

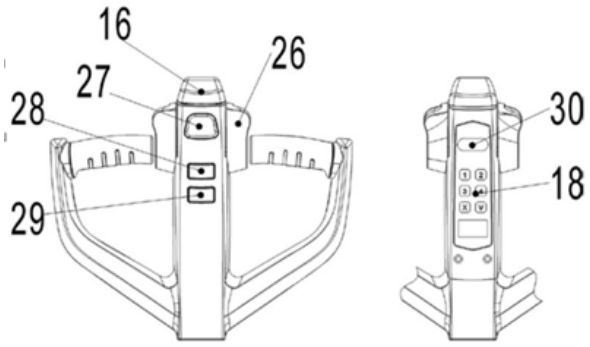
2-6-1 appearance



2-6-2 functions

Tiller head through the up and down buttons, belly switch, tortoise speed button,

Accelerators and password locks engage with controllers to control some of the vehicle's movements



A Password Lock (18)

B up and down (28,29)

C Belly switch (16)

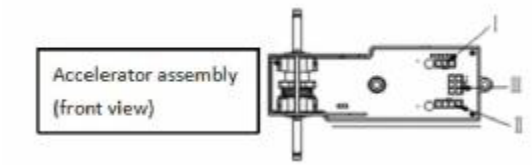
D Accelerator (26)

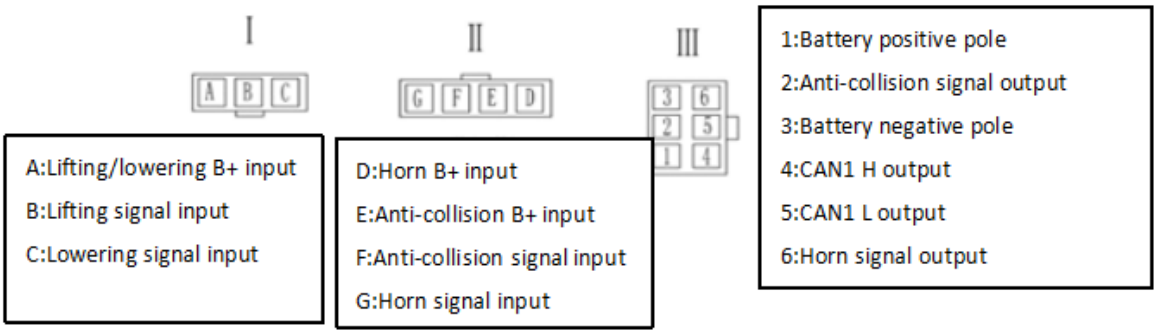
E Turtle Speed Switch (30)

F Horn switch (27)

2-6-3 Tiller head detection

1) Use a multi meter to measure the resistance between pin 4 and pin 5 of III.
Rated resistance: 120.0_





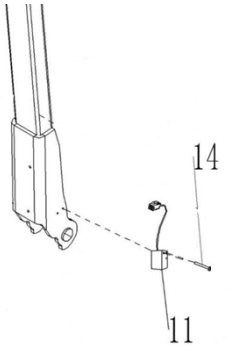
2) Use a multi meter to measure the on/off condition of the belly switch and the horn switch respectively. If not connected and CAN resistance is wrong, replace tiller

2-6-4 Removal and installation

Preliminary steps
1 Remove the shell to access the vehicle interior
2Turn off the key switch and emergency stop switch,
program
1. Remove the fixing screw of the lower cover of the tiller and disconnect the cable to remove the lower cover of the tiller (25)
2 Remove the tiller upper cover fixing screw to remove the tiller upper cover (24)
Perform the above steps in reverse order to install the tiller head assembly (26).

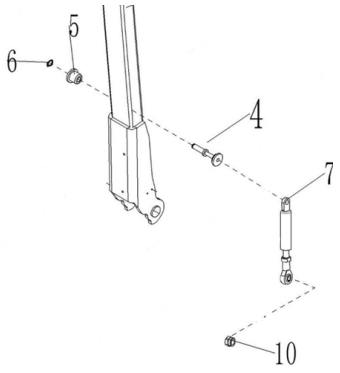
2-6-5 tiller proximity switch removed and installed

Preliminary steps
1 Safe parking o
2 Close the key switch and emergency stop switch
program
1. Press down the tiller 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 tiller proximity switch (11).

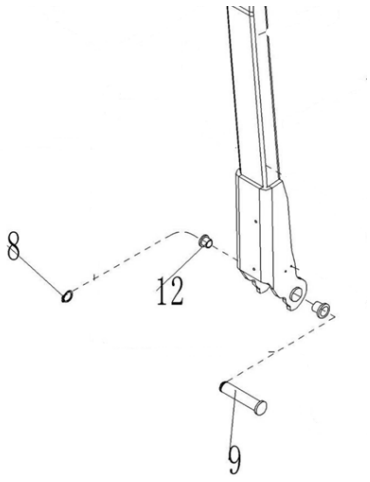


2-6-6 Tiller air spring removed and installed

Preliminary steps
1 Safe parking
2 Close the key switch and emergency stop switch
Program
1 Press down the tiller to disconnect the proximity switch from the tiller 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 tiller air spring in reverse order.



2-6-7 Tiller removed and installed



Preliminary steps

1 Safe parking.

2 Close the key switch and emergency stop switch.

Program

1 Press down the tiller to disconnect the proximity switch from the tiller 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 tiller

Follow the steps above to install tiller s in reverse order

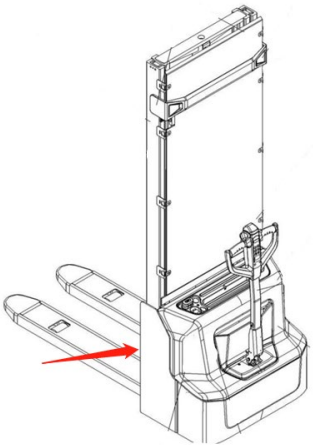
2-7 CURTIS Handheld programmer

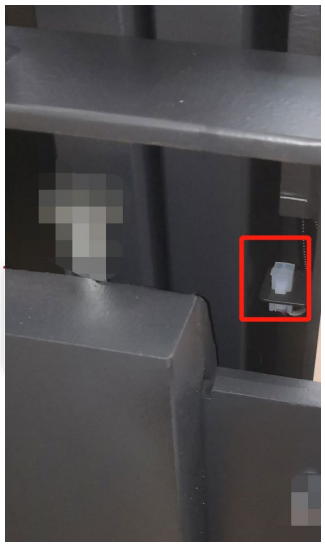
2-7-1 Operation precautions and connection to the vehicle controller:

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...

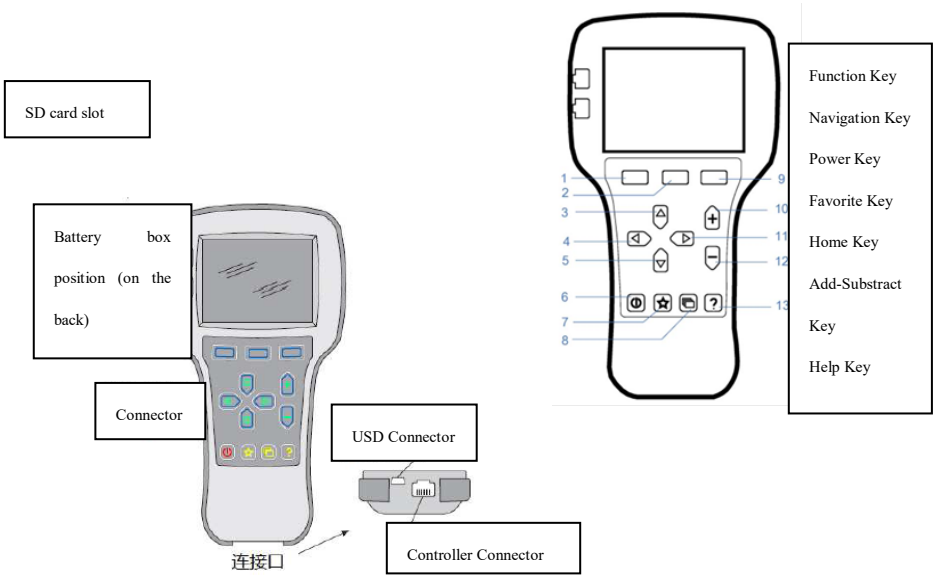
If necessary, open the corresponding sub-item of the detection menu, run the vehicle, and observe the change of the handheld value.

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

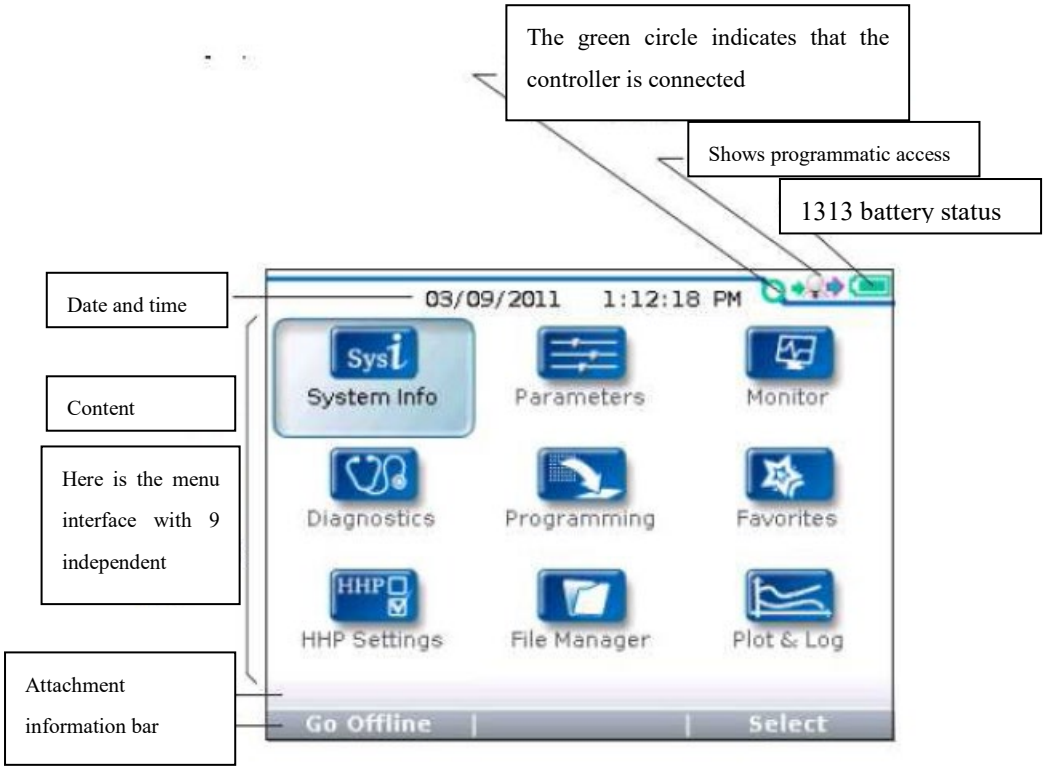
The programmer has 2 interfaces, one is used to communicate with the electronic control, the other is used to communicate with the PC, the programmer has a battery box and a memory card slot

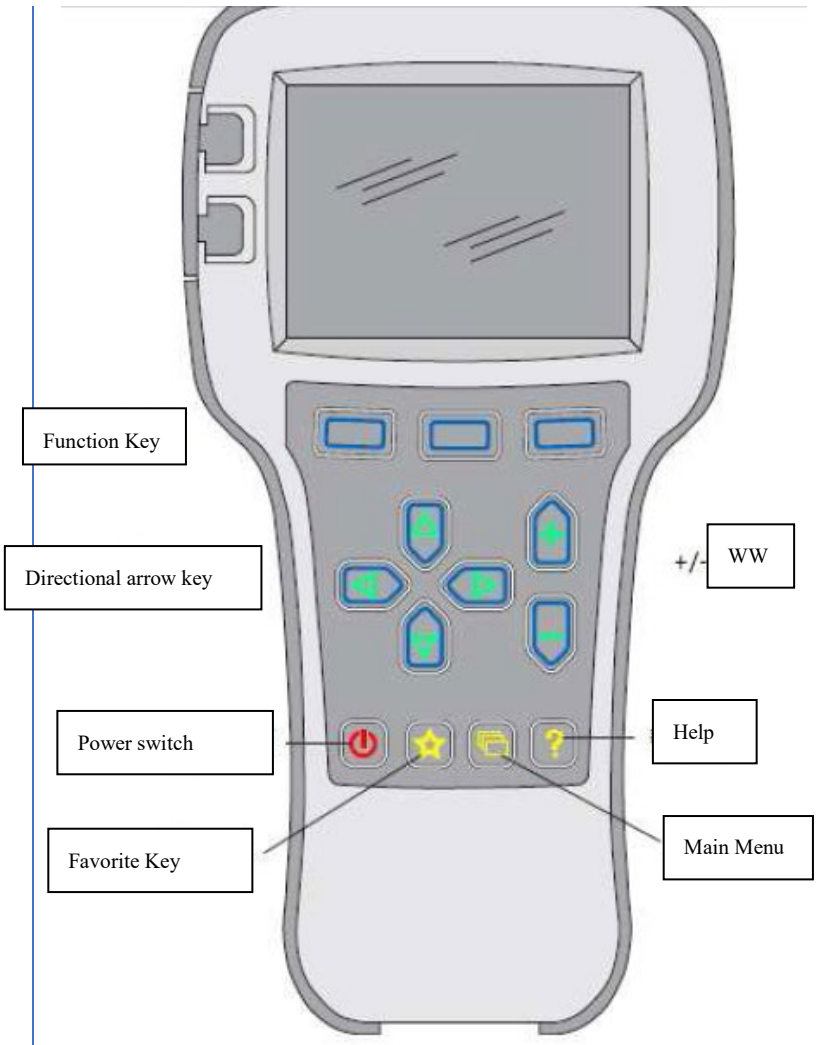


1 Power on the programmer

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.

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





function keys

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

Directional arrow key

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

+ /-Button

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

Power switch

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

Key of favorite

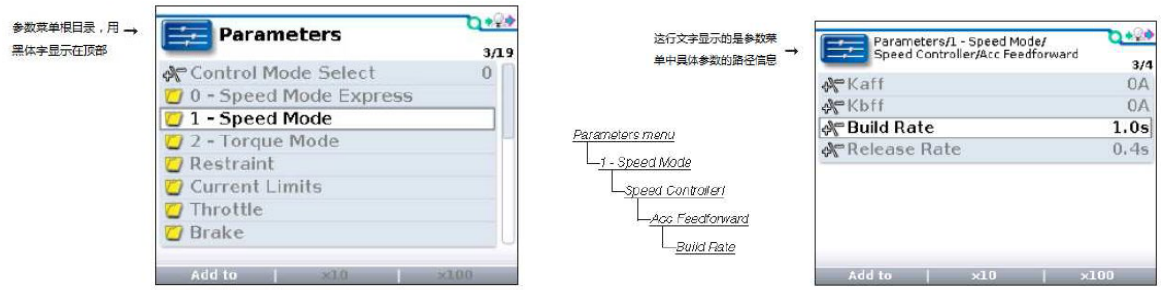
There are 2 ways to enter the menu of "Favorites" 1. You can enter through the main menu "Favorites"; 2. You can also press this key to enter

2. Menu structure

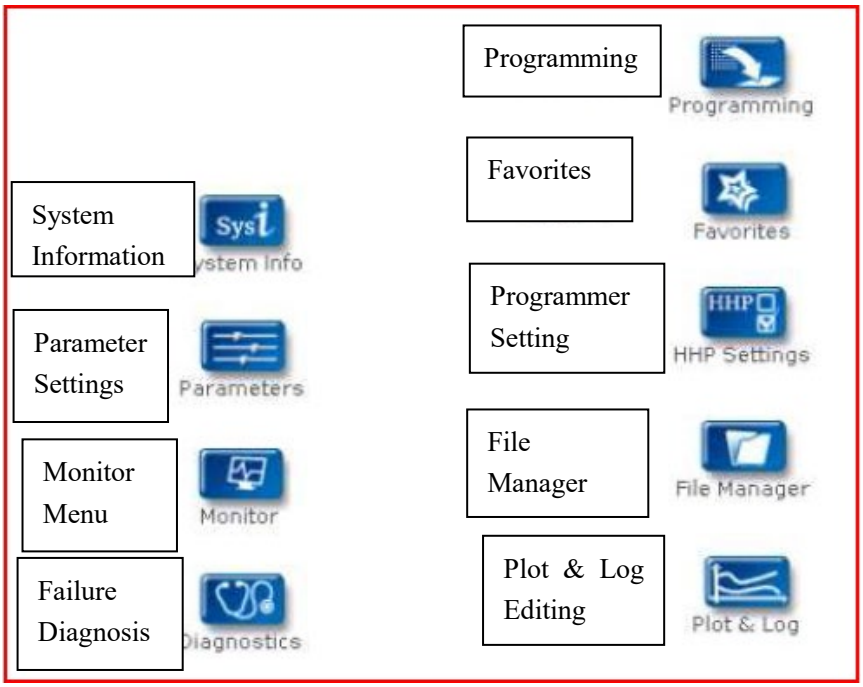
The main menu consists of nine submenus, each of which is displayed with a specific icon, and each item of the submenu is arranged in a hierarchy.

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

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



Nine main menus



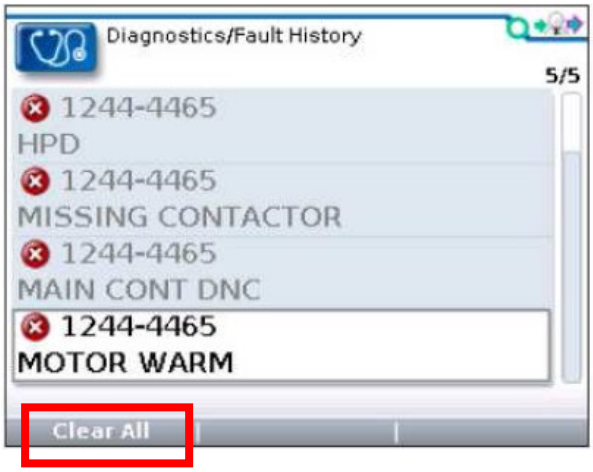
3 Fault diagnosis menu

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

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

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

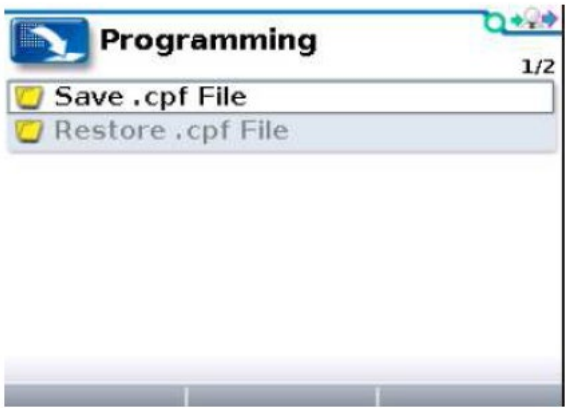
folder.



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

4. Programming edit menu

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



Save.cpf Files

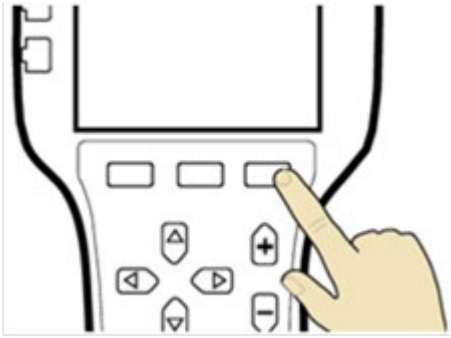
The Save. CPF File function in the program menu may be used to backup current setted parameters. You can save as many.cpf files as you want, and each.cpf file shall be named differently.

Restore.cpf Files

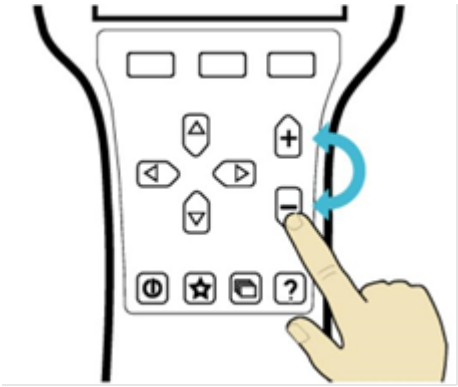
CPF Files to restored may be selected from the earlier saved. CPF Files instead of the current controller's. CPF Files. When the entire data recovery process is completed,

5. Parameter Settings

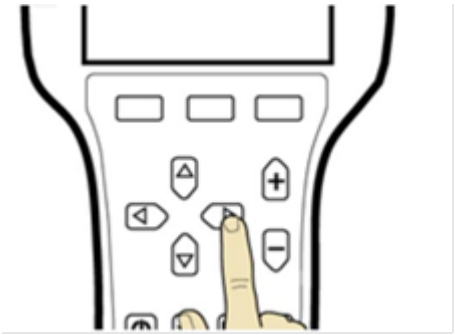
Select "Parameters" from the main page and press "Select" to enter the parameter setting page, in which you can adjust or modify the parameters of the controller.

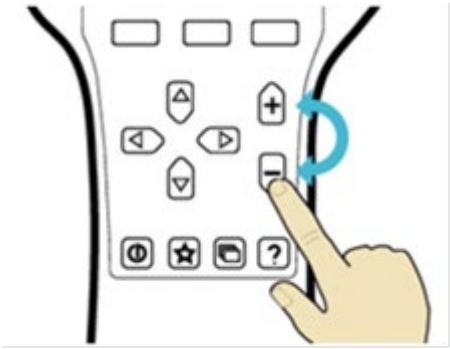


Parameters can be adjusted or modified in two ways: one is in the parameter list page as shown in the figure below;



The other is through the parameter edit page as shown below





2-8 Troubleshooting for each fault code

Fault code measures

Code	Display	Cause	Source
0	LOW_BDI	Low battery	1212C-2503 controller
1	PUMP_SRO_FAULT	The lifting or lowering switch acts before the key switch	1212C-2503 controller
2	SRO_FAULT	Wrong operation sequence of direction, interlock and key switch	1212C-2503 controller
3	HPD_FAULT	Interlocking and accelerator operation sequence is incorrect; Or after emergency reverse action, the accelerator does not return to home position	1212C-2503 controller
4	WIRING_FAULT	Throttle wiring fault	1212C-2503 controller
5	THROTTLE_FAULT	Throttle fault	1212C-2503 controller
6	PRECHARGE_FAULT	Controller Fault	1212C-2503 controller
7	MAIN_DRIVER_FAULT	Internal main contactor problem	1212C-2503 controller
8	MAIN_RELAY_WELDED	Electric control internal contactor welded	1212C-2503 controller
9	MAIN_RELAY_DNC	Electric control internal contactor does not close	1212C-2503 controller
10	BRAKE_OFF_FAULT	Open circuit or coil short circuit in the internal drive of the electromagnetic brake	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 EM brake internal driver short circuited or the coil is open circuited	1212C-2503 controller
14	CURRENT_SENSE_FAULT	Electric control fault	1212C-2503 controller
15	HARDWARE_FAULT	The electric control fails or the motor responds incorrectly	1212C-2503 controller
16	SOFTWARE_FAULT	Electric control fault	1212C-2503 controller
17	PARAMETER_CHANGE_FAULT	Parameter change fault	1212C-2503 controller
18	MOTOR_SHORT	motor short	1212C-2503 controller

19	MOTOR_OPEN	motor open	1212C-2503 controller
20	CONTROLLER_OVERCURRENT	Electric control overcurrent	1212C-2503 controller
21	MOTOR_TEMP_HOT_CUTBACK	Motor overcurrent cutback	1212C-2503 controller
22	CONTROLLER_OVERTEMP_CUTBACK	controller over temp cutback	1212C-2503 controller
23	CONTROLLER_UNDERTEMP	controller under temp	1212C-2503 controller
24	CONTROLLER_SEVERE_OVERTEMP	controller severe over temp	1212C-2503 controller
25	OVERVOLTAGE_CUTBACK	overvoltage cutback	1212C-2503 controller
26	SEVERE_OVERVOLTAGE	severe overvoltage	1212C-2503 controller
27	UNDERVOLTAGE_CUTBACK	Under voltage cutback	1212C-2503 controller
28	SEVERE_UNDERVOLTAGE	severe under voltage	1212C-2503 controller
29	PARAMETER_FAULT	electric control defective or parameter set fault	1212C-2503 controller
30	GAGE_PDO_TIMEOUT	Instrument communication time out	1212C-2503 controller
32	PDO_TIMEOUT	Tiller communication time out	1212C-2503 controller
33	LIFT_DRIVER_FAULT	Driver 1 (J1-3) fault	1212C-2503 controller
34	LOWER_DRIVER_FAULT	Driver 2 (J1-11) fault	1212C-2503 controller
36	BMS_PDO_TIMEOUT	BMS communication timeout	1212C-2503 controller
37	EMR_SEQUENCING_FAULT	Action of emergency reverse switch before power on	1212C-2503 controller
38	TILLER_HANDSHAKE_FAILED	Handshake between tilled and electric control failed	1212C-2503 controller
39	COAST_SRO_FAULT	The interlock switches from On to Off when the vertical traction switch acts before the key switch or when the vertical walking switch is closed	1212C-2503 controller
40	PUSH_SRO_FAULT	Push the action of switch before power on	1212C-2503 controller
80	Mode fault	Tiller tortoise speed button fault	tiller
81	Lift fault	Lift button fault	tiller
82	Lower fault	Lower button fault	tiller
83	BMS Communication	Lithium battery communication outage	tiller

	Outage		
90	Over Voltage	battery over voltage	Li-on battery
91	Over Discharge	battery over discharge	Li-on battery
92	Communication Outage	battery communication outage	Li-on battery
93	Under Voltage	battery Under Voltage	Li-on battery
94	Over Current	battery overcurrent	Li-on battery
95	Over Temperature Protect	battery severe over temp	Li-on battery
96	Temperature Protect	battery over temp	Li-on battery

1212E Fault code measures (EN1175)

No	Error Code	Fault Name	Possible cause	Fault Source
1	11-1	Severe Under voltage	Controller defective Battery defective	1212E Controller 1212E Controller
2	12-1	Under voltage Cutback	Incorrect battery voltage Main relay defective Controller AD defective	1212E Controller
3	13-1	Severe Overvoltage	Incorrect battery voltage Main relay defective Controller AD defective	1212E Controller
4	13-2			
5	14-1	Overvoltage Cutback	Incorrect battery voltage Main relay defective Controller AD defective	1212E Controller
6	15-1	Controller Severe Under temp	Temperature sensor defective Low ambient temperature	1212E Controller
7	16-1	Controller Over temp Cutback	Temperature sensor defective High current for a long time	1212E Controller
8	17-1	Controller Severe Over temp	Temperature sensor defective	1212E Controller
9	21-1	Throttle Fault	Throttle wiring fault Incorrect throttle type setting Incorrect throttle operation Steering Angle Pot wiring fault	1212E Controller
10	21-2			
11	21-3			
12	21-4			
13	22-1	HPD Sequencing	Incorrect throttle operation Throttle defective	1212E Controller
14	23-1	Main Relay Welded	Main relay defective	1212E Controller
15	24-1	Main Relay Did Not Close	Main relay defective Incorrect relay pull in voltage setting	1212E Controller
16	24-2			
17	25-1	Main Driver Fault	Main driver defective	1212E Controller
18	25-2			
19	26-1	Pre charge Failed	Pre charge PTC defective	1212E Controller
20	26-2			
21	31-1	Stall Detected	Pre charge PTC defective	1212E Controller

22	32-1	Motor Short	Motor Short	1212E Controller
23	32-2			
24	33-1	Motor Open	Motor Open	1212E Controller
25	33-2			
26	34-1	EM brake failed To Set	EM brake defective	1212E Controller
27	41-1	Push SRO	Incorrect operation sequence Controller defective	1212E Controller
28	42-1	Interlock SRO Fault	Incorrect operation sequence Controller defective	1212E Controller
29	43-1	Low BDI	Battery over discharged	1212E Controller
30	44-1	Speed Supervision	Speed is out of allowed range	1212E Controller
31	44-2			
32	44-3			
33	44-4			
34	44-5			
35	51-1	Over Current Fault	Controller defective Current sensor defective	1212E Controller
36	52-1	Current Sense Fault	Current sampling circuit defective	1212E Controller
37	52-2			
38	53-1	Driver Fault	Driver open or short Incorrect parameter settings	1212E Controller
39	53-2			
40	53-3			
41	53-4			
42	54-1	PUMP SRO Fault	Incorrect operation sequence Switch defective Incorrect parameter settings	1212E Controller
43	54-2			
44	54-3			
45	54-4			
46	54-5			
47	55-1	EMR SRO Fault	EMR switch defective Incorrect operation sequence Incorrect parameter settings	1212E Controller
48	55-2			
49	55-3			
50	56-1	Creep SRO Fault	Incorrect operation sequence Cost	1212E Controller
51	56-2			
52	56-3			
53	56-4			

54	61-1	PDO Timeout	CAN bus too heavy Incorrect parameter setting	1212E Controller
55	61-2			
56	61-5			
57	62-SDO Abort ID	PDO Mapping Error	Incorrect variable data length Incorrect access mode Incorrect CAN index	1212E Controller
58	71-1	Hardware Fault	MOSFET defective Micro defective	1212E Controller
59	71-2			
60	71-3			
61	71-4			
62	71-5			
63	81-Parameter index	Parameter Out Of Range	Incorrect variable data	1212E Controller
64	82-1	Parameter Fault	Incorrect parameter settings FRAM defective	1212E Controller
65	82-2			
66	82-3			
67	82-4			
68	82-6			
69	83-Block num	NV Failure	FRAM operation failed	1212E Controller
70	83-2			
71	83-3			
72	83-4			
73	83-5			
74	84-code	Supervision	Cross check failed	1212E Controller
75	80	Mode fault	Tiller Turtle speed button failure, Turtle speed button detected closed before power on.	Tiller
76	81	Lift fault	Rise button failure, the rise button is detected as being pressed before the power is turned on.	Tiller
77	82	Lower fault	Faulty drop button, the drop button is detected as being pressed before the power is turned on.	Tiller
78	83	BMS Communication Outage	Lithium battery communication timeout, 1. Lithium battery BMS damaged. 2. Lithium battery to handle Tiller communication line broken. 2. handle Tiller communication module damaged.	Tiller

79	84	Throttle FAULT	The gas pedal is not in the neutral position before the code is entered, and the gas pedal needs to be reset to clear the fault.	Tiller
80	85	Controller Communication Outage	Controller communication lost	Tiller
82	86	Lift system failure	Pump station output continuous operation, lifting system failure, possibly rising micro switch failure	Tiller
83	90	Over Voltage	Battery voltage is too high. 1, may be the charger overcharge. 2, battery BMS problems. 3, the vehicle for a long time downhill, caused by the feedback current charging.	Lithium Battery
84	91	Over Discharge	1, lithium batteries are not used for a long time, resulting in low battery power. 2, overuse.	Lithium Battery
85	92	Communication Outage	Battery communication timeout, communication timeout with controller	Lithium Battery
86	93	Under Voltage	Battery voltage is too low, 1, long-term storage, not in time to charge. 2, the battery internal cell damage, resulting in the inability to charge into the power.	Lithium Battery
87	94	Over Current	1, the use of equipment is not in accordance with the original program set by the controller to run. 2, after the replacement of the controller, the parameters do not match. 3, the lithium battery current detection problems.	Lithium Battery
88	95	Over Temperature Protect	.Severely high battery temperature, use or transport environment, causing severe internal high temperature of the battery.	Lithium Battery
89	96	Temperature Protect	High battery temperature, use or transport environment, causing high temperature inside the battery.	Lithium Battery

3 Drive/brake system

3-1 Overview

3-1-1 Component

The drive/brake system includes the following:

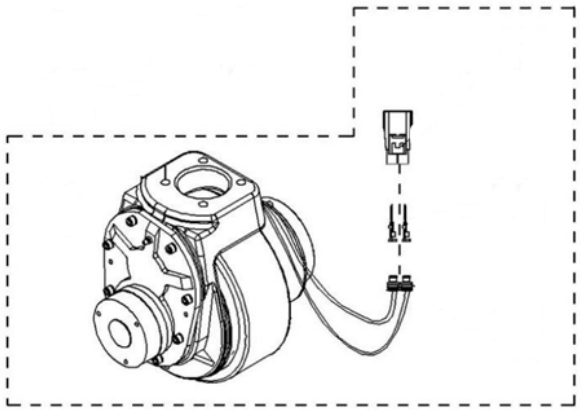
1 The drive motor controlled by the controller transmits the rotational force to the drive shaft (electricity mechanical power) (3-2)

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) (3-3)

3 The accelerator sends a CAN number to the drive motor controller to accelerate the motor (CAN signal) (3-4)

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

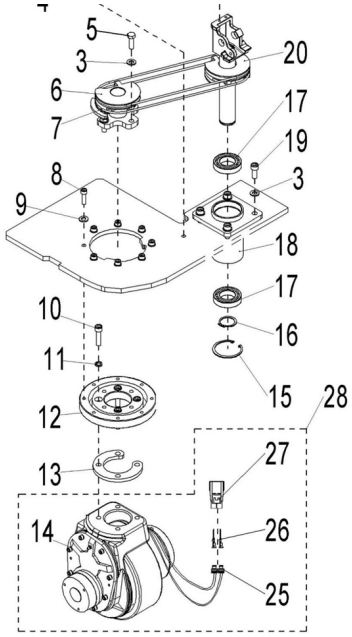
Controlled by the controller

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

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 tiller to the operating area
3 determine the driving direction,
4 Twist the accelerator on the tiller

Removal/assembly of drive assembly



Preliminary steps

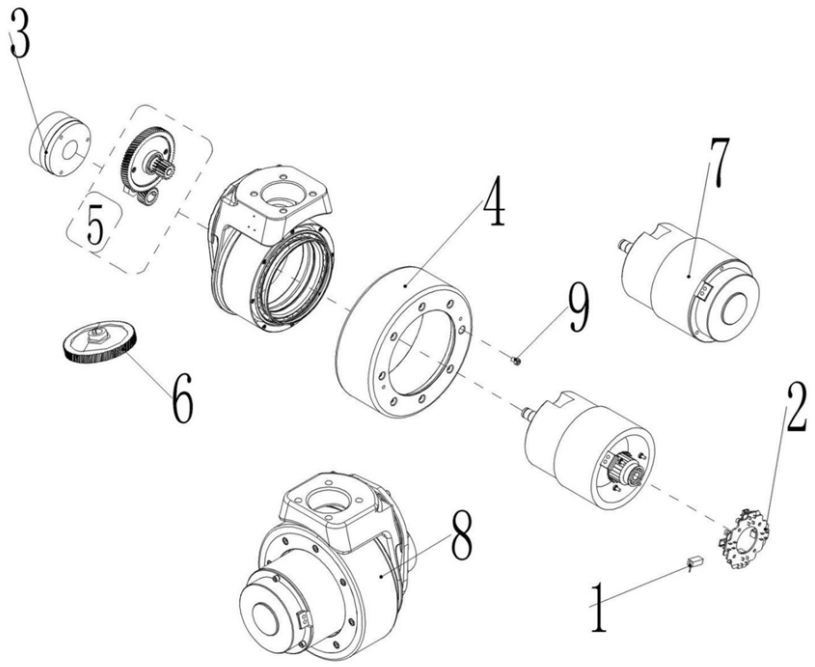
1. Safely park the vehicle and remove the shell
2. Close key and emergency stop switch.
3. Disconnect the battery connector.

procedure

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 5 8 5 KG.
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 (1 0) 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 Ml and M2 is measured using a milliohmmeter. Nominal resistance: 0.4 Ω
2 Test insulation at 1000 Vac and Min. 10 m Q use insulation tester. If there is a problem with insulation, please replace it with a new motor

Carbon brush removal/assembly

I. 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 tiller 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: 0.4Q
2 Test the insulation at 1000 Vac and Min. 10MO 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.

procedure

I 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

Problem	Possible causes
Drive motor does not work	Switch not off (battery connector, key switch, seat switch, f / R switch or parking brake switch): Turn off the switch. If it still fails to operate, use a voltmeter to test the power supply of the control panel and the current of each switch. However, turn on the service brake switch.
	Bad signal. Fuse blown: Check the battery connections. Check the connection of the battery connector. Check fuses, drivers and logic. Replace the fuse if it is blown. Check whether the drive motor and control panel may cause the fuse to blow. Some of the reasons are: Working under excessive load, current limit is too high
	Low battery voltage: Check the battery terminal voltage. If it is too low, charge the battery.
Drive motor does not work	Excessive wear of the carbon brush (from the spring compression plate to the lowest position of the carbon brush).
Traction does not operate during normal operation, but hydraulic operation is normal	Defects in the brake cause excessive resistance. Increased heat causes motor stalling. Check brake adjustment.
	Overweight Traction Load: Reduce Duty Cycle Load.
Traction and hydraulic pressure will not last the whole normal operation period	The lift car is equipped with too small battery:
	Battery not fully charged during battery charging: Check whether the battery is charged Check the battery charger for failure.
	The battery replacement interval is too long or the cooling time of the replacement battery is too short.
	The battery has one or more defective single cells, causing the rated capacity and capacity of the battery to be lower than normal:
	Due to the failure of the drive system, the drive system consumes too much battery power. Check the brake adjustment. Check the wheel bearing, axle and other mechanical parts for correction to eliminate the fault. Change to a tire with less friction
	The hydraulic system consumes too much battery power due to lifting and tilting faults, or the hydraulic conditions of the duty cycle are incorrect: Reduce the setting of the hydraulic relief valve to the capacity used only.

	Replace with a smaller hydraulic pump. Check the mast for restrictions during operation.
	After a work shift, the forklift's working capacity exceeds its designed capacity without available power:
Battery positive (-) or negative (-) in direct contact with forklift frame (body) or drive motor	Battery or control panel wires in contact with the vehicle frame: Carry out continuity test and move wire contact. Remove the lead in sequence until the fault is cleared. The fault will break at the end of the wire
	Dirty motor: clean carbon powder in time
	Wet motor: motor wet
	The battery is not fully charged or poor: Charge the battery.
Forklift does not reach the maximum speed	Faults in the drive motor, control panel or drive line: Check the vehicle speed in both directions and the steering speed limit proximity switch. If you need to adjust the control panel, adjust according to the corresponding section of Section 2 Electrical System. If the drive motor fails, test the motor components

3-4-2 Drive axle

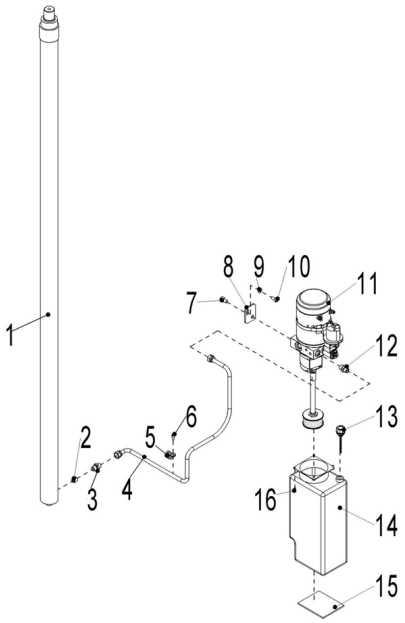
Problem	Possible causes
Noise or vibration in the transmission	Incorrect oil level: Meet the correct oil level
	Use non-standard oil: Replace the oil with standard oil.
	Gear damaged or dented: Replace the gear.
	Bearing damage: Replace the bearing.
	Loose mounting bolts: Apply thread compound to the threads of the bolts and retighten to the specified torque.
Noise or vibration in the brake disc pack	Use non-standard oil or friction materials: Replace oil or friction materials with standard materials.
	Friction plate wear: Replace the friction plate.
Leakage of installation part	Loose mounting bolts: Apply thread compound to the threads of the bolts and retighten 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]

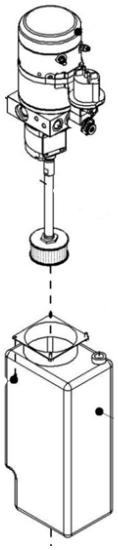
3 The hydraulic oil tank stores the hydraulic oil returned from the lifting cylinder. The stored oil is sucked by the main hydraulic pump for reuse. [Section 4-5]

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.

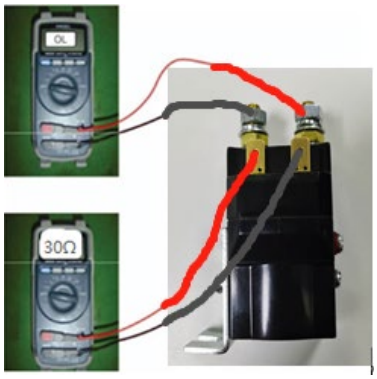
The pump motor is connected to the controller through a motor contactor. The controller operates the pump motor contactor based on inputs from multiple switches and sensors and internal parameter settings.

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

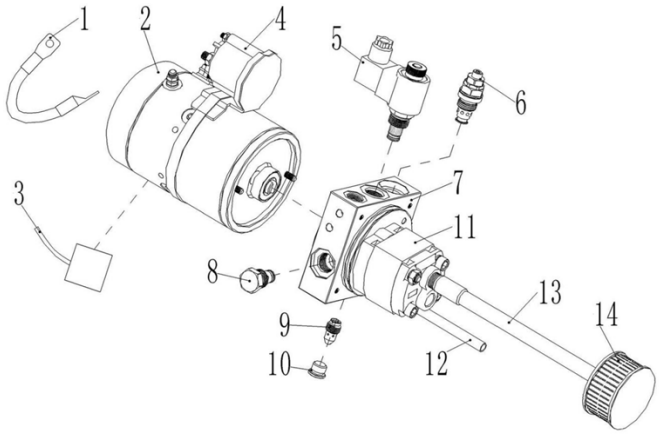
Pressurized hydraulic fluid can cause severe burns and may even result in amputation.
Before performing the following steps, make sure that the pressure has been released from the system.

procedure

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



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 followso

Motor test

I Use a milliohm meter to measure the resistance between the electromagnetic brakes. Rated resistance: 0.40

2 Test the insulation at 1000 Vac and Min. 10MQ 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.

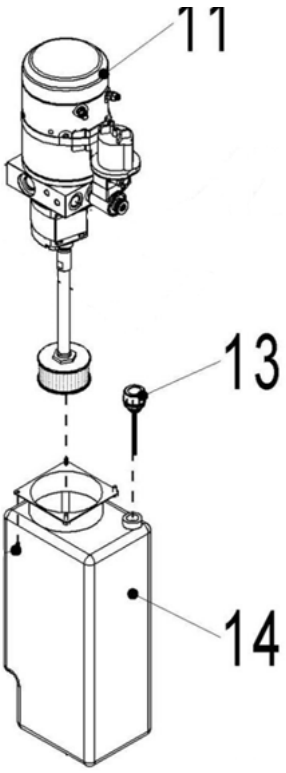
3 Remove the fixing screws of the carbon brush and the carbon brush holder.

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 and oil pan.

⚠ 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.

procedure

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

Problem	Possible causes
Hydraulic pump motor does not work.	Poor connection or fuse blown. Check battery connections. Check the key fuse. Check whether the motor of the hydraulic pump may cause the fuse to break.
	Key switch, upper limit switch, line contactor not closed. Turn off the key switch. Use a multi meter to check the power flow through the key switch, the line contactor coil and the line contactor. The key switch must be turned off.
	Insufficient voltage. Charge or replace the battery. Check that the cable terminals are tightly aligned with the battery terminals and the control panel connector. Check whether the wires inside the cable are broken.
	Incorrect operation of lifting and driving systems.
	During battery charging operation, the battery is not fully charged.
	Hydraulic system consumes too much battery power due to incorrect lifting or hydraulic control for work cycles.
	Hydraulic pump motor overheating. If the motor temperature reaches 155 degrees C (311 degrees F)

4-4-2 Hydraulic pump

Problem	Possible causes
Noise in the pump.	The oil level is low.
	The oil is very thick (viscosity is too high)
	The pump inlet line is limited.
	Wear parts in the pump.
	The oil is dirty.
	Air leaks into the inlet line.
The oil temperature is too high.	The oil level is low.
	There are restrictions on the passage.
	The oil is too thin.
	There is air leakage in the system.
	The pump is too worn.
	The system is operating under too high pressure.
Leakage at pump shaft seal.	The shaft seal is worn.
	Internal wear of pump body.
	Operation with a low oil level in the tank can cause suction on the seal.
	During installation, the seal is cut at the part of the pump or keyway.
	The sealing lip is dry and hardened by heat.
The pump is unable to deliver fluid.	The oil content in the tank is low.
	The pump inlet line is limited.
	There is air leakage in the pump inlet pipeline. Loose bolts. Defect in suction line of bay.
	The viscosity of the oil is wrong.
	The pump is too worn.
	Pump shaft failure
	The bolts for the pump do not have the correct torque.

5 Lifting/tilting/auxiliary 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

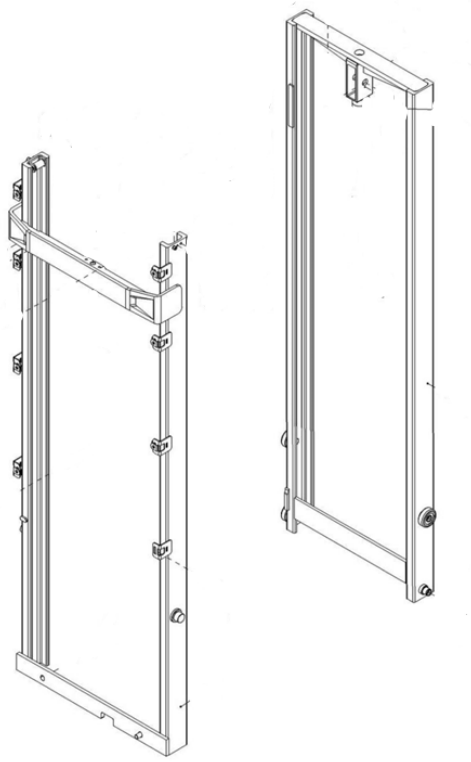
Chain: the part that lifts the bracket and mast

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 Mast

5-2-1 appearance



Mast lift

The mast assembly uses two masts and a single acting cylinder to lift the load. Rollers mounted on the inside and outside of the fork and the mast facilitate these up/down movements.

Cylinder

After receiving the hydraulic oil from the pump station, the rod of the cylinder extends upward to push the internal mast, while the fork is pulled by the lifting chain, which is connected to the outer mast to lift with the chain.

Lower
If the operator controls the lever to open the outlet port in the poppet of the multiway valve, the oil output from the standard cylinder will begin to flow out by gravity.

When the oil is drained, the cylinder rod and the attached inner Mast will retract.
When the inner Mast is lowered, the tension of the lifting chain will be relaxed and the bracket will also be lowered.

5-2-2 Fork

A Fork Inspection

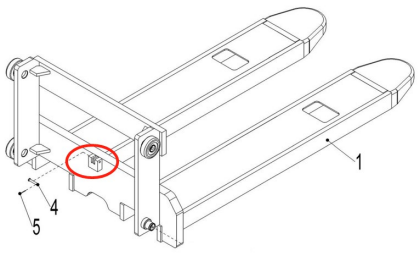
Forks should be checked at least every 12 months. If the vehicle is used in multiple shifts or heavy work, it should be checked every 6 months.

1. Check forks carefully for cracks. Pay particular attention to the rear section, all welding areas and mounting brackets. Forks 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 from the original angle beyond 90 degrees by more than 3 degrees, the fork shall be removed from service.

B chain tension adjustment
I. Fill lOcm-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:

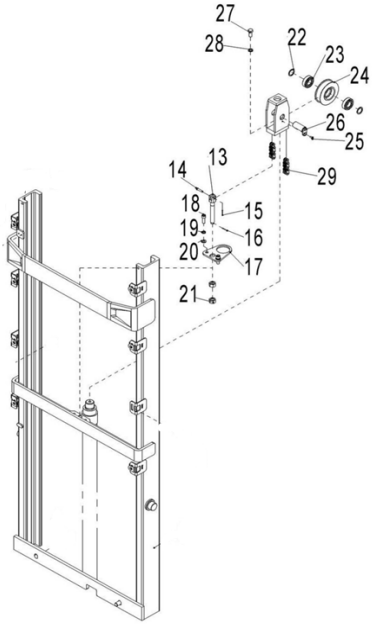
1. Place the sliding pointer on one of the three boxes at the bottom of the meter scale.
2. Place the pointer window on the square containing the chain spacing found above
3. Fix the measuring instrument on the other side of the lifting chain again so that the fixed pointer rests on the upper pin of 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 10 cm-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.



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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

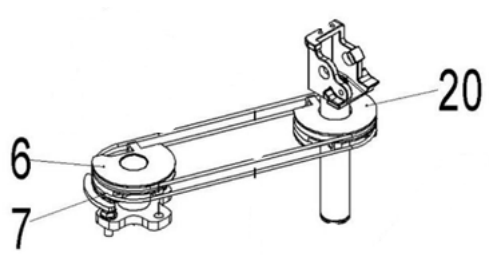
Problem	Possible causes
The hydraulic system will not lift the load.	There is a leak that causes air to enter the hydraulic system on the inlet side of the hydraulic pump
	Emergency descent valve opens manually.
	Too much wear on hydraulic pump
	.Incorrect load (too heavy).
	Mast does not align with other lifting parts and cannot move freely.
	The moving mast part does not have enough lubricant.
	Bracket or Mast rollers (bearings) are worn and do not move (jam)
Lifting cylinder extension is too slow.	Insufficient oil supply for lifting cylinder.
	Poor sealing of lifting cylinder
	Mast does not align with other lifting parts and cannot move freely.
	The moving mast part does not have enough lubricant.
	Bracket or Mast roller (bearing) worn and stationary (stuck)
Mast does not be lowered completely or at all.	Descent spool damage and contamination
	Damaged or bent lifting cylinder.
	Load drum defective (bearing) or incorrectly adjusted.
	There is not enough lubricant in the moving mast area.
Fork not lowered properly.	Air in hydraulic system.
	Mast does not align with other lifting parts and cannot move freely.
	The transport chain needs to be adjusted.
	The moving mast part does not have enough lubricant.
	Forks or mast rollers (bearings) are worn and must not be moved (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 tiller 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 Operation

A. Steering control mechanism

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

B. Neutral position

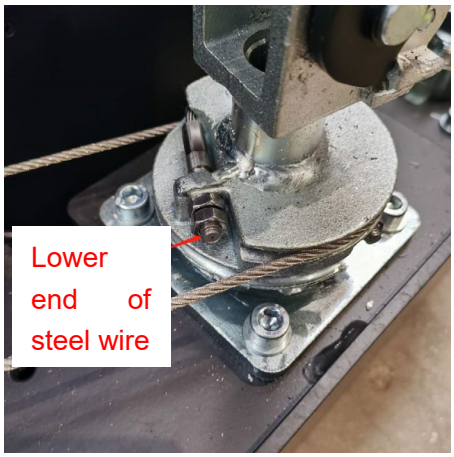
When the steering shaft of the tiller is in neutral, the wire rope connecting them is in a non-stressed state

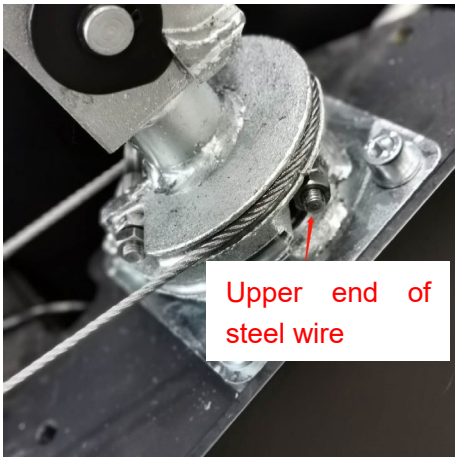
C. Turn left

When the steering shaft of the tiller 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 tiller 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.





7 Schematic diagram

7-1 Hydraulic schematic

a.

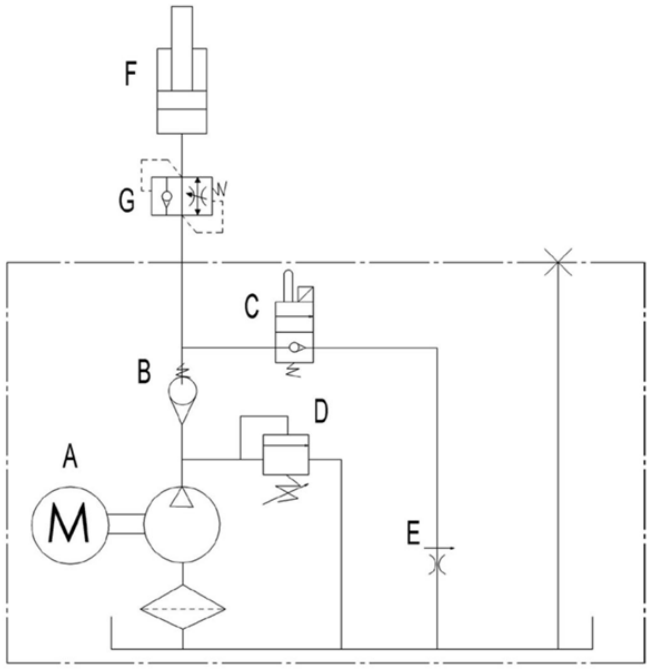


Table 3: Hydraulic Symbol Description

No	Code	Item	No	Code	Item
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	Relief valve			

b.

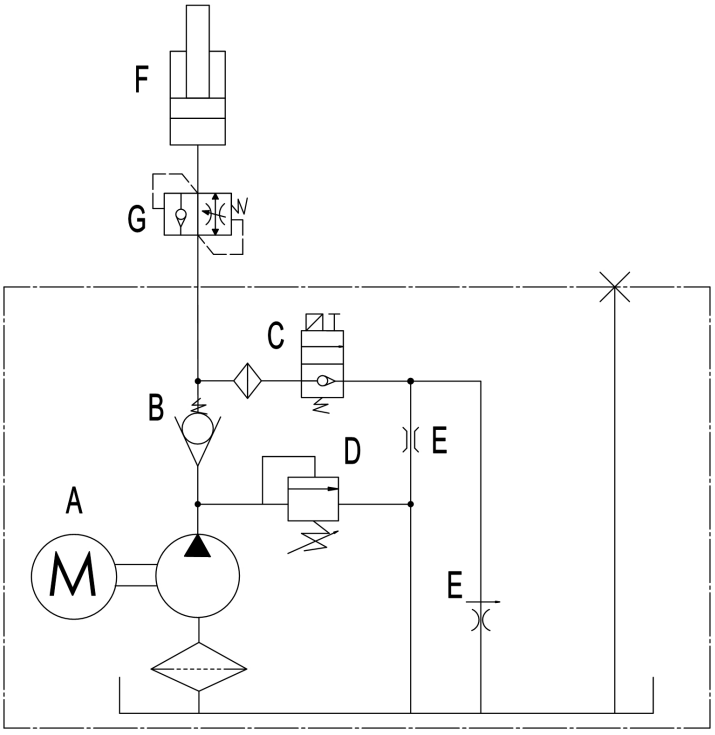
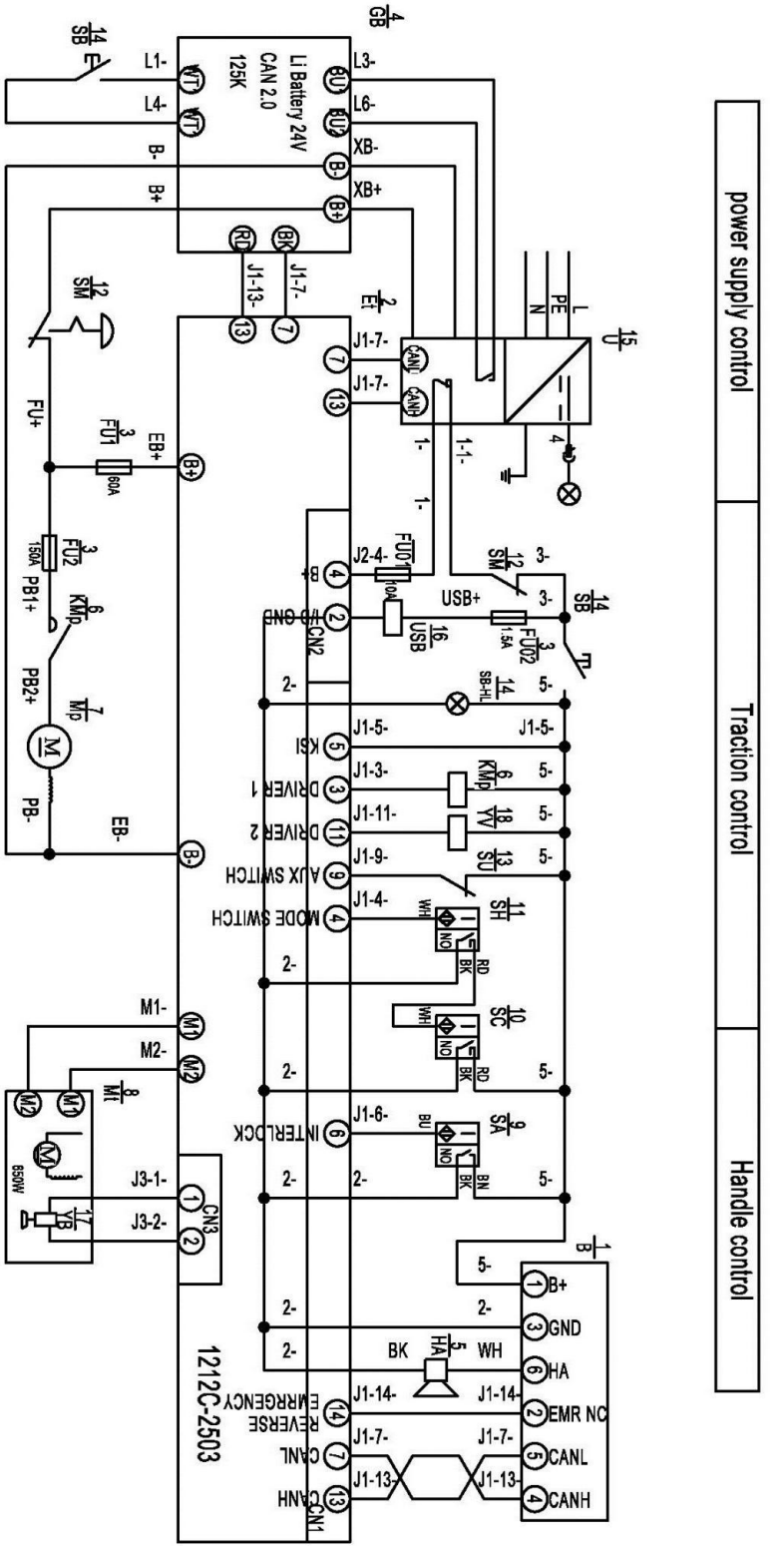


Table 4: Hydraulic Symbol Description

Code	Item	Code	Item
A	Hydraulic power unit	E	Throttle valve
B	check valve	F	Cylinder
C	Solenoid valve	G	Safety valve
D	Relief valve		

7-2 Electrical schematic

a. circuit diagram



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

Fig 6：12ES-XN Electrical diagram

Table 5: Explanation of Electrical Symbols

No	Code	Item	No	Code	Item	No	Code	Item
1	B	Tiller	7	MP	Pump motor	13	SU	Height limit micro switch
2	Et	Controller	8	MT	Traction motor	14	SB	Button switch
3	FU	Fuse	9	SA	Inter lock	15	U	Charger
4	GB	Battery	10	SC	Lifting speed limit switch	16	USB	USB
5	HA	Horn	11	SH	Steering speed limit switch	17	YB	Electromagnetic brake
6	KMP	Oil pump contactor	12	SM	DC power switch	18	YV	Lowering solenoid valve

b. Circuit Diagram (EN1175:2020)

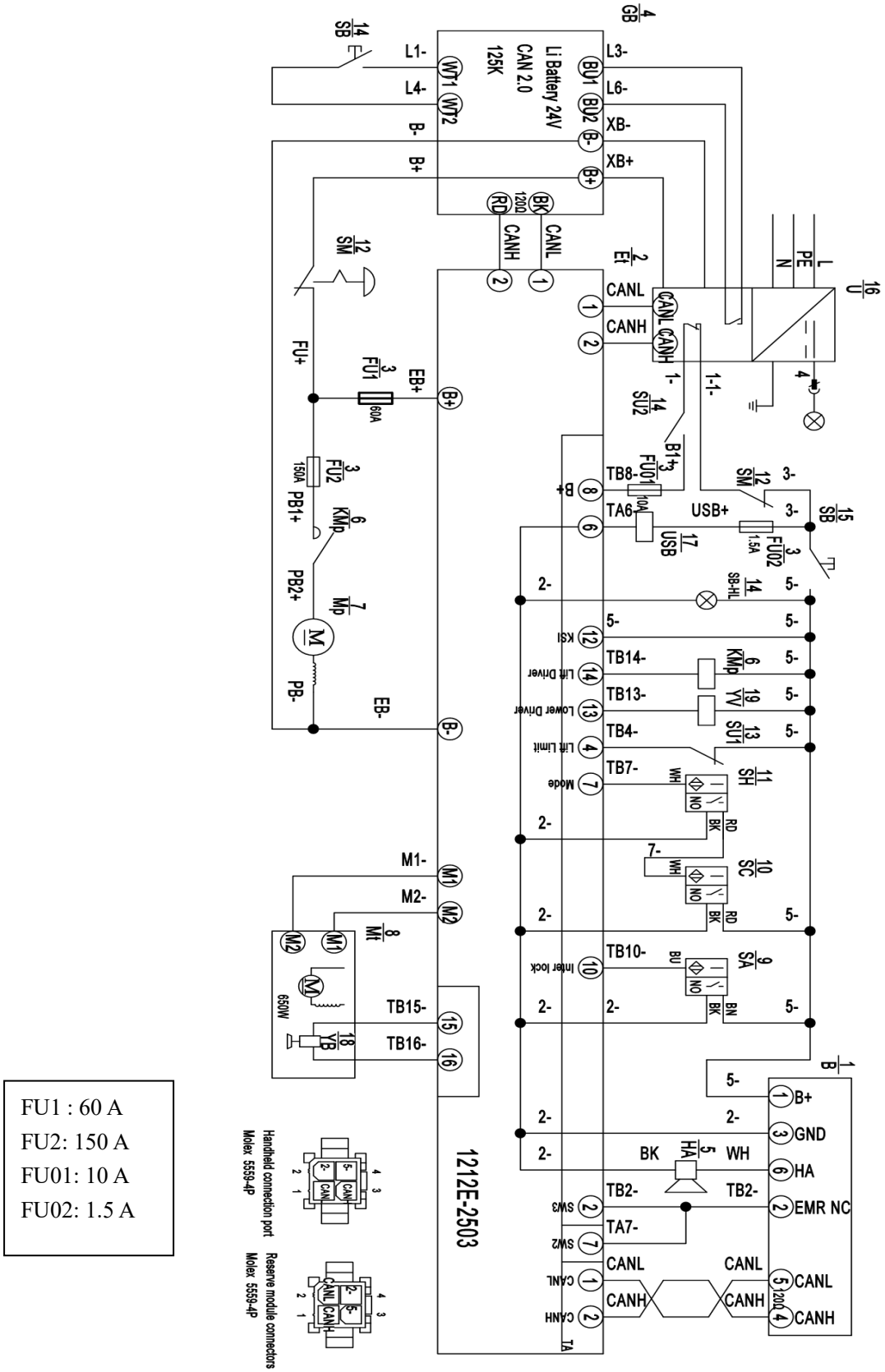


Fig 7: Electrical diagram (manual steering) 12ES-XN (EN1175:2020)

Table 6: Explanation of Electrical Symbols

Code	Item	Code	Item	Code	Item
B	tiller	Mt	Traction motor	SB	Button switch
Et	controller	SA	Inter lock	U	Charger
FU	Fuse	SC	Lifting speed limit switch	USB	USB
GB	Battery	SH	Steering speed limit switch	YB	Electromagnetic brake
HA	Horn	SM	DC power switch	YV	Lowering solenoid valve
KMp	Oil pump contactor	SU1	Height limit microswitch		
Mp	Pump motor	SU2	Safety switch		

7-3. Schematic diagram of braking system

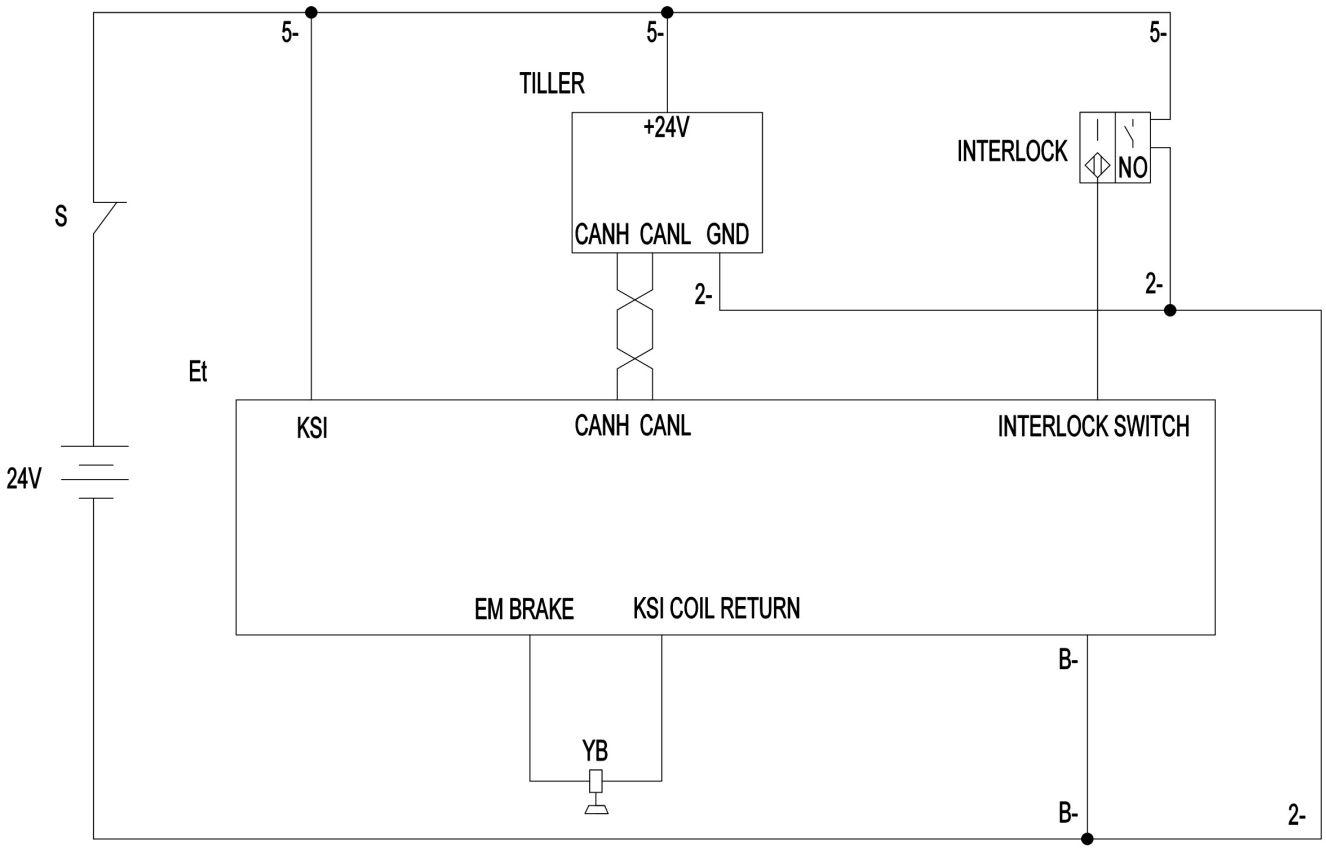


Fig 8：Schematic diagram

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 Volts （VAC）	Input Current （A）	Power Factor	Overall efficiency	Rated output volts (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 20MQ/DC 500V,					

8-1-3 Lithium battery charging programs and instructions

Use according to the table below to avoid exceeding the specified usage requirements, otherwise the product may be damaged.

discharge	Maximum Continuous Discharge Current	100A	
	Maximum Pulse Discharge Current	150A	Do not exceed 10 seconds
		200A	Do not exceed 3 seconds
	Discharge cut-off voltage	≥22V	
charge	Standard charging current	20A	
	Maximum charge current	30A	0.5C
	Charging Voltage	28~29.6V	

Charge the battery:

1) Lithium-ion batteries can only be charged using an approved charger within the allowable temperature range.
2) The storage time of forklift trucks without battery compensation charging shall not exceed 24 weeks.
3) Improper connector plugs for industrial forklift trucks or battery chargers for use with lithium ion batteries may damage the battery connectors.

4) Operate lithium ion batteries only with appropriate forklift trucks and battery chargers.

5) Batteries can only be charged, repaired or replaced by trained personnel. These instructions and those of the battery manufacturer must be observed when performing these operations.

8.1.4Lithium battery charger indicator light description

Indicator label		
No-load indication	Red green lights flashing alternately	
Battery indicator	Red light flashes at 1s interval and the battery power is less than 80%. Yellow light flashes at 1s interval, battery power > 80%; Green light flashes at 1s interval, battery power 100%	
Error indication	Overvoltage (current) failure	red green red---
	Over temp or under temp	red green red green--
	Charger overheating	green red----
	Output under voltage	red green---
	Input AC anomaly	Input AC anomaly
	Composite error	green red green---
Fully charge shutdown indication	Green light is always on	

8.1.5Lithium 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

8.1.6 Troubleshooting

Fault	Explanation
No power	Check whether the AC input is correctly connected and the power cord is damaged.
Can’t charge	Check whether the B+ and B-wires of the charger are connected properly
Low Output Voltage at Charge	Check that the CAN bus of the module is properly connected to the control PCB board, otherwise contact the manufacturer for after-sales service support
Low Output Current at Charge	Check that the CAN bus of the module is properly connected to the control PCB board, otherwise 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.