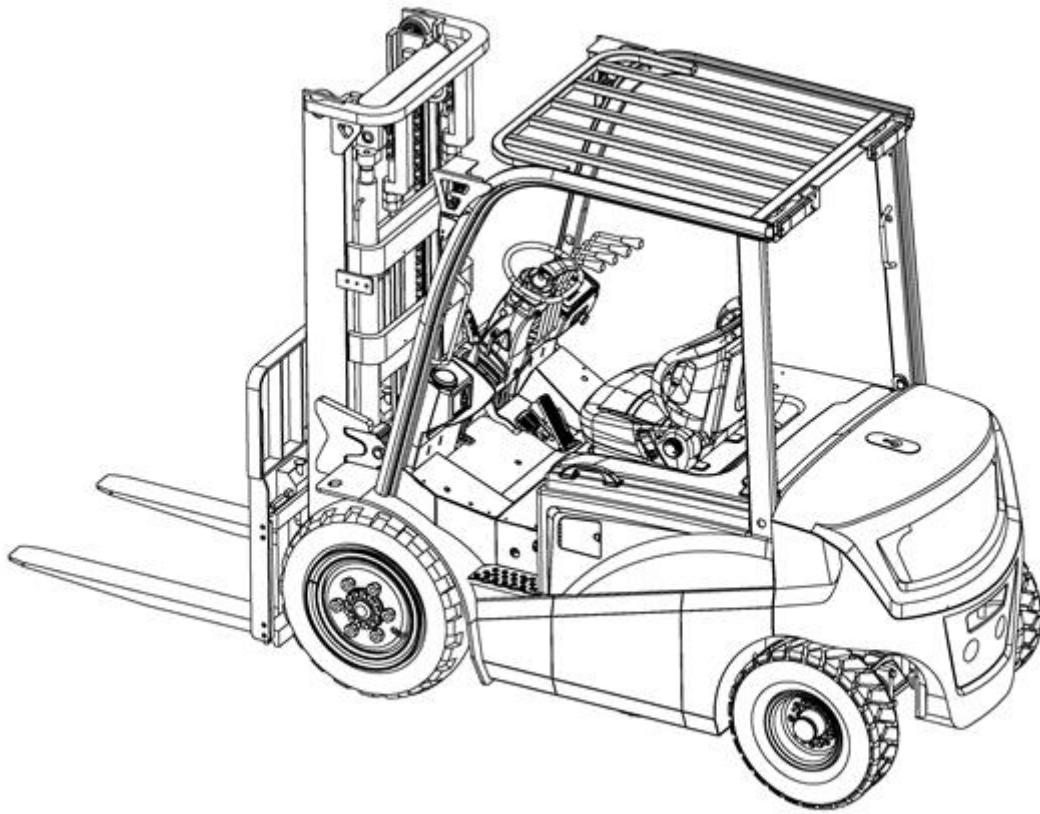


## **WARNING**

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



FE4P25-35Q series-SM-003-2023-EN

# Service Manual

**FE4P25-35Q series battery balanced forklift**

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# 1.In General

## 1-1 How to use this manual

### 1-1-1 Composition of this manual

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

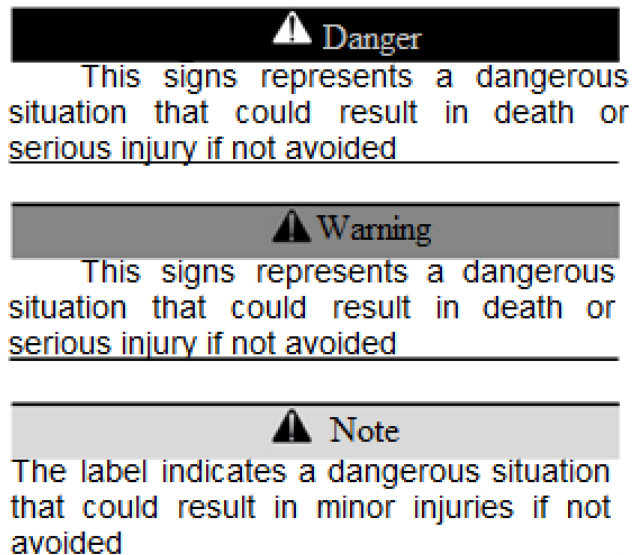
The introduction section of this manual introduces the functions of the vehicle with attention to its different components. More detailed specific information is available in the main body of this manual for you, including the schematic diagram of the vehicle components, the principle they work, the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

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

Section	Headings
1	Commonly
2	Electronic System
3	Driving/Braking System
4	Hydraulic System
5	Lift/Tilt/Auxiliary System
6	Steering System
7	Schematic Diagram
8	Miscellaneous
9	Battery Charger

### 1-1-2 Definitions of Warning Signs

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



### 1-2 Glossary

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

Item	Descriptions
Accelerator	A device that converts mechanical motion to an analog voltage mode and transmit to a controller to control the speed at which a vehicle is driven.
Actuator	A device (e.g. a hydraulic cylinder and motor) that converts hydraulic power into mechanical force and motion.
Ampere (A)	A measurement unit of current. The current of a voltage passing through an ohmic resistor.
Battery	Two or more batteries, which are inter-connected with each other to provide current.
Coulomb meter	(Battery Discharge Indicator) an electrically controlled display that shows the operator the current charge of a battery.
Busbar	A re-conducting conductor that wired to other smaller conductors.
Communication Modes	CAN (Controller Area Network) is the standard for communication among microcontrollers and/or devices.
Condenser	A device for short-time electrical energy storage.
Goods Holder	A supporting structure on which a fork is mounted.
Check Valve	A valve that allows oil to flow in one direction rather than in the other.
Circuit	A path along which current can travel from the positive (+) side of the source to

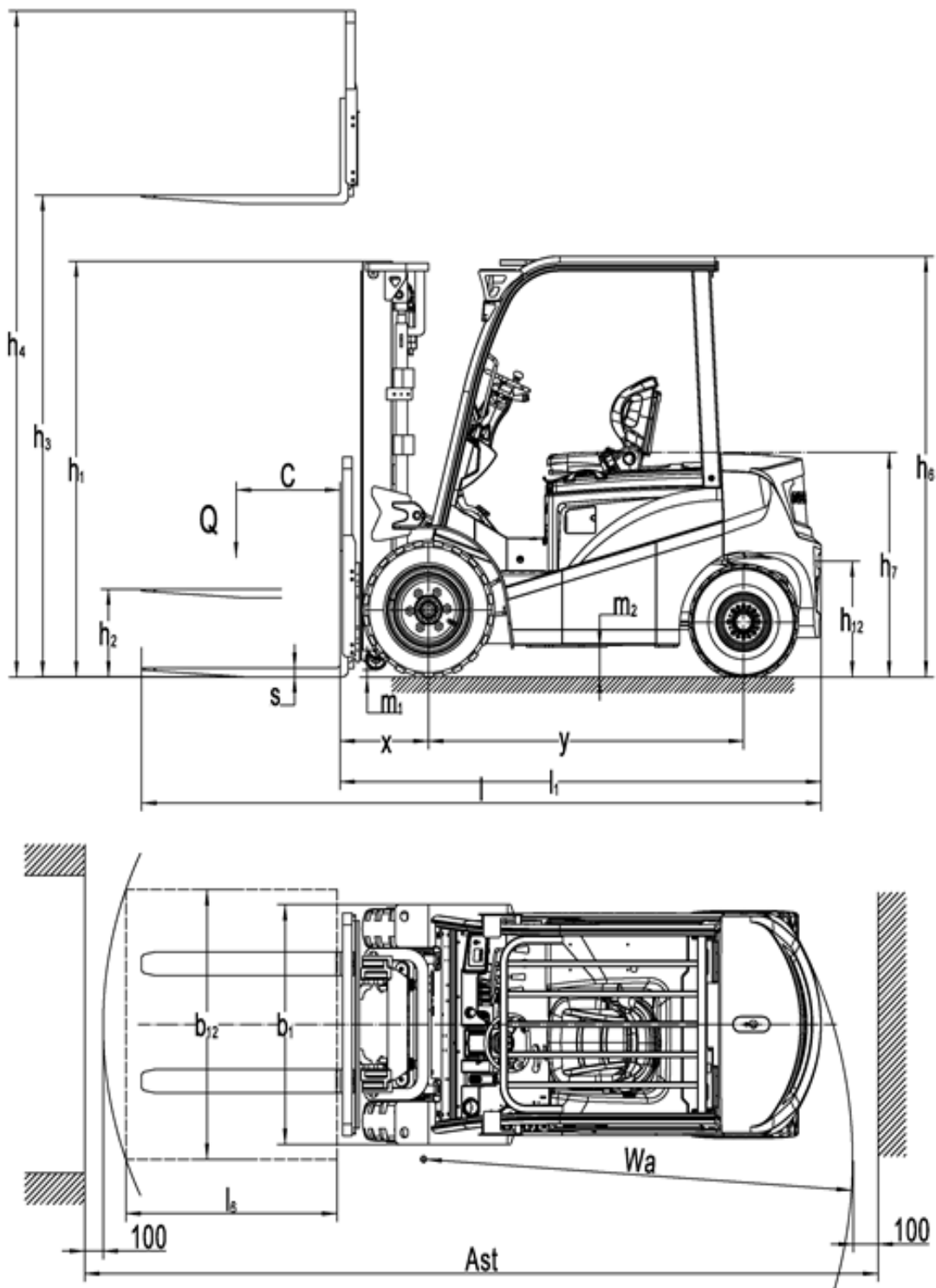
	the negative (-) side. This can be obtained with wires and electrical components.
Connector	A part of a wire assembly or harness wired to another wire assembly or harness to for an easier Disassembly and Assembly operation.
Co-contactor	A switch, relay, or part of a contactor that opens or closes a circuit.
Components of Co-contactor	An electrical element consisting of an electromagnetic coil and a set of heavy contact tips, which controls current flow through the coil, create a magnetic field, and close or open contact tips.
Coil of Co-contactor	An electromagnet used to open or close contact tips in a contactor component.
Control Valve	A valve unit includes multiple directional blocks, each of which has a corresponding actuator.
Counterweight	The weight mounted on the back of the forklift to ensure a stable status, especially when lifting heavy loads.
Current Limiting	The maximum permissible armature current of the stopped drive motor during the pulse.
Oil Cylinder	A container that maintains pressurized oil and converts hydraulic power into rectilinear motion.
DC-DC Convertor	A device that converts a high-voltage DC onto a low-voltage DC.
Digital Signal	A signal in which the element can be either of two different values, e.g. high voltage and low voltage.
Diode	A semiconductor device that allows current to flow from the anode to the cathode in one direction.
Directional Valve	A valve that directs the flow of oil according to the position of the valve element.
display	An electrical device that converts voltage input into a visual output.
Drive Axle	A device that receives power from a driving motor.
Driving Controller	A control device to drive an electric motor, which includes an inverter and a logic circuit.
Handheld Programmer	A maintenance tool program to calibrate and diagnose CURTIS controllers of trucks.
Parking Brake	A pair of brakes that electromagnetically activate their respective motors upon the stationary of the vehicle.
Encoder	A device that detects the direction and speed of a motor to produce a pulse signal.
Fan	A device that generates an airflow to cool an electric motor and a controller.
Filter	A mechanical device used to accommodate a filter element, or a filter device used to prevent contamination flow through a system.
Flow Protector	A valve that prevents the hydraulic oil extraction of the control valve from the lifting cylinder when the hydraulic line breaks unexpectedly, which prevents the mast from dropping suddenly.
Flow Regulator	A valve that reduces the pressure by limiting the flow of a hydraulic line.
Pallet Fork	Two claw objects.
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 overlarge current flowing through a given part of the circuit.

Fixture	A fitting to secure an assembly consisting of two or more wires.
Radiator	A mounting frame for cooling semiconductors.
Hydraulic System	A hydraulic element circuit to convey oil pressure.
Hydraulic Oil Tank	A chamber for the oil storage in a hydraulic system.
Mandatory Sign	A symbol indicating the state of a vehicle when it is on or flashing.
Seat Switch	A switch to disable the vehicle movement when the operator leaves the seat.
Main Hydraulic Pump	A gear pump uses mechanical power from an electric motor to pressurize the oil stored in a tank and distribute to various actuators.
Portal	The front vertical structure of the forklift extends and retracts to lift and lower the load.
Master Cylinder	The hydraulic cylinder which is responsible for the start-up of the driving brake.
Needle Valve	A valve to lower the backstay manually when the lifting lever is not available.
Normal State	A term used with switches or relays. Their "normal state" means that they are not under any control of stress, temperature, pressure or electricity.
Ohm ( $\Omega$ )	A resistance unit. The resistance will be such that one volt shall push one ampere of current through it only.
Timely	The time it takes for a current to flow through a transistor.
Open Circuit	A connection or component of a circuit without continuity.
Hole	A limited passage in a hydraulic circuit, including a limited flow or pressure generation in a given chamber (e.g. a small bore).
Top Cover	A overhead frame structure which protects the operator from falling objects
Overload	A condition that the existing voltage or current is greater than the capacity of a given circuit or component.
Piston Rod	A part that push oil into the cylinder chamber
Suffocated	The part of an electric brake in which the current generated is directed back to the armature.
Port	An input or output point on a hydraulic element
Power Socket	A connecting socket that installed on the forklift.
Pressure	a fluid force as per unit area
Proximity Detector	A sensor, which can detect the presence of objects nearby without any physical contact.
Pump Controller Unit	A control device for a hydraulic motor, which includes an inverter and a logic circuit.
Safety Valve	A valve that limits the pressure of the hydraulic system by releasing excess oil
Resistance	A component made of a material with a specific current impedance.
Return Filter	A filter to collect contaminants in oil returned to a hydraulic tank
Rotor	A part of rotating motor.
Outline	A bar chart of an electrical or electronic component that uses symbols to show the individual components as well as how the wires and connectors work electrically
Serial Port	A port that communicates one-to-one with the controller.



Service Brake	A pair of brakes built into the drive shaft to enable the vehicle when the operator applies the pedal for stationary
Short Circuit	An unwanted electrical connection between two or more components.
Side Shifter	An accessory that moves the fork and its load to the left and right
Socket	The male contact of the connector which slides over the male contact of the other connector (pin).
Magnetic Valve	A directional valve that moves the valve element when the magnetic coil is equipped with a magnetic valve.
Solid State	A term that refers to semiconductor components or circuits that wired without moving parts, e.g. diodes and transistors.
Stator	a fixing part in the motor
Steering Shaft	A column that connects the steering wheel to the steering gear to allow the operator to use steering wheel controller
Joystick	A hydraulic component that deliver oil to the right or left side of the steering cylinder as required by the operator
Steering System	Hydraulic element loop, including steering unit, circuit and actuator
Steering Gear	A axle mounted on the rear wheel of a vehicle
Switch (SW)	The component to control a circuit by opening or closing the circuit.
System	Electrical components, circuits, and connections that provide power for specific tasks.
Thermal Sensor	A sensor activated at a pre-conditioned temperature.
USB	A connecting device providing a power supply of 5V.
Valve	A component that controls the pressure, direction, or velocity of a hydraulic system
Voltage	A measurement unit of electrodynamic force. A volt is the force that required for an ampere of current to pass through an ohmic resistor in a circuit.
Watt	A unit of power measurement. The power for one volt to push one ampere of current through an ohmic resistor. The outcomes of amperage (current) multiplied by volts (voltage) is watts (power).
Wire	A path of conductors to provide for current flow in and out of different electrical components.
Wiring Diagram	A visualized figure that represents a component in the way it actually looks. Which is used to show the locations of components, and the connections between them.
Zener Diode	A special diode to regulate voltage or protect a system from overvoltage.

## 1-3 Performance and Specifications



**a. FE4P25Q-Technical data (list 1-1)**

Identification	No.	Item	Unit	Model		
	1.1	Manufacturer's type designation		FE4P25Q	FE4P25QM	FE4P25QH
	1.2	Drive: electric(battery or mains), diesel, petrol gas, manual)		Electric		
	1.3	Type of operation(hand, pedestrian, standing, seated, order-picker)		Seated		
	1.4	Load capacity/rated load	Q(kg)	2500	2500	2500
	1.5	Load centre distance	C(mm)	500	500	500
	1.6	Load distance, centre of drive axle to fork	x(mm)	478	478	478
	1.7	wheelbase	y(mm)	1620	1620	1620
Weights	2.1	Service weight incl. battery(see line 6.5)	kg	3600	3650	3800
	2.2	Axle loading ,laden front/rear	kg	5500/600	5540/610	5660/640
	2.3	Axle loading, unladen front/rear	kg	1540/2060	1580/2070	1620/2180
Wheels、Chassis	3.1	Type: solid rubber, superelastic, pneumatic, polyurethane		Pneumatic		
	3.2	Tyres size, front		7.00-12-12PR		
	3.3	Tyres size, rear		6.00-9-10PR		
	3.4	Wheels, number front/rear(×=driven wheels)		2×/2	2×/2	2×/2
	3.5	Track width, front	b10(mm)	973	973	973
	3.6	Track width, rear	b11(mm)	982	982	982
Basic Dimensions	4.1	Mast/fork carriage tilt forward/backward	α/β(°)	6/10	6/10	6/10
	4.2	lowered mast height	h1(mm)	2070	2070	2070
	4.3	Free lift	h2(mm)	135	135	135
	4.4	Lift height	h3(mm)	3000	3000	3000
	4.5	Extended mast height	h4(mm)	3974	3974	3974
	4.6	Overhead load guardheight	h6(mm)	2150	2150	2150
	4.7	Seat height/standing height	h7(mm)	1130	1130	1130
	4.8	Coupling height	h12(mm)	580	580	580
	4.9	Overall length	l1(mm)	3568	3568	3568
	4.10	Length to face of forks	l2(mm)	2498	2498	2498
	4.11	Overall width	b1(mm)	1150	1150	1150
	4.12	Fork dimensions	s/e/l(mm)	40/120/1070		
	4.13	Fork carriage DIN15173 - ISO2328, class/type A,B		ISO2328 2A		
	4.14	Fork carriage width	b3(mm)	1040	1040	1040
	4.15	Ground clearance ,laden, under mast	m1(mm)	135	135	135
	4.16	Ground clearance, centre of wheelbase	m2(mm)	150	150	150
	4.17	Aisle width for pallets 1000×1200 crossways (buffer of 200mm included)	Ast(mm)	3908	3908	3908
	4.18	Aisle width for pallets 800×1200 lengthways (buffer of 200mm included)	Ast(mm)	4108	4108	4108
	4.19	Turning radius	Wa(mm)	2230	2230	2230
Performance Data	5.1	Travel speed, laden/unladen P-mode	km/h	14/15	16/17	19/20
	5.2	Lift speed, laden/unladen	m/s	0.30/0.4	0.40/0.50	0.46/0.56
	5.3	lowering speed, laden/unladen	m/s	<0.6	<0.6	<0.6
	5.4	Max. drawbar pull, laden/unladen	N	13000/14000	17000/18000	

	5.5	Max. Gradient performance, laden/unladen	%	15/15	20/25	20/28
	5.6	Service brake		Hydraulic		
E-Motor	6.1	Drive motor rating S <sub>2</sub> 60 min	kW	11	16	16
	6.2	Lift motor rating at S <sub>3</sub> 15%	kW	16	24	24
	6.3	Battery standard		Lion	Lion	Lion
	6.4	Battery voltage, nominal capacity K <sub>5</sub>	V/Ah	76.8/206 76.8/277/412/554(option)		76.8/277 76.8/412/554 (option)
	6.5	Battery weight	kg	200		240
	6.6	Battery dimensions l/w/h	mm	770/600/680		770/600/680
Other Details	8.1	Type of drive control		AC	AC	AC
	8.2	Operating pressure for attachments	M.pa	17.5	17.5	17.5
	8.3	Oil volume for attachments	l/min	36	36	36
	8.4	Sound level at driver's ear according to EN 12053	dB(A)	74	74	75

## b. FE4P28Q-Technical data (list 1-2)

	No.	Item	Unit	Model		
Identification	1.1	Manufacturer's type designation		FE4P28Q	FE4P28QM	FE4P28QH
	1.2	Drive: electric(battery or mains),diesel, petrol gas, manual)		Electric		
	1.3	Type of operation(hand, pedestrian, standing, seated, order-picker)		Seated		
	1.4	Load capacity/rated load	Q(kg)	2800	2800	2800
	1.5	Load centre distance	C(mm)	500	500	500
	1.6	Load distance, centre of drive axle to fork	x(mm)	483	483	483
	1.7	wheelbase	y(mm)	1700	1700	1700
Weights	2.1	Service weight incl. battery(see line 6.5)	kg	3860	3910	4100
	2.2	Axle loading ,laden front/rear	kg	6010/650	6040/670	6210/690
	2.3	Axle loading, unladen front/rear	kg	1680/2180	1710/2200	1790/2310
Wheels、Chassis	3.1	Type: solid rubber, superelastic, pneumatic, polyurethane		Pneumatic		
	3.2	Tyre size, front		7.00-12-14PR		
	3.3	Tyre size, rear		6.00-9-12PR		
	3.4	Wheels, number front/rear(x=driven wheels)		2x/2	2x/2	2x/2
	3.5	Track width, front	b10(mm)	973	973	973
	3.6	Track width, rear	b11(mm)	982	982	982
Basic Dimensions	4.1	Mast/fork carriage tilt forward/backward	α/β(°)	6/10	6/10	6/10
	4.2	lowered mast height	h1(mm)	2070	2070	2070
	4.3	Free lift	h2(mm)	140	140	140
	4.4	Lift height	h3(mm)	3000	3000	3000
	4.5	Extended mast height	h4(mm)	4079	4079	4079
	4.6	Overhead load guardheight	h6(mm)	2150	2150	2150
	4.7	Seat height/standing height	h7(mm)	1130	1130	1130
	4.8	Coupling height	h12(mm)	580	580	580
	4.9	Overall length	l1(mm)	3663	3663	3663

	4. 10	Length to face of forks	l2(mm)	2593	2593	2593
	4. 11	Overall width	b1(mm)	1150	1150	1150
	4. 12	Fork dimensions	s/e/l(mm)	45/125/1070		
	4. 13	Fork carriage DIN15173 - ISO2328, class/type A,B		ISO2328 3A		
	4. 14	Fork carriage width	b3(mm)	1100	1100	1100
	4. 15	Ground clearance ,laden, under mast	m1(mm)	135	135	135
	4. 16	Ground clearance, centre of wheelbase	m2(mm)	150	150	150
	4. 17	Aisle width for pallets 1000×1200 crossways (buffer of 200mm included)	Ast(mm)	3933	3933	3933
	4. 18	Aisle width for pallets 800×1200 lengthways (buffer of 200mm included)	Ast(mm)	4133	4133	4133
	4. 19	Turning radius	Wa(mm)	2350	2350	2350
Performance Data	5. 1	Travel speed, laden/unladen P-mode	km/h	13/15	16/17	19/20
	5. 2	Lift speed, laden/unladen	m/s	0.30/0.4	0.40/0.50	0.42/0.56
	5. 3	lowering speed, laden/unladen	m/s	<0.6	<0.6	<0.6
	5. 5	Max. drawbar pull ,laden/unladen	N	13000/14000	17000/18000	17000/18000
	5. 6	Max. Gradient performance, laden/unladen	%	15/15	20/25	20/28
	5. 7	Service brake		Hydraulic	Hydraulic	Hydraulic
E-Motor	6. 1	Drive motor rating S <sub>2</sub> 60 min	kW	11	16	16
	6. 2	Lift motor rating at S <sub>3</sub> 15%	kW	16	24	24
	6. 3	Battery standard		Lion	Lion	Lion
	6. 4	Battery voltage, nominal capacity K <sub>5</sub>	V/Ah	76.8/206 76.8/277/412(option)		76.8/277 76.8/412/554 (option)
	6. 5	Battery weight	kg	200	200	240
	6. 6	Battery dimensions l/w/h	mm	770/600/680	770/600/680	770/600/680
Other Details	8. 1	Type of drive control		AC	AC	AC
	8. 2	Operating pressure for attachments	Mpa	17.5	17.5	17.5
	8. 3	Oil volume for attachments	l/min	36	36	36
	8. 4	Sound level at driver's ear according to EN 12053	dB(A)	75	75	76

### c. FE4P30Q-Technical data (list 1-3)

Identification	No.	Item	Unit	Model		
	1. 1	Manufacturer's type designation		FE4P30Q	FE4P30QM	FE4P30QH
	1. 2	Drive: electric (battery or mains), diesel, petrol gas, manual)		Electric		
	1. 3	Type of operation (hand, pedestrian, standing, seated, order-picker)		Seated		
	1. 4	Load capacity/rated load	Q(kg)	3000	3000	3000
	1. 5	Load centre distance	C(mm)	500	500	500
	1. 6	Load distance, centre of drive axle to fork	x(mm)	483	483	488
	1. 7	wheelbase	y(mm)	1800	1800	1800
Weights	2. 1	Service weight incl. battery (see line 6. 5)	kg	4070	4120	4300
	2. 2	Axle loading ,laden front/rear	kg	6390/680	6420/710	6540/760
	2. 3	Axle loading, unladen front/rear	kg	1750/2320	1790/2330	1880/2420

Wheels、Chassis	3.1	Type: solid rubber, superelastic, pneumatic, polyurethane		Pneumatic		
	3.2	Tyres size, front		28x9-15-14PR		
	3.3	Tyres size, rear		6.50-10-10PR		
	3.4	Wheels, number front/rear(×=driven wheels)		2×/2	2×/2	2×/2
	3.5	Track width, front	b10(mm)	1004	1004	1004
	3.6	Track width, rear	b11(mm)	982	982	982
Basic Dimensions	4.1	Mast/fork carriage tilt forward/backward	$\alpha/\beta(^{\circ})$	6/10	6/10	6/10
	4.2	lowered mast height	h1(mm)	2075	2075	2075
	4.3	Free lift	h2(mm)	140	140	140
	4.4	Lift height	h3(mm)	3000	3000	3000
	4.5	Extended mast height	h4(mm)	4079	4079	4079
	4.6	Overhead load guardheight	h6(mm)	2150	2150	2150
	4.7	Seat height/standing height	h7(mm)	1130	1130	1130
	4.8	Coupling height	h12(mm)	580	580	580
	4.9	Overall length	l1(mm)	3773	3773	3773
	4.10	Length to face of forks	l2(mm)	2703	2703	2703
	4.11	Overall width	b1(mm)	1226	1226	1226
	4.12	Fork dimensions	s/e/l(mm)	45/125/1070		
	4.13	Fork carriage DIN15173 - ISO2328, class/type A,B		ISO2328 2A		
	4.14	Fork carriage width	b3(mm)	1100	1100	1100
	4.15	Ground clearance ,laden, under mast	m1(mm)	140	140	140
	4.16	Ground clearance, centre of wheelbase	m2(mm)	150	150	150
	4.17	Aisle width for pallets 1000×1200 crossways (buffer of 200mm included)	Ast(mm)	4083	4083	4083
	4.18	Aisle width for pallets 800×1200 lengthways (buffer of 200mm included)	Ast(mm)	4283	4283	4283
	4.19	Turning radius	Wa(mm)	2400	2400	2400
Performance Data	5.1	Travel speed, laden/unladen P-mode	km/h	14/15	16/17	19/20
	5.2	Lift speed, laden/unladen	m/s	0.30/0.4	0.40/0.50	0.46/0.56
	5.3	lowering speed, laden/unladen	m/s	<0.6	<0.6	<0.6
	5.4	Max. drawbar pull, laden/unladen	N	14000/15000	20000/21000	20000/21000
	5.5	Max. Gradient performance, laden/unladen	%	15/15	20/25	20/28
	5.6	Service brake		Hydraulic		
E-Motor	6.1	Drive motor rating S <sub>2</sub> 60 min	kW	11	16	16
	6.2	Lift motor rating at S <sub>3</sub> 15%	kW	16	26	26
	6.3	Battery standard		Lion	Lion	Lion
	6.4	Battery voltage, nominal capacity K <sub>5</sub>	V/Ah	76.8/206 76.8/277/412/554(option)		76.8/277 76.8/412/554 (option)
	6.5	Battery weight	kg	200		240
	6.6	Battery dimensions l/w/h	mm	770/600/680		770/600/680
Other Details	8.1	Type of drive control		AC	AC	AC
	8.2	Operating pressure for attachments	Mpa	17.5	17.5	17.5
	8.3	Oil volume for attachments	l/min	36	36	36
	8.4	Sound level at driver's ear according to EN 12053	dB(A)	76	76	77

**d. FE4P35Q-Technical data (list 1-4)**

	No.	Item	Unit	Model		
				FE4P35Q	FE4P35QM	FE4P35QH
Identification	1. 1	Manufacturer's type designation		FE4P35Q	FE4P35QM	FE4P35QH
	1. 2	Drive: electric(battery or mains),diesel, petrol gas, manual)		Electric		
	1. 3	Type of operation(hand, pedestrian, standing, seated, order-picker)		Seated		
	1. 4	Load capacity/rated load	Q(kg)	3500	3500	3500
	1. 5	Load centre distance	C(mm)	500	500	500
	1. 6	Load distance, centre of drive axle to fork	x(mm)	488	488	488
	1. 7	wheelbase	y(mm)	1800	1800	1800
Weights	2. 1	Service weight incl. battery(see line 6.5)	kg	4480	4530	4640
	2. 2	Axle loading ,laden front/rear	kg	7140/840	7160/870	7230/910
	2. 3	Axle loading, unladen front/rear	kg	1960/2520	1980/2550	2030/2610
Wheels、Chassis	3. 1	Type: solid rubber, superelastic, pneumatic, polyurethane		Pneumatic		
	3. 2	Tyre size, front		28x9-15-14PR		
	3. 3	Tyre size, rear		6.50-10-10PR		
	3. 4	Wheels, number front/rear(x=driven wheels)		2x/2	2x/2	2x/2
	3. 5	Track width, front	b10(mm)	1004	1004	1004
	3. 6	Track width, rear	b11(mm)	982	982	982
Basic Dimensions	4. 1	Mast/fork carriage tilt forward/backward	$\alpha/\beta(^{\circ})$	6/10	6/10	6/10
	4. 2	lowered mast height	h1(mm)	2185	2185	2185
	4. 3	Free lift	h2(mm)	145	145	145
	4. 4	Lift height	h3(mm)	3000	3000	3000
	4. 5	Extended mast height	h4(mm)	4079	4079	4079
	4. 6	Overhead load guardheight	h6(mm)	2150	2150	2150
	4. 7	Seat height/standing height	h7(mm)	1130	1130	1130
	4. 8	Coupling height	h12(mm)	580	580	580
	4. 9	Overall length	l1(mm)	3818	3818	3818
	4. 10	Length to face of forks	l2(mm)	2748	2748	2748
	4. 11	Overall width	b1(mm)	1226	1226	1226
	4. 12	Fork dimensions	s/e/l(mm)	50/125/1070		
	4. 13	Fork carriage DIN15173 - ISO2328, class/type A,B		ISO2328 3A		
	4. 14	Fork carriage width	b3(mm)	1100	1100	1100
	4. 15	Ground clearance ,laden, under mast	m1(mm)	145	145	145
	4. 16	Ground clearance, centre of wheelbase	m2(mm)	150	150	150
	4. 17	Aisle width for pallets 1000x1200 crossways (buffer of 200mm included)	Ast(mm)	4123	4123	4123
	4. 18	Aisle width for pallets 800x1200 lengthways (buffer of 200mm included)	Ast(mm)	4323	4323	4323
	4. 19	Turning radius	Wa(mm)	2440	2440	2440
Performance	5. 1	Travel speed, laden/unladen P-mode	km/h	13/15	16/17	17/19
	5. 2	Lift speed, laden/unladen	m/s	0.26/0.4	0.4/0.5	0.40/0.56

	5. 3	lowering speed, laden/unladen	m/s	<0.6	<0.6	<0.6
	5. 5	Max. drawbar pull ,laden/unladen	N	13000/14000	17000/18000	17000/18000
	5. 6	Max. Gradient performance, laden/unladen	%	15/15	20/25	20/28
	5. 7	Service brake		Hydraulic	Hydraulic	Hydraulic
E-Motor	6. 1	Drive motor rating S <sub>2</sub> 60 min	kW	11	16	16
	6. 2	Lift motor rating at S <sub>3</sub> 15%	kW	16	26	26
	6. 3	Battery standard		Lion	Lion	Lion
	6. 4	Battery voltage, nominal capacity K <sub>5</sub>	V/Ah	76.8/277 76.8/412/554(option)		
	6. 5	Battery weight	kg	240	240	240
	6. 6	Battery dimensions l/w/h	mm	770/600/680		
Other Details	8. 1	Type of drive control		AC	AC	AC
	8. 2	Operating pressure for attachments	M pa	17.5	17.5	17.5
	8. 3	Oil volume for attachments	l/min	36	36	36
	8. 4	Sound level at driver's ear according to EN 12053	dB(A)	77	77	78



## **1-4 Safety Notes**

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

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

### **General**

#### **Safety Instructions**

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

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

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

## **Personal Safety**

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

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

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



## **Working Garment**

If you are wearing baggy clothes or have long hair that is not handled safely, please do not operate the vehicle or carry out maintenance.

Both can be caught by any moving part and cause serious injuries

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

Masks are required when polishing the body and an air breathing device is advised when painting. Welder-gloves, welding masks/goggles, aprons and other suitable welding clothing are required when welding.

## **Security of Service**

### **Pre-service**

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

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

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

Make sure the tools are in good condition.

## **Disassembly and Installation**

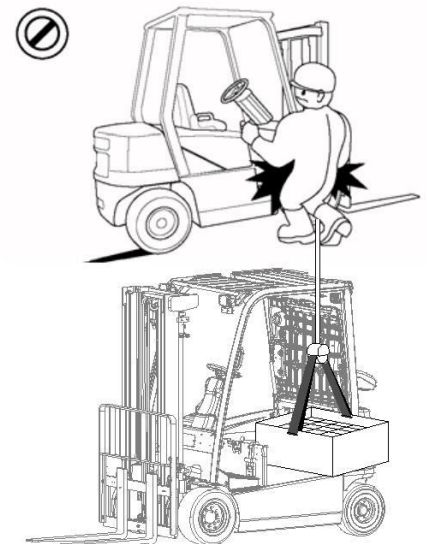
Make sure the working environment is clean, clean and dry before installing the vehicle.

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

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

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

Work platform is advised to perform maintenance for safe operations.



## **Lifting**

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

When removing any components, please use appropriate lifting procedures

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

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

### **Disassembly/Assembly**

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

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

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

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

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

### **Hazards of Compressed Air**

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

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

## **Hazard of Hydraulic Oil**

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

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

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

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

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

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

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

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

Make sure that all raised components are properly locked.

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

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

## **Mechanical Hazards**

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

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

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

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

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

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

## **Electrical Hazards**

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

Do not wire to any oily cable.

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

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

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

## **Fire and Burning Hazards**

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

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

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

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

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

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

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

## 1-5 Maintenance

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

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

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

### Necessary Check as Required

Item	Inspection Standard and Method
Display board	Press Enter You can access diagnostic mode by pressing this button while driving
Idler Wheel of Goods Holder	Measure the distance from the bottom of the inner frame to the bottom of the sliding frame bearing to ensure an upright inner frame and then adjust the squeezed roller.
The power module	Must be fully discharged before contact with any electrical components.
Fuse Holders	Check the removed components fuses and replace if necessary.  5A: Backup/parking light, relay/power supply, fan, strobe, flash, rear/headlight  10 A: key switch  20 A: DC-DC Convertor and Horn  500 A: main fuse
Operator's Seat	Check that the operator's seat for proper working and gently lubricate the slider track.
Wheel bolting	Make sure that the wheel bolts and nuts are fixed as follows: Tightening torque of rear wheel: 121-162 Nm  Tightening torque of front/drive wheel: 480 ~ 588 N·m
Drive axle gear box	Check gear box for lubricant Refill the lube oil into the plug opening for shell level inspection.



### Check per 10 service hours or daily

Item	Inspection Standards and Methods
Travel system	<p>Check for loose parts and fasteners.</p> <p>Check the dashboard indicator light for abnormalities.</p> <p>Check that the horn and other alarms are functioning properly.</p> <p>Check mast and hoist chains for wear and abnormal pins/rollers.</p> <p>Check the gear rack, forks and attachments for damage and abnormalities.</p> <p>Check tires, valves and wheels for abnormalities.</p> <p>Inspect the roof guard for damage and abnormalities.</p> <p>Check the hydraulic system for oil leaks and damage.</p> <p>Check the transaxle for oil leaks.</p> <p>After adjusting the driver's seat and placing the control lever in neutral, turn the key switch on and check the overall operation of the system.</p>
Mast	Lubricate the beam where the rollers are located.
Batteries (Lead Acid)	<p>Check the battery case for loose connections, frayed cables and properly seated batteries.</p> <p>Clean the top of the battery. If necessary, use 0.5 kg (1 lb) of baking soda and 4 liters (1 gallon) Hot water solution to clean the top of the battery.</p> <p>Check the specific gravity of the battery. If the specific gravity reading is below 1.150, the battery must be charged.</p> <p>Check the electrolyte levels of all cells. Keep the electrolyte level approximately 13 mm above the plate (50 inch). Add water as needed. Use distilled water only. Water should be added after charging the battery</p>
LED Indicator	Check that the parking brake light is working and that the indicator lights
Tires and wheels	Check tires and wheels for wear, cuts, grooves and contamination

### First check 50-100 hours or after a week

Item	Inspection Standards and Methods
Drive axle	Change gear oil

### Inspection per 500 service hours or 3 months

Item	Inspection Standards and Methods
Tilt cylinder	Lubricate chassis and mast pivot bolt fittings. Check the pins for loose retaining bolts or wear. Measure and adjust cylinder rod extension (max. 3.18 mm / 0.13 in) Standard bolt tightening torque: 95 ±15 N m (70 ±11 lb ft)
Cross head roller	Check the crosshead roller guard and retainer for damage.
Masts, chains and accessories	Check controls for lift cylinders, tilt cylinders and attachments for proper operation. Check for loose rack bolts and nuts and remove contamination if found. Check forks and attachments for proper operation. Lubricate all chains with a brush and inspect their anchor points for abnormalities.
Steering axis	Fittings for lubricating steering shafts.
Drive axle	Change gear oil.
Control Panel	Clean the control panel. Maximum allowable air pressure: 205 k Pa (29.7 psi)
F/R switch	Check tightness of F/R switch mounting bracket and adjust as necessary. Check for loose wiring and secure if necessary.
Parking brake	Check the parking brake to ensure the vehicle is stationary on a 15% grade and repair or replace if necessary.
Hydraulic oil	Check hydraulic oil level and refill as necessary.

### Inspection per 1,000 service hours or 6 months once

Item	Inspection Standards and Methods
Drive and hydraulic pump motors	Dust and inspect the drive motor and end shield area. Maximum allowable air pressure: 205kPa (29.7 psi)
Hydraulic oil return filter	Replace the return filter in the hydraulic tank.
Tires and wheels	Check tires for wear, cuts, grooves, contaminants, and more. Check the wheel components for cracks, wear, damage, corrosion, etc.  Front / Drive Wheel Standard Torque: 480 ~ 588 N·m
Lifting chain	Lift chain wear testing is performed by measuring the wear of the links and pins.

### Per 2,000 service hours or annually once

Item	Inspection Standards and Methods
Hydraulic system	Replace hydraulic oil and filter.
Rear wheel	Disassemble and assemble the rear wheel to reassemble the bearings.
Basic maintenance	Under normal circumstances, regular inspections are performed at least per 12 months. Regular 6-month inspections if working long hours or under heavy load. Replace if any of the following are found: Crack healing on forks, welding, brackets, etc.

## 1-6 Lube

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

### Lubricating Oil Specification

The following lubricants are recommended for chains and connecting rods:

Item	Specification
1	DIN 51825 Standard Oil and Grease

### Hydraulic Oil (HYDO)

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

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

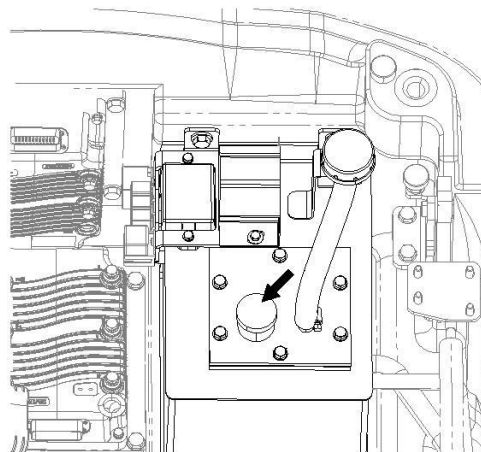
If the hydraulic fluid becomes cloudy, it is evidenced that the water or air has entered the system. Water or air in the system will cause pump failure.

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

### Gear oil

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

API GL-4 or SAE 80W oil is acceptable



Note: Multi-stage oil mixing is not allowed for transmissions. Multi-stage oil with high molecular weight polymers as vi improvers lose their viscosity effectiveness due to the permanent and temporary shear of vi improvers and hence are not recommended for use in drives and compartments of drive system.

### **Brake oil**

Heavy duty hydraulic brake oil that certified by qualified supplier is required

## **1-7 Instructions of Disassembly/Assembly**

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

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

### **Preparation before disassembly**

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

No water shall be allowed inside the system.

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

## Check and test before disassembly

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

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

The following information shall be also checked and recorded:

Vehicle model number, serial number and operation hours

Reasons of the vehicle needs to be dismantled

Check for symptoms, locations and causes of failures

(repeat the same failure if needed)

Check any part which is not suitable.

Check the parts for damage or looseness.

If possible, check the maintenance condition of the vehicle.



## Notes for disassembly

Disassembly:

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

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

Please use the right tools to remove specific parts.

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

Do not overstrain. Check and find the causes

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

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

Check and test in disassembly

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

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

Keep the distance

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

Remove pressure fittings

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

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

Bearing Disassembly

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

**Notes after disassembly**

Be clean

Clean disassembled parts and keep them away from contaminants.

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

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

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

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

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

### Dust proof

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

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

## Notes for assembly

### Parts installation

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

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

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

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

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

### Tighten the bolts and nuts

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

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

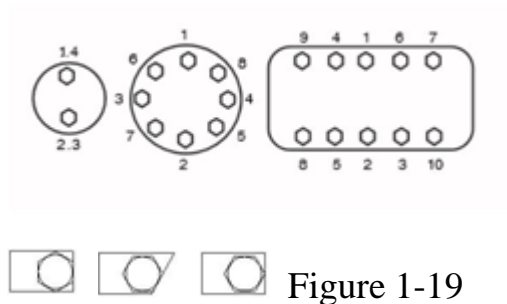


Figure 1-19

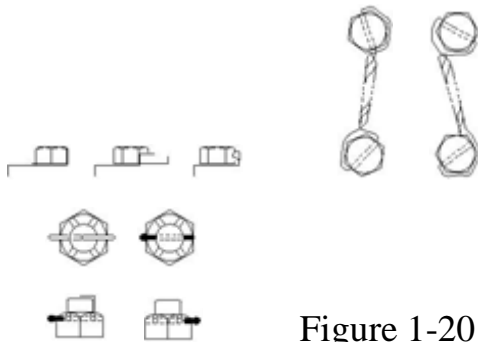


Figure 1-20

## Assembly Inspection

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

## Reassemble the gaskets

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

## Assembly adjustment

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

## Assemble pressed parts

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

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



## Assemble keys and keyways

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

## Handling the general part

### Handling the packaging

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

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

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

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

### Assemble the parts

Please soak the leather package in oil before use.

### Handling the O-rings

Please remember to check the condition of the O rings.

Hardened O-rings shall not be stored for long.

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

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

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

#### Handling the oil seal

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

Lips opposite to the seal shall be lubricated evenly.

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

#### Oil seal installation.

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

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

When inserting the oil seal, please use the guide device and fixture to avoid any damage to the oil seal.

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

#### Bearing handling

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

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

The bearing shall be kept packaged until it is installed.

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

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

Please note the following when installing the bearing.

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

When you are insert the inner ring of the bearing with a reasonable tolerance, the fixture is required with pressure to the inner ring. For hot insertion, the bearing shall be heated to 120°C (248°F) . However, please note that excessive heating can reduce the hardness of the bearing surface.

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

Handle the retainer

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

## **Hydraulic circuit fittings**

1. For metal tube to hose installation, the tube shall be installed and all bolts shall be tightened by hands.
2. Tighten the bolt at the rigid end.
3. Install hose and tighten all bolts by hands
4. Place all the hose in a position where it will not contact with the machine or other hoses.
5. Tighten the bolts at both joints
6. Start up the engine.
7. Move the control lever to full position.

8. Inspect the hose during tool movement. Make sure that the hoses do not contact any machines or other hose.
9. Shut off the motor
10. If necessary, place the hose in a new position so that it will not touch the position when moving the tool.

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

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

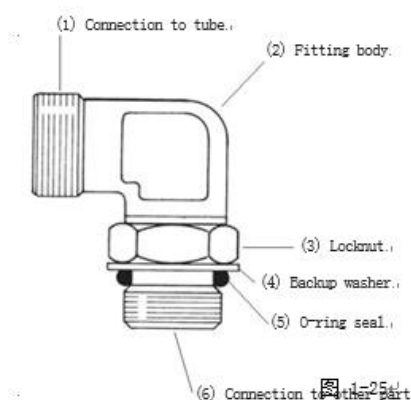


Figure 1-25

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

## Tighten accessories of other types

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

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

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

## 1-8 Standard Torque

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

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

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

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

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

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

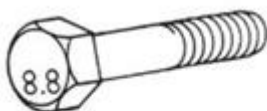
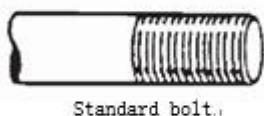


Figure 1-30



Standard bolt.

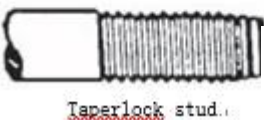


Figure 1-31

Taperlock stud.

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

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

## For metric fasten

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

## For British fasteners

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

## 1-8-2. Standard torques for fastening fittings

### Standard torques for O-ring surface seal fittings

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

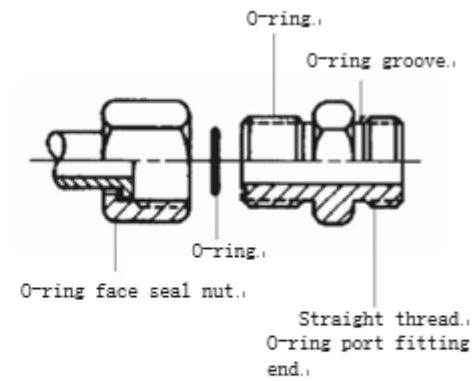


Fig 1-32

Thread size(inch)	Sealing joint nuts for O-ring face	
	(N · M) ↗	Pounds/feet
9/16 16-18↗	16 ± 3↗	12 ± 2↗
1 1/4 / 16-16↗	30 ± 4↗	22 ± 3↗
1 1/2 / 16-16↗	50 ± 7↗	37 ± 5↗
1 3/4 14↗	90 ± 10↗	65 ± 7↗
1 3/8 / 16-12↗	120 ± 15↗	90 ± 10↗
1 3/4 / 16-12↗	160 ± 20↗	120 ± 15↗
1 1/2 / 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) ↗
10.9 mm (0.625 in) ↗	7.5 ± 0.5 N · m (65 ± 5 lb · in) ↗	4.5 ± 0.5 N · m (40 ± 5 lb · in) ↗



Fig 1-33



37° bell and straight threaded O - ring accessories



Pic 1-34

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

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

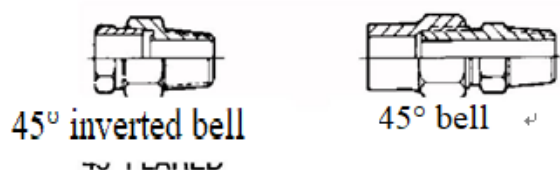


Fig 1-35

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 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.Electric control system

### 2-1. Overview

The electric system of the FE4P25-35Q series electric forklift truck is powered by a 76.8V lithium battery pack. The traction power of the vehicle is provided by an AC motor. The lifting power of goods is driven by AC motor oil pump to produce oil pressure, and then by hydraulic pipeline through the hydraulic cylinder on both sides of the door frame to achieve the lifting, tilt and side movement of cargo fork. The acousto-optic system is powered by lead-acid/lithium battery at 76.8V to 24V.

### Control power system

AC controller, this type of controller integrates high safety, reliability, flexibility, easy operation and one, through advanced control software to ensure that the motor in different modes, can run smoothly, including full speed and high torque state regenerative braking, zero speed and torque control, proprietary input/output ports and software, it ensures the economy and high efficiency of the control of electromagnetic braking and hydraulic system. The selected AC variable frequency motor is efficient, durable and essentially maintenance-free.

The control system is Inmotion controlling system



Fig.2-20 Inmotion controller

## 2-2. Emergency Stop Button

### 2-2-1. Appearance and Specifications



Item	Specification
Emergency Stop Switch	CE4T-10R-01

### 2-2-2. Function

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

#### (1) Emergency stop button

When emergency, press red mushroom-head button down to cut off power to stop function of traveling, turning, lifting. To resume the function, rotate the button according to the arrowhead indication.

#### (2) Key switch

key can turn on or turn off controlling power

Turn off (OFF): In this position, power is cut off and key can be inserted and pulled out

Turn on (ON): Turn forward from off position, switch is turned on, forklift starts up



**Do not turn on ignition key and step accelerator down simultaneously.**

**Take off key to prevent unqualified operating when get off forklift.**

**Take off key when charging or parking to prevent unqualified operating.**

The DC circuit is open

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

## 2-3. Controller and Related Equipment

### 2-3-1. Appearance and Specifications



Controller assembly

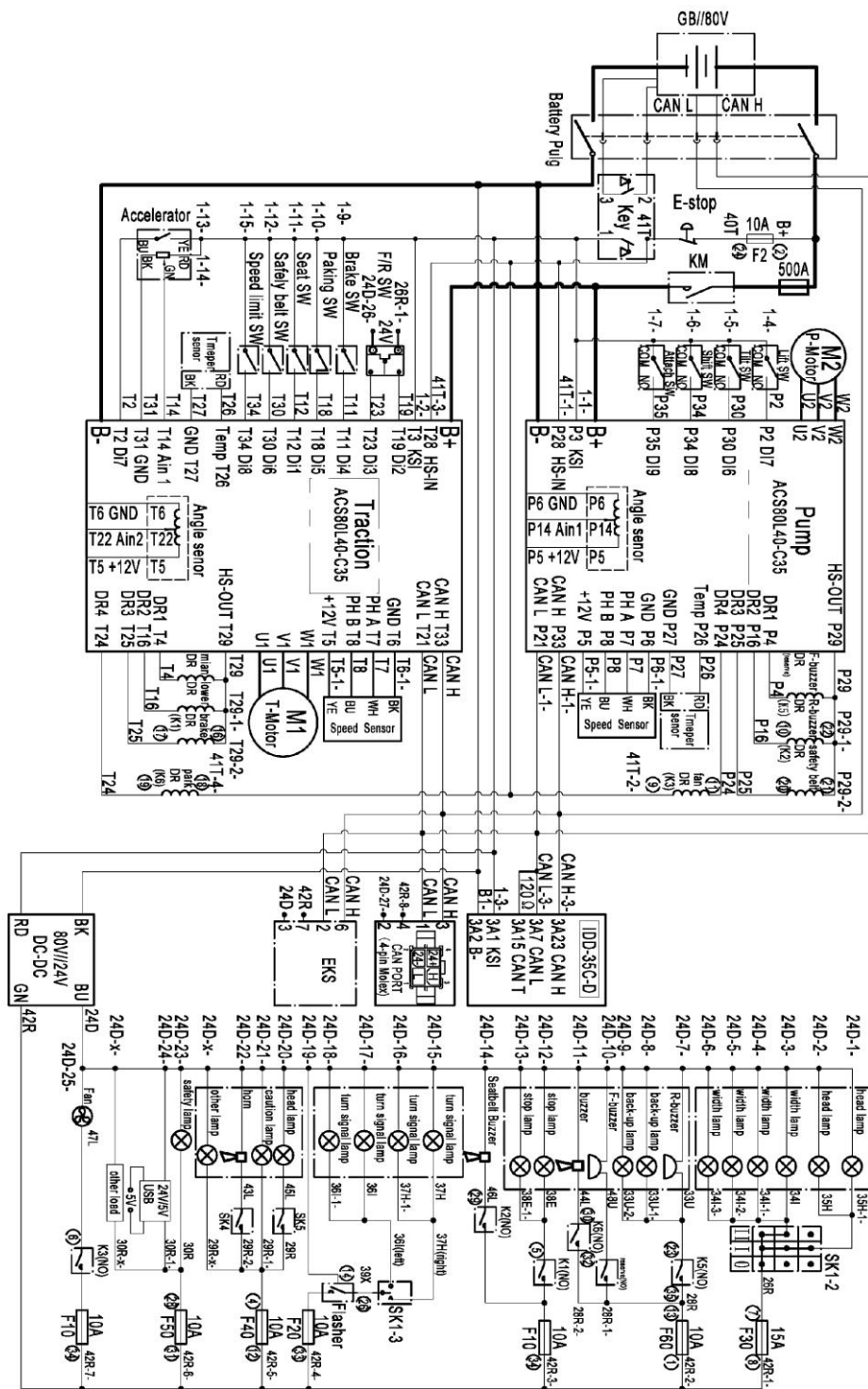


Inmotion controller

### Technical specifications

No.	Description	Specification	Serial Number	Description	Specification
1	PWM Working frequency	10KHZ	8	Accelerator control signal	2 lines of 0-5K $\Omega$ /5K $\Omega$ -0, 3 lines of potentiometer, 0-5V, current source, electron accelerator
2	Insulation strength with radiator	>500Vac	9	Speed control type	Single end/swing /VCL input
3	Logical port input voltage	If the falling edge > 1.5v, then the voltage is high; if the rising edge >4.4V, then the voltage is high	10	Operating ambient temperature	-40°C to 50°C
4	KSI input current	<1.0A	11	Storage ambient temperature	-40°C to 50°C
5	Input current of logical end	<10mA	12	Current limit of over temperature	The current is limited at 85°C and will cut off at 95°C
6	Maximum output frequency	300Hz	13	Current limit of low temperature	The current will cut off at 40°C
7	Total drive current	<10A	14	Sealing	IP65perIEC529
15	Relevant standards	1) EMC Interference: EN50081-2/08.93; Anti-interference: EN50082-2:1995 2) Safety and Anti-flying: EN1175 3) UL Component Authentication 4) Satisfy the UL583 insulation test			

## 2-3-2. Circuit, Functions and Circuit Diagram





## Critical Power Supply of controller

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

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

Current to the contactor of the line Power supply of controller.

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



Circuit contactor

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

**Key switch**

**Emergency Switch**

**Forward/reverse units**

**Accelerator**

**Seat Switch**

**Brake pedal switch**

**Parking brake switch**

**Hydraulic control switch**

**Horn relay**

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

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

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

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

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

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



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

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

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

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

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

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

## 2-3-3. Test

### A. Controller

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

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

Item	Multi-meter terminals		Range of normal value	
	Red indicating pen	Black indicating pen	Polarity measurement	Resistance measurement
1	B+	U/V/W/B-		1M $\Omega$ and above
2	B-	U/V/W		1M $\Omega$ and above
3	U/V/W	B+	0.3-0.6V	
4	B-	U/V/W	0.3-0.6V	

Pull multi-meter to  $\Omega$  mode (resistance) Pull the multi-meter to the diode mode (polarity measurement)

- 1). Remove the cables and wires that connected to the controller, and release all the internal power of capacitor (discharge the B + and B - terminals with 30  $\Omega$  resistance).
- 2). Test the diode voltage (0.3-0.6v) with a multi-meter and check if it is normal.

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



Notes: The multi-meter pointers shall not be inverted in use

## B. Line contactor and fuse



Figure 2-22

Line contactors

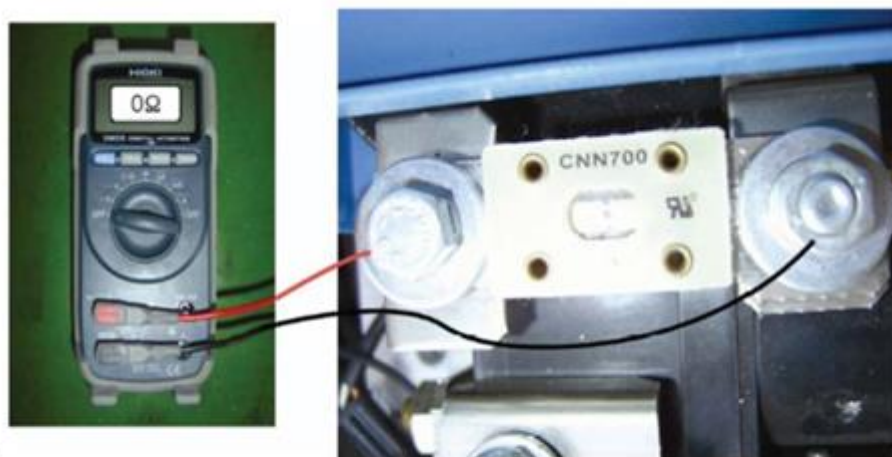


Figure 2-23

Circuit fuse

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

## 2-3-4. Disassembly and Installation

### **Access to control panel**

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

Note: Please remember that the controller contains ESD (electrostatic discharge) sensitive components.

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

### **Disassemble/install drive motor controllers**

Note: Please remember that the controller contains ESD (electrostatic discharge) sensitive components.

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

1. Disconnect the control harness from the controller connectors
2. Disconnect U, V and W cables. Tightening torque:  $9.5 \pm 1 \text{ N} \cdot \text{m}$  ( $7.0 \pm 0.7 \text{ lb} \cdot \text{ft}$ )
3. Remove B+ and B- wires from the drive motor controller
4. Loosen and remove the drive motor controller
5. Perform the above steps in reverse order to install the drive motor controller

### **Disassembly/installation of pump motor controller**

1. Disconnect the control harness from the controller connectors
2. Disconnect U, V and W cables. Tightening torque:  $9.5 \pm 1 \text{ N} \cdot \text{m}$  ( $7.0 \pm 0.7 \text{ lb} \cdot \text{ft}$ )
3. Remove B+ and B- wires from the pump motor controller
4. Loosen and remove the pump motor controller
5. Perform the above steps in reverse order to install the pump motor controller

### **Disassembly/installation of circuit contactor**

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

### **Disassembly/installation of line fuse**

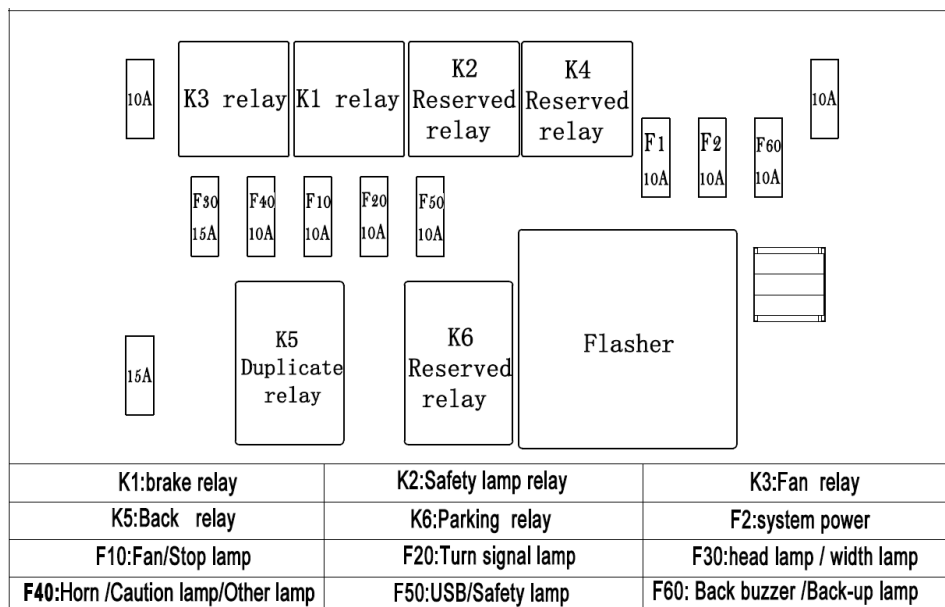
1. Remove B+x line from line fuse.
2. Remove the line fuse.
3. Perform the above steps in reverse order to install the line fuse

## 2-4. Miscellaneous Load

### 2-4-1. Fuse holder

#### A. Function and composition

To protect DC load from overcurrent, equipped with the fuse box as the following shown.



#### B. Disassembly and Installation

##### Preliminary steps

- 1.Close the key switch
- 2.Disconnect the battery connector.
- 3.Remove the cover.

##### Steps

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

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

## 2-4-2. DC-DC Convertor

### A. Appearance and Specifications



Item	Specification
Maximum power	IN 300W
Input voltage	DC 80V
Output voltage	DC 24V

### B. Circuits and Functions

The DC-DC converter power supply (80V/) into a 24V power supply, which is suitable for various loads.

The functions of each terminal are as follows:

1.The INPUT terminal receives power from the battery to activate the DC-DC converter.

2.Collect the OUPUT terminal with green (24V+), which overrides the load supplied from the converter and then passes the fuse box to the load.

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

### 2-4-3. Lamp Bank

This model is equipped with a variety of lamps, each of which has a different purpose.

Headlights (L/R) illuminate the path in front of the vehicle

The rear lights illuminate the path behind the vehicle

The reverse lights will turn on during reverse operation

Press the brake pedal and the brake light will turn on

### 2-4-4. Horn

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



## 2-5. Display panel

### 2-5-1. Display introduction

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

### 2-5-2. Function

Instrument display function (Inmotion system)









1	Tortoise speed	11	E Mode
2	Fault alarm	12	S Mode
3	Battery alarm	13	Battery level
4	Lift lock	14	Travel Speed
5	Seat	15	Steering Angle
6	Parking	16	Forward/Reverse
7	Cancel	17	Speed Mode
8	Enter	18	Working Time
9	Tortoise Mode		
10	P Mode		

Indicator function



NO.	Parameter Name	Description	Remarks
1	Tortoise speed lamp	Light up when the vehicle is running in turtle speed mode	
2	Fault light	Light up when the vehicle fails	
3	Battery lamp	When the battery level is lower than or equal to 20%, the default value is 20%	
4	Lift lock lamp	When the power level is less than or equal to 10%,the lift lock lamp is on, and the default value is 10%	
5	Seat lights	Seat switch on when off	
6	Handbrake lamp	Light up when the handbrake is on	

## Key functions

Icon	Name	Function
	Up key	Move the cursor up or add 1 to the selected number; Switch S mode (tortoise speed mode) on the main interface; When entering a password, it represents 1;
	Left shift key	Move the cursor to the left; Switch P mode on the main interface; When entering a password, it represents 3
	Right key	Move the cursor to the right; Switch E mode on the main interface; When entering a password, it represents 4;
	Move Down Key	Move the cursor down or subtract 1 from the selected number up; When entering a password, it represents 2;
	Escape key	Cancel the current content or return to the previous menu level;
	Confirm key	Confirm the current operation and enter the menu mode under the main interface;

The initial operator password for entering the menu is "11111";

## Key combination

Icon	Name	Function
	Up key	In the main interface, press the "Up" and "Down" keys simultaneously to view the instrument information, including the instrument number, SIM card number, and software version number
	Move Down Key	

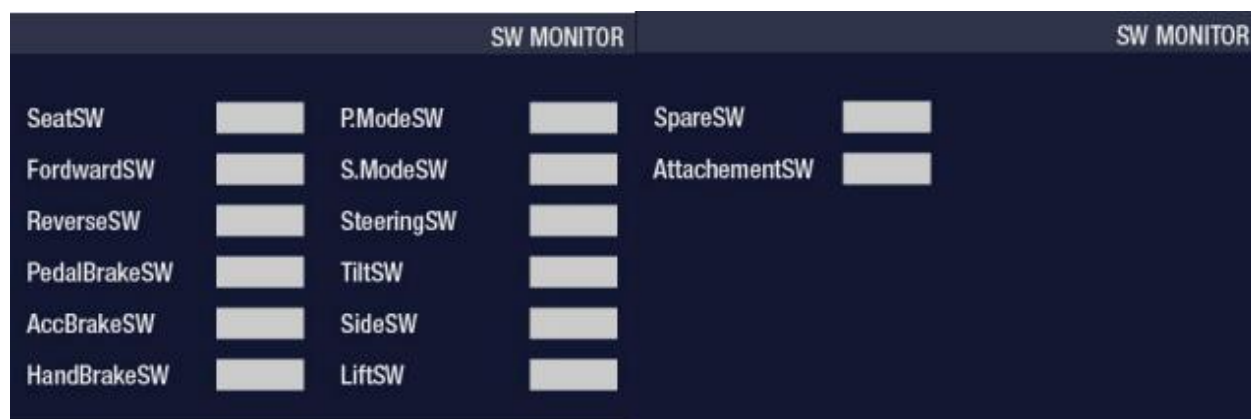
## Display content of startup interface



Interface display		Function description
1	Battery power and value	Display battery power range 0-100%; The icon is red when the battery level is 0-9, yellow when the battery level is 10-19, green when the battery level is 20-100 in lead acid mode, and blue when the battery level is in li-battery mode (the battery level alarm value is 20 in lead acid mode, and 21 in lithium mode). The icon filling is displayed as the battery level increases
2	SPE mode switching	Switch to S, P, and E speed modes
3	Forward and reverse switch	When the forward switch is closed, the forward icon is displayed, when the reverse switch is closed, the reverse icon is displayed, and when both forward and reverse are not closed, the neutral N icon is not displayed
4	Speed switching	Vehicle speed display, switch speed display with decimal display in other settings
5	Speed unit	When switching speed units in other settings, the display of km /h or MPH can be switched, and the speed value will change with the unit switching
6	Steering angle	The steering angle range is displayed as -90°to 90°, with the pointer pointing left at -90° and pointing right at 90°. The value increases in clockwise increments.
7	Chinese and English mode	The interface displays “模式” in Chinese and "Mode" in English
8	Hour meter display	Display the working time in the controller, with an accuracy of 1h or 0.1h
9	Trouble display	The main interface displays fault E : xxx, and the fault name is displayed in the operation monitoring

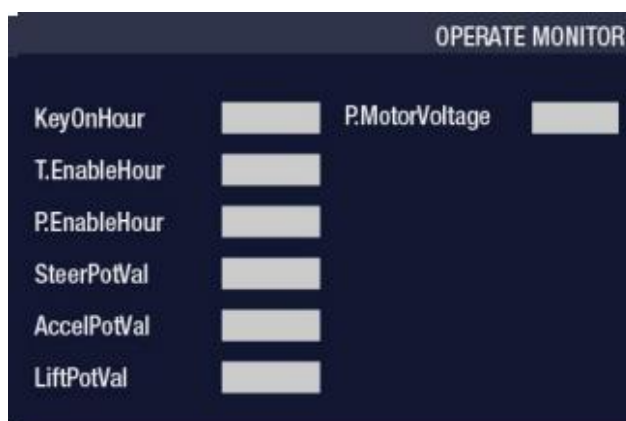
## 2-5-3. Menu functions

### a. Switch monitoring display content



SW MONITOR		Function Description
1	Seat SW	Displays the status of the seat switch, with 0 representing open and 1 representing closed
2	Forward SW	Displays the forward gear switch status, with 0 representing open and 1 representing closed
3	Reverse SW	Displays the status of the reverse gear switch, with 0 representing open and 1 representing closed
4	Pedal Brake SW	Displays the status of the brake pedal, with 0 representing open and 1 representing closed
5	Accel Brake SW	The accelerator pedal status is displayed, with 0 representing open and 1 representing closed
6	Hand brake SW	Display the parking/handbrake switch status, with 0 representing open and 1 representing closed
7	P. Mode SW	Display the P mode switch status, with 0 representing open and 1 representing closed
8	S. Mode SW	Displays the S mode switch status, with 0 representing open and 1 representing closed
9	Steering SW	Display the steering switch status, with 0 representing open and 1 representing closed
10	Tilt SW	Display the tilt switch status, 0 represents open, 1 represents closed
11	Side SW	Displays the side-shift switch status, with 0 representing open and 1 representing closed
12	Lift SW	Display the lift switch status, 0 represents open, 1 represents closed
13	Spare SW	The standby switch status is displayed, with 0 representing open and 1 representing closed
14	Attachment SW	Display the switch status of the accessory, 0 represents open, 1 represents closed

b. Operation monitoring display content



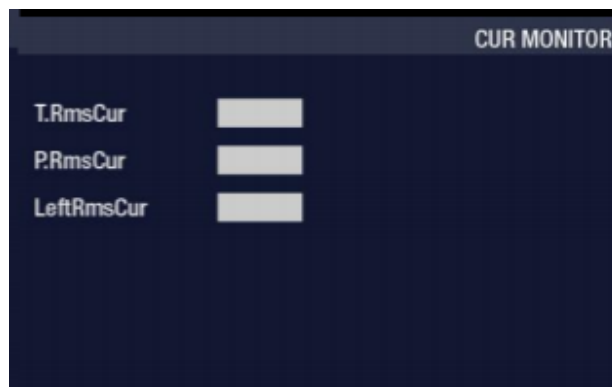
OPERATE MONITOR		Function Description
1	Key On Hour	Display the startup and operation time of the traction controller
2	T. Enable Hour	Display the running time of the traction controller
3	P. Enable Hour	Display the operating time of the oil pump controller
4	Steer Pot Val	Display the steering analog AD sampling value, which can be used to check whether the steering potentiometer signal is normal
5	Accel Pot Val	Display the analog AD sampling value of the accelerator pedal to determine whether the accelerator signal is normal
6	Lift Pot Val	Display the analog AD sampling value of the lift pump to determine whether the lift potentiometer signal is normal
7	P. Motor Voltage	For semi AC configuration, DC pump empty output monitoring
8	T. Fault Info.	The main interface displays fault codes, and traction fault information is displayed in operation monitoring
9	P. Fault Info.	The main interface displays fault codes, and the operation monitoring displays oil pump fault information

### c. Temperature monitoring display content



TEMP MONITOR		Function Description
1	T.M. Temp	Display the current traction motor temperature
2	T.ACS. Temp	Display the current traction drive temperature
3	P.M. Temp	Display the current pump motor temperature
4	P.ACS. Temp	Displays the current pump driver temperature
5	Left M. Temp	Displays the current left drive wheel motor temperature for dual drive vehicles
6	Left ACS. Temp	Displays the current left drive wheel drive temperature for dual drive vehicles

### d. Current monitoring display content



CUR MONITOR		Function Description
1	T. Rms Cur.	Display the traction motor current when the vehicle is traveling
2	P. Rms Cur.	Displays the pump motor current when the vehicle is lifted
3	Left Rms Cur.	Displays the left drive wheel phase current for dual drive vehicles

## e. Traction setting display content



T. M. SET		Function Description
1	T.E. Max Speed	Traction max speed for E running mode.
2	T.E. Acc	Traction max acceleration for E running mode
3	T.REDU. Brake	The braking rate when the accelerator is not released. The higher the value, the stronger the braking effect
4	T.NEU. Brake	Traction max deceleration at the neutral brake. The higher the value, the stronger the braking effect
5	T.REV. Brake	The braking rate when switching in the forward and reverse directions. The greater the value, the stronger the braking effect
6	T.PED. Brake	Traction max deceleration at the pedal brake, The higher the value, the stronger the braking effect
7	T.S. Max Speed	Traction max speed for S running mode
8	T.P. Max Speed	Traction max speed for P running mode
9	T.P. Max Acc	Traction max acceleration for P running mode. Higher values accelerate faster
10	T.Pot. Active High	Maximum effective value of accelerator analog quantity, used for accelerator calibration
11	T.Pot. Active Low	Accelerator analog minimum effective value for accelerator calibration
12	T.Pot Error.High	Accelerator analog quantity higher than this value reports a fault
13	T Pot Error Low	Accelerator analog quantity below this value reports a fault
14	T.Rev Speed Scale	The speed ratio in reverse, 102 represents 80% of the forward speed
15	Fan On Temp	The temperature for turning on the fan
16	Fan Off Temp	The temperature for turning off the fan.
17	Roll Back Active Time	Active Roll Back function the unit is ms
18	T.SPE. Max Speed	Used to set the speed of the SPE mode

## f. Pump setting display content



P. M. SET		Function Description
1	P. Max Speed	Pump drive max speed
2	P. Lift Accel	Pump drive max acceleration, The higher the value, the stronger the acceleration effect
3	P. Lift Speed	Set the maximum rotational speed for lifting. The higher the value, the faster the lifting speed
4	P. Creep Speed	Set the maximum hydraulic steering speed
5	P. Tilt Speed	Set the maximum tilt speed. The higher the value, the faster the tilt speed
6	P. Side Speed	Set the maximum rotation speed for side-shift. The larger the value, the faster the side-shift speed
7	P. Attachment Speed	Set the attachment maximum speed. The larger the value, the faster the accessory speed
8	P. Spare Speed	Set the spare maximum speed. The higher the value, the faster the speed
9	P. Lift Decel	Set the lifting deceleration. The higher the value, the stronger the deceleration effect
10	P.L.Pot.Active High	Maximum effective value of lifting analog quantity, used for lifting potentiometer calibration
11	P.L.Pot.Active Low	Minimum effective value of lifting analog quantity, used for lifting potentiometer calibration
12	P.L.Pot.Error High	If the lifting analog quantity is higher than this value, a fault will be reported
13	P.L.Pot.Error Low	Failure is reported when the lifting analog quantity is lower than this value



## g. Battery settings display content



BDI SET		Function Description
1	BDI	The BDI value.
2	Bat. Voltage	Displays the battery voltage detected by the controller
3	BDI.Reset SW	not used
4	BDI.Reset Vol	When the battery voltage exceeds the reset voltage value and the battery power is lower than 70%, the battery power is reset to 100%
5	Bat.Full SW	not used
6	Bat.Full Vol	Voltage value set when the battery is fully charged
7	Bat.Min SW	not used
8	Bat.Min Vol	Voltage value set when the battery is empty
9	BDI.Decrease SW	Consistent with controller values
10	BDI.Decrease Rate	Rate at which power drops
11	Bat.Min Add SW	not used
12	Bat.Min Add Vol	not used
13	Bat.Max Add SW	not used
14	Bat.Max Add Vol	not used
15	BDI.Led Level	When the battery power reaches this value, the battery power display icon on the main interface of the instrument lights up (if parameters need to be modified, the actual effect is that 20 represents lead acid mode, and 21 represents lithium mode)
16	BDI.Lim Level	When the battery power reaches this value, the lifting lock display icon on the main interface of the instrument lights up, lifting is prohibited, and travel speed is limited

## h. Steering setting display content



STEER SET		Function Description
1	Steer Lim Speed On	Activate the turn speed limit function
2	Steer Min Lim Scale	Speed ratio during cornering
3	Steer Pot Active High	Maximum effective value of steering analog quantity, used for steering potentiometer calibration
4	Steer Pot Active Low	Steering analog minimum effective value, used for steering potentiometer calibration
5	Steer Pot Error High	If the steering analog quantity is higher than this value, a fault is reported
6	Steer Pot Error Low	Steering analog quantity below this value reports a fault
7	Steer Pot Neau High	not used
8	Steer Pot Neau Low	not used
9	Start Reduce Angle	Angle used to set the start of speed limit
10	End Reduce Angle	Used to set the angle at which the speed limit ends
11	Steer Pot Mid Value	Intermediate value for calibrating the point potentiometer

i. Other settings display content

OTHER SET	
Oper.PasswordSet	BootPasswordEn
Adm.PasswordSet	SpeedDisplay
LanguageSet	Version
StorePara.	T.C.Version
RestorePara.	P.C.Version
BrightnessAdjust	S.C.Version

Other set		Function Description
1	Language Set	Chinese and English language selection
2	Store Para	Write a value of 1 to save the modified parameters
3	Restore Para	Write a value of 1 and restore to the factory default value
4	Version	Display instrument software version information
5	T.C. Version	Display traction electronic control software version information
6	P C. Version	Display pump electronic control software version information
7	S.C. Version	Display steering electronic control software version information

## 2-6. Jiachen HDU 1296

### 2-6-1. Function introduction



The Handheld Unit is a powerful and intuitive programming and diagnostic tool that can monitor and modify controller parameters online, allows users to save parameter files online, saves the parameter files to the Handheld Unit or an external USB storage device, and sends the edited parameter files to the motor controller when online.

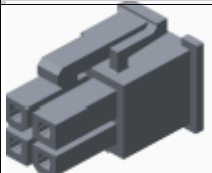
Fault diagnosis and troubleshooting tasks can be performed, which is convenient for users to analyze the cause of the fault. It is widely used in industrial vehicles of Inmotion electronic control system.

#### Technical parameters

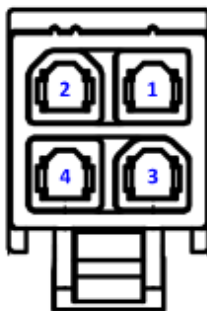
No.	Parameter	Value	Units
1	Rated operational voltage	12~96	VDC
2	Working temperature	-20~70	°C
3	Storage temperature	-40~85	°C
4	Working humidity	95% RH max	RH
5	Degree of protection	IP51 on the front, IP40 on the back	-

#### Interface pin definition

The external power supply and communication interface of the Handheld Unit adopts the RJ45 network port, which is connected to the electric control through a spiral adapter cable, and the spiral wire interface is a Molex 4PIN connector.

Plug model	Plug picture	Pin model
Molex 4-pin connector, Mini -Fit Jr.™ (5557) series, 0039013048 Molex 4, Mini -Fit Jr.™ (5557), 0039013048		0039000077 Or 39 -00 -0038

The schematic diagram of the interface pin number:

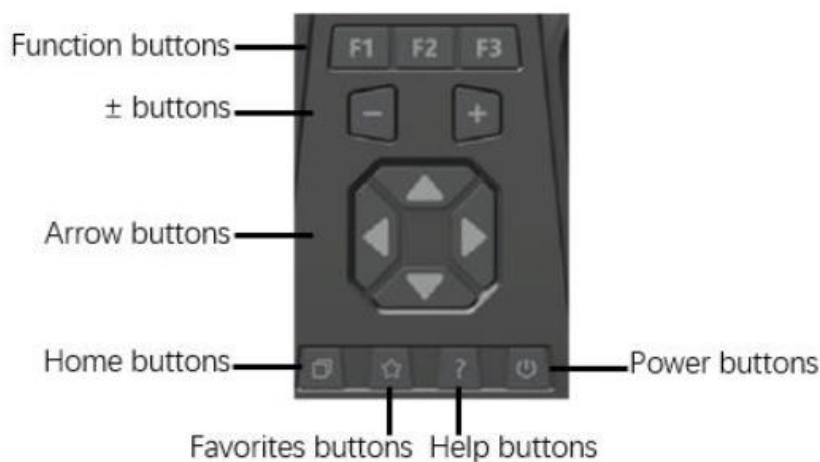


The interface pin definition:

Pin number	Description	Pin number	Description
1	CAN_L	3	CAN_H
2	-	4	B+

## KEY

The Handheld Unit uses silicone buttons, a total of 13 buttons, which are up, down, left, right, increase, decrease, F1~F3 function buttons, power button, favorites button, home button, and help button.



**Function buttons:** F1~F3 function buttons, Correspond to the content at the bottom of the screen, this button is invalid when there is no content;

**Arrow buttons:** Arrow buttons can switch up, down, left and right on the main interface; enter the application, the left key can also return to the previous menu item, and the right key can enter the next menu item;

**+/- button:** In the parameter modification interface, it is used to increase or decrease the parameter; in other interfaces, it is the parameter page turning function; the current value can be switched in the scrollable items, such as language selection, backlight brightness, etc.;

**Power button:** The power button can turn on or off the Handheld Unit

### Under AA battery power supply:

- 1) When the Handheld Unit is running, press the power button on any interface for 3s, the Handheld Unit will shut down;
- 2) After the Handheld Unit is turned off, press the power button for 1 second, and it will restart to run.

**Favorites button:** This button is another way to quickly start the application. This button can view the list of added favorites.

**Home button:** Press this button in the main interface to cycle through various applications. Press the main interface key in other interfaces to return to the main interface display.

**Help button:** Press this key to view the help text for the current interface, and close the help text display when you press this key again.

## 2-6-2. Function description

### Main interface menu

The main interface of the Handheld Unit includes 9 function button icons, USB connection status, CAN connection status and low battery indication. Operate the 4 direction buttons to switch the main interface function icons, the highlighted icon is the selected icon, press the home button to cycle through the function icons press the confirmation key F3 corresponding to the function key to enter the application function sub -interface.

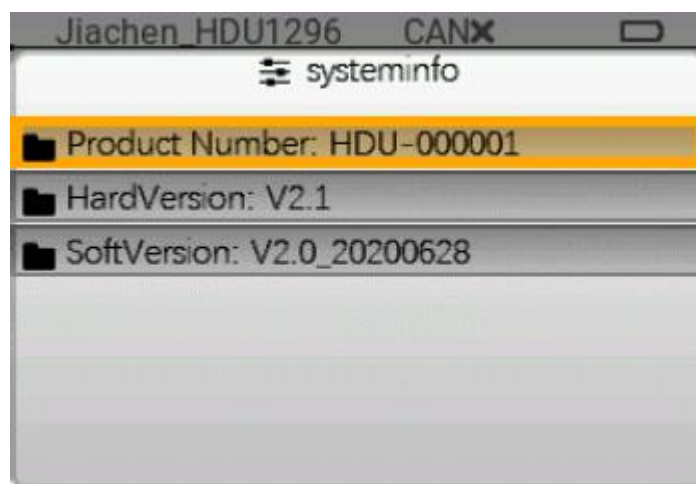


Main interface

## Description of the main interface content

No.	Parameter name	Description
1	Battery level	When the battery level is low, an empty battery icon appears;
2	Connection status	Display CAN communication status. When the device receives CAN data, it displays CAN ; when the device does not receive CAN data for 1s over time, it displays CAN ; When the USB selects the Master mode and inserts the USB storage device, the USB icon can be displayed;
3	System Information	Display product serial number, hardware version number, software version number;
4	Parameter setting	Modify the setting parameters of the electric control;
5	Parameter Monitoring	View the monitoring parameters of the electric control;
6	Fault information	View current faults and historical faults;
7	Programming	used to obtain all the parameters and values of the controller (according to the currently confirmed protocol, store the consistent and valid data), which can be exported to the internal Flash; The parameters of the internal Flash can also be restored to the electronic control;
8	Favorites Items	used to favorite customer monitoring parameters and setting parameters;
9	System settings	Set the current backlight brightness, communication mode, and USB mode;
10	File management	Perform file management on external USB storage devices; Manage files stored in internal Flash;
11	Graphic display	It is used to observe the change curve of monitoring parameters and can store the data;
Show item subtotal		

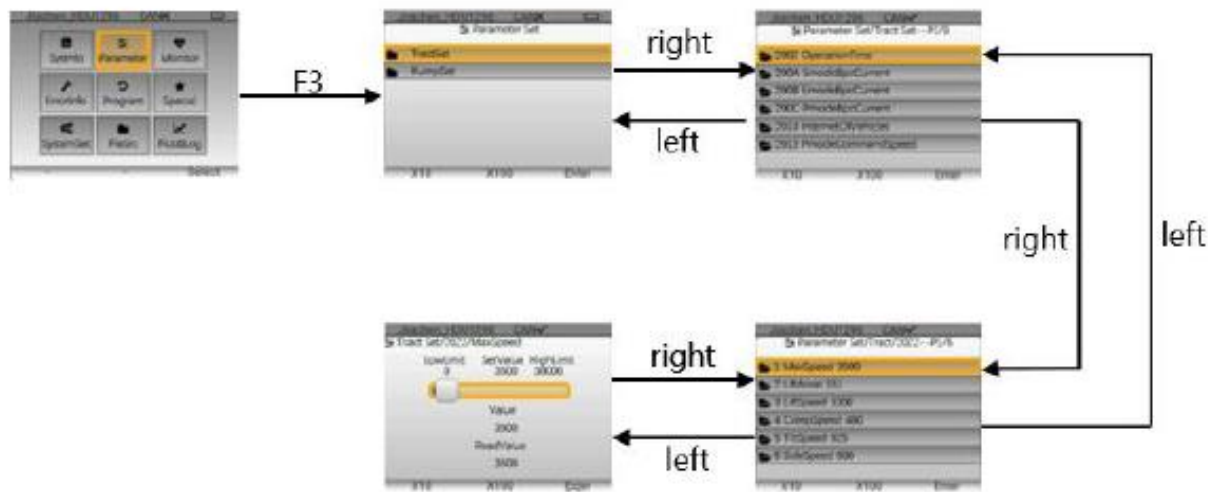
### 2-6-3. System Information



System Information Interface

## Parameter setting

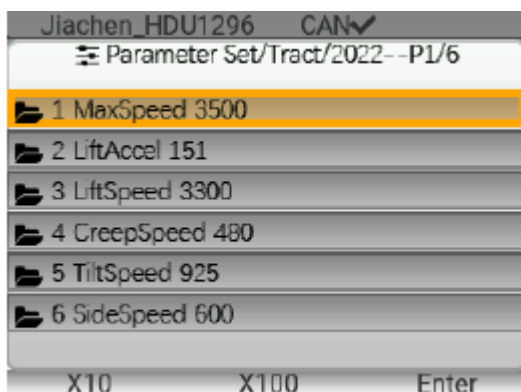
Select the "**Parameters**" function icon in the main interface and press the "**F3**" key to enter the parameter setting sub -interface; the parameter setting sub -interface is divided into Tract Set and Pump Set, which are allocated according to the index address and sub -index of the CAN open protocol; total Tract Set parameters 292 items, a total of 220 items for Pump Set parameters; each page displays up to 6 parameter items; in the sub -interface, press the "**right key**" or "**F3 key**" to enter the next sub -menu; press the "**left key**" , will return to the previous sub -menu, the up and down keys are used to select items; the **± key** is used to turn pages, the "**+ key**" is used to turn pages down, and the "**-key**" is used to turn pages up.



Schematic diagram of parameter setting menu operation

After entering the parameter modification interface, as shown in the lower left corner of picture, use the "**± key**" to modify the parameter value. Each time you press it, the parameter will increase or decrease by 1; if you increase or decrease by 10 each time, you can press the function key "**F1**". When you press the "**± key**" at the same time to modify; if you increase or decrease by 100 each time, you can press the "**± key**" at the same time to modify while pressing the function key "**F2**".

In the menu item selection page, the number "**P1/6**" in the upper right corner of the interface means that there are 6 pages in total, and the current page is the first page; "**+ key**" to scroll down, "**- key**" Turn pages up.

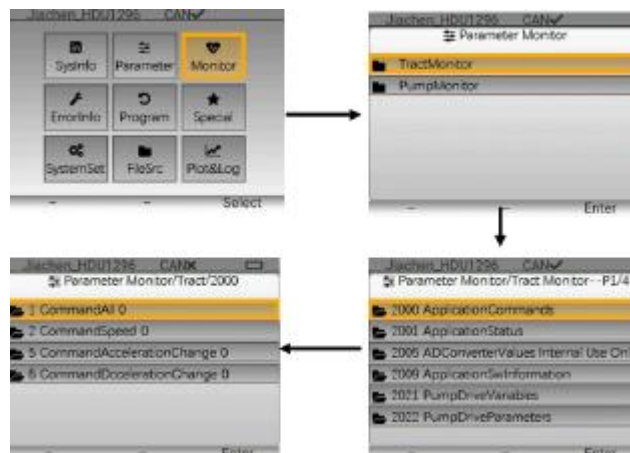


Parameter setting menu item selection page



## 2-6-4. Parameter monitoring

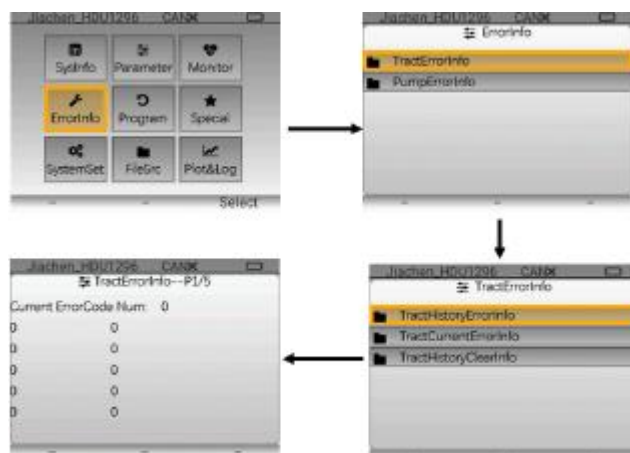
Select the "Monitor" function icon on the main interface. The sub -interfaces are divided into Traction Monitor and Pump Monitor, which are allocated according to the index address and sub -index of the CANOpen protocol; there are a total of 97 entries for Traction Monitor parameters, and a total of 51 entries for Pump Monitor parameters; the operation logic and the parameter setting interface is the same.



Parameter monitoring interface

## Fault information

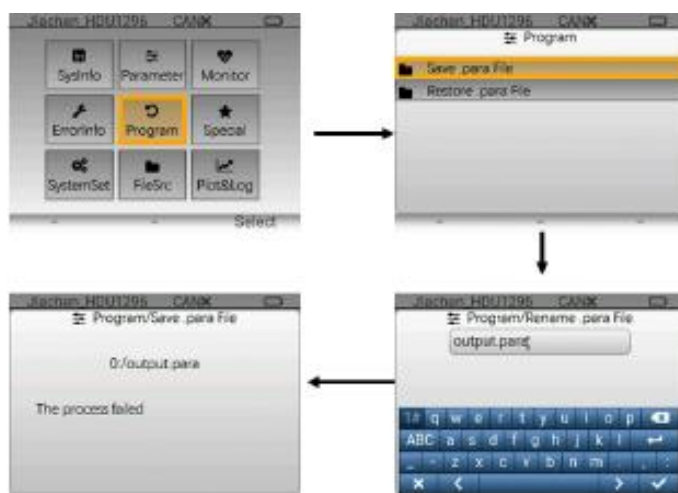
Select the "**Error Info**" function icon on the main interface, you can view the Tract Error Info and Pump Error Info; you can view the current and historical faults of each controller, and you can also clear the historical faults.



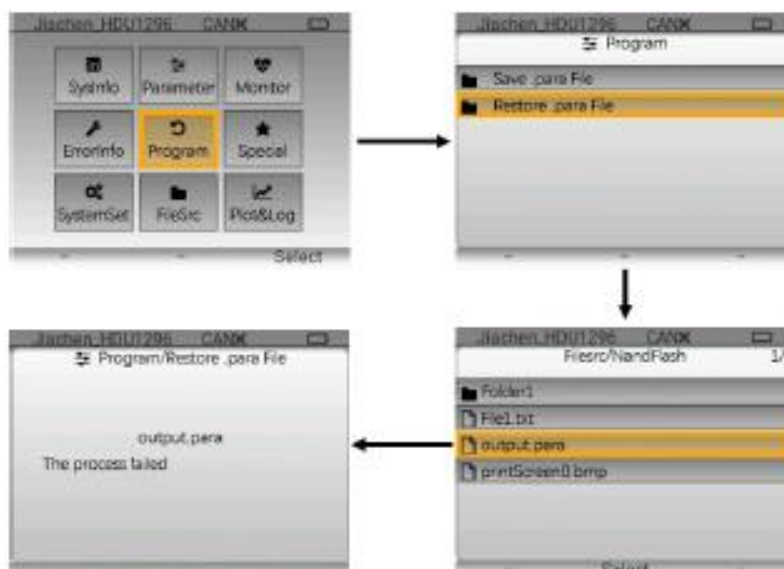
Error information interface

## Programming

Select the "**Program**" function icon in the main interface, you can save the parameters of the electronic control as a "para" file, or restore the parameters in the "para" file to the electronic control. (Note: The "original. para" file stored in the device is a parameter export protocol file, please do not delete it.)



Programming -parameter export interface



Programming -parameter import interface

## System Settings

Select the "**System Set**" function icon in the main interface to set the current backlight brightness, communication mode (RS232 or CAN), USB mode and system language and other local settings.

- a) Backlight brightness: adjust between 10~100, press the corresponding "+" and "-" keys, the value will increase or decrease correspondingly;
- b) Communication mode: The communication mode can be set to RS232 or CAN communication mode. After the setting is successful, it will be effective after the next startup;
- c) USB mode: When set to Master mode, the Handheld Unit can recognize external USB storage devices, and the connection status of the external USB devices can be displayed in real time; when set to Slave mode, the Handheld Unit can be recognized as a storage device by the computer, and copy the files on the computer (the file name must be in English) to the internal Flash of the Handheld Unit;
- d) Language setting: local language can be selected the default is English;
- e) CAN bus rate setting: 125 (default), 250, 500kbps;
- f) RS232 bus speed setting: 9600, 19200, 38400, 115200.



System setting interface

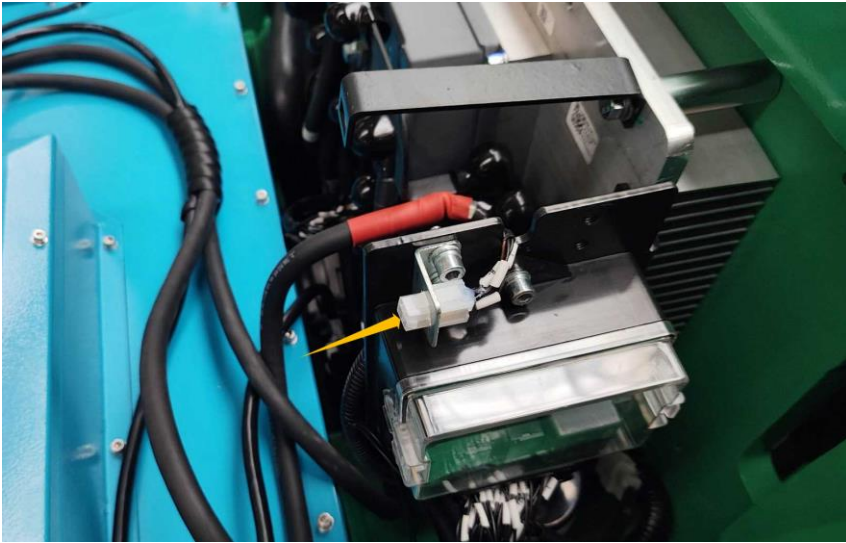
## 2-6-5. Introduction to the menu structure

This module contains the basic information of the Handheld Unit, covering the product serial number and software and hardware version information.

No.	Test Item	Description	Remarks
1	Product Number	Display the product serial number (for example, HDU-xxxxxx)	
2	Hard Version	Display hardware version information	
3	Soft Version	Display software version information	

## 2-6-6. Connection port

The connection port to the handheld unit is shown in the figures as below.



## 2-7. Controller fault table diagnostics and troubleshooting

### Inmotion system

No.	Code display on the instrument	Troubleshoot	Fault cause
1	20	Incorrect start Accelerator pedal switch active before key on	Release pedal switch
2	21	Incorrect start Forward switch or reverse switch active before key on	Turn off the direction switch
3	22	Forward switch and reverse switch active at the same time	Direction switch fault
4	23	Throttle analog value out of range	Throttle fault or analog need to be calibrated
5	24	Throttle analog fault	
6	25	Seat belt fault, or the seat belt is not fastened	Check seat belt switching signal
7	31	Traction controller CAN communication fault	Check CAN wire of controller and display
8	32	Battery voltage low	Need charge
9	34	CPU fault	Reset key
10	36	Incorrect start Tilt switch active before key on	Reset tilt switch
11	37	Incorrect start Side switch active before key on	Reset side switch
12	38	Incorrect start Attachment switch active before key on	Reset attachment switch
13	39	Incorrect start Tilt switch active before key on	Reset tilt switch
14	40	Lift analog value out of range	Lift analog fault or need to be calibrated
15	43	Steer analog value out of range	Steer analog fault or need to be calibrated
16	44	Traction controller speed protection	Vehicle speed is too high alarm
17	45	Traction controller encoder fault	1. Traction controller encoder fault 2. Traction motor speed sensor connection wire is open
18	81	Traction controller temperature is low	Traction controller temperature is low alarm

19	82	Traction controller temperature is high	Traction controller temperature is high alarm
20	83	Traction controller temperature sensor fault	Traction controller temperature sensor fault
21	84	Traction motor temperature is low	1. Traction motor temperature is low 2. Traction motor temperature sensor is fault
22	85	Traction motor temperature is high	1. Traction motor temperature is high 2. Traction motor temperature sensor is fault
23	86	Traction motor temperature sensor fault	1. Traction motor temperature sensor is fault 2. Traction motor temperature sensor connection wire is open
24	87	Traction motor encoder fault	1. Traction motor encoder fault 2. Traction motor speed sensor connection wire is open
25	88	DC bus voltage of traction controller is high	1. DC bus voltage high 2. The ramp is too steep
26	89	DC bus voltage of traction controller is low	Need to charge or check power wiring
27	90	The default value of the traction controller is updated	Reset key
28	91	Traction drive limit	Battery low vehicle speed limit
29	97	Open drain of traction output open or short	Check the wire of open drain of traction output open or short
30	98	Traction controller over current or short	Check power wiring
31	101	Traction controller short	1. Check power wiring 2. Controller enable before contactor pull
32	102	Traction controller temperature is high cut back	Traction controller temperature is high need cool
33	103	Traction motor temperature is high cut back	1. Traction motor temperature is high need cool 2. Traction motor temperature sensor fault
34	104	Traction controller over current	1. Vehicle overload or Mechanical clamping 2. Traction motor speed sensor fault
35	105	Traction controller pre-charge failed	Replace the pre charge resistance
36	110	DC bus voltage of traction controller is low cut back	Battery need charge
37	111	DC bus voltage of traction controller is high cut back	DC bus voltage of traction controller is high cut back
38	112	DC bus voltage of traction controller is high cut back (Hardware monitoring)	DC bus voltage of traction controller is high cut back(Hardware monitoring)

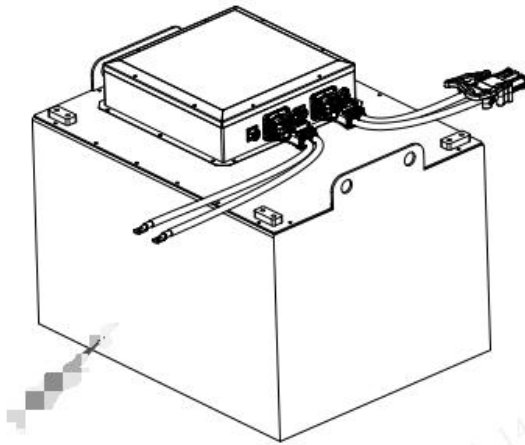
39	114	Internal power supply error	Traction motor temperature sensor or speed sensor connection wire is open
40	121	Pump controller temperature is low	Pump controller temperature is low alarm
41	122	Pump controller temperature is high	Pump controller temperature is high
42	123	Pump controller temperature sensor fault	Pump controller temperature sensor fault
43	124	Pump motor temperature is low	1. Pump motor temperature is low 2. Pump motor temperature sensor fault
44	125	Pump motor temperature is high	1. Pump motor temperature is high 2. Pump motor temperature sensor fault
45	126	Pump motor temperature sensor fault	1. Pump motor temperature sensor fault 2. Pump motor temperature sensor connection wire is open
46	127	Pump controller encoder fault	1. Pump motor speed sensor fault 2. Pump motor speed sensor connection wire is open
47	128	DC bus voltage of pump controller is high	DC bus voltage of pump controller is high
48	129	DC bus voltage of pump controller is low	Check power wiring
49	130	The default value of the pump controller is updated	Reset key
50	132	Pump drive limit	Battery voltage low need charge
51	137	Open drain of pump output open or short	Check the wire of open drain of pump output open or short
52	138	Pump controller over current or short	Check power wiring
53	141	Pump controller short	
54	142	Pump controller temperature is high cut back	
55	143	Pump motor temperature is high cut back	Pump motor temperature is high alarm
56	144	Pump controller current calibration error	Reset key
57	145	Pump controller pre-charge failed	Replace the pre charge resistance
58	150	DC bus voltage of pump controller is low cut back	DC bus voltage of pump controller is low cut back
59	151	DC bus voltage of pump controller is high cut back	DC bus voltage of pump controller is high cut back
60	152	DC bus voltage of pump controller is high cut back(Hardware monitoring)	DC bus voltage of pump controller is high cut back (Hardware monitoring)
61	153	Pump controller CPU fault	Reset key

62	154	BMS CAN bus Off	The BMS CAN communicate incorrectly
63	155	BMS over temperature protection	BMS over temperature protection
64	171	BMS CAN Error	BMS CAN Error
65	79	HPG CONTROLLER INCORRECT START	HPG controller incorrect start
66	161	DISPLAY CAN FAULT	Check display and controller CAN connection



### 3.Battery

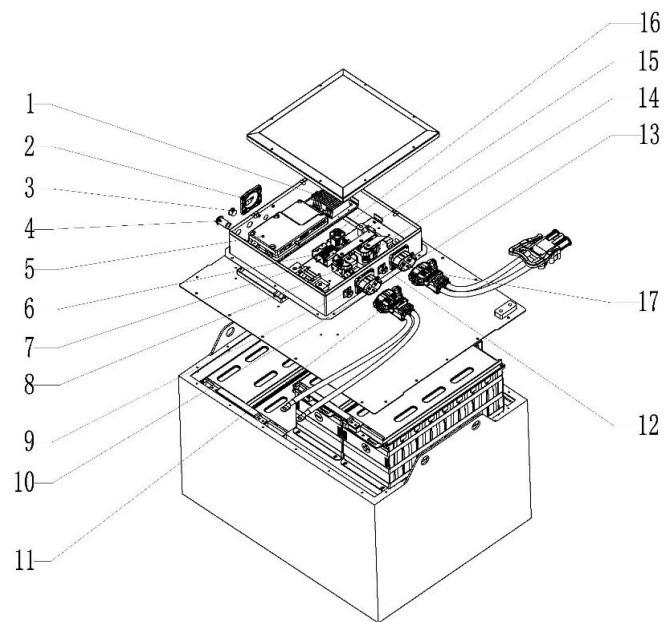
#### 3-1. Appearance and Specifications



No.	Item	Battery system parameters	Remark
1	Cell model	LiFePO4	
2	Rated voltage	76.8V	
3	Operating voltage	2.5V*N ~ 3.65V*N	N=24
4	Standard charging current	0.5C	
5	Standard discharging current	200A	
6	Maximum discharging current	400A/5s	
7	Heating	≤0°C Start heating, > 5°C stop heating	Option
8	Cooling mode	Natural cooling	
9	IP protection class	IP54	
10	Shipping capacity	65%SOC±5%	
11	Cabinet color	Blue (PANTONE 314C)	
12	Insulation resistance	Any electrode of the battery pack relative to the cabinet > 50MΩ, test voltage 500V	
13	Operating ambient temperature	Charging: 0°C ~ 55°C	Pay attention to ventilation and heat dissipation when the temperature is >45 °C
		Discharging: -20°C ~ 60°C	
14	Recommended storage conditions	-15°C~60°C,30%-50%SOC,The recommended long-term storage temperature is 0 °C ~ 35 °C	
		Humidity is≤85%RH	

## 3-2. Battery internal parts

The parts of lithium battery



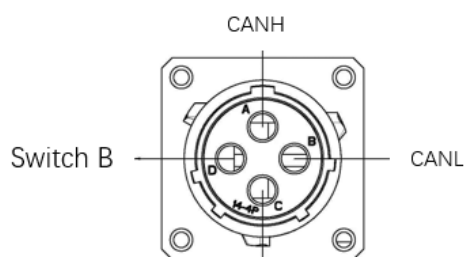
NO.	Name	QTY	Remark
1	DCDC	1	
2	Antenna	1	
3	LED metal indicator	1	
4	Buzzer	1	
5	BMS(A555-G)	1	The software varies according to the capacity
6	Gold resistor	1	
7	Current divider	1	
8	Relay(400A)(discharge)	1	
9	Vehicle communication socket	1	
10	High voltage discharge socket	1	
11	Discharge cable assembly -30G lifting	1	
12	Charging communication socket	1	
13	High voltage charging socket	1	
14	Relay(300A)(recharge)	1	
15	Fuse	1	
16	Relay(heating)	1	
17	Charging cable assembly -30G lifting	1	

### 3.3. Introduction of lithium battery port

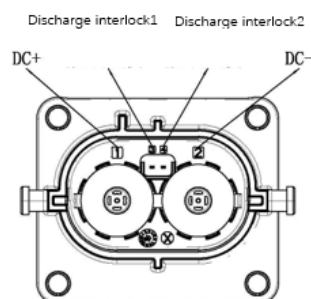
The charging and discharging port description



#### Discharge socket pin definition

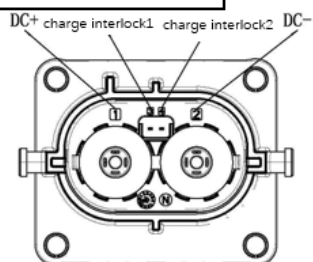


Amphenol vehicle communication  
socket RT00144PW03

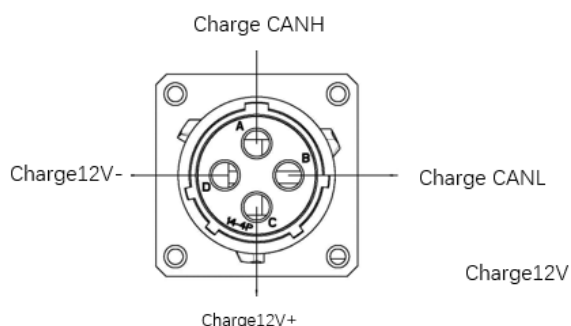


Huzheng discharge socket  
FHV201280CX-SM61J (50 flat band  
interlocking with shield-X key)

#### Charge socket pin definition



Huzheng charge socket  
FHV201291CN-SM81J (70 flat band  
interlocking with shield-N key)



Amphenol charging communication  
socket RT00144PW03

### 3-4. Lithium battery fault analysis and description

Fault repair list of battery pack system					
No.	Fault type	Preliminary estimate	Test method	Failure confirmation	Countermeasure
1	The battery pack shall have no output after starting, and the switch indicator light shall be on	1. Abnormal communication with forklift 2. System internal components damaged	1. Check the alarm code on the locomotive display to confirm the specific fault. If it is confirmed as CAN communication problem, the discharge connectors shall be disconnected, and the both ends of the battery pack discharge connectors of CAN communication shall be checked for 120 $\Omega$ resistance;	1. If the resistance is measured to be infinite, the the CAN communication wire harness is indicated as disconnected. In this case, the CANH and CAN CAN shall be checked for normal break-over between the discharge connector and the panel communication port, and then the panel communication harness CAN shall be checked for break-over. 2. If there is resistance and is far bigger than 120 $\Omega$ , damage may be indicated inside the BMS CAN chip.	1. Replace damaged wiring harness; 2. Replace damaged BMS
			1. Disconnect the discharge plug and start the battery pack separately to check whether the discharge plug has an output.	If there is an output, the locomotive may have an internal circuit error which will result disability of the battery pack output	Check the locomotive communication and power lines

			1. Remove the battery box cover and high pressure box cover, check whether the fuse is normal (in the case of shutdown, select the lead file of the multi-meter and use the meter pen to check the two ends of the fuse. If there is a drop of sound, then it is normal. If there is no sound, then the fuse is damaged.)	Broken fuse	Before replacing the fuse, check whether there is a short circuit between the positive and negative discharge of the locomotive and the battery pack. If there is no short circuit, then replace the fuse; if there is a short circuit, first deal with short circuit fault, and then replace the fuse.
2	The battery pack have no output after starting, and the switch indicator light is not on	1.System internal components damaged 2.Insufficient system voltage	1.Select the DC voltage mode of the multi-meter, test the total positive and negative voltages at both ends with the meter pen, and check whether the total voltage of the system is normal;	The system voltage is low, and BMS cannot work normally	Charge the battery pack first
			2.Select the lead mode of the multi-meter, and check if the communication harness S1_A and the S1_B of the panel have normal lead	Turn on the light and confirm the fault of BMS to replace BMS preliminarily	Replace panel communication harness
			3. After the voltage harness is connected normally, press the start switch to check if the BMS is on;	After pressing the start switch, the BMS does not turn on the light, and the fault of BMS is preliminarily confirmed	Replace BMS
3	The battery pack cannot be charged. The indicator light of the battery pack is on	1. Abnormal communication with forklift; 2. System internal components damaged	1. Check if the 12V charging socket harness , GND, CANH and CNAL harness is normal	The conduction is abnormal	Replace the cable harness of the charging socket
			2. Connect the charger to check the fault code of the charger display; switch off to see if there's any loose for charging terminals and terminal jump; check the CAN communication if there are 120 $\Omega$ resistance on both ends	If no120 $\Omega$ resistance is detected, then the CAN chip is damaged	Replace BMS
4	The battery pack cannot be charged. The	1. The charger has no 12V auxiliary power output; 2.	1. Disconnect the charger and battery pack, and check the charger for 12V auxiliary power output separately after starting up;	1.The charger has no 12V auxiliary power output	Replace the battery charger

	indicator light of the battery pack is not on	System internal components are damaged	2. Check if the 12V charging socket harness , and GND harness are normal	Wire harness is not working properly	Replace the cable harness of the charging socket
			3. Confirm if the 12V auxiliary power output of the charger is normal, and the wiring harness of the charging socket is normal. Keep the charger on and connect to the battery pack, and then check if the BMS is on.	The BMS does not turn on the light, and the fault of BMS is preliminarily confirmed	Replace BMS
5	The battery pack cannot shut down	1. Car key switch get a short circuit, 2.Internal components of battery pack system are damaged	1. Car key switch get a short circuit, 2. Internal components of battery pack system are damaged	The battery pack can switch the machine normally and the locomotive switch harness is short-circuited	Check the wire harness of forklift switch
			2. After disconnect the battery pack from the forklift and pressing the start switch button on the battery pack, the battery pack cannot be shut down normally. After disconnecting the battery box panel and the wire harness on the switch, the battery can be shut down normally	The battery pack can switch the machine normally and the locomotive switch harness is short-circuited	Replace the start-up switch
			3. Disconnect the battery pack from the connection to the forklift and the wiring harness on the switch.	BMS fault	Replace BMS



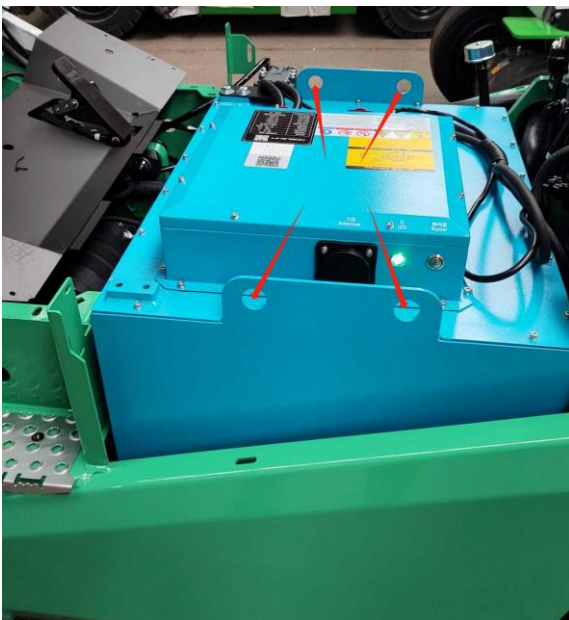
### 3-5. Disassembly and Installation

When installing and replacing lithium batteries, they shall be fixed reliably and shall not be overturned; It is forbidden to knock the pole post and lead clamp; Strong impact shall be avoided during handling.

1. Open side panels on both sides



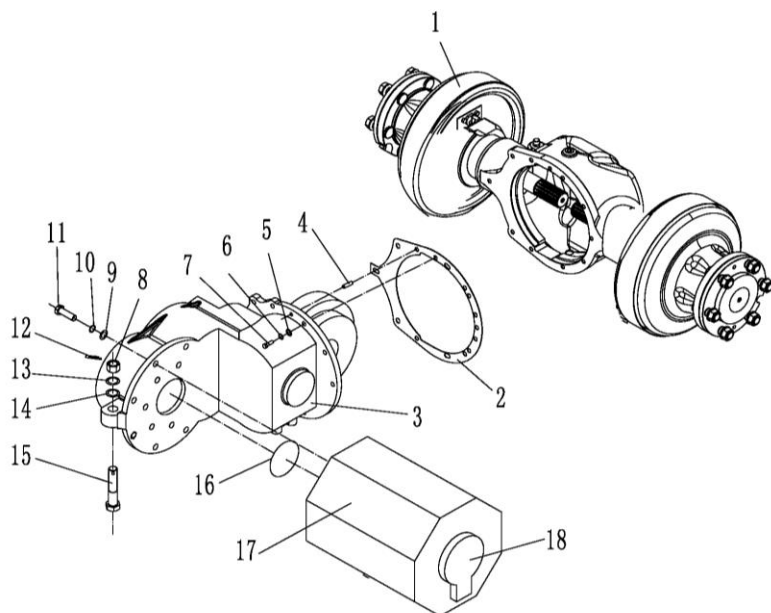
2. Turn off the power and unplug the main power cables, the battery can then be lifted using a spreader



## 4. Drive / Brake System

### 4-1. Overview

#### 4-1-1 Drive system



NO	Name	QTY	Remark
1	Drive axle(AQ)	1	30-35
1	Drive axle(AQ)	1	25-28
2	Seal washer	1	
3	Gear box (ZN)	1	FE4P25-35Q
3	Gear box (ZN)	1	FE4P25-35QM/H
4	Dowel pin GB119.2-10x24	1	
5	Washer GB97.1-12-200HV	12	
6	Washer GB93-12	12	
7	Bolt GB5786-M12x1.5x45-8.8	12	
8	Nut GB6178-M20-8	1	
9	Washer GB97.1-14-200HV	5	
10	Washer GB93-14	5	
11	Bolt GB5785-M14x1.5x160-8.8	5	
12	Split pin GB91-4x40	1	
13	Washer GB93-20	9	
14	Washer GB97.1-20-200HV	1	
15	Bolt GB31.1-M20x90-8.8	1	
16	O ring 90x2.65	1	
17	AC. Motor (HP) HPQ11-4NL-B	1	FE4P25-35Q
17	AC. Motor (HP) HPQ16	1	FE4P30-35QM/H
18	Encoder(HP)	1	



The drive/brake system consists of the followings:

1 The drive motor regulated by the respective controller transmits the rotating force to the drive shaft (electric mechanical power).

2 The drive shaft converts the rotational force transmitted from the drive motor into torque and speed suitable for driving through its gear set and sends them to the corresponding wheels (mechanical power). They also contain service brakes, which are actuated by depressing the brake pedal to produce braking power (hydraulic power friction).

3 The accelerator sends an electrical signal to the drive motor controller to accelerate the motor (analog signal digital signal).

4 The F/ R unit sends an electrical signal to the drive motor controller to determine the drive direction of the motor (analog signal digital signal).

5 The service brake pedal assembly injects brake fluid into the drive shaft to drive the service brake (hydraulic power friction).

6 The parking brake built into each drive axle secures the motor shaft when engaged to ensure that the vehicle is stationary (mechanical power friction).

## **4-2. Drive motor**

### **4-2-1 How to run it**

Electrically, the drive motors rotate their respective drive wheels so that the vehicle can move forward / backward

Controlled by controller

Each drive motor is connected to the controller through U, V and W lines. The controller operates the drive motor according to inputs from multiple switches and sensors and internal parameter settings.

The drive motor operates when the following conditions are met:

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

2 Operator seat (seat switch),

3 Determine the driving direction (F / R unit),

4 Accelerator pedal pressed (accelerator)

Motor speed detection (encoder operation)

Each drive motor is equipped with an encoder, which is used as the speed sensor of the motor. It includes two hole sensors, and a gear is installed on the drive shaft of the motor to interact with the two hole sensors. The gear rotates simultaneously with the drive shaft so that the gear teeth periodically pass through the magnetic field of each hole sensor. When the top platform of the gear passes through the magnetic field, it is close to the hole sensor, so the magnetic flux increases. On the other hand, when the bottom platform passes through the magnetic field, the distance increases and the magnetic flux decreases accordingly

The cycle occurs again and the magnetic flux has a waveform that generates a voltage pulse. The controller analyzes the amplitude of the pulse to calculate the speed of the motor. The smaller the amplitude, the higher the speed of the motor.

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

Overheat protection (thermal sensor operation)

Each drive motor is equipped with a thermal sensor to prevent overheating. Once the motor is heated to 145 °C (293 °F), the overheat alarm is activated and the operating performance of the motor is limited.

## 4-2-2 Test of drive motor

Stator test

1. Carefully wipe the contamination on the stator surface with a clean cloth dipped in alcohol.

Note: contamination in the stator can cause coil damage and therefore damage to the stator itself.

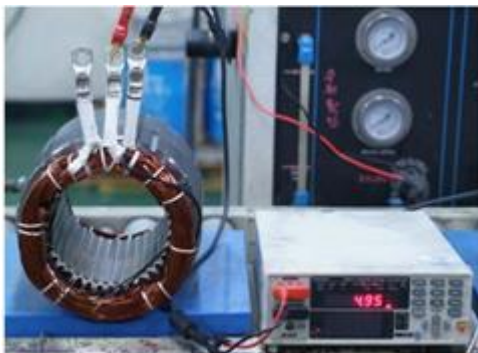
Stator test

1. Carefully wipe the contamination on the stator surface with a clean cloth dipped in alcohol.

Note: contamination in the stator can cause coil damage and therefore damage to the stator itself.

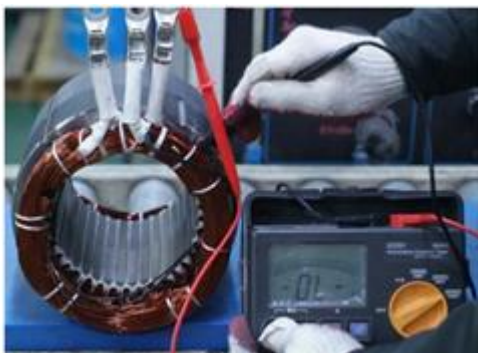
2. Use a milliohmmeter to measure the resistance of each phase (UV, VW, WU).

Rated resistance: 0.4  $\Omega$



3. Test insulation at 1000 VAC and min Use insulation tester for 10m  $\Omega$ .

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



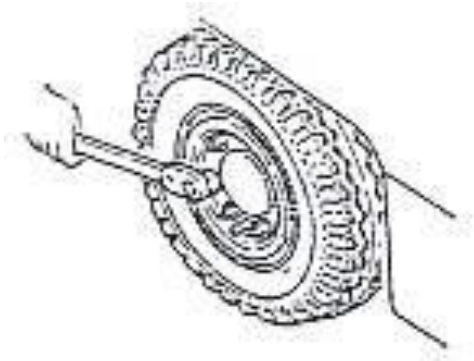
### 4-2-3 Removal / installation of drive wheel



1. Place a jack or block of wood under the forklift to empty the wheel and loosen the nuts.
2. Remove the nuts and the drive tire.
3. Perform the above steps in reverse order to install the drive wheels.

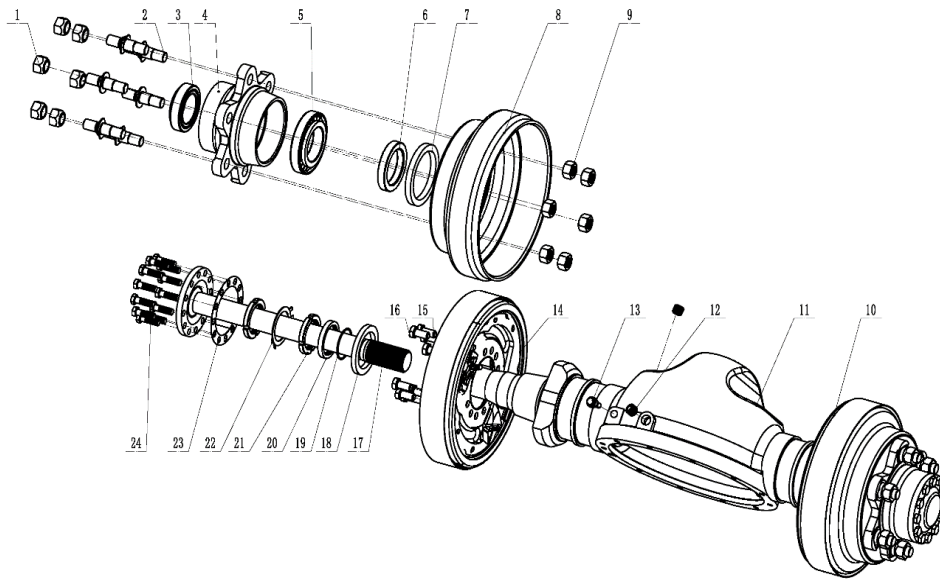
#### Wheel nut tightening torque (FE4P25-35Q)

Front wheel:	28X9-15-14PR	480-588N·m
	7.00-12-14PR	480-588N·m
	7.00-12-12PR	480-588N·m
Rear wheel:	6.50-10-10PR	121-162N·m
	6.00-9-12PR	121-162N·m
	6.00-9-10PR	121-162N·m

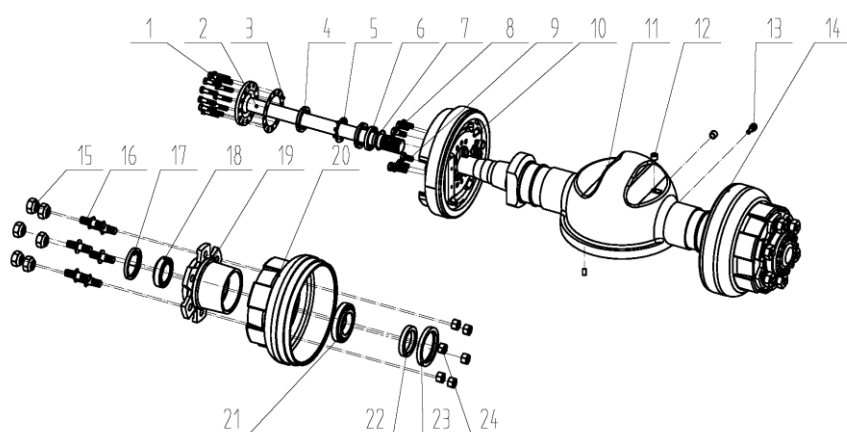


## 4-3. Drive axle

### 4-3-1 Appearance and specifications



NO.	Name	QTY.	Remark
1	Cone nut - 24354-32311B	12	25-28
2	Column bolt - 24353-72001B	12	25-28
3	Bearing 33012	2	25-28
4	Hub-A20A3-02011JXX	2	25-28
5	Bearing 30214	2	25-28
6	Oil seal retaining ring - 24453-02121G	2	25-28
7	Oil seal 100X1125X12-Z6351-01004	2	25-28
8	Brake hub - 22673-02031	2	25-28
9	Nut M20X1.5-B4223-00020B	12	25-28
10	Right brake assembly REF00056R	1	25-28
11	Drive axle shell -A22A3 - 02041A	1	25-28
12	Blockage - 22193-03001	3	25-28
13	Vent plug assembly - 90106-65690	1	25-28
14	Left brake assembly REF00056L	1	25-28
15	Bolt M14X1.5X38-25953-72001	4	25-28
16	Bolt M14X1.5X30-A22A3-02051	12	25-28
17	Half shaft - A20A3-02051	2	25-28
18	Oil seal 75X100X10-25555-00008	2	25-28
19	O-ring 59.6X2.4	2	25-28
20	Bushing - 25555-00007	2	25-28
21	Round nut M58X2-25555-00004	4	25-28
22	Check washer 58-25555-00006	2	25-28
23	Half shaft pad - A22A3-02031	2	25-28
24	Half-shaft bolt - 24453-02061B	24	25-28



NO.	Name	QTY.	Remark
1	Half-shaft bolt - 24453-02061B	24	30-35
2	Half shaft - A22J3-02011	2	30-35
3	Gasket - A22A3-02031	2	30-35
4	Round nut M58X2-25555-00004	4	30-35
5	Stop washer 58-25555-00006	2	30-35
6	Bushing 60X75X10-24453-02121G	2	30-35
7	O-ring 59.6X2.4-2555-00008	2	30-35
8	Brake bolt - 25953-72001	2	30-35
9	Brake bolt - A22A3-02051	4	30-35
10	Right brake assembly - AXQ-Q03E5-1520R	12	30-35
11	Bridge shell-A22J3-02021A	1	30-35
12	Screw plug - 22193-03001	3	30-35
13	Vent plug assembly - 90106-65690	1	30-35
14	Left brake assembly 1270-24433-70411	1	30-35
15	Hub nut - 23913-02041B	12	30-35
16	Hub bolt - 25303-02102B	12	30-35
17	Oil seal 75X100X10-25555-00009	2	30-35
18	Tapered roller bearings 33012	2	30-35
19	Hub - 25555-00003	2	30-35
20	Brake drum - 24453-02131	2	30-35
21	Tapered roller bearings 30214	2	30-35
22	Oil seal retaining ring 72X100X16-24453-02121G	2	30-35
23	Oil seal 100X125X12-Z6351-01004	2	30-35
24	Nut M20X1.5-B4223-00020B	12	30-35

The drive axle has the advantages of reasonable design structure, reliable performance and long service life. The axle housing is made of cast steel with good rigidity and large bearing capacity. See the table below.

Main Technical Parameters

Type of truck		FE4P25-28Q	FE4P30-35Q
Drive axle structure type		The front wheel drive, the axle and the frame are fixed	
Type of braking		Front double - wheel brake, internal expansion, hydraulic type	
Tyre mounting distance	mm	960	1158
Brake shoe friction plate size (length × width × thickness )	mm	348×60×8	348×76×8
Friction plate area	cm <sup>2</sup>	209×4	264×4
Inner diameter of brake drum	mm	310	314
Outer diameter of brake	mm	348	349
Sub-pump cylinder diameter	mm	28.58	28.58

## 4-3-2 How to operate

### Driving function

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

When the motor shaft rotates, its connected pinion also rotates, and then rotates the helical gear, and the spline is connected to the pinion. Since the helical gear has several times more teeth than the pinion, the first deceleration occurs between the two gears and the torque multiplies accordingly:

The sun gear meshed with the spiral hearing rotates simultaneously with the rotation of the spiral hearing. The rotation of the sun gear causes the three planetary gears to move around the sun gear. As contained in the ring gear, the planetary gears maintain their circular motion without becoming out of mesh. These gears are so named because the way they work together can be compared to the planetary orbit around the sun.

## **Braking function**

Once the brake pedal is pressed, brake oil is injected into the drive shaft through the master cylinder to push the piston. Then, the pushed piston compresses the friction disc and the steel disc overlapped with each other; There is friction between them. Thus, the friction disc loses its rotating power. When the friction disc loses power, all other rotating parts, including the wheel, slow down and stop together. After the brake pedal is released, the brake oil is discharged, the return spring returns the compression disc to the original position, leaves a gap between the inner disc and the outer disc, and rotates to release the brake. Therefore, all Other rotating parts become free to rotate.

## **4-3-3 Drive gear oil replacement**

### **Preliminary steps**

Park the vehicle on a flat ground. Check whether the parking brake indicator lights up, then place the F/ R switch in neutral.

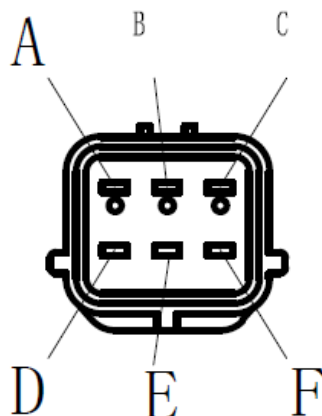
### **Process**

- 1 Lift the gantry and support it with support blocks.
- 2 Turn off the key switch.
- 3 Unscrew the oil level check plug and remove the oil drain plug to drain the oil.
- 4 Clean and install the drain plug.
- 5 Unscrew the oil replenishing plug and fill with oil. Maintain the proper oil level by checking the dip stick.
- 6 Install the oil level check plug and tighten the oil replenishment plug together.
- 7 Lift the gantry and remove the support block.



## 4-4. Accelerator

### 4-4-1 Appearance and specifications



No.	Plug-in definition	Color
A	Power supply + 12V - + 80V	Red
B	Signal output, 0-10V	Green
C	Ground wire 1	Black
D	COM (common)	White
E	Idle switch signal	Blue
F	None	N/A

### 4-4-2 How does it work

Electric vehicle is powered by a drive motor. As a result, the accelerator that determines the vehicle's travel speed is connected to the drive motor controller.

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

As shown above, Signal A or B sent by the accelerator are communicated to the controller by CAN. In principle, the values of the two signals shall be the same. If they differ by more than the tolerance, it will be identified as a problem in the electrical system or accelerator and a fault code will appear on the display.



### 4-4-3 Disassembly and installation

#### Preliminary steps

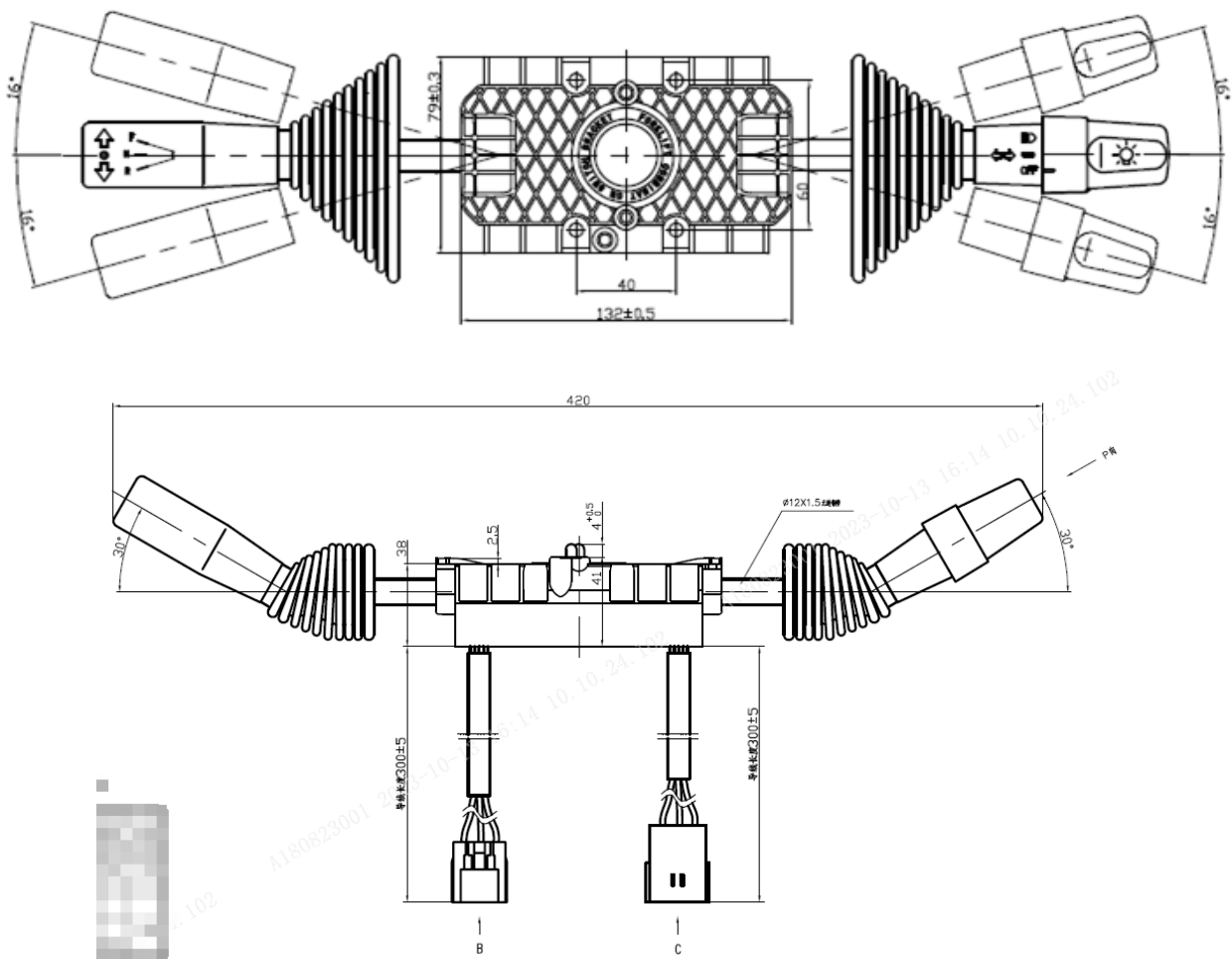
1. Turn off the key switch.
2. Remove floor covering mat

#### Process

1. Lift the base plate slightly and perform the following steps:
2. Remove the accelerator pedal connector from the main harness.
3. Loosen the three sets of bolts and nuts and remove the accelerator.
4. Perform the above steps in reverse order to reinstall the accelerator pedal.

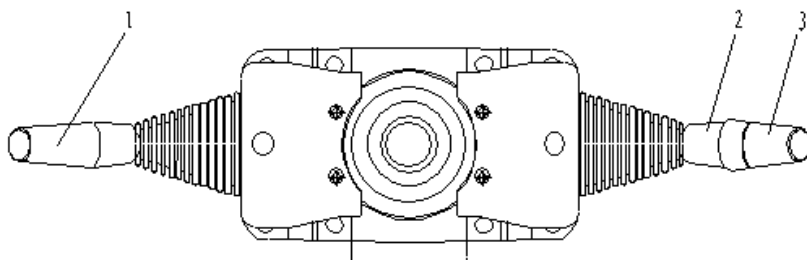
### 4-5. F/R units

#### 4-5-1 Appearance and specifications



## 4-5-2 How does it work

The combination switch is a combination of direction switch, turn light switch and large and small light switch.



1. F/R direction switch

2. Turn light switch

3. Large and small light switch

The direction switch controls the driving direction of the vehicle and transmits the signal to the display for display. Push the handle forward, pull the handle backward, and set the middle position to neutral. When the handle is set to the backward position, the reversing light and warning light are on and the reversing buzzer sounds.

The steering light switch indicates the turning direction of the forklift. When the switch handle is turned to the steering position, the steering light flashes.

Push forward	Left turn signal flashing
Middle	Median position
Pull back	Right turn signal flashing

The large and small lamp switch controls the on and off of the large and small lamps. This switch has second gear. When it is rotated to the first gear, the small light will be on. When it is rotated to the second gear, the large and small lights will be on.

Automotive lighting \ Gear position	Gear position		
	OFF	Gear I	Gear II
Indicator lamp	×	○	○
Taillight	×	○	○
Headlamp	×	×	○

○: Light on ×: Light off


Rear headlamp switch

The rear headlamp switch is a single gear switch, which controls the lighting and extinguishing of the rear headlamp. Pull up and light up the rear headlamp, and push down to extinguish the rear headlamp.

The F/ R direction switch (forward/ reverse) is used to enable the operator to use the connection to the F/R combination switch to select the driving direction of the vehicle.

The F/ R direction switch has one connector (4-pin connector, B-direction), which can be connected with multiple devices interact as follows:

B direction



JS-4-20( AP )


Terminals	1	2	3	4
Color	Brown	Red	Green	Black
Line cross-sectional area	0.75	0.75	0.75	0.75
Handle gear	320	325	320	320
Forward gear		+		
Stop gear				Negative Electrode
Reverse gear				

Note: The advance and retreat parts are the electronic switching.  
Operating voltage: DC12, 24V  
Load current: 0.5A(MAX)

The 4-pin connector pins of the F/R direction switch are all connected with the F/R switch to provide 24V power supply and receive the operator's requirements through forward, reverse or undirected switches.

When the switch is in neutral, it sends voltage signals from the forward and reverse terminals. The C-way connector is the vehicle's lamp switch connector, as shown below.

C direction



JS-8-10( AP )

Terminals	1	2	3	4	5	6
Color	Dark Yellow	Orange	Grey	Brown	Yellow	Red
Line cross-sectional area	0.75	0.75	0.75	1.0	0.75	1.5
Handle gear	320	320	325	440	440	445
	60W	60W	+	60W	50W	+
Turn right gear						
Close gear						
Turn left gear						

C Line 7 and 8 are horn contact control lines, 7 is black and 8 is white

## 4-6. Brake system

### 4-6-1 Overview

The brake system is composed of brake pedal, brake master cylinder and wheel brake, which is the internal expansion oil pressure type of the front two wheels braking.

### 4-6-2 Brake pedal

The structure of the brake pedal is as shown in the figure. The pedal converts the pedal force acting on the pedal into the brake oil pressure through the push rod of the brake master cylinder.

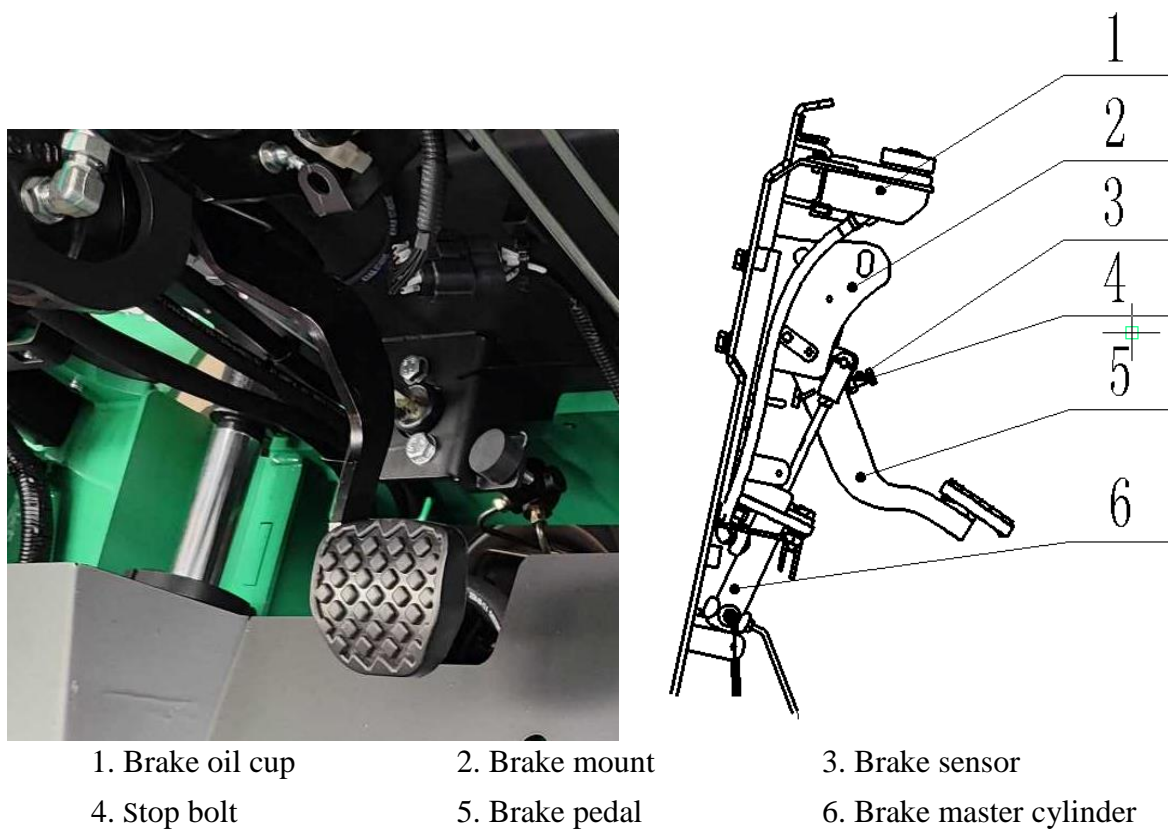
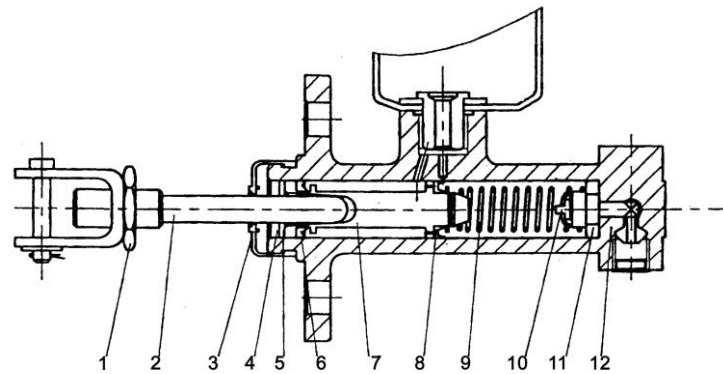


Figure: Brake pedal assembly

### **4-6-3 Brake master cylinder**

The master cylinder consists of a valve seat, a check valve, a return spring, a main cup, a piston and an auxiliary cup. The end is fixed with stop washer and stop steel wire, and the outside is protected by rubber dust cover. The master cylinder piston acts by operating the brake pedal through the push rod. When the brake pedal is pressed, the push rod pushes the piston forward, and the brake fluid in the pump body flows back to the oil storage tank through the oil return port until the main leather cup blocks the oil return hole. After the main cup is pushed through the oil return port, the brake fluid in the front chamber of the master cylinder is compressed and the check valve is opened to flow to the slave cylinder through the brake pipeline. In this way, the piston of each slave cylinder extends outward to make the brake shoe friction plate contact with the brake drum to achieve the effect of deceleration or braking. At this time, the piston rear chamber is supplemented by brake fluid from the oil return port and oil inlet port. When the brake pedal is released, the piston is pressed back by the return spring. At the same time, the brake fluid in each brake wheel cylinder is also compressed by the return spring of the moving shoe, so that the brake fluid returns to the master cylinder (piston front chamber) through the one-way valve, the piston returns to its original position, and the brake fluid in the master cylinder flows back to the oil storage tank through the return port. The pressure of the check valve is adjusted to a certain proportion to the residual pressure in the brake pipeline and the brake wheel cylinder, so that the leather cup of the wheel cylinder is correctly placed to prevent oil leakage and eliminate the possible air resistance during emergency braking.

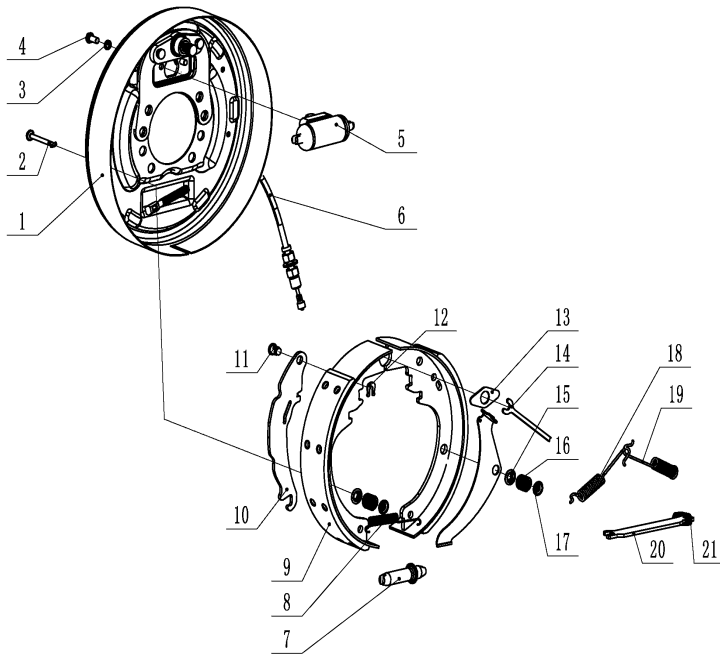


- |               |                      |               |                 |
|---------------|----------------------|---------------|-----------------|
| 1.Lock nut    | 2.Push rod           | 3.Dust cover. | 4.Lock wire     |
| 5.Lock washer | 6.Auxiliary seal cup | 7.Piston.     | 8.Main seal cup |
| 9.Spring.     | 10.Check valve       | 11.Seat.      | 12.Pump body    |

Figure Brake master cylinder

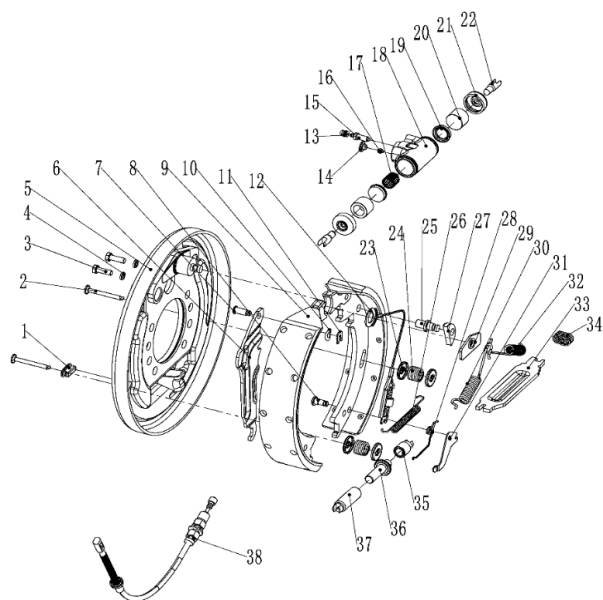
#### 4-6-4 Brake

The brake is a double shoe brake, which is installed on both sides of the drive axle. The brake consists of two sets of brake shoes, brake cylinder and regulator. One end of the brake shoe is in contact with the fixing pin and the other end is in contact with the adjusting device. Press the parking brake part against the return spring and pressure spring rod. In addition, the brake is also equipped with a parking brake mechanism and an automatic adjusting device.



Brake(25-28)

NO.	Name	QTY	Remark
1	Brake base plate assembly 23653-73011	1	Bilateral symmetry
1	Brake backing plate assembly (right)	1	
2	Spring tension rod 23653-72101	4	
3	Spring washer GB93-6	2	
4	Bolt GB5782-M8x16	2	
5	Brake wheel cylinder assembly 22373-72041	1	
6	Brake cable assembly OC11246-14603	1	Bilateral symmetry
6	Brake cable assembly right OC11246-24603	1	
7	Clearance adjuster 23653-72041	1	
8	Spring 23653-72051	1	
9	Friction plate assembly 23653-73021	2	Bilateral symmetry
9	Friction plate assembly (right)	1	
10	Hand brake rod 23653-72071C	1	Bilateral symmetry
10	Hand brake rod (right)	1	
11	Support pin 22673-72231	1	
12	Elastic gasket 24433-70160G	1	
13	Gasket 23653-72131	1	
14	Push rod 23653-7261	1	
15	Pressure spring seat 23653-72121	4	
16	Spring 23653-72091	4	
17	Spring compression cover 23653-72111	4	
18	Return spring 23673-72261	1	
19	Tension spring 2353-72171	1	
20	Hand brake push rod 23653-72081	1	Bilateral symmetry
20	Hand brake push rod (right)	1	
21	Compression spring 23673-72391	1	



Brake(30-35)

NO	Name	QTY.	Remark
1	Rubber plug 24433-70040G		
2	Spring tension rod 24433-70010G		
3	Bolt M8 × one point two five × 20GB/T5783-2000		
4	Spring washer GB93-6		
5	Brake base plate assembly (left) 24433-7200G		Bilateral symmetry
5	Brake backing plate assembly (right)		
6	Hand brake rod (left) 24433-70140G		Bilateral symmetry
6	Hand brake rod (right)		
7	Pin 2 24433-70150G		
8	Pin 1 24433-70110G		
9	Brake shoe with friction plate assembly (left) 24433-71000G		Bilateral symmetry
9	Brake shoe with friction plate assembly (right)		
10	Elastic gasket 24433-70160G		
11	Rod pin retainer 24433-70170G		
12	Spring cable device 24433-73000G		
A	Brake wheel cylinder assembly		Contains NO.13 to 22
13	Cylinder bleed screw cap 24433-76100G		Not available separately
14	Thread protection plug 24433-76080G		Not available separately
15	Cylinder bleed screw 24433-76090G		Not available separately
16	Brake wheel cylinder oil plug 24433-76070G		Not available separately
17	Cylinder spring 24433-76040G		Not available separately
18	Brake wheel cylinder 24433-76010G		Not available separately
19	Cylinder cup 24433-76030G		Not available separately
20	Cylinder piston 24433-76020G		Not available separately
21	Cylinder shield 24433-76050G		Not available separately
22	Cylinder piston rod 24433-76060G		Not available separately
23	Pressure spring seat 24433-70020G		
24	Compression spring 24433-70030G		
25	Pin 4 24433-70801		
26	Tension spring 24433-70050G		



27	Guide block 24433-70080G		
28	Torsion spring (left) 24433-70090G		Bilateral symmetry
28	Torsion spring (right)		
29	Guide plate 24433-70060G		
30	Return spring (II) 24433-70070G		
31	Pawl (left) 24433-70100G		Bilateral symmetry
31	Pawl (right)		
32	Return spring (I) 24433-70010G		
33	Push rod (left) 24433-70120G		Bilateral symmetry
33	Push rod (right)		
34	Push spring 24433-70130G		
35	Clearance adjusting rod 24433-74040G		
36	Clearance adjusting screw (left) 24433-74020G		Bilateral symmetry
36	Clearance adjusting screw (right)		
37	Clearance adjusting sleeve 24433-74010G		
38	Brake cable assembly 24433-77010G		L=1270
38	Brake cable assembly (right)		R=1790

### (1) Brake action

The brake wheel cylinder presses the brake drum with the same force as the main brake shoe and the secondary brake shoe until the upper end of the secondary brake shoe is against the fixed pin, and the brake shoe moves towards the rotation direction of the brake drum. After holding the fixed pin, the friction force between the friction plate and the brake drum increases. Because the main brake shoe gives the auxiliary brake shoe a much greater pressure than the brake cylinder pressure, a great brake force is generated.

The brake action in reverse is the opposite of that in forward.

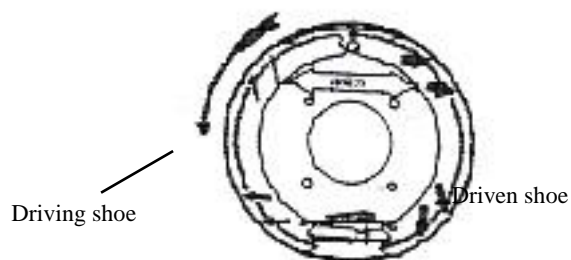


Figure forward action

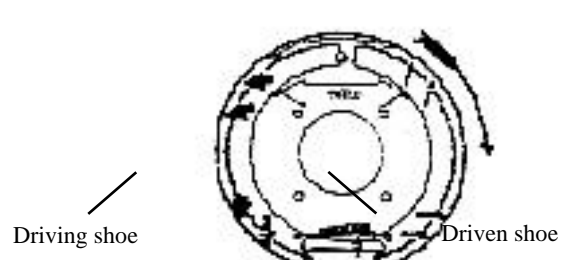


Figure backward action

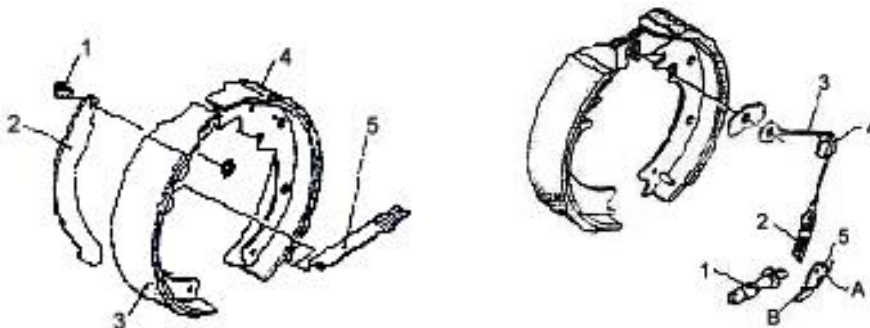
## (2) Parking brake

The parking brake device is assembled in the wheel brake and consists of a pull rod and a push rod. The pull rod is installed on the side of the main brake shoe by the pin and pulled

The action of is transmitted to one side of the auxiliary brake shoe through the push rod.

## (3) Clearance self-adjusting mechanism

The clearance self-adjusting mechanism can maintain proper clearance between the friction plate and the brake drum. The clearance self-adjusting mechanism only operates when reversing.



1.Pin	2.Pull rod	3.Driving shoe
4.Driven shoe	5.Strut	

1.Regulating mechanism	2.Spring	3.Inhaul cable
4.Guide slot	5.Pull rod	

## (4) Action of clearance automatic adjustment mechanism

When the forklift is backing up, brake operation is carried out. The auxiliary brake shoe contacts with the main brake shoe and rotates together to make the pull rod turn right around point a, as shown in the figure, point B is raised. After the brake is released, the pull rod turns left under the action of spring force, and point B drops. When the clearance between the friction plate and the brake hub becomes larger, the vertical distance of point B rotation increases, the adjuster is moved by a tooth, the adjusting rod becomes longer, and the clearance decreases accordingly. The clearance adjustment range is 0.40mm-0.45mm.

#### 4-6-5 Parking brake control

The parking brake handle is cam type, and the brake force can be adjusted by the adjuster located at the end of the brake handle.

Adjustment of braking force: turn the adjuster clockwise to increase the braking force; turn the adjuster anticlockwise to reduce the braking force.

Tensile force: 196N ~ 294N.

Elongate in this direction

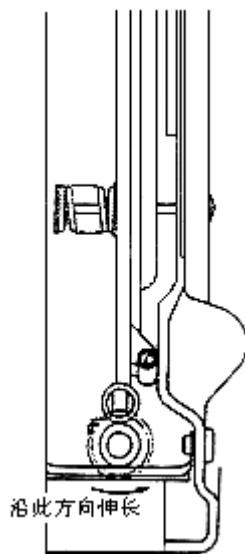


Figure Clearance self-adjusting mechanism

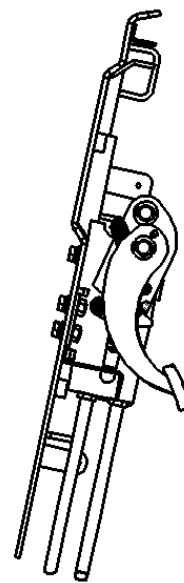


Figure Parking brake pedal

#### 4-6-6 Key points of brake disassembly and adjustment

When the wheel and hub are disassembled, the disassembly, assembly and adjustment of the brake and the adjustment method of the brake pedal.

##### 1. Brake disassembly

(1) Remove the support pin, adjusting rod, adjusting device and spring on the auxiliary brake shoe.

(2) Remove the shoe return spring.



(3) Remove the fixed spring from the main brake shoe.

(4) Remove the main brake shoe and auxiliary brake shoe. Remove the adjuster and adjuster spring at the same time.

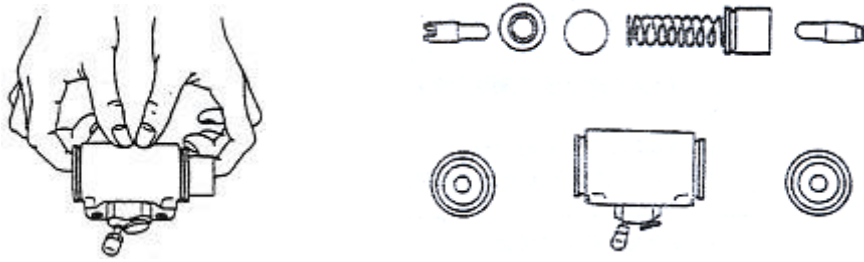


(5) Remove the brake pipe from the brake cylinder. Then remove the mounting bolts of the brake cylinder and remove the brake cylinder from the brake base plate.

(6) Remove the E-ring used to fix the brake cable on the brake base plate. Then remove the bolts that install the brake base plate, and remove the brake base plate from the drive axle.



(7) Disassemble the brake cylinder: remove the dust ring. Press one side of the piston to push out the other side of the piston, and then press this side of the piston with your fingers.



## 2. Brake inspection

Inspection of all parts, repair or replacement of damaged parts.

(1) Check whether there is rust on the inner surface of the cylinder and the outer circumference of the piston; then measure the clearance between the piston and the pump body.

Standard size: 0.03mm-0.10mm; limit size: 0.15mm

(2) Visually check whether the piston cup is damaged and deformed, and replace it if there is any abnormality.

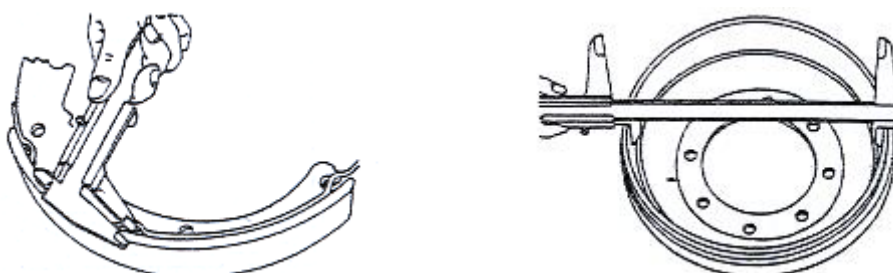
(3) Measure the free length of the brake cylinder spring, and replace it when it exceeds the reference.

(4) Measure the thickness of the friction plate and replace it when it exceeds the wear limit.

Standard value: 8.0mm; limit value: 2.0mm

(5) Visually inspect the inner surface of the brake drum. If there is damage or partial wear, grind it for correction. If it exceeds the correction limit, replace it.

Standard value: 314mm; limit value: 316mm.

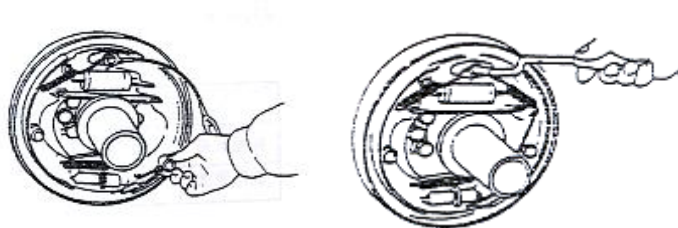


### 3.Brake assembly

- (1) Apply brake fluid on the cup and piston of the brake cylinder, and assemble the spring, piston cup, piston and anti-ring in sequence.
- (2) Install the brake cylinder on the brake base plate.
- (3) Install the brake base plate on the drive axle.
- (4) Apply heat-resistant grease all over as shown in the figure.

**Be careful not to apply it to the friction plate.**

- (a) the contact surface between the base plate and the brake shoe;
  - (b) fixing pins;
  - (c) the contact surface between the shoe and the spring seat;
  - (d) hand brake pull rod support pin;
  - (e) adjusting mechanism threads and other rotating parts.
- (5) The parking brake cable is clamped with E-shaped retaining ring.
  - (6) Install the brake shoe with the fixed spring.
  - (7) Install the compression spring onto the hand brake push rod, and then install the push rod onto the brake shoe.

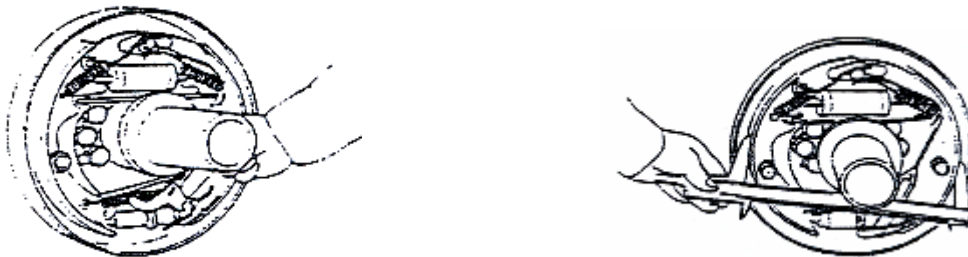


- (8) Install the brake shoe guide plate onto the support pin, and then install the brake shoe return spring. Install the main shoe first, then the auxiliary shoe. As shown in Figure 2-28
- (9) Install the adjuster, adjuster spring, ejector rod and ejector rod return spring. Note the following:

- (a) The thread direction of the adjuster and its installation direction;
- (b) Adjuster spring direction (the adjuster teeth are not allowed to contact with the spring);
- (c) The direction of the return spring of the ejector pin (the spring hook at the end of the support pin shall be fixed on the opposite side of the ejector pin);
- (d) The lower end of the adjusting lever must be in contact with the tooth part of the adjuster.

(10) Connect the brake oil pipe to the slave cylinder.

(11) Measure the inner diameter of the brake drum, the outer diameter of the brake shoe and adjust the regulator so that the difference between the inner diameter of the brake drum and the outer diameter of the brake shoe friction plate is 0.3mm-0.5mm



#### 4.Operation test of automatic gap adjuster

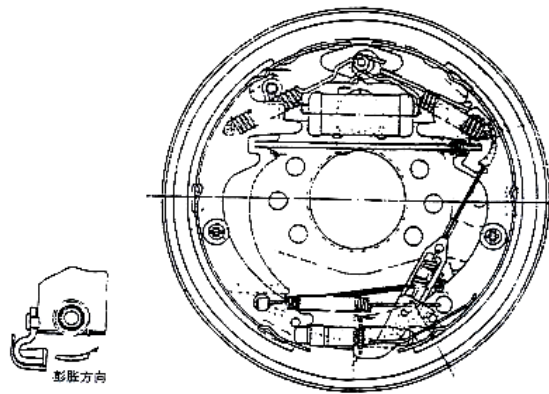
(1) First, make the diameter of the brake shoe close to the specified installation size, and pull the adjusting lever by hand to make the adjuster rotate. When the hand is released, the adjusting lever returns to its original position, while the adjuster gear does not rotate.

Note: the adjuster can work normally even when the hand is released and the adjuster gear returns together with the adjusting lever.

(2) If the adjuster fails to do the above actions when pulling the adjusting lever, the following inspection shall be carried out:

(a) Install the adjustment lever, top bar, top bar spring and compression spring seat firmly;

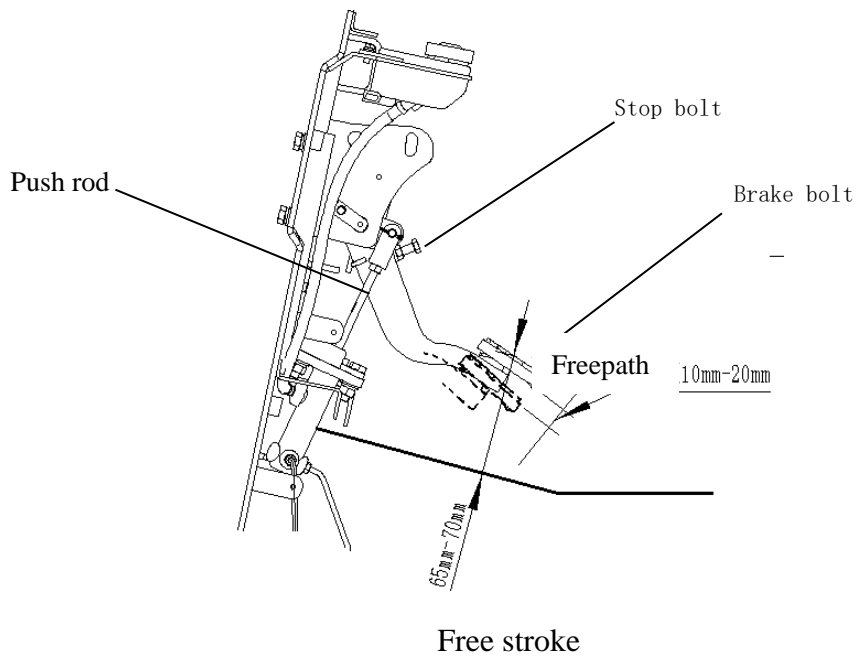
(b) Check whether the ejector return spring and adjuster spring are damaged, and then check whether the rotation of adjuster gear and its engagement part are excessively worn or damaged. Check whether the lever is in contact with the gear. Replace damaged parts.



#### 4-6-7 Brake pedal adjustment

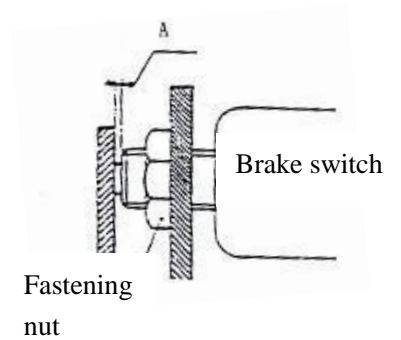
- (1) Shorten the push rod;
- (2) Adjust the pedal stop bolt and the pedal height;
- (3) Lengthen the push rod until the front end of the push rod contacts with the piston of the master cylinder, and then return 1-2 turns to ensure the free stroke of the pedal is between 10 mm and 20 mm;
- (4) Lock the push rod nut and pedal stop bolt nut.





#### (5) Adjustment of brake switch

- (a) After the height of the brake pedal is adjusted, loosen the lock nut of the brake switch;
- (b) Pull off the plug to separate the wire;
- (c) Turn the switch so that the clearance  $A = 1\text{mm}$ ;
- (d) Make sure that the brake light is on when the brake pedal is depressed;
- (e) Finally lock the nut.



## 4-6-8 Fault analysis and troubleshooting

Problem	Cause analysis	Exclusion method
Poor braking	1 Brake system oil leakage	repair
	2 Brake shoe clearance not adjusted	Regulator
	3 Brake overheating	Check for slipping
	4 Poor contact between brake drum and friction plate	Resetting
	5 Impurities attached to friction plate	Repair or replace
	6 Impurities mixed into brake fluid	Check brake fluid
	7 Improper adjustment of brake pedal (micro valve)	adjustment
Brake noise	1 The surface of friction plate is hardened or foreign matters adhere to it	Repair or replace
	2 The base plate is deformed or the bolt is loose	Repair or replace
	3 Brake shoe is deformed or installed incorrectly	Repair or replace
	4 Friction plate wear	replace
	5 Loose wheel bearing	Repair or replace
System move No all	1 Oil stain on the friction plate surface	Repair or replace
	2 Brake shoe clearance not adjusted	Regulator
	3 Sub pump failure	Repair or replace
	4 Brake shoe return spring damaged	replace
	5 Brake drum deflection	Repair or replace
System move No Power	1 Brake system oil leakage	Repair or replace
	2 Brake shoe clearance not adjusted	Regulator
	3 Air in the brake system	Deflation
	4 Brake pedal is not adjusted correctly	Resetting

## 4-6-9 Maintenance and service

① Before running in test, the new drive axle shall be filled with gear oil (the selection of gear oil shall be strictly in accordance with the specification, and the specific model shall refer to table 2-1). Oil shall be injected from the oil filling hole on the upper part of the axle housing until oil overflows from the oil level hole in the middle of the axle housing.

② The thickness of the friction plate on the brake shoe is 8mm. The minimum thickness allowed is 2mm. These two parts are key parts of the brake system, which shall be checked once a month. If excessive wear is found, it shall be replaced in time to avoid accidents.

③ Technical maintenance every 50h:

I. After the new bridge works with the main engine for 50h, the gear oil shall be replaced.

When changing oil, clean the bridge and add new oil.

II. Check the fastening of each fastener. If it is loose, fasten it immediately.

III. Check whether there is oil leakage at the connection between the wheel half shaft and the hub. If there is any leakage, reapply the sealant.

④ Monthly technical maintenance:

I. check the wear condition of brake drum to see if there is destructive wear.

II. Check the wear condition of the brake shoe. When the wear has not met the use requirements, replace it immediately.

III. Check whether the oil level of the axle housing meets the requirements. If the oil level drops, make up in time.

⑤ Technical maintenance every half a year: replace the gear oil in the bridge every half a year.

⑥ Annual technical maintenance: the work shall be disassembled and inspected for one year.

⑦ Requirements for inspection and commissioning items during installation:

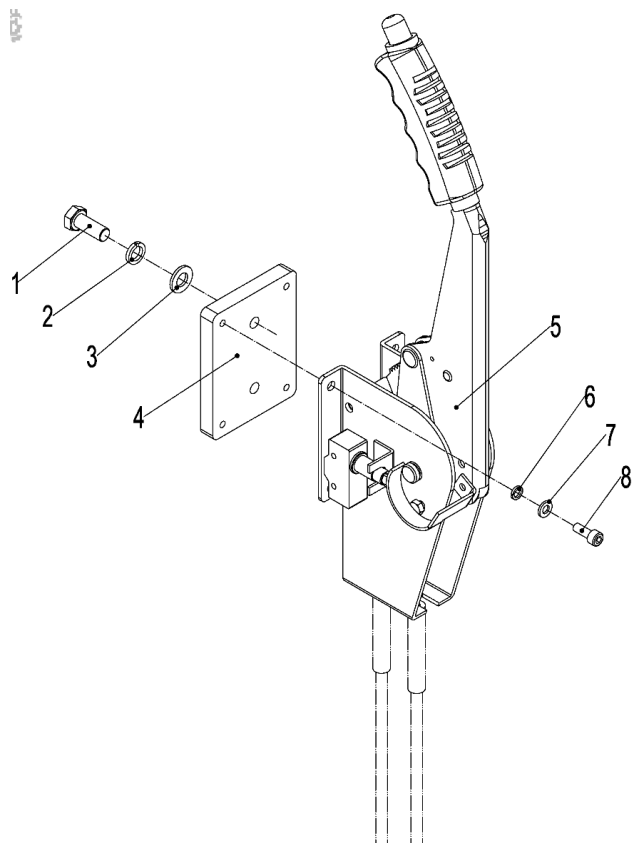
When reinstalling the drive axle hub, pay attention to adjusting the brake clearance adjuster so that the clearance between the brake drum and the friction plate is between 0.3mm and 0.5mm. The tapered roller bearing on the hub shall be filled with about 100ml of 3 × lithium grease.

Adjustment of wheel hub bearing clearance: tighten the lock inner nut until the wheel hub brake drum can only barely rotate. Then turn the lock inner nut backward by 1 / 8 turn. At this time, the hub brake drum shall be able to rotate freely without jamming, obvious axial clearance and yaw. Then assemble the lock washer, and finally lock it with the lock outer nut.

## 4-7. Parking brake

### 4-7-1 Appearance and specifications

100%



NO.	Name	QTY
1	Bolt GB5783-M10x20-8.8	2
2	Spring washer GB93-10	2
3	Flat washer GB97.1-10-200HV	2
4	Backing plate (hand brake)	1
5	Hand brake assembly	1
6	Flat washer GB97.1-6-200HV	4
7	Spring washer GB93-6	4
8	Bolt GB5783-M6x16-8.8	4

## 4-7-2 How does it work

For this model, the parking brake is built into each drive shaft. Once the operator pulls the lever, the cable assembly pulls the brake lever, which in turn presses the brake piston and the resilient disc. This causes the compression discs to produce friction braking forces in the drive shaft. In this case, all rotating parts in the drive shaft are no longer able to move, thus keeping the drive wheel stationary. And once the lever is pushed back, the cable no longer pulls the lever, releasing the brake. In addition, the parking brake switch is installed behind the lever. The switch opens when the lever moves to engage the parking brake and closes when the lever moves to release the brake.

## 4-7-3 Parking brake test

### Warning

If the parking brake is not properly adjusted, the vehicle rolls over, resulting in a dangerous situation:

If the parking brake fails during this process, be prepared to operate the driving brake.

1. Place rated load capacity on fork
2. Tilt the vehicle up 15%.
3. Stop the forklift with the service brake at the half of the tilt, and the brake will automatically engage as the parking brake.

4. If the parking brake has been adjusted correctly, the vehicle shall remain stationary

If the vehicle descends, refer to Section 4-8-4 parking brake failure exclusion.



## 4-8. Troubleshooting

### 4-8-1 Driving 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. Check all cells for one or more defective cells. Check the specific gravity of each cell. The maximum density difference from the highest battery to the lowest battery shall not exceed. 020 SG (specific gravity)
	Incorrect operation of the control panel: Refer to "2-3-5 motor controller test" and "2-7 diagnosis / calibration / troubleshooting".
Drive motor does not work	Encoder failure.
Traction does not operate during normal operation, but hydraulic operation is normal	The brake is defective, resulting in excessive resistance. The increase in heat causes the motor to stop running. Check the brake adjustment.
	There is too much heat in the control panel for the following reasons: Overweight traction load: reduce duty cycle load. Bay thermal sensor failure: refer to "Section 2-7 in display panel Handling fault on ". These may cause the drive motor to fail, Control panel faulty or drive fuse open
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	The battery is dirty and the electrolyte is on the top of the battery and in contact with the frame. The current flows through the battery box, which applies voltage to the forklift frame: clean the battery with baking soda and water solution.
	Battery or control panel wire connection in contact with forklift frame: Carry out continuity test and move wire contact. Remove the wires in sequence until the fault is cleared. The fault will be disconnected at the end of the wire
	Dirty motors:
	Wet motor:
Forklift does not reach the maximum speed	The battery is not fully charged or poor: Charge the battery. Check the single battery. If necessary, replace the single battery.
	Faults in drive motor, control panel or drive train: Check the forklift speed in both directions. If you need to adjust the control panel, adjust it according to the corresponding section of "Section 2 electrical system". If the drive motor fails, test the motor assembly
Slow acceleration of forklift	Drive control overheating, temperature sensing switch on. Note: if the temperature is 145 ° C (293 ° f), the thermal switch will give a warning.

## 4-8-2 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.
	Incorrect oil level: Meet the correct oil level
	Foreign matter (water) introduced into oil: Replace the oil.
	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.



	Damaged mounting surface: After removal, readjust or replace the components.
	O-ring damage: Replace the O-ring.
Hub leakage	Damaged oil seal: Oil seal replacement
	O-ring damage: Replace the O-ring.
Input shaft leakage	Damaged oil seal: Replace the oil seal.
	Motor O-ring damaged: Replace the motor O-ring.
	Damaged motor mounting part or housing: Replace the components.
Air respirator leakage	Too much oil: Meet the correct oil level
	Air respirator damaged: Clean or replace vent
	Use non-standard oil: Replace the oil with standard oil.
Brake disc pack leakage	Brake seal damaged: Replace sealing ring
	Brake seal not installed correctly: Reinstall or replace the seal.
	The sliding parts of the brake seal (damaged shaft, bearing seat or piston): Replace damaged components.
	The outer particles are placed on the sliding parts of the seal: Clean sliding parts and master cylinder and replace them if damaged parts are found
	Material or oil passage damage: Replace damaged parts
	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.

### 4-8-3 Service brake

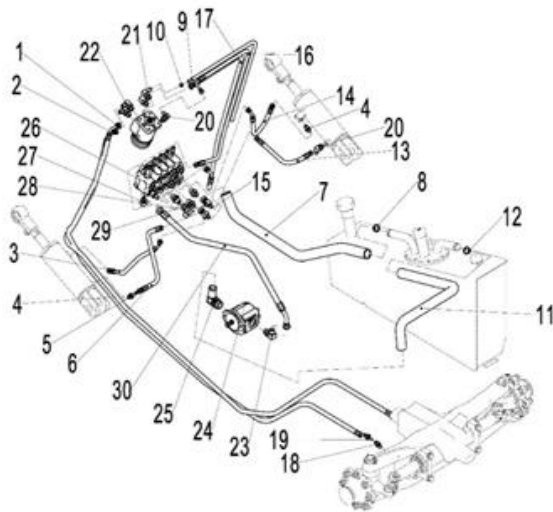
Problem	Possible causes
Pedal resistance is not firm (spongy)	Leakage or low level
	Air in the brake hydraulic system.
	Master cylinder loosening
Too much pressure of pedal when braking	Mechanical resistance on the brake pedal.
	Limit the brake lines.
	Bad master cylinder
Pedal towards the floor	Leakage or low level.
	Bad master cylinder.
Excessive pedal travel	Incorrect pedal adjustment.
	Leakage or low level
	Air in the brake hydraulic system.
	Bad master cylinder.
Brake not applicable	Leakage or low level.
	Air in the brake hydraulic system.
	The linkage is not adjusted correctly or bent.
	There is oil or brake fluid on the brake disc.
	Bad master cylinder.
Uneven braking or roughness (flutter) during braking	There is oil or brake fluid on the brake disc.
	There is poor contact between the steel plate and the friction plate.
	Uneven (uneven) brake discs
	Pressure plate bearing loose
	Broken disc and friction disc assembly

### 4-8-4 Parking brake

Problem	Possible causes
Brake not engaged	The parking brake is not adjusted correctly.
	The parking brake cable is not adjusted correctly.
	The brake disc is too worn

## 5. Hydraulic system

### 5-1. Overview



#### 5-1-1 Component

NO.	Name	QTY	Remark
1	Hydraulic Tube Assembly (Extraordinary)8-L3000-1SC-60°	1	
2	Hydraulic Tube Assembly (Extraordinary)8-L2500-1SC-60°	1	
3	Hydraulic Tube Assembly (90°)6-L750-1SC-60°	1	
4	Connector (straight)6-G1/4 M14X1.5-60 °	3	
5	O-ring - inside 11.2x2.65	4	
6	Hydraulic Tube Assembly (90°)6-L700-1SC-60°	1	
7	Rubber hose (return oil)	1	
8	Hose hoops QC/T390 - - 38 (34)	4	
9	Return oil hose 23X5	2560 (mm)	Unit is mm
10	Hose hoops QC/T390 - (22-26),	2	
11	Rubber hose (oil absorption)	1	
12	Hose hoops QC/T390 - (40-45)	2	
13	Hydraulic Tube Assembly (135°)6-L450-1SC-60°	1	
14	Hydraulic Tube Assembly (Straight)6-L600-1SC-60°	1	
15	Connector (tee) 7-2XM14X1.5 - M16X1.5 -60°	2	
16	Hydraulic Tube Assembly (90°)6-L1320-1SC-60°	1	
17	Hydraulic Tube Assembly (90°)8-L1320-1SC-60°	1	
18	Connector (straight) 8-2XM16X1.5-60 °	2	
19	O-ring - inside 13.2x2.65	2	
20	Connector (lock bend)6-G1/4 M14X1.5 -60°	2	
21	Connector (lock bend)11-M20x1.5-0	1	
22	Connector (lock bend) 10-M20X1.5 - M16X1.5 -60°	3	
23	Connector (lock bend)12-G1/2- M22X1.5 -60°	1	
23	Connector (lock bend)25-M33X2--Φ33	1	
24	Gear pump	1	
24	Gear pump	1	
24	Gear pump	1	

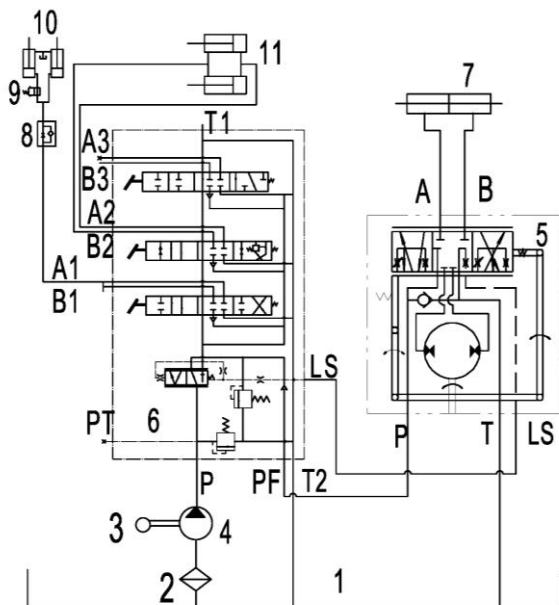
25	Joint (to bend) 25 - G1 - $\Phi$ 32	1	
25	Joint (to bend) 15-M27x2-M22x1.5-60°	1	
26	Connector (straight) 12-2XM22X1.5 -60°	1	
27	Connector (lock bend) 6-M12X1.5 - M14X1.5 -60°	1	
28	Connector (lock bend)12-M20x1.5-M22x1.5-60°	1	
29	Connector (straight) 8-M20X1.5 - M16X1.5 -60°	1	
30	Hydraulic Tube Assembly (90°)13-L2600-2SC-60°	1	

The hydraulic system operates multiple brakes with pressurized oil from the main hydraulic pump and draws oil from these actuators.

- 1.The main hydraulic pump is driven by the pump motor controlled by the controller.
- 2.The main hydraulic pump uses the rotating force output from the motor to pressurize the oil in the hydraulic tank and send the oil to the priority valve.
- 3.The priority valve determines which device is preferred between the steering and the control valve, and then supplies most of the pump oil to the priority valve.
- 4.The hydraulic tank stores the hydraulic oil that is returned from the actuator. The stored oil is drawn in by the main hydraulic pump for reuse.

## 5-2. Pump motor

### 5-1-2 hydraulic schematic diagram



- |                       |                       |                      |                         |
|-----------------------|-----------------------|----------------------|-------------------------|
| 1. Hydraulic oil tank | 2. Oil suction filter | 3. Pump motor        | 4. Gear pump            |
| 5. Steering gear      | 6. Multi way valve    | 7. Steering cylinder | 8. Speed limiting valve |
| 9. Shut off valve     | 10. Lifting cylinder  | 11. Tilt cylinder    |                         |

### 5-2-1 How does it work

The pump motor electrically transfers power to the main hydraulic pump for pumping hydraulic oil to operate the hydraulic system.

The pump motor is connected to the pump motor controller through U, V and W lines. The controller operates the pump motor based on inputs from multiple switches and sensors and internal parameter settings.

The pump motor operates when the following conditions are met:

The key switch is on.

With the operator seated, the seat switch is on.

One of the hydraulic control switches, the F/ R switch or the accelerator switch signals the controller. Turning the F/ R switch to forward or reverse will trigger the pump motor to run at idle for 6 seconds. It then goes into PP mode to stop unless it's in six seconds

The clock signals from the accelerator. To restart the pump motor, the operator shall return the F/ R switch to neutral before switching it forward or backward, or move one of the hydraulic levers to turn on the corresponding switch.

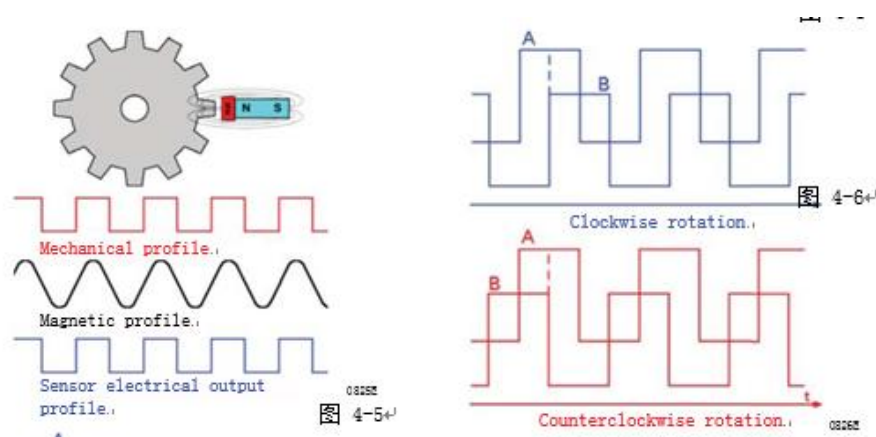
#### Motor speed detection (encoder operation)

The pump motor is equipped with an encoder, which is used as the speed sensor of the motor. The controller analyzes the amplitude of the pulse to calculate the speed of the motor. The smaller the amplitude, the higher the speed of the motor.

Like other sensors, the encoder generates the main signal (signal a) and the reference signal (signal B) through two hole sensors. As shown in Figure 4-6, the sequence of the generated signals varies according to the direction of rotation.

#### Overheat protection (thermal sensor operation)

The pump motor is equipped with a thermal sensor to prevent overheating. Once the motor is heated to 145 °C(293 °F), an overheat alarm is activated and the motor's performance is limited.



## 5-2-2 Pump motor and main hydraulic pump removal / installation

1. Remove the counterweights first



2. After the counterweight is removed, remove the pump motor U V W cables



3. Remove the hydraulic tubing



4 Remove the fixing screw , the motor can be removed

## 5-3. Main hydraulic pump

### 5-3-1 How does this work

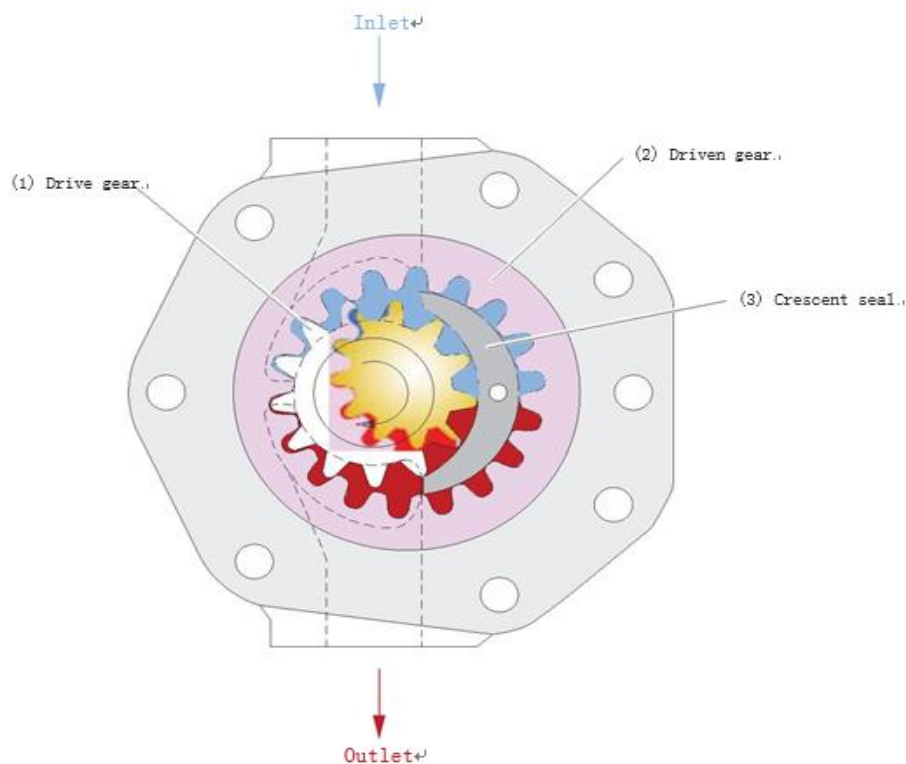


Figure 4-13

This model uses internal gear pump as its main hydraulic pump. The internal gear pump includes a driven gear (2) [external gear] and a driving gear (1) [internal gear], as shown in the figure. The volume of the meshing area between the driving gear and the driven gear increases as they rotate and draw oil. The suction cage is then placed between the teeth of the two gears and the crescent seal (3) (the bright area in the figure) and brought to the outlet as the volume of the gear engagement area decreases. The high pressure chamber (discharge) and the low pressure chamber (suction) are sealed by a crescent seal (3). Theoretically, the internal gear pump has less pulsation than the external gear pump.



## 5-3-2 Disassembly and assembly

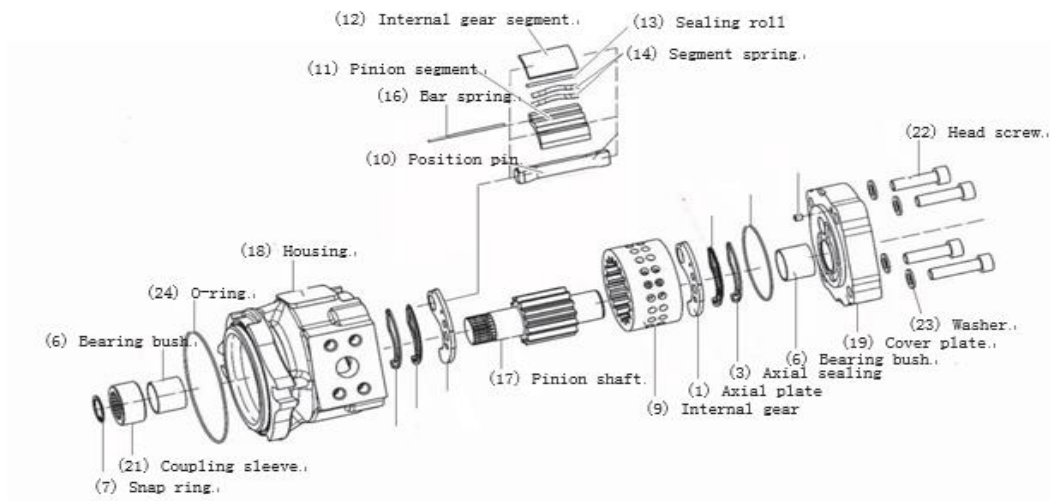
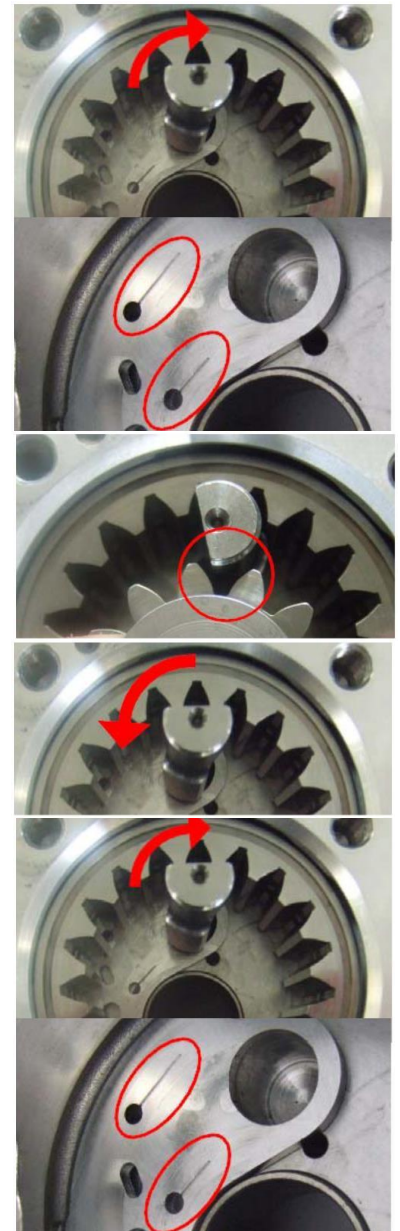


图 4-14

### Disassemble

1. Loosen and remove the 4 screws (pos.22) on the cover plate (pos.19).
  2. Carefully remove the cover plate (pos. 9) from the housing (pos. 18).
  3. Remove the shaft plate II (2), pinion shaft (17), rod spring (16), segment (11,12), segment spring (14,15) and sealing roller (13). Note the position of the pinion shaft (17), which may be locked by the locating pin (10), as shown.
  4. Remove the inner gear (9), rotate the locating pin (10) by about 90 °. After that, pull out the locating pin (10).
  5. Remove shaft plate I (1)
- Below are the backup ring (4) and the axial seal (3).



### Parts

- (1) Make sure that the axial seal (3) and the left support ring (4) are in good condition in the machined groove. The groove of shaft plate I (2) must be upward as shown in the figure.
2. Install the dowels (10) first, as shown. Then place the inner gear (9) and turn the locating pin (10) about 90 °
3. Install the pinion shaft (17) and make sure it is not obstructed by the dowels (10), as shown.
4. Install the pinion Section (11) and the internal gear Section (12). Make sure that the side of the inner gear segment (12) with two bevels is shown on top of the pinion segment (11) (green mark).

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

6. Place the section spring II (15) so that the 2 bows are pressed on the sealing roller, as shown in the figure.

7. Install in the same way as the bow against the inner gear segment (12

8. Install shaft plate II (2) close to the housing or damage to the bearing bush (6) hydraulic system in the cover plate (19

9. Check the green O-ring (20) and check the position on the cover plate (19). Install the flexible axial seal (3) first, then the right-hand ring (5). It is helpful to cover the axial seal (3) and the right backup ring (5) with grease, which makes assembly easier.

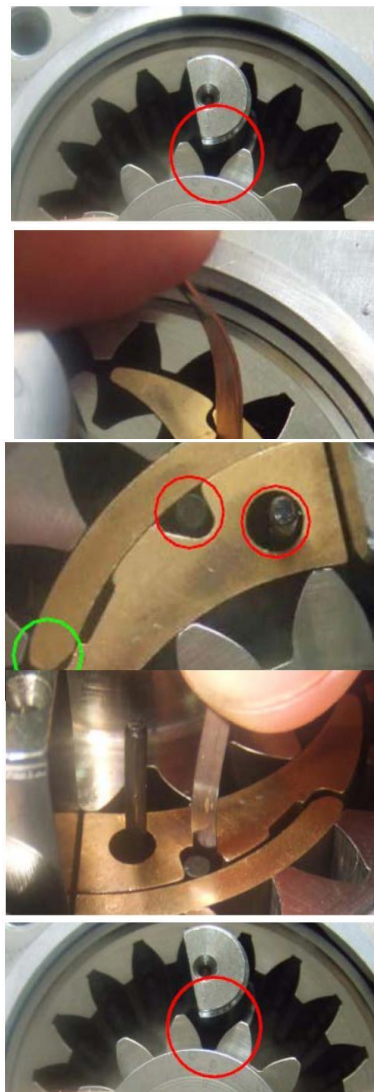
The straight pins must be located in the cover plate (19) or in the housing (18).

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

If the gap is greater than 0.6 mm (0.024 in), the axial plate or seal may slide, removing the pump again!

11. Tighten the four screws with 50 N m (37 LB ft).

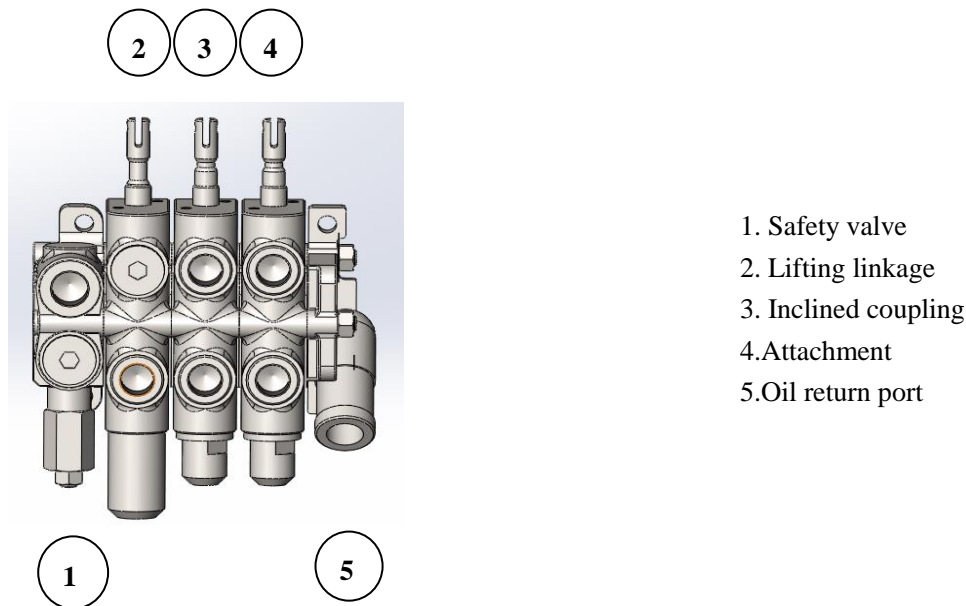
Note: if the pump is assembled correctly, the pinion shaft shall be able to turn by hand.



## 5-4. Multi-way and priority valves

### 5-4-1 Appearance and specifications

The multi-way valve adopts two-piece four body type. The hydraulic oil from the working oil pump is controlled by the multi-way valve stem to distribute the high-pressure oil to the lifting cylinder or tilt cylinder. There are safety valve and self-locking valve inside the multi-way valve. The safety valve is set on the upper side of the oil inlet of the multi-way valve to control the system pressure; The self-locking valve is set on the tilt valve plate, which is mainly used to prevent serious consequences caused by misoperation of the control lever of the tilt cylinder without pressure source. A check valve is installed between the oil inlet and the oil suction port of the lifting valve plate, and between the oil inlet of the lifting valve plate and the oil inlet of the tilt valve plate.



### 5-4-2 How does this work

The multi way valve adopts the two piece four body type. The hydraulic oil from the working oil pump is controlled by the multi way valve stem to distribute the high pressure oil to the lifting oil cylinder or the tilt oil cylinder. There are safety valve and self-locking valve inside the multi way valve. The safety valve is set on the upper side of the oil inlet of the multi way valve to control the system pressure; the self-locking valve is set on the tilt valve plate, which is mainly used to prevent serious consequences caused by wrong operation of the control rod in the case of no pressure source of the tilt cylinder. A check valve is installed between the oil inlet and the oil suction port of the lifting valve plate, and between the oil inlet port of the lifting valve plate and the oil inlet port of the tilting valve plate

The pressure of the main safety valve has been adjusted before delivery, and the user is not allowed to adjust and disassemble it at will.

The priority valve measures the hydraulic oil to the control valve and steering unit after receiving the oil from the main hydraulic pump, in order to always give priority to the steering system when steering is required.

Priority valve is mainly composed of steering safety valve, spring, valve core and valve body as shown in the figure. Its working principle is that port P is the oil inlet of the steering pump, port CF is connected with the oil inlet of the steering gear, port EF is connected with the oil inlet of the multi way valve of the working system, port LS is connected with the control port of the steering gear, and port t is the oil return port of the safety valve.

When oil is fed into port P, hydraulic oil is preferentially supplied to port CF through valve element 3. When the steering gear is not working, the CF port is in a closed state. At this time, the pressure of the LS port is zero, the right end of the valve core enters the oil, and the hydraulic pressure acts on the right end of the valve core. Overcoming the pre pressure of spring 2, the valve core moves to the left. At this time, the P port is connected with the EF port to realize the functions of lifting, tilting, side shifting, etc.

When the steering gear works, the CF port is connected with the steering cylinder through the steering gear, and the gear pump oil enters the steering cylinder first to realize steering

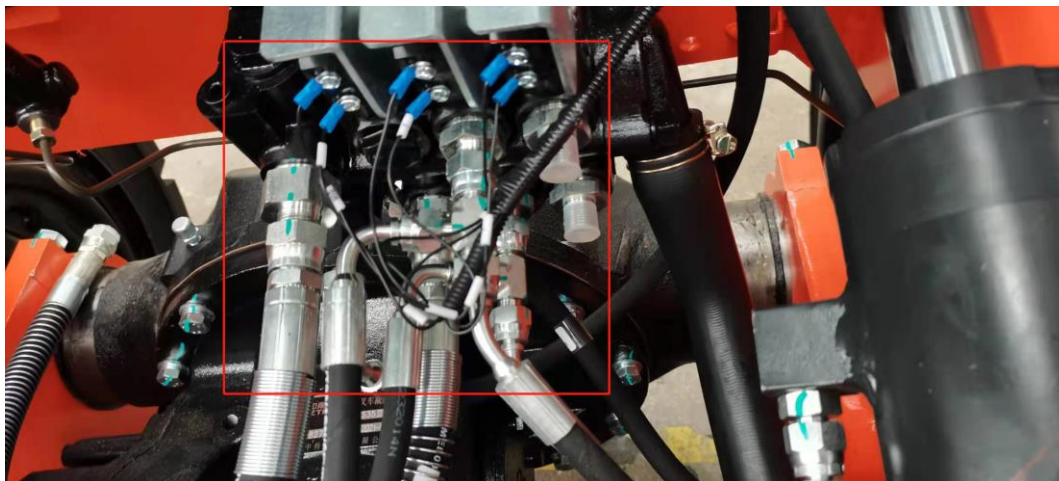


### 5-4-3 disassembly and assembly of multi way valve

1. Remove the connection between the control lever and the multi-way valve



2. Remove the connector and micro-switch



3. Remove the fixing bolts



## 5-5. Troubleshooting

### 5-5-1 Pump motor

Fault phenomenon	Possible causes
The hydraulic pump motor does not work.	Poor connection or blown fuse. Check the battery connections. Check the key fuse. Check whether the hydraulic pump motor may cause the fuse to blow.
	Key switch, seat switch or line contactor not closed. Turn off the seat and key switch. Use a multimeter to check the power flow through the seat switch, key switch, line contactor coil and line contactor. The key switch, seat switch and wiring connector must be turned off for the power steering function to operate.
	Insufficient voltage. Charge or replace the battery. Check all battery cells for one or more defective battery cells. Check the specific gravity of each battery cell. The maximum density difference from the highest battery to the lowest battery shall not exceed 0.020 SG (specific gravity). Check whether the cable terminal is closely matched with the battery terminal and the control panel connector. Check whether the wire inside the cable is broken.
	Incorrect operation of the lift and drive system.
The battery does not work continuously and completely	The battery installed on the forklift is too small. Study and question the use of forklift trucks in their full working conditions, select and purchase the appropriate battery capacity to understand the working hours.
	During the battery charging operation, the battery is not fully charged. Check whether the battery is evenly charged (charging makes the specific gravity of all batteries the same). Check the battery charger for defects.
	The charging interval of the battery is too long or the cooling time of the charging battery is too short. Reduce battery life. Before charging, please extend the cooling time of the battery before putting it into use.
	The battery has one or more defective battery cells, which may result in below rated capacity and battery capacity. Test and identify defective cells. Replace the defective battery. Battery cells are connected in series, one bad battery cell results in high resistance in series with other cells. This reduces the speed of the motor as the battery resistance increases. This can happen when other batteries are almost fully charged.
	The hydraulic system consumes too much battery power due to incorrect lift and tilt devices or hydraulic controls for the duty cycle. Reduce the hydraulic relief valve setting to the capacity required for the application. Replace with a smaller hydraulic pump (if any). Check the mast for restrictions during operation. Remove the quick disconnect and install the connection with less oil flow resistance. Check the defective hydraulic control valve and pilot relief valve. Remove any restrictions in the hydraulic circuit.
	Check for restrictions on movable hydraulic attachments. Check sliding parts, bearing wear, hinge binding and proper lubrication on necessary parts.

	<p>Hydraulic pump motor overheated.</p> <p>If the motor temperature reaches 155°C (311°F)</p> <p>The controller does warn of overheating and reduce performance.</p>
The hydraulic speed of forklift is very slow	<p>Pump motor control circuit overheated.</p> <p>If the temperature of the power unit reaches 100°C (212°F), the controller will display overheat warning and reduce performance.</p>

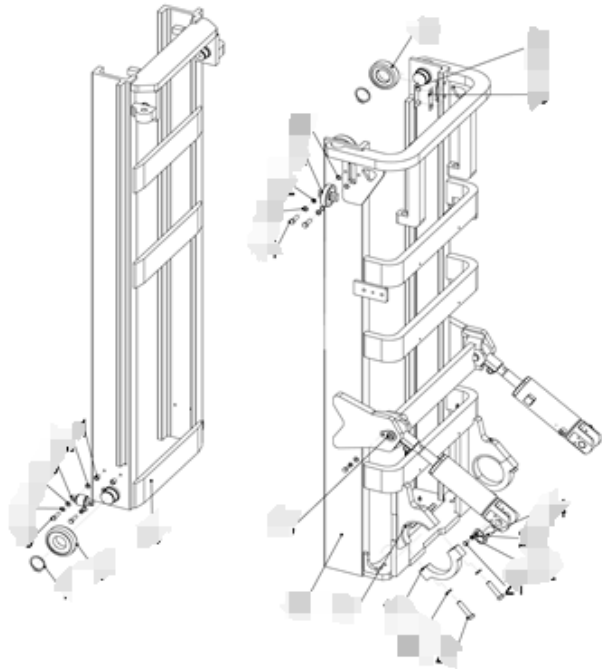
## 5-5-2 Main hydraulic pump

Fault phenomenon	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.
	Relief valve set too low.
	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. The relief valve is set too high. Restrictions in flow control valves, check valves and oil circuits.
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 pump or the shoulder of 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.

## 6. Lifting/tilting/auxiliary system

### 6-1. Overview

The lifting system is a two-stage roller type vertical lifting and shrinking system, which is composed of inner and outer door frames and fork frames



### 6-2. How to operate

#### A. Mast tilt

Mast tilt operation is performed by two double acting cylinders. In the case of each cylinder, one end is connected to the chassis of the vehicle and the other end to the side of the Mast.

#### Tilt forward

Push the tilt lever to move the tilt spool of the multi-way valve to send the hydraulic oil to the opposite chamber of each cylinder rod and extract the oil from the rod chamber. This causes the piston to push forward, tilting the front door frame mounted on the cylinder rod on the axis connected to the vehicle.

#### Tilt backward

Pull the tilt lever to move the tilt spool of the multi-way valve to send the hydraulic oil to the chamber of each cylinder rod and extract the oil from the opposite chamber. This causes the piston to be pushed back, tilting the rear mast mounted on the cylinder rod onto the connecting shaft to the vehicle.



## B. Standard Mast lifting

The standard (STD) Mast assembly uses two Mast and two single acting cylinder cylinders to lift the load. Rollers mounted on the inside and outside of the carriage and Mast respectively facilitate these up / down movements.

### Cylinder

After receiving the hydraulic oil from the lift part of the multi way valve, the rod of the standard oil cylinder stretches out to push the internal Mast upward. At the same time, the bracket is also pulled by the lifting chain, which is connected to the external Mast to lift together 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.

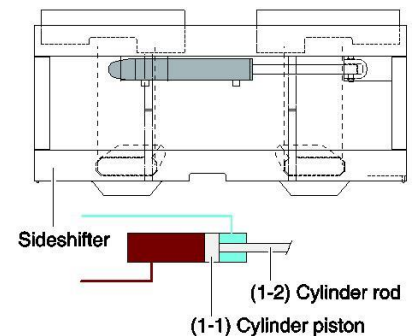
When the oil is drained, the cylinder rod and the attached inner Mast will retract.

When the inner Mast is lowered, the tension of the lifting chain will be relaxed and the bracket will also be lowered.

## C. Side shifter

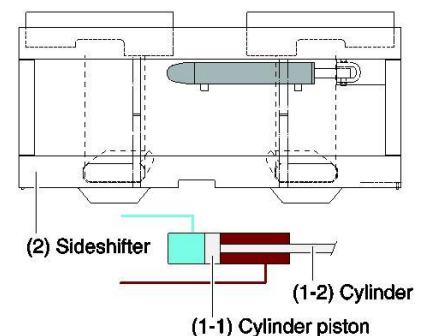
### Move to the right

Press down the sideshift rod to move the AUX1 valve element of the multiway valve to send the hydraulic oil to the left chamber of the cylinder piston (1-1) and recover the oil in the right chamber. This causes the piston (1-1) to push forward with the side-shifter (2) mounted on the piston rod (1-2) and also moves the fork attached to it to the right.



### Move to the left

Pull the side-shift lever to move the AUX1 spool of the multi-way valve to send hydraulic oil to the right chamber of the cylinder piston (1-1) and recover the oil in the left chamber. This causes the piston (1-1) to push back together with the Side-shifter (2) mounted on the piston rod (1-2) while moving the fork attached to it to the left.



## 6-3. Fork service

### A. fork inspection

The forks shall be checked at least every 12 months. If the forklift is used in multi shift or heavy work, it shall be checked every six months.

1. Check the fork carefully for cracks. Pay special attention to the heel (A), all welding areas and mounting brackets (B). Check hanging the top and bottom of the hook on the forklift use fork hook.

A cracked fork shall be replaced

2. Check the angle between the upper surface of the fork blade and the front surface of the fork shank.

If the angle (C) exceeds 93 degrees or deviates from 90 degrees the original angle is more than 3 degrees, the fork shall be stopped, such as some special apply the fork as shown in.

3. Check the upper surface of blade (D) and the front surface of handle (E) with straight edge.

The straightness of the deviation of straightness exceeds 0.5% of the blade length or the blade handle height is 5 mm / 1000 mm (0.18" / 3"), stop using the front fork.

4. When installing on the fork frame, check the connection between one fork tip and the other height difference. The difference of fork tip height may lead to uneven load support and cause entering the load problems.

The maximum recommended difference in fork height (F) is 6.5 mm for pallet fork (0.25 inch) and full tapered fork 3 mm (0.125 inch). Maximum allowable difference of the height for fork tip between two or more forks is 3% of blade length (L).

If the difference of fork tip height exceeds the maximum allowable difference, change one or two forks.

5. Check the front fork blade (J) and handle (H) for wear, especially pay attention to the heel (G). If the thickness is reduced to 90% of the original thickness or smaller, replace the front fork.

Fork blade length may also be reduced by wear, especially in the tapered fork and pressing plate. If the blade length is no longer as expected, replace the fork from service.

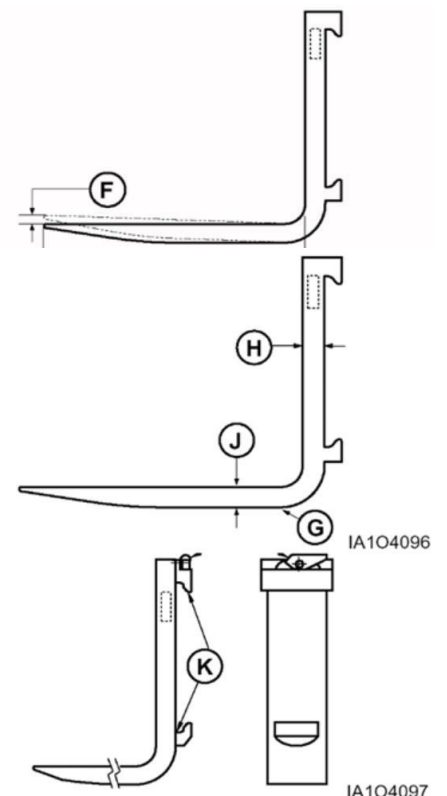
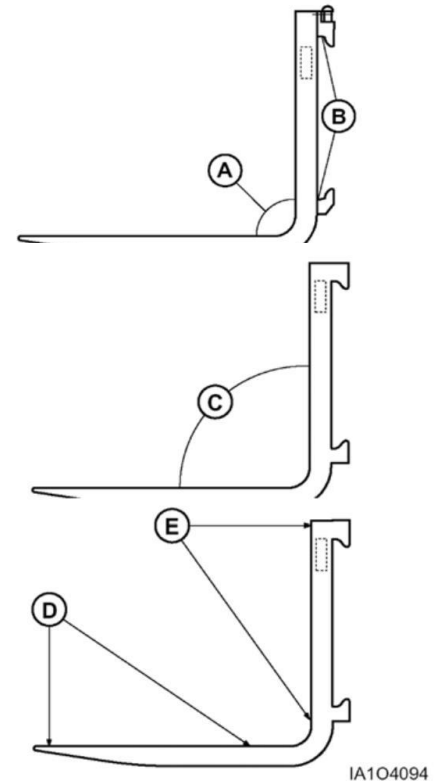
6. Check the fork frame (K) for wear, extrusion and other local deformation, this may cause excessive lateral swing of the fork. Cross on hook fork large gaps may cause them to fall off the carrier.

The fork showing obvious signs of damage shall be stopped.

7. Check the lock and other front fork fixings to ensure they are in place and work normally.

The hook yoke is engaged using a spring pin (M) located in the top hook notch in the top carrier bar to hold the fork in place.

When adjusting the front fork spacing, prevent the fork from sliding out of the carriage through the stop end. These stops are located at both ends of the carriage and at the bottom yoke in the path.



In some cases, a load backrest can be used extension instead of stops.

The shaft mounting fork can use any collar or gasket on the shaft to the fork one side.

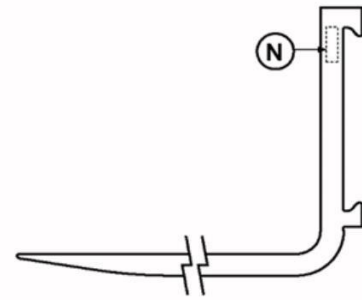
They can also use U-bolts, pins or similar devices, it engages the fork through the top structure of the bracket.

8. Check that the fork mark (N) is readable. Update tags as needed to maintain readability.

9. Lift the mast and operate the tilt lever until the top surface of the fork is parallel as the ground. Place two straight bars with the same width as the bracket, horizontally cross fork.

10. Measure the distance from the bottom of each of the two rods to the floor for fully tapered and polished (FTP) forks, the forks must be parallel full length of all other forks within 3 mm (0.12 in.), degrees are 6.4 mm (0.25 in.).

11. Place a fork (one third of the tip) on one that will not move under the fixture. Then operate the tilt control carefully until it is stuck the back of the car just lifted off the floor. Use the second fork to perform the phase the same procedure. Repeat step 9.



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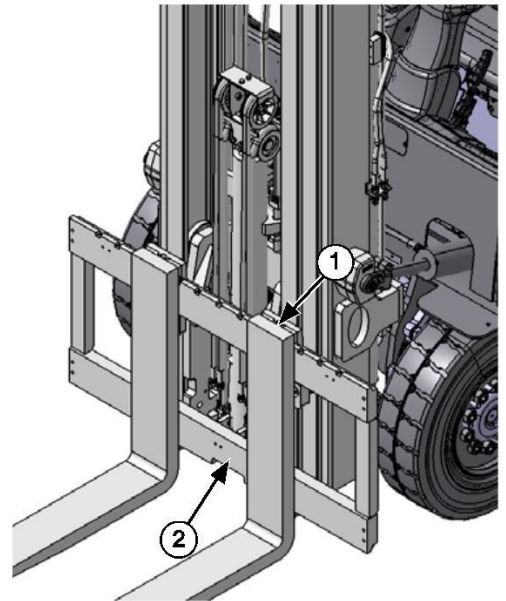
## B. Fork removal / installation

1. Lower the fork completely.

2. Unlock the latch at area (1).

3. Slide the fork into the center groove (2) and remove it.

4. Perform the above steps in reverse order to install the front fork.

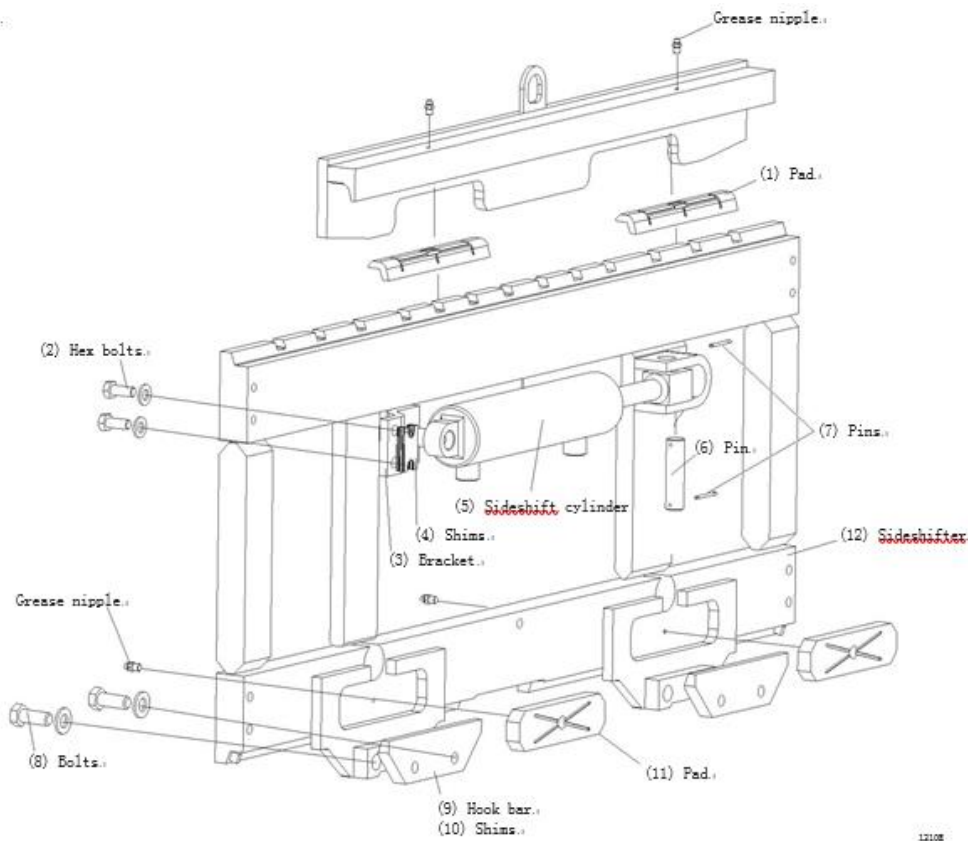


Note: during disassembly, check the fork and fork frame,

and replace them for possible damage, any part that is cracked or excessively rusted.

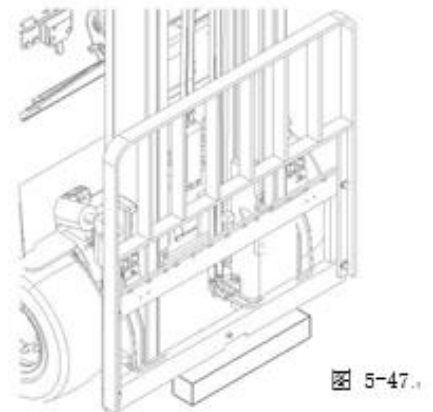
## 6-4. Side-shifter service

### A Standard side-shifter and cylinder removal / installation



#### Initial steps

1. Lift the bracket and place a wooden block under it.
2. Lower the bracket onto the wood block and secure the crane to the load backrest.
3. Remove the fork.
4. Remove residual pressure in the hydraulic system by moving the lever back and forth several times by closing the key



## Process

1. Mark the hose and port of the side-shift cylinder as reference for assembly.
2. Disconnect the hose from the side-shift cylinder and plug and cap the hose and port. Prepare the oil pan to catch any oil that is coming out of the hose and the cylinder port.
3. Remove the hexagon bolt and washer, and then remove the gasket. When installing, apply thread sealant on the hexagon bolt. When installing, adjust the thickness of the gasket so that the gap between the bracket and the cylinder is at least 1.5 mm (0.06 in).
4. Slide the side shifter out of the bracket. During installation, check whether the clearance between bracket and side shifter is consistent. If this is not the case, the hook bar must be shimmed on each side. They can be removed by removing the bolts and washers. After installation, lubricate all gaskets with grease through their respective fittings.
5. After removing the pin, pull out the split pin and remove the side-shift cylinder.
6. Perform the above steps in reverse order to install the side-shifter body and the side-shift cylinder.

## 6-5. Tilt cylinder service

### A. Integral removal / installation of tilt cylinder

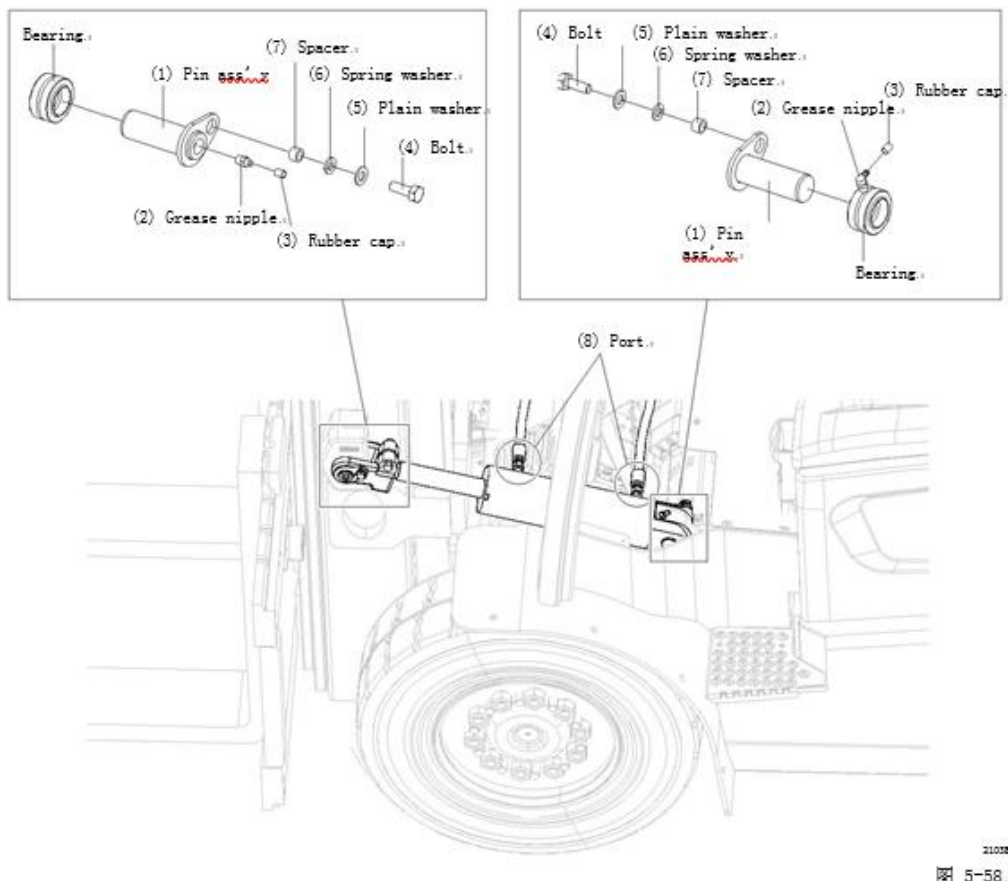


Figure 5-58

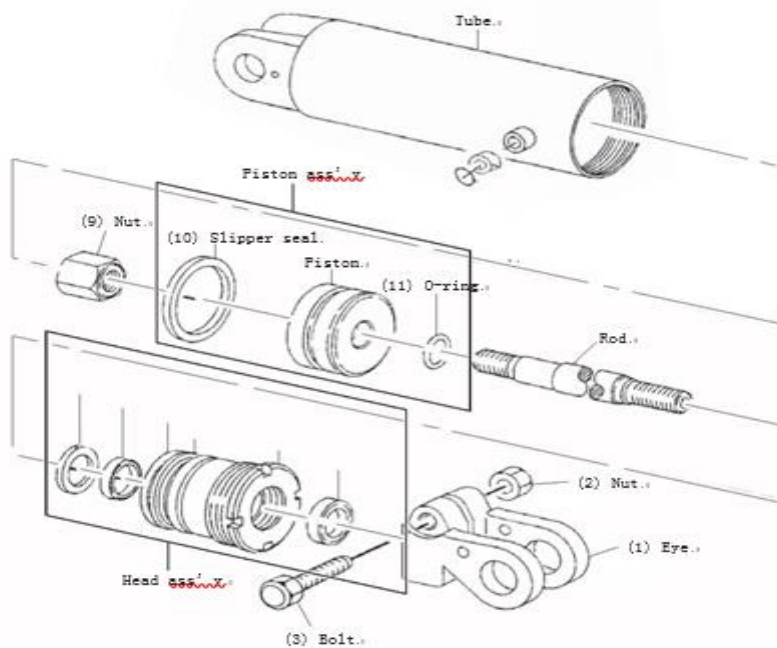
## **Initial steps**

1. Prepare a hoist and tie the straps to both sides above the Mast.
2. Remove residual pressure in the hydraulic system by moving the lever back and forth several times by closing the key
3. Prepare the oil pan.
4. Remove the base plate

## **Process**

1. Mark the hose and port (1) as an assembly reference.
2. Disconnect the hoses from the ports and plug them. Prepare the oil pan to catch any oil coming out of the hose and cylinder port.
3. Remove the bolt (4), washers (5, 6), and shim (7) from the Mast end of the cylinder.
4. Pull out the pin (1) from the end of the Mast.
5. Repeat steps 3-4 for the frame end of the cylinder.
6. Remove the tilt cylinder.
7. Perform the above steps in reverse order to install the tilt cylinder.
8. Refill the tank with hydraulic oil according to the specifications and perform the tilt cylinder alignment procedure.

## B. Disassembly / assembly of tilt cylinder



5-60

Tools needed: claw spanner

1. Place the tilt cylinder in a vise and use a dog wrench to remove the rod assembly.

Installation torque:  $270 \pm 30$  Nm ( $200 \pm 22$  lb ft)

2. Loosen the nut (2) and bolt (3) and remove the eye (1).

Installation torque:  $95 \pm 15$  Nm ( $70 \pm 11$  lb ft)

3. Remove the butt from the head.

4. Remove the seal ring (4).

The lip shall face the head during installation.

5. Remove the U-cup (5).

6. Remove the O-ring (6).

Install the contact side of the support ring so bent.

7. Remove the backup ring (7).

8. Remove the dust seal (8).

The lip shall face the head during installation.

9. Remove the nut (9).

Installation torque:  $402 \pm 29$  Nm ( $297 \pm 21$  lb ft)

10. Remove the piston assembly.

11. Remove the slipper seal (10).

12. Remove the O-ring (11).

13. Perform the above steps in reverse order in order to assemble the tilt cylinder.

Note: after assembly of the tilt cylinder, make sure that the dust cover and plug are used new seal port.



## 6-6. Mast side cylinder

### A. Overall removal / installation of main lift cylinder

1. Remove the chain.

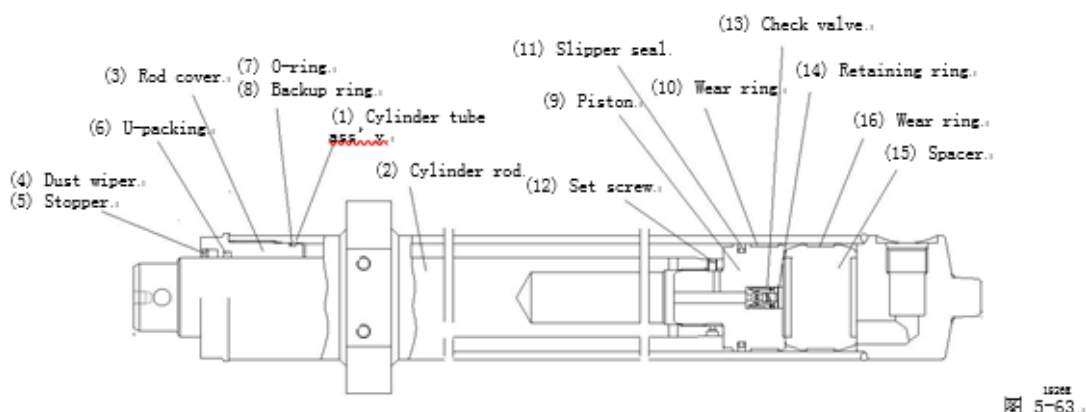


2. Remove the upper and lower fixing bolts and hoops of the oil cylinder



- 3 Remove the lifting oil pipe and lift the middle gantry to remove the oil cylinder

### B. Main lift cylinder removal / assembly



Tools needed: claw spanner



## Initial steps

Remove the main lift cylinder (see Section 5-3-7).

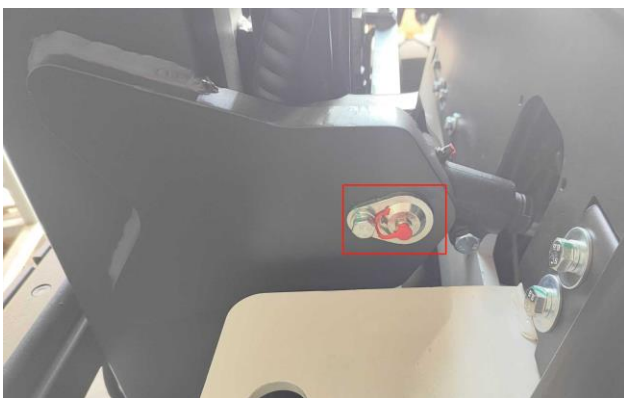
## Process

1. Using a claw wrench, remove the rod cap (10).
2. Remove the O-ring (7) and support ring (8) from the outer diameter of the rod cover (3), the dust wiper (4), the plug (4) and the U-ring seal (6) from the inside. Install the U-gasket (6) with the lip facing outward. Check the condition of the dust wiper (4).
3. Secure the cylinder tube assembly (1) in a vise and remove the cylinder rod (2).
4. Loosen the set screw (12).
5. Unscrew the piston (9)
6. Remove the sliding seal ring (15) and wear ring (10) from the outside diameter of the piston (9), and remove the retaining ring (14) and check valve (13) from the inside.
7. Remove the wear ring (16) and the gasket (15).
8. Check the condition of the seal and replace the damaged or worn seal.
9. Perform the above steps in reverse order to assemble the main lift cylinders.

Note: make sure that the port is resealed with a dust cap after the cylinder is assemble

## 6-7. disassembly and assembly of gantry assembly

1. Use the crane to lift the gantry at the specified lifting point
2. Remove the lifting oil pipe
3. Remove the tilt cylinder pin shaft



- 4 remove the gantry fixing tile to remove the gantry

## 7. Steering system

### 7-1. Overview



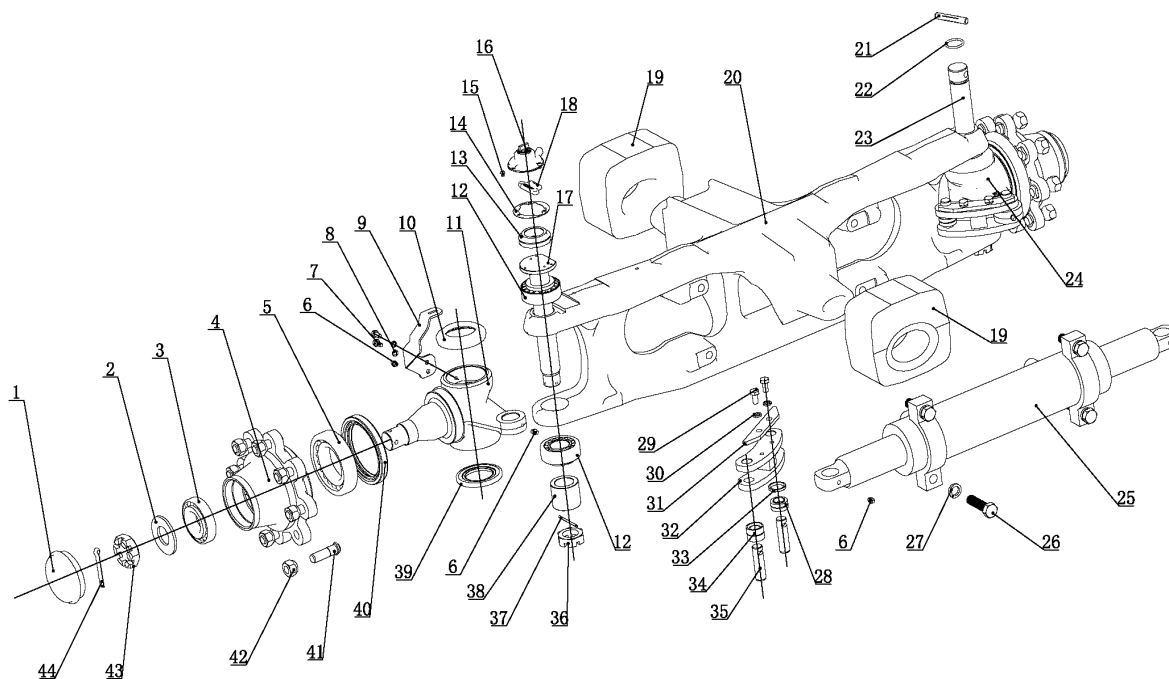
The steering system is a set of devices that turn the vehicle left or right. In this model, the steering system is hydraulically operated and consists of a control group and an actuator group:

1. The control group determines the speed and direction of steering and supplies hydraulic oil to the operation group accordingly. This group includes steering wheel and steering device.
2. The operation group converts the hydraulic power transmitted from the control part into mechanical power through the hydraulic oil to make the rear wheel turn. This group includes the steering cylinder, steer axle and two rear wheel assemblies. [Section 7-2]

Unlike cars, forklifts use the rear wheels as steering wheels, because their priority is not to drive at speed, but to ensure a wider steering angle in a narrow area.

## 7-2. Steering axle

### 7-2-1 Appearance and specifications




No.	Name	QTY	Remark
A	30Q steering axle-AQ	1	
1	Hub cap (1218-10200)	2	
2	Gasket G27Z4-30711	2	
3	Bearing 30207	2	
4	Gasket G27Z4-30711	2	
5	Bearing 30211	2	
6	Straight through nozzle M6(Q700B06)	6	
7	Bolt M6X12	2	
8	Spring washer 6	2	
9	Sensor linkage bracket AQ-Z03N3-20201	1	
10	Oil seal 264973	2	
11	Left knuckle assembly AQ-Z03N3-22311	1	
12	Bearing 33206	4	
13	Spacer sleeve Z03M2-33051	2	
14	Sealing gasket KOMV4-30231	1	
15	Flat round head hexagon socket screw M4X6	3	
16	Sensor mounting cover assembly A1674-32131	1	
17	Knuckle kingpin AQ-Z03N3-22111	1	
18	Corner positioner AQ-Z03N3-40291	1	
19	cushion H24N4-32451	2	
20	Cast steering axle Z03M2-10200MKSA	1	
21	Slot Pin 9.5X57(226986B)	2	
22	O-ring 25x2.65(Z6053-02502)	2	
23	Kingpin G27Z4-33031	1	

24	Right steering knuckle assembly G27Z4-33301QT	1	
25	Steering cylinder Z03M2-10400	1	
26	Bolt M14X50	4	
27	Spring washer 14	4	
28	Radial joint bearing GE16ES	4	
29	Bolt M8x16	4	
30	Spring washer 8	4	
31	Baffle A21B4-32081B	2	
32	Connecting rod A21B4-32081B	2	
33	Bush H24C4-12003	2	
34	Radial joint bearing Z-GE16ES-K27	2	
35	Connecting rod pin A21B4-32261AB	2	
36	Slotted nut 249289	2	
37	Pin 3.2x40(15225)	2	
38	Bush G27Z4-33071	2	
39	Oil seal G27Z4-33201	2	
40	U-shaped sealing ring B85X110X12D(Z6031-08524)	2	
41	Hub bolt 23654-32041B	16	
42	Hub nut 23654-34051B	16	
43	Slotted nut M30X2(A21B4-32311)	2	
44	Pin 6.3X50	2	

## 7-2-2 Disassembly and assembly method of steering axle

1) Assemble special spillage at the counter weight lifting indication, remove the fixing screws, and then use the line crane to slowly lift, lower the center of gravity to the designated maintenance storage area.



 **Caution:** The lifting ring on the counterweight is only allowed to lift the counterweight, not the whole vehicle

2) Remove the tire



3) First remove the joint and then remove the fixing bolt, then can remove the steering axle



## 7-2-3 Disassembly and assembly of steering gear

1 Open the casing and remove the oil pipe



2 Remove the fixing bolts





## 7-3. Troubleshooting

Problem	Possible causes
It takes too much force to turn the steering wheel	Priority valve (if equipped) releases pressure oil at a low setting
	The pump oil pressure is low and the pump is worn.
	Steering gear cover too tight
	The steering column is not aligned with the steering gear.
	The priority valve spool remains in one position.
	The steering gear does not need lubrication.
	The level in the hydraulic supply tank is low.
The steering wheel did not return to the center position correctly.	The steering gear cover is too tight.
	The steering column is not properly aligned.
	The valve element in the steering gear is limited.
	The priority check valve allows the lift and tilt hydraulic oil to affect the hydraulic circuit.
Pump oil leakage.	Loose hose connections.
	Bad shaft seal
Low oil pressure.	The oil level is low.
	The priority valve (if equipped) relief valve spring is weak.
	The relief valve (priority valve) does not move from the open position.
	Oil leakage inside or outside the system.
	Bad pump.
The pump makes noise when turning the steering wheel, and can't move smoothly	Air in the steering hydraulic circuit.
	The pump is too worn.
	The oil pipe connection at the inlet side of the pump is loose.
	The viscosity of the oil is wrong.
	The oil level in the hydraulic tank is very low.
	There is air in the steering system.
	Incorrect pump operation.
	Dirt in the steering system
	The steering gear is not operating correctly.
	Limitation of the steer axle linkage.
	The steering cylinder has worn components.
The oil temperature is too high.	The viscosity of the oil is wrong.
	Air is mixed with oil.
	Relief valve set too high (priority valve).
	There are restrictions in the return circuit.

## 8. Battery charger

The safety precautions, product features, technical performance, operation steps, installation and debugging, fault treatment, equipment maintenance of SKC-N lithium intelligent charger are expounded and explained. Please read this manual carefully after opening the box, and keep it properly for later inspection. The Company reserves the right to modify the specification, and has the right to avoid further notice.



Caution

**Warning**



Danger! High Voltage

The voltage of this equipment is dangerous high voltage, which may endanger life safety.

Please strictly observe all warning instructions in the equipment and instructions.

### 8-1. Precautions for safe operation

#### Security statement

Using this equipment without following the safety precautions in this chapter may lead to life danger, injury and equipment damage! The manufacturer does not undertake any claims arising therefrom.



## Safety tips

To ensure personal and equipment safety, the personnel operating this equipment must abide by the following principles and regulations:

Before the equipment is powered on, please make sure that the equipment is well grounded;




Before the equipment is powered on, please make sure that the input voltage, frequency, circuit breaker or fuse of the device and other conditions meet the specifications;

All tools should be insulated properly to prevent the exposed metal parts from touching the metal frame and causing short circuit;

Ensure the stable operation of the equipment. The equipment should be operated in a clean and well-ventilated environment as far as possible, and the operating environment should not contain volatile gas or flammable gas.

## Safety regulations

Tips and warnings can be viewed in different positions of the manual to indicate possible dangers. The symbols used are as follows:

NO.	Safety identification		Meaning
1		Danger	Failure to take appropriate preventive measures may result in death or serious injury.
2		Warn	Failure to take appropriate preventive measures may result in property loss or minor injuries.
3		Pay attention to	If proper preventive measures are not taken, property losses may be caused.

## Conditions of use

Altitude not exceeding 2000m;

Equipment operating ambient temperature  $-20^{\circ}\text{C} \sim +50^{\circ}\text{C}$ ;

The maximum relative humidity of the ambient air does not exceed 95% (when the ambient air temperature is  $25 \pm 5^{\circ}\text{C}$ );

The installation foundation should be stable, should have no violent vibration or impact, the vertical inclination is not more than 5%;

No conductive or explosive dust at the place of operation, no gases or vapors that corrode metals or destroy insulation.

For outdoor operation, a roof needs to be installed above the equipment to prevent rain.

## Product overview

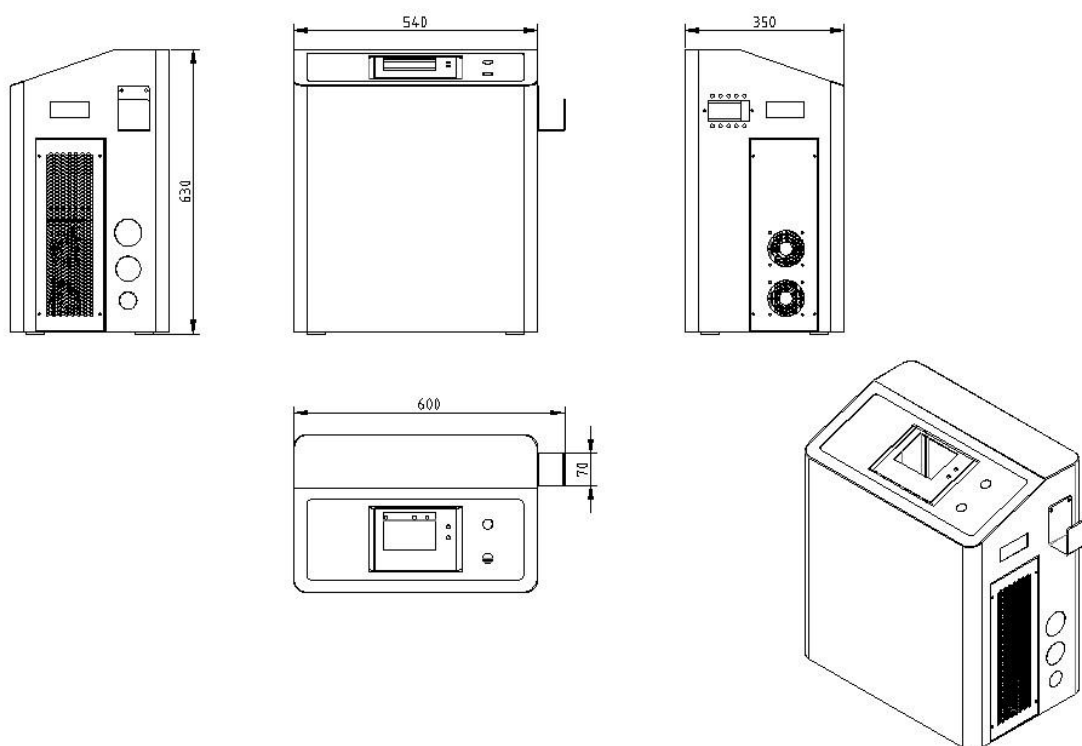
SKC-N lithium intelligent charger is a new intelligent charger. The product has high input power factor, low input current harmonic, high efficiency, good EMC performance, simple process, high standardization degree, high reliability, beautiful appearance, simple use, operation, maintenance, far better than the same application types of products, can be widely used in transportation, industry, logistics and other industries.

## 8-2. Technical configuration parameters of intelligent charger

Item	Parameter index		
Charger model	SKC-N80200(National standard gun/REMA)		
Input technical parameters			
Input voltage	Three phase four line 240V	Three phase five line 380V	Three phase four line 480V
Input voltage range	176V-250V (Full-load) 145V-176V (Down load)	340V-485V (Full-load) 280V-340V （Linear down to half a load ）	305Vac～530Vac （Full-load ） 305Vac～260Vac （Linear down to half a load ）
Input current	<70A	<38A	<42A
Frequency	45Hz~65Hz		
Power factor	≥0.9		
Current distortion	≤5%		
Output technical parameters			
Maximum voltage	DC100V	DC100V	DC100V
Maximum current	200A	200A	200A
Maximum power	20KW	20KW	20KW
Output voltage range	42~100VDC	42~100VDC	42~100VDC
Limit the range of current adjustable	10A-200A	10A-200A	10A-200A
Efficiency	>90%		
Voltage ripple	<3%		
Current ripple	<3%		
Voltage regulation accuracy	5‰		
Current regulation accuracy	1%		
Charging curve	BMS given		
Working environment conditions			
Operating ambient temperature	-20~45℃ regular work; 45~70℃ reduced output.		
Storage temperature	-40~70℃		
Relative humidity	0~95%		
Altitude	≤2000m Full load output		
Defensive function			

<b>Input protection</b>	Input under-voltage, input overvoltage
<b>Output protection</b>	Output overvoltage, output short circuit, battery reverse connection
<b>Over-temperature protection</b>	Over-temperature inside the module protects shutdown.
<b>Abnormal protection</b>	Abnormal power device protection shutdown
<b>Emergency stop protection</b>	When an uncontrollable abnormality occurs, the shutdown can be forced through the emergency stop button
<b>Interface</b>	
<b>CAN interface</b>	1 way
<b>485 interface</b>	The 7-inch touch screen can support 1 way
<b>Human-computer interaction</b>	
<b>Display mode</b>	7-Inch touch screen、Segment code screen【 Specific to the actual customized selection shall prevail 】
<b>External shape and protection</b>	
<b>Case size</b>	External size (host) 540 (L) 350 (W) 630 (H)
<b>Levels of protection</b>	IP21
<b>Other</b>	
<b>Heat dissipation mode</b>	Forced air cooling

## Structure and dimensions of the charger



## 8-3. Installation and commissioning

### 1. Installation precautions

The operating voltage and current of some components in the power supply system are very large, and to ensure personal safety, the following regulations shall always be observed:

1). Only those who have received training in power system and have full knowledge of power system can install the system of power system. The aforementioned safety regulations and local safety regulations shall always be observed during installation.

2). The system voltage may reach 320Vdc or 475Vac, which is a dangerous voltage. The installation and operation are insulation to ensure personal safety.

3). To operate inside the power system cabinet, ensure that the power system is not charged. The main input and battery supply of the power supply system must be disconnected.

4). Place the power supply equipment in the room with a lock, lock the cabinet, and the person in charge of the power supply equipment shall keep the key.

### 2. Input wiring description

(The specific input method is subject to the physical objects)

#### 1). No plug input line



No plug input line



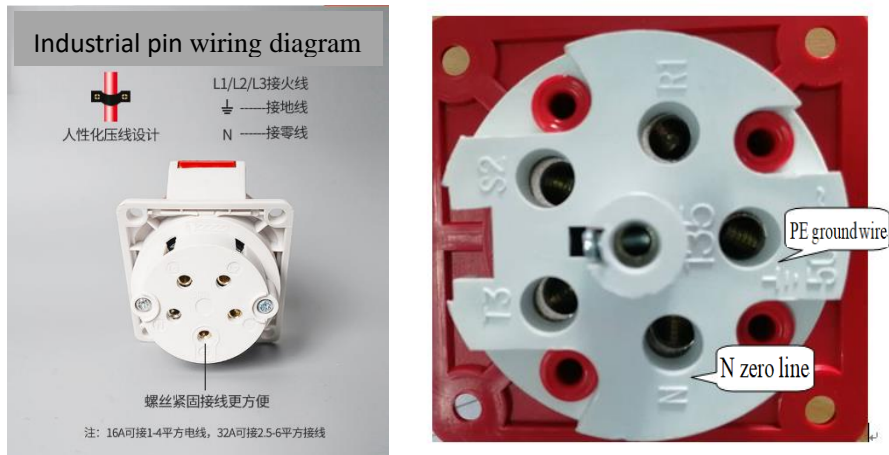
Yida plug input line



Hongyan plug input line

No plug input line is divided into three-phase 4-wire and three-phase 5-wire specifications, and the three-phase 4-wire interface is A, B, C, and PE. Explanation: ABC is 3 fire lines and PE is ground. The three-phase 5-wire interface is A, B, C, N, and PE. The three-phase 5-wire interface adds an N-line (zero line) to the three-phase 4-wire interface.

## 2) Yida plug input line



### Wiring definition:

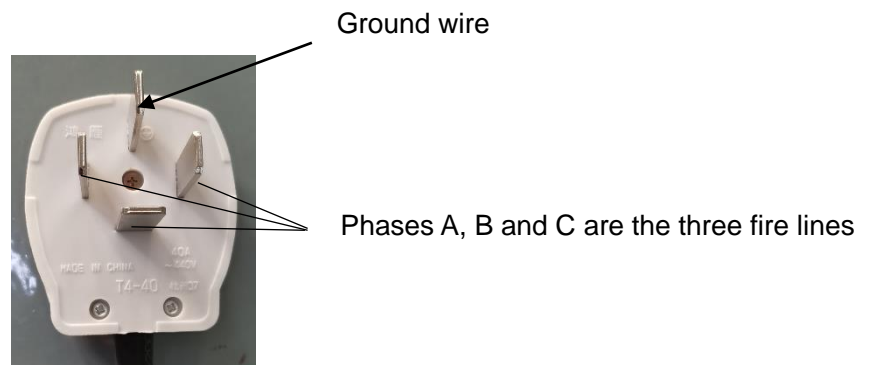
The Yida interface is a three-phase 5-wire. R1 S2 T3 = L1 L2 L3 = A B C = U V W (The four logos are all national logos) are connected to three live wires, PE or ground wire identifies the ground wire, and N connects to the neutral wire.

### Installation method:

The screw holes are on the side, and the wires are inserted into the holes, and the screws can be tightened from the side.

16A can be connected to 1-4 square lines, 32A can be connected to 2.5-6 square lines, and 63A can be connected to 4-10 square lines.

## 3). Hongyan plug input line



### Wiring definition:

Interface for the three-phase 4-wire, plug front line sequence: left one phase, the next two phases, the right three phases, the uppermost for the ground.

**Warning:** PE protection earth must be connected, otherwise it may threaten personal and equipment safety. The N line must not be connected incorrectly, otherwise it will burn the internal components of the machine. The company is not responsible for the accident caused by the user misunderstanding the AC input line, thank you for your cooperation.

### 3. Output wiring instructions

(The concrete object shall prevail.)

#### 1). Output Wall DC charging gun



Output Wall DC charging gun

#### Wiring definition

The charging gun is designed according to GB/T 20234.3-2015.

DC power line: DC+, DC-.

Equipment ground wire: PE.

Charging communication line: S+, S-.

Charging connection confirmation line: CC1, CC2.

Low voltage auxiliary power supply line: A+, A-.

#### 2). Output REMA plug



Output REMA charging plug

#### Wiring definition

The AC wiring part of the user is located at the rear lower cabinet door. AC input open switch whole machine power supply. PE is the earth, A is A phase power supply, B is B phase power supply, and C is C phase C power supply.

## 4. Commissioning operation instructions

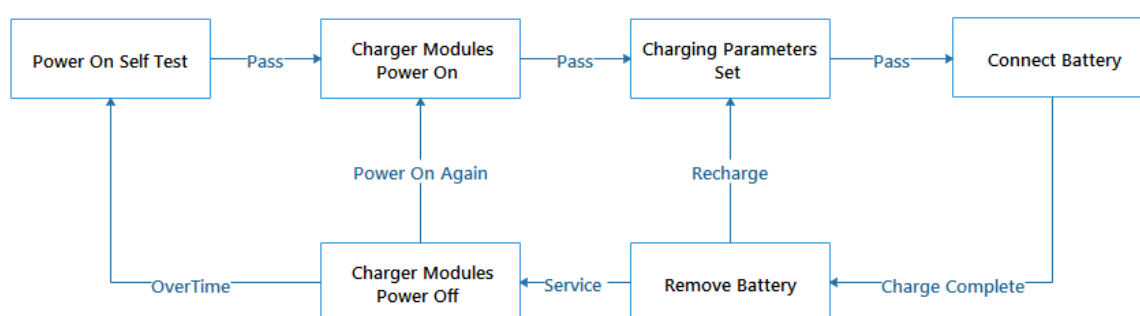
### Precautions before powering on the machine

Before the charger is turned on, check whether the battery box wiring is correct, whether a short circuit occurs or the positive and negative terminals are reversed. Avoid the charger from burning components or wiring due to overload.

The charger can be put into use only after it is turned on without abnormal, overheating and other alarm messages.

In order to operate the charger and equipment safely, it is strictly forbidden to disconnect the battery switch directly in the case of output current, except in emergency situations.

### Operation flow chart



### Specific operations

#### (1) Power on check

Make sure that the AC input zero-fire line and DC output positive and negative wiring are correct, the input and output are not short-circuited; the input voltage and frequency are normal. It is ready to be powered on at any time.

Offline online charging lines cannot be accessed at the same time.

#### (2) Power on

- ① Check whether the AC fan wind direction is correct after power-on.
- ② The touch screen can be turned on normally and communicates with the charger normally.

#### (3) Access battery

- ① The battery voltage and current levels meet the requirements of the charger.
- ② The battery polarity is not reversed.
- ③ The battery is good and there is no abnormality.


#### (4) Power off





- ① After the charging current and voltage drop are 0, exit the battery.
- ② Turn off the AC input air switch.

## 8-4. Charger display and simple troubleshooting


### 8-4-1 Charger display

Common mode - Wait charge			
<b>Battery BMS information</b>	<b>Charger information</b>	<b>Charger state</b>	
Voltage demand: V	0.0	Output U: V	0.0
Current demand: A	0.0	Output I: A	0.0
CHG SOC limit: %	100.0	Charge T: M	0
Residual cap: %	0.0	Charge C: Ah	0.0
Charging permit	stop	Charge P: kWh	0.0
		<b>Charger control</b>	
		2020-07-24 14:28:24	
		Mode switch	
		Turn on	
		Turn off	

Click on the icon: , enter the help description interface.

Click on the icon:  or  switch alarm sound ,  to turn on the alarm sound state,  to turn off the alarm sound state.

The control operation requires password permission. The default password is: 123456.

Click on the boot icon: , switch the charging control to on or off.

Click the purple part charging status information bar to enter the information display bar of the single charging module.


Click on the battery BMS battery bar to enter the detailed BMS information display.

Click mode switching to switch between the normal mode-level reservation mode.

### Help description interface

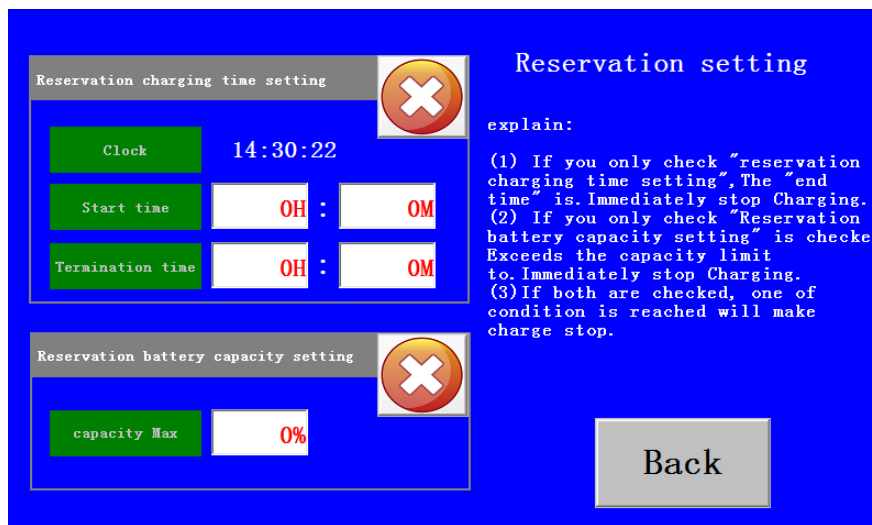
<b>Explain:</b>	<b>Factory Setting</b>
1. Display the output information of the charger	
2. Display battery charging information	
3. Display BMS related information	
4. Control the output of the charger	<b>Reservation Setting</b>
5. HMI SW version: V2.2 (2020.7.14)	
HMI HW version: TPC7012Ew	
main board SW version: V 1.0	
main board HW version: V 1.7	<b>Back</b>



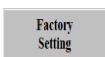
Click on the icon:  , back to main interface.

Click the reservation icon to set the time of the reservation mode. The password is 123456.

Reservation function setting instructions:



The image shows a 'Reservation setting' screen with a blue background. On the left, there are two sub-panels. The top panel, 'Reservation charging time setting', has a title bar with a close button (X). It contains three green buttons: 'Clock' (showing 14:30:22), 'Start time' (showing 0H : 0M), and 'Termination time' (showing 0H : 0M). The bottom panel, 'Reservation battery capacity setting', also has a title bar with a close button (X) and a green button 'capacity Max' (showing 0%). To the right of these panels is an 'explain:' section with three numbered points: (1) If you only check "reservation charging time setting", The "end time" is. Immediately stop Charging. (2) If you only check "Reservation battery capacity setting" is checked Exceeds the capacity limit to. Immediately stop Charging. (3) If both are checked, one of condition is reached will make charge stop. At the bottom right is a 'Back' button.


Click on the icon:  , enter the password input interface and enter the factory parameter setting interface after the password is entered correctly.


### Password input interface




The image shows a 'Please enter the password:' screen with a blue background. In the center is a white 'Edit Box' containing the text 'Edit Box'. Below the edit box are three buttons: 'Cancel', 'Modify the password', and 'OK'.

Enter the correct password in the password input box. The default password is 888888.

Click on the icon:  , return to the help description interface.

Click on the icon:  , enter the password modification interface

Click on the icon:  , if the password is entered correctly, enter the parameter setting interface. Otherwise, the password input is incorrect. Please re-enter.

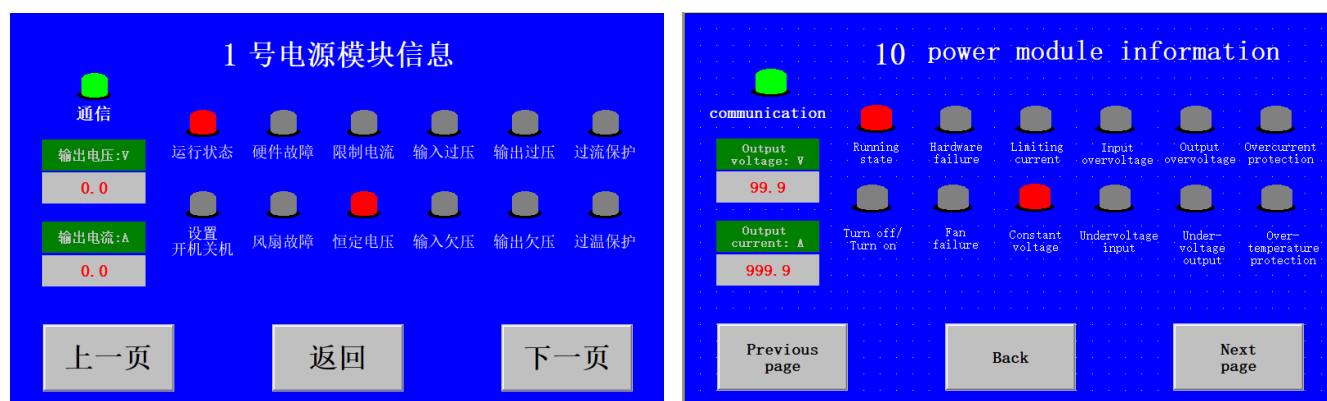
## Parameter setting

Parameter setting information: The rated voltage, rated current and shunt range are related to the machine hardware and must not be modified at will after shipment.


If the above parameters need to be modified, please consult the manufacturer. The charger number is convenient for the user to distinguish, and the user can set it at will.

The debugging interface is used for debugging by the manufacturer, and the user is not allowed to operate at will.

## Power module information display interface



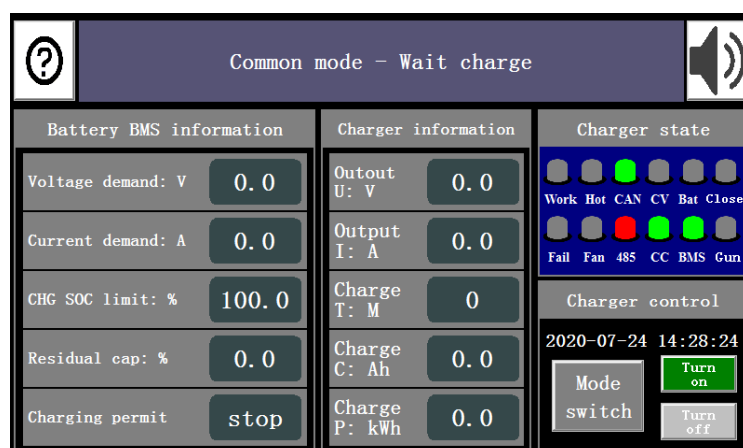
Click on the icon: , switch module information forward.

Click on the icon: , back to main interface.

Click on the icon: , switch module information backwards.

Display single-supply module output voltage, output current, various operating states.

## Detailed charging process



## Charging steps

- (1) Select "On" charging control mode. The “CAN” and “485” indicators light green.
- (2) The DC charging gun is connected to the battery normally.
- (3) The “remaining capacity” is less than the “permissible charging SOC limit” to start charging.
- (4) The “Battery” indicator lights up in green (after the charger detects the battery voltage, it lights up) and the “BMS” indicator lights up in green.
- (5) When the "work" light is green and the "output voltage" is similar to the "battery pack voltage", the charger output relay will be activated and the charger will officially start charging the battery. At this time, "output current" and "output voltage" will be output according to "current demand" and "voltage demand".
- (6) After the BMS is charged, the charging termination command is sent and the charger ends charging.
- (7) During the charging process, charging can be terminated if the charger fails (Charger information of "overheating", "abnormal" light is the charger failure), if the BMS is finished charging, or if the "Charge Allow" is disabled, or if the charging control is in the "Stop" state due to personal actions.

In the reservation mode, the charger will only work when it is at the set appointment time.

## Segment code screen display interface



Backlight: ■ Lake Blue-Standby ■ Green-Normal Charge ■ Purple-pused  
■ Yellow-Forced Charge ■ White-Set ■ Red-Failure

LED light: ■ Green Light Always On-Power on ■ Blue Light -Flashing ■ Red Light in communication-Fault

## Keynote introduction

Button 1:

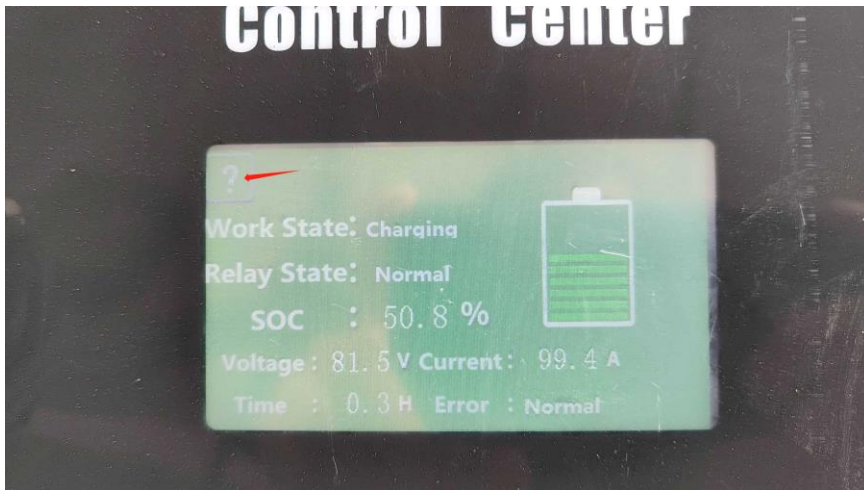
Normal state or standby state or strong charge state short press- -enter pause state- -again to return to the previous state Set state short press- - -corresponding set value from add 0.2 Set the state long press- - -voltage setting, current setting, and finally jump to the standby state.


Button 2:

Standby state long press- - -enter strong charge state- - -long press again into standby state Set state short press- -corresponding set value minus 0.2.

## The Divan screen display interface

### Main page



The main screen contains charging information and power, etc. The background color blue indicates standby, suspended or full state, green indicates charging state, and red indicates fault state. Click the battery icon (  ) on the touch screen, the battery information screen is displayed, click“?” icon the hierarchical screen is displayed.

### Charging steps

- (1). After the charger is powered on, connect the charging interface of the charger to the charging interface of the battery.
- (2). On the charging main screen, Charge Connection should be displayed as Normal, and Battery Level is normal percentage.
- (3). The communication between the charger and the BMS is normal, the battery sends "allow charging", the BMS voltage demand and BMS current demand are both greater than 0, and the charger detects the battery voltage.
- (4). The charger works and the background color changes to green. Enter the pre-charge stage, adjust the output voltage to the battery voltage, pull the output contactor, and then output according to the BMS voltage and BMS current requirements.
- (5). After the battery is fully charged, the battery sends "do not allow charging" or temporarily stops charging. Pressing the "Pause" metal button on the charger panel will stop charging. Disconnect the charging interface of the charger from the battery after the charger stops.

## 8-4-2 Troubleshooting for charger

### Troubleshooting instructions

When the charger works abnormally, find the charging status display area on the right side of the charger touch screen, pass the status indicator above to determine the cause of the failure, and then carry out troubleshooting.

#### 1. Troubleshooting instructions for 7-inch touch screen charger

When the charger is working abnormally, find the charging status display area on the right side of the touch screen of the charger, determine the cause of the fault through the status indicator lamp above, and then troubleshoot the fault.

NO.	Failure phenomenon	Cause of failure	Solution
1	The BMS status indicator is not on	1. The battery BMS in the car is damaged. 2. The charger controller is faulty. 3. The internal 12V auxiliary power supply of the charger is damaged. 4. Poor charging of the charging gun.	1. Charge the replacement car. If normal, the battery BMS is damaged. If the same problem occurs, the internal controller of the charger or the 12V auxiliary power supply is faulty. 2. Check whether the charging interface is firmly connected.
2	The "CAN" status indicator lights up in red.	CAN communication port between main control board and module is fault.	1. Check the connection line between the master control board and the module, and if invalid, use the solution step 2. 2. Replace the main control board. If not, use the solution, step 3. 3. Replace the charging module.
3	The 485 status indicator is red	Communication failure between the main console and the touchscreen.	1. Check the connection line between the main control panel and the touch screen, and use the solution step 2 if invalid. 2. Replace the main control board. If it fails, use the solution step 3. 3. Replace the touch screen
4	The "abnormal" status indicator lights up in red.	Charger internal module failure or protection.	1. Click the blue background area of the main interface and enter the detailed interface of module information. If it is "input under-voltage" or "AC input fault", measure whether the charger three-phase power supply voltage is normal, if normal, power and open the charger side door, plug and pull whether the charging module is normal, and replace the charging module if still abnormal.

## 2. Troubleshooting instructions for Segment code screen charger

NO.	Failure phenomenon	Cause of failure	Solution
1	The charger cannot be charged after being connected to the battery, the communication light does not flash, and the word "battery" is not bright	1. The BMS of the vehicle battery is damaged. 2. Charger controller fails. 3. The 12V auxiliary power supply inside the charger is damaged. 4. Poor connection of the charging interface.	1. Charge the replacement car. If normal, the battery BMS is damaged. If the same problem occurs, the internal controller of the charger or the 12V auxiliary power supply is faulty. 2. Check whether the charging interface is firmly connected.
2	The charger is connected to the battery, the communication light flashes, the word "battery" is bright, and the word "allowed" is	The BMS does not send the allowable charging instruction.	Contact the battery manufacturer.
3	The charger air switch is immediately switched on	The charger emergency stop switch is not started. Internal components of the charger are damaged.	1. Turn the emergency stop knob on the charger panel clockwise in the arrow. 2. If the fault still exists after the operation according to Step 1, contact the charger manufacturer for investigation.

## 3. Troubleshooting instructions for Divan screen charger

NO.	Failure phenomenon	Cause of failure	Solution
1	The charging screen on the panel after power on does not display	No display on the touch screen	1. Whether the three-phase switch on the side of the charger is open. 2. Check whether the input three-phase power supply is on or not. 3. Whether the AC220V voltage inside the charger to the 24V power supply is normal. 4. Whether the 24V power module in the charger is damaged. 5. Whether the 24V power supply on the touch screen is normal.
2	It does not charge after starting up, the touch screen is bright, and the background color is blue	Working state: standby Charging connection: Disconnected Fault information: normal Battery capacity: 0.0%	Whether the charging gun is connected with the forklift, and whether the connection is in place

3	It does not charge after starting up, the touch screen is bright, and the background color is blue	Working state: standby Charging connection: normal Fault information: normal Battery capacity: 0.0%	1. Click the "Battery Information" interface: Whether you have received the charger message: "Yes". Received BMS message: "No". Check whether the +12V power supply of the charging tip A+ and A- is normal. If it is normal, it is a problem with the battery. Contact the battery manufacturer.
4	It does not charge after starting up, the touch screen is bright, and the background color is red	Working state: fault Charging connection: normal Fault information: not detected Battery voltage is measured Battery capacity: 0.0%	Open the top cover and use the multi-meter to measure whether there is voltage on the positive and negative terminals of the connection between the charging gun and the charging machine: No voltage is a battery pack problem. If there is voltage, further measure whether there is voltage on GND and VBAT on the main control board. If there is voltage, the main control board is damaged
5	It does not charge after starting up, the touch screen is bright, and the background color is red	Working state: fault Charging connection: normal Fault information: charging Charger module communication timeout Battery capacity: 0.0%	1. Cut off the power of the charging machine, open the left door of the charging machine, and check whether the plug-in terminal of the charging module is loose.

**Note: The charger failure phenomenon is not in the above list, or the problem is not solved after investigation, please contact the manufacturer!**

## **8-5. About after-sales warranty**

### **1. Warranty conditions**

Due to transportation reasons, the user found that the product or accessories were damaged during the unpacking inspection;

The user fully complies with the installation, storage and use rules specified in this specification.

### **2. Term of service**

From the date of the product, the specific time shall be subject to the time of signing the contract.

### **3. Warranty method**

The manufacturer is responsible for free replacement or repair within the warranty period;

If the warranty period is exceeded, the user shall negotiate with the manufacturer for paid replacement or repair.

### **4. Liability exemption**

The following conditions are not covered by the Company warranty:

- The whole machine and parts have exceeded the warranty period;
- "Product damage during transportation" caused by user reasons;
- The equipment operates in very harsh conditions beyond described in this manual;
- Machine failure or damage caused by repair, change or disassembly by our service personnel;
- Any installation and use beyond specified in the relevant national standards;
- Man-made damage.

### **5. Not responsible for exchange terms:**

● Change must ensure that the appearance of the product is intact, no appearance of scratching, deformation.

- Damage caused by irresistible fire, floods, lightning strikes and earthquakes.

**If the above conditions cause product failure and the customer requests maintenance, the company will evaluate whether it can assist in providing paid services.**