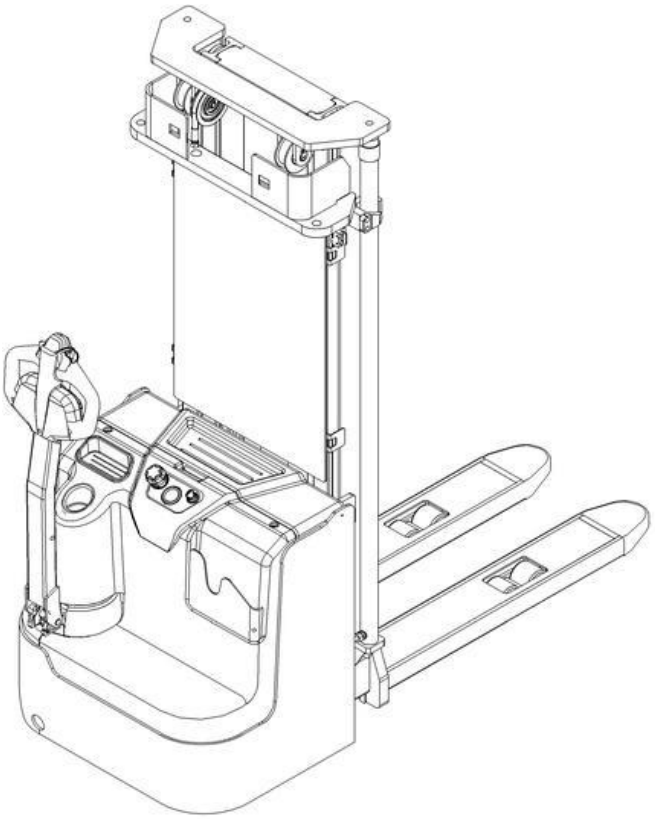
Service Manual

Electric Stacker

PS XXL



WARNING

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

NOTE:

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

Version 04/2023

PS 12/16/20L-SM-003-EN

FOREWORD

Before operating the electric stacker, read this ORIGINAL INSTRUCTION HANDBOOK carefully and understand the usage of the truck completely. Improper operation could create danger.
This handbook describes the usage of different electric stackers. When operating and servicing the truck, make sure, that it applies to your type.

Chapter 11 describes specialized stipulations and regulations for the American market. Follow these instructions and stipulations if you operate the truck within the American market!

Keep this handbook for future reference. If this or the warning/ caution labels are damaged or got lost, please contact your local dealer for replacement.

This truck complies with the requirements according to EN ISO 3691-1 (Industrial trucks- safety requirements and verification, part 1), EN 12895 (Industrial trucks- electromagnetic compatibility), EN 12053 (Safety of industrial trucks- test methods for measuring noise emissions), EN 1175-1 (Industrial truck safety – electrical requirements), assumed the truck is used according to the described purpose.
The noise level for this machine is <70 dB (A) according to EN 12053.

ATTENTION:

- Environmentally hazardous waste, such as batteries, oil and electronics, will have a negative effect on the environment, or health, if handled incorrectly.
- The waste packages should be sorted and put into solid dustbins according to the materials and be collected disposal by local special environment protection bureau. To avoid pollution, it’s forbidden to throw away the wastes randomly.
- To avoid leaking during the use of the products, the user should prepare some absorbable materials (scraps of wooden or dry duster cloth) to absorb the leaking oil in time. To avoid second pollution to the environment, the used absorbable materials should be handed in to special departments in terms of local authorities.
- Our products are subject to ongoing developments. Because this handbook is only for the purpose of operating /servicing the stacker, therefore please have understanding, that there is no guarantee out of particular features out of this handbook.

NOTE: On this manual, the left sign means warning and danger, which can lead to death or serious injury if not followed.

Copyright

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CORRECT APPLICATION
It is only allowed to use this electric stacker according to this instruction handbook.

The trucks described in this handbook are self-propelled pedestrian controlled electric power stacker, with electrically powered low height lifting function. The trucks are designed for stacking operations in dedicated racking by lifting and lowering the palletized load up to the desired lifting height.

A wrong usage can cause human injuries or can damage equipment.
The operator/ the operating company has to ensure the correct usage and has to ensure, that this truck is used only by staff, which is trained and authorized to use this truck.

The truck has to be used on substantially firm, smooth, prepared, level and adequate surfaces. The truck is intended to be used for indoor applications with ambient temperatures between +5°C and + 40°C and for intensive operations without crossing permanent obstacles or potholes. Operating on ramps is not allowed. While operating, the load must be placed approximately on the longitudinal centre plane of the stacker.
Lifting or transporting people is forbidden. If travelling the load must be lowered to the lifting point.

It is not allowed to use this truck on tail lifts or loading ramps.

The capacity is marked on the load diagram as well on the Identification plate. The operator has to consider the warnings and safety instructions.
Operating lighting must be minimum 50 Lux.

<u>Modification</u>
No modifications or alterations to this truck which may affect, for example, capacity, stability or safety requirements of the truck, shall be made without the prior written approval of the original truck manufacturer, its authorized representative, or a successor thereof. This includes changes affecting, for example braking, steering, visibility and the addition of removable attachments. When the manufacturer or its successor approve a modification or alteration, they shall also make and approve appropriate changes to capacity plate, decals, tags and operation and maintenance handbooks.

By not observing these instructions, the warranty becomes void.

1.1 INTRODUCTION–MAINTENANCE SAFETY PRECAUTIONS

Maintenance work may cause injuries. Always take care to perform work safe, at least observing the following. It is of utmost importance that maintenance personnel pay strict attention to these warnings and precautions to avoid possible injury to themselves, others or damage to the equipment. A maintenance program must be followed to ensure that the machine is safe to operate.

The specific precautions to be observed during maintenance are inserted at the appropriate point in the manual. These precautions are, for the most parts, those that apply when servicing hydraulic and larger truck component parts.

⚠WARNING MODIFICATION OF THE TRUCK WITHOUT CERTIFICATION BY A RESPONSIBLE AUTHORITY THAT THE TRUCK IS AT LEAST AS SAFE AS ORIGINALLY MANUFACTURED, IS A SAFETY VIOLATION.

⚠WARNING SINCE THE TRUCK MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA RESPONSIBIUTY OF THE OWNER OR OPERATOR.

⚠WARNING FAILURE TO COMPLY WITH SAFETY PRECAUTIONS, LISTED IN THIS SECTION MAY RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

- When carrying out any operation or maintenance, have trained and experienced personnel to carry out the work.
- When carrying out any operation or maintenance, carefully read operation and maintenance handbook.
- Read all the precautions given on the decals which are fixed to the truck.
- Be sure you fully understand the content of the operation. It is important to prepare necessary tools and parts for maintain the truck.

- Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

CAUTION HEAVY

- It should be noted that the machines hydraulic systems operate at extremely high potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system. Relieve system pressure by cycling the applicable control several times with the engine(motor) stopped and ignition on, to direct any line pressure back into the reservoir. Pressure feed lines to system components can then be disconnected with minimal fluid loss.

- Remove all rings, watches and jewelry when performing any maintenance.

- Wear well-fitting helmet, safety shoes and working Clothes When drilling grinding or hammering always. Wear protective goggles. Always do up safety clothes properly so that they do. Not catch on protruding parts of machines. Do not wear oily clothes. When checking, always release battery plug. DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.

- During maintenance do not allow any unauthorized person, to stand near the machine.
- Flames should never be used instead of lamps. Never use a naked flame to check leaks or the level of oil or electrolyte.

- Immediately remove any oil or grease on the floor of the operator's compartment or on the handrail. It is very dangerous if someone slips while on the machine.

- Always use pure oil or grease, and be sure to use clean containers.
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire or flame. As preparation for use of fire extinguishers and other fire- fighting equipment.
- Keep the battery away from fire hazards. The generated gases are explosive.
- Store all the oils in a specified place.
- Keep the flammable things away from the machine. Do not smoke at the working place.
- Battery should always be disconnected during replacement of electrical components.

- Always use the grades of grease and oil recommended by NOBLELIFT choose the viscosity specified for the ambient temperature.

- Exhaust gas is dangerous provide ventilation when working in a closed space.
- Avoid breathing dust that may be generated when handling components containing asbestos fibers. Wear a gas mask if necessary.

- When working on top of the machine, be careful not to lose your balance and fall.

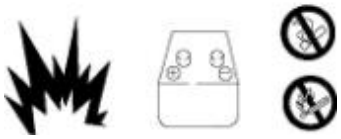
- Hand a caution sign in the operator's compartment (for example "Do not start" of "Maintenance in progress"). This will prevent anyone from starting or moving the machine by mistake.

- When welding on the machine or working on the electrical system, ALWAYS turn the key switch OFF and remove the battery plug from the battery. Park the machine on firm, flat ground. Lower the fork to the min height and stop the motor.

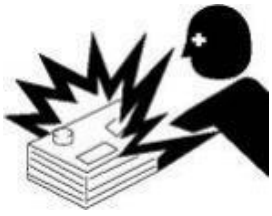
- Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin and eat holes in clothing. If you spill acid on your clothes or skin, immediately flush with large quantities or water.

- When working on the battery, wear goggles or safety glasses. If splashed into the eyes, flush with water and get medical attention immediately.

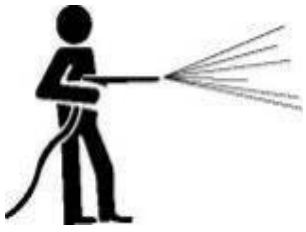
- Battery terminals touched by metal objects can cause short circuit and burn you. Keep tools away from the terminals.
- Keep sparks, lighted matches, and open flame away from the top of battery. Battery (hydrogen) gas can explode.
- When disassembling and assembling the battery, make sure that the battery terminals (+, –) are correctly connected.



- If water gets into the electrical system, abnormal operation or failure can result. Do not use water or steam on sensors, connectors and instruments in the cab.
- Do not handle electrical equipment while wearing wet gloves, or in wet places, as this can cause electric shock.



- When working with other, choose a group leader and work according to his instructions. Do not perform any maintenance beyond the agreed work.
- Unless you have special instructions to the contrary, maintenance should always be carried out with the motor stopped. If maintenance is carried out with the motor running, there must be two technicians present: One operating the stacker and the other one performing the maintenance. In such a case,never touch any moving part.



- Before making adjustment, lubricating or performing any other maintenance, shut off all power controls.
- When removing parts containing O-ring Gaskets or seal clean the mounting surface and replace with new sealing parts.
- Thoroughly clean the machine. In particular, be careful to clean the grease fittings and the area around the dipsticks. Be careful not to let any dirt or dust into the system.
- Use only approved nonflammable cleaning solvents.
- When changing the oil or fitter, check the drained oil and filter for any signs of excessive metal particles or other foreign materials.
- Always use NOBLELIFT genuine parts for replacement.
  ENSURE REPLACEMENT PARTS OR COMPONENTS ARE IDENTICAL OR EQUIVALENT TO ORIGINAL PARTS OR COMPONENTS.
- When checking an open gear case, there is a risk of dripping things in. Before removing the covers to inspect such cases, empty everything from your pockets. Be particularly careful to remove wrenches and nuts.

1.2 MEASUREMENT CONVERSIONS

Length

Unit	cm	m	km	in	ft	yd	mile
cm	1	0.01	0.00001	0.3937	0.03281	0.01094	0.000006
m	100	1	0.001	39.37	3.2808	1.0936	0.00062
km	100000	1000	1	39370.7	3280.8	1093.6	0.62137
in	2.54	0.0254	0.000025	1	0.08333	0.02777	0.000015
ft	30.48	0.3048	0.000304	12	1	0.3333	0.000189
yd	91.44	0.9144	0.000914	36	3	1	0.000568
mile	160930	1609.3	1.6093	63360	5280	1760	1

1mm=0.1cm, 1μm=0.001mm

Area

Unit	cm^2	m^2	km^2	a	ft^2	yd^2	in^2
cm^2	1	0.0001	_	0.000001	0.001076	0.000012	0.155000
^{2}	10000	1	0.000001	0.01	10.764	1.1958	1550.000
km^2	_	1000000	1	10000	1076400	1195800	_
a	0.01	100	0.0001	1	1076.4	119.58	_
ft^2	_	0.092903	_	0.000929	1	0.1111	144.000
yd^2	_	0.83613	_	0.008361	9	1	1296.00
in^2	6.4516	0.000645	_	_	0.006943	0.000771	1

1ha=100a, $1mile^2$=259ha=$2.59km^2$

Volume

Unit	cm_3 =cc	m_3	*l*	in_3	ft_3	yd_3
cm_3 = m *l*	1	0.000001	0.001	0.061024	0.000035	0.000001
$_3$	1000000	1	1000	61024	35.315	1.30796
l	1000	0.001	1	61.024	0.035315	0.001308
in_3	16.387	0.000016	0.01638	1	0.000578	0.000021
ft_3	28316.8	0.028317	28.317	1728	1	0.03704
yd_3	764529.8	0.76453	764.53	46656	27	1

1gal(US)=3785.41 cm_3=231 in_3=0.83267gal(US)

Pressure

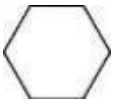
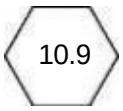
Unit	kgf/cm_2	bar	Pa=N/m_2	KPa	lbf/in_2	lbf/ft_2
kgf/cm_2	1	0.98067	98066.5	98.0665	14.2233	2048.16
bar	1.01972	1	100000	100	14.5037	2088.6
Pa=N/m_2	0.00001	0.001	1	0.001	0.00015	0.02086
kPa	0.01020	0.01	1000	1	0.14504	20.886
lbf/in_2	0.07032	0.0689	6894.76	6.89476	1	144
lbf/ft_2	0.00047	0.00047	47.88028	0.04788	0.00694	1

kgf/cm_2=735.56 Torr(mmHg)=0.96784atm

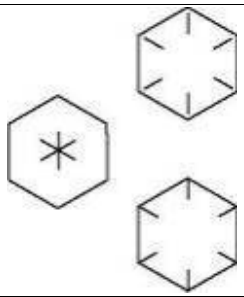
Standard tightening torque

The following charts give the standard tightening torques of bolts and nuts.
Exceptions are given in sections of “Disassembly and Assembly”

METER TABLE

Classification	4T, 5T	10T
Bolt type		
Bolt size	Torque kgf ·m (lbf· ft)	Torque kgf ·m (lbf ·ft)
M4	0.2 ± 0.02	0.4 ± 0.04
M5	0.3 ± 0.03	0.8 ± 0.08
M6	0.5 ± 0.05	1.4 ± 0.14
M8	1.2 ± 0.12	3.3 ± 0.3
M10	2.3 ± 0.23	6.5 ± 0.7
M12	4.0 ± 0.4	11.3 ± 1.1
M14	6.4 ± 0.6	17.9 ± 1.8
M16	9.5 ± 0.9	26.7 ± 2.7
M18	13.5 ± 1.4	38.0 ± 3.8
M20	18.6 ± 1.9	52.2 ± 5.2
M22	24.7 ± 2.5	69.4 ± 6.9
M24	32.1 ± 3.2	90.2 ± 9.0
M30	62.6 ± 6.3	176.1 ± 17.6
M36	108.2 ± 10.8	304.3 ± 30.4
M42	171.8 ± 17.2	483.2 ± 48.3
M45	211.3 ± 21.1	594.3 ± 50.4

INCH TABLE

	4T, 5T	10T
Classification Bolt type		
Bolt size	Torque kgf · m (lbf · ft)	Torque kgf · m (lbf · ft)
1/4	0.6 ± 0.06	1.7 ± 0.2
5/16	1.2 ± 0.12	3.0 ± 0.3
3/8	2.0 ± 0.20	5.6 ± 0.5
7/16	3.2 ± 0.32	8.9 ± 0.9
1/2	4.7 ± 0.47	13.4 ± 1.3
9/16	6.8 ± 0.68	19.0 ± 1.9
5/8	9.3 ± 0.93	26.1 ± 2.6
3/4	16.0 ± 1.60	45.1 ± 4.5
7/8	25.5 ± 2.55	71.6 ± 7.2
1	38.0 ± 3.80	106.9 ± 10.7
1-1/8	54.1 ± 5.41	152.2 ± 15.2
1-1/4	74.2 ± 7.42	208.9 ± 20.9
1-3/4	98.8 ± 9.88	277.8 ± 27.8
1-1/2	128.2 ± 12.82	360.7 ± 36.1

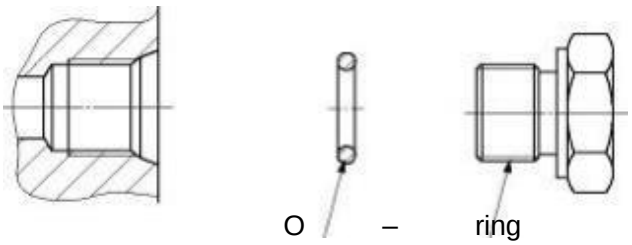
The torque in above table shall not be applied to nylon or nonferrous bolts or washer. The same is valid for not standardized ones.

H Newton meter: 1 Nm = 0.1kgfm

TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

The following torque shall be applied to the split flange bolts.

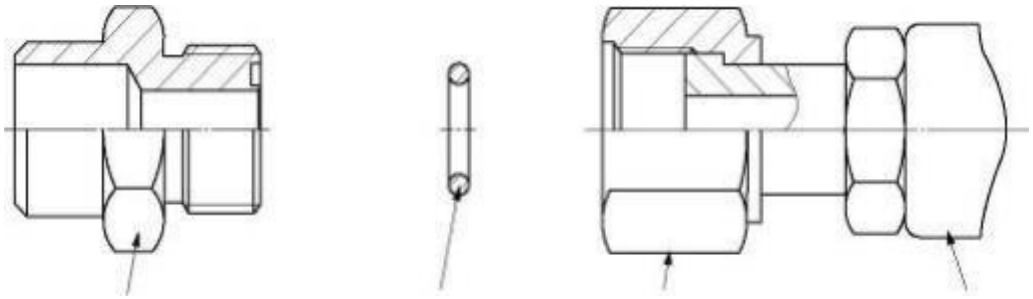
Diameter (mm)	Flat width (mm)	Torque	
		kgf·m	N·m
10	14	6.7 ± 0.7	66.7 ± 6.8
12	17	11.5 ± 1	112 ± 9.8
16	22	28.5 ± 3	279 ± 29



PF THREAD

Thread	Torque (kgf · m)
1/8	1.1 ± 0.1
1/4	2.6 ± 0.2
3/8	4.6 ± 0.3
1/2	8.5 ± 0.4
3/4	19 ± 1.0
1	33 ± 2.0

TORQUE FOR SWIVEL NUT WITH O-RING

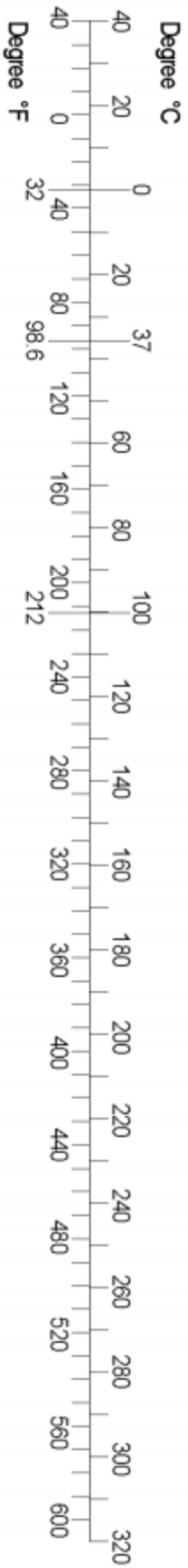


Tube O.D (inch)	Thread (in)	Torque (kg f · m)
1/2	UN 13/16 - 16	9.5 ± 0.95
3/4	UN 1 3/16 - 12	18 ± 1.8
1	UN 1 7/16 - 12	21 ± 2.1

APPROXIMATE CONVERSIONS

SI Unit		Conv Factor		Non–SI Unit		Conv Factor		SI Unit
Torque								
Newton meter (N · m)	×	8.9	=	ln · in	×	0.113		N·m
Newton meter (N · m)	×	0.74	=	lb ·ft.	×	1.36		N·m
Newton meter (N · m)	×	0.102	=	kg · m	×	7.22		lb ·ft.*
Pressure (Pa = N/m^2)								
kiloPascal (kPa)	×	4.0	=	in. H_2O	×	0.249		kPa
kiloPascal (kPa)	×	0.30	=	in. Hg	×	3.38		kPa
kiloPascal (kPa)	×	0.145	=	psi	×	6.89		kPa
(bar)	×	14.5	=	psi	×	0.069		bar*
(kg/cm^2)	×	14.22	=	psi	×	0.070		
Newton/mm^2	×	145.04	=	psi	×	0.069		f/bar^{2*}
MegaPascal (MPa)	×	145	=	psi	×	0.00689		
(Pa=N · m^2)			=	psi				k MPa
Power r (W = J/s)								
kiloWatt (kW)	×	1.36	=	PS	×	0.736	=	kW
kiloWatt (kW)	×	1.34	=	(cv)	×	0.746	=	kW
kiloWatt (kW)	×	0.948	=	HP	×	1.055	=	kW
Watt (W)	×	0.74	=	Btu/s	×	1.36	=	W
(W=J/s)			=	ft · lb/s				
Energy (J = N·m)								
kiloJoule (kJ)	×	0.948	=	Btu	×	1.055	=	kJ
Joule (J)	×	0.239	=	calorie	×	4.19	=	J
(J=N · m)								
Velocity and Acceleration								
meter per sec^2 (m/s^2)	×3.28		=	ft/s^2	×	0.305	=	m/s^2
meter per sec (m/s)	× 3.28		=	ft/s	×	0.305	=	m/s
kilometer per hour (km/h)	× 0.62		=	mph	×	1.61	=	km/h
Horse Power/Torque								
BHP × 5252 R.P.M. = TQ (lb ·ft)					TQ Z R.P.M. 5252 = B.H.P.			
Temperature								
°C = (°F–32) ÷ 1.8					°F= (°C Z 1.8) + 32			
Flow Rate								
liter/min (dm^3/min) = l/min			×	0.264	=	US gal/minZ3.785		

Note:( ) Non–SI Unit



1. DESCRIPTION OF THE STACKER

a. Overview of the main components

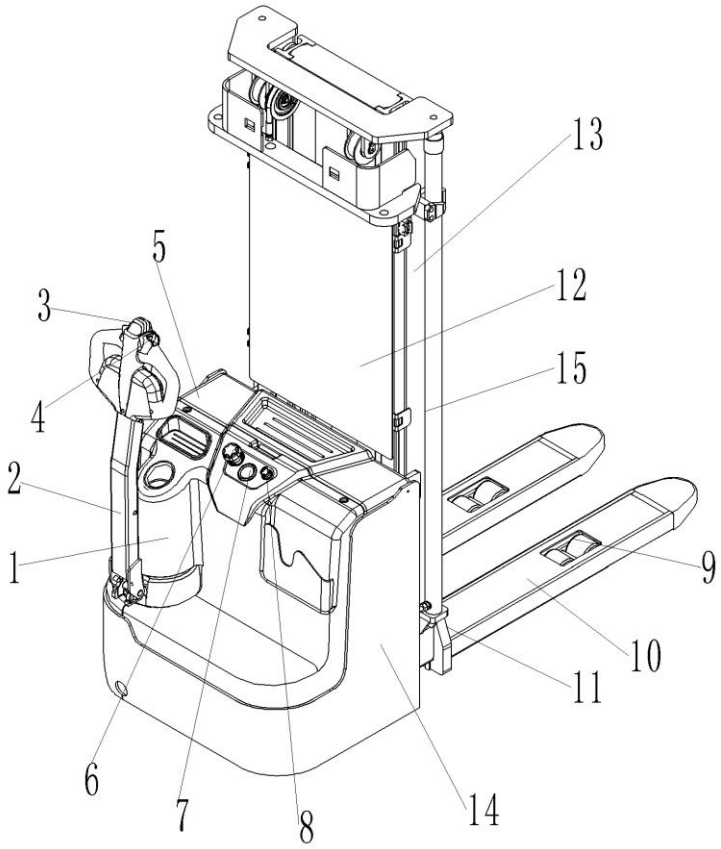


Fig. 1: Overview main components

1. Main cover
2. Handle
3. Safety (belly) button
4. Accelerator (butterfly button)
5. Battery cover
6. Emergency button
7. Discharge indicator and charging indicating LED
8. Key switch
9. Load roller
10. Pallet
11. Load backrest
12. Protective board
13. Mast
14. Chassis
15. Hydraulic system

b. Main technical data

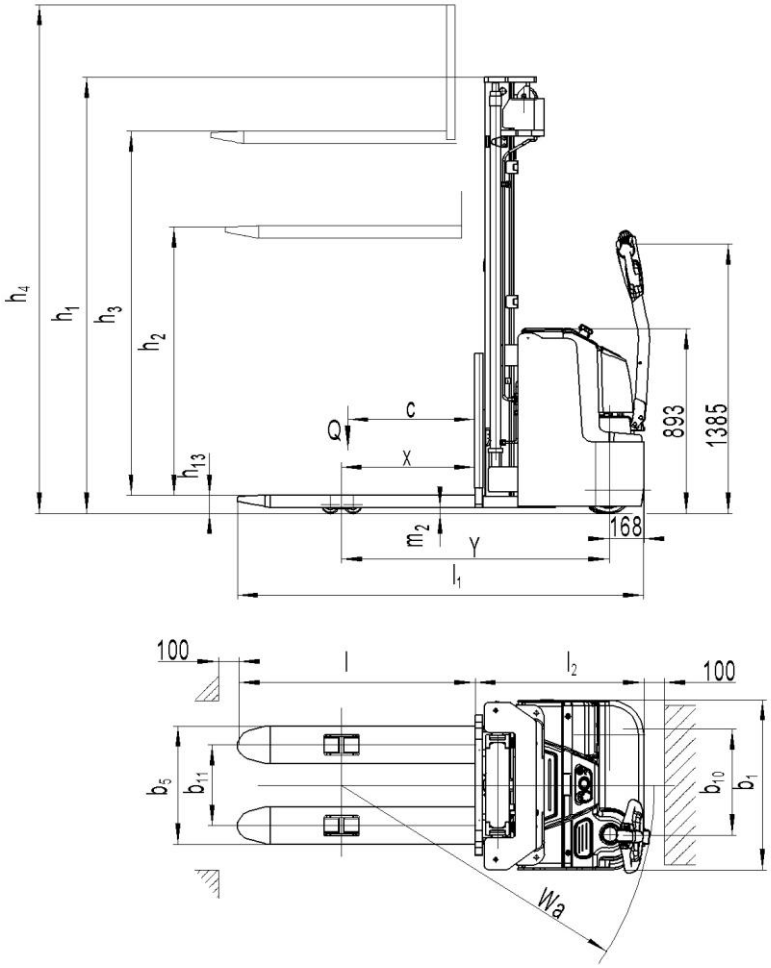


Fig. 2: Technical data

Table1: Main technical data for standard version

	Type sheet for industrial truck acc. to VDI 2198					
Distinguishing mark	1.2	Manufacturer`s type designation		PS 12L (3600)	PS 16L (4600)	PS 20L (4600)
	1.3	Power (battery ,diesel, petrol, gas, manual)		Battery		
	1.4	Operator type		Pedestrian		
	1.5	Load Capacity / rated load	Q(t)	1.2	1.6	2.0
	1.6	Load centre distance	C(mm)	600		
	1.8	Load distance ,centre of drive axle to fork	x(mm)	647		
	1.9	Wheelbase	y(mm)	1248	1293	1429
Weight	2.1	Service weight	Kg	1007	1340	1579
	2.2	Axle loading, laden front/rear	Kg	684/1523	930/2010	1000/2579
	2.3	Axle loading, unladen front/rear	Kg	610/397	850/490	900/679
Tires chassis	3.1	Tires		Polyurethane (PU)		
	3.2	Tire size, front	∅xW (mm)	∅230×75		

	3.3	Tire size, rear	∅xW (mm)	∅84×70		
	3.4	Additional wheels(dimensions)	∅xW (mm)	∅150x54		
	3.5	Wheels, number front/rear(x=driven wheels)		1x+1/4		
	3.6	Track, front	b_{10} (mm)	522		
	3.7	Track, rear	b_{11} (mm)	390		
Dimensions	4.2	Lowered mast height	h_1 (mm)	2308	2108	2228
	4.3	Free Lift height	h_2 (mm)	1760	1520	1520
	4.4	Lift height	h_3 (mm)	3530	4530	4530
	4.5	Extended mast height	h_4 (mm)	4088	5088	5208
	4.9	Height of tiller in drive position min./ max.	h_{14} (mm)	850/1385		
	4.15	Height, lowered	h_{13} (mm)	90		
	4.19	Overall length	l_1 (mm)	1919	1964	2100
	4.20	Length to face of forks	l_2 (mm)	769	814	950
	4.21	Overall width	b_1 (mm)	820		
	4.22	Fork dimensions	s/e/l (mm)	60/180/1150		
	4.25	Width across forks	b_5 (mm)	570		
	4.32	Ground clearance, centre of wheelbase	m_2 (mm)	28	28	23
	4.33	Aisle width for pallets 1000X1200 crossways	Ast(mm)	2336	2406	2536
	4.34	Aisle width for pallets 800X1200 lengthways	Ast(mm)	2323	2393	2523
	4.35	Turning radius	Wa(mm)	1440	1510	1640
Performance data	5.1	Travel speed, laden/ unladen	km/h	6.0/6.0	5.7/6.0	5.4/6.0
	5.2	Lift speed, laden/ unladen	m/s	0.09/0.14	0.13/0.20	0.13/0.20
	5.3	Lowering speed, laden/ unladen	m/s	0.25/0.20	0.28/0.23	0.28/0.23
	5.8	Max. gradeability, laden/ unladen	%	6/12	6/12	6/10
	5.10	Service brake		Electromagnetic		
Electric- engine	6.1	Drive motor rating S2 60min	kw	1.3	1.3	1.7
	6.2	Lift motor rating at S3 10%	kw	1.5	3.2	3.2
	6.3	Battery acc. to DIN 43531/35/36 A, B, C, no		2VBS	3VBS	3PZS
	6.4	Battery voltage, nominal capacity K5	V/Ah	24/180	24/270	24/350
	6.5	Battery weight	kg	175	230	288
	6.6	Energy consumption acc: to VDI cycle	kWh/h	0.95	1.59	1.70
Additional data	8.1	Type of drive control		AC- speed control		
	8.4	Sound level at driver`s ear acc. to EN 12053	dB(A)	<70		

Designation	Lowered mast height h1(mm)	Free Lift height h2(mm)	Lift height h3(mm)	Extended mast height h4(mm)
PS 12L				
Two stage mast	1958	—	2830	3380
	2108	—	3130	3680
	2308	—	3530	4080
Two stage mast FFL (Full-Free-Lift)	1958	1410	2830	3380
	2108	1560	3130	3680
	2308	1760	3530	4080
Three stage mast FFL (Full-Free-Lift)	2008	1420	4230	4780
	2108	1520	4530	5080
PS 16L				
Two stage mast	1958	—	2830	3380
	2108	—	3130	3680
	2308	—	3530	4080
Two stage mast FFL (Full-Free-Lift)	1958	1410	2830	3380
	2108	1560	3130	3680
	2308	1760	3530	4080
Three stage mast	2008	—	4230	4780
	2108	—	4530	5080
Three stage mast FFL (Full-Free-Lift)	1708	1120	3330	3880
	1908	1320	3930	4480
	2008	1420	4230	4780
	2108	1520	4530	5080
	2343	1756	5230	5780
	2408	1820	5430	5980
PS 20L				
Two stage mast	2078	—	2830	3500
	2228	—	3130	3800
	2428	—	3530	4200
Two stage mast FFL (Full-Free-Lift)	1978	1310	2630	3300
	2078	1410	2830	3500
	2228	1560	3130	3800
	2428	1760	3530	4200
Three stage mast	2128	—	4230	4900
	2228	—	4530	5200
Three stage mast FFL (Full-Free-Lift)	1978	1310	3930	4600
	2128	1420	4230	4900
	2228	1520	4530	5200

c. Description of the safety devices and warning labels(Europe and other, excepting USA)

For the USA –market, the description of the safety and warning labels is mentioned in chapter 17.

A Crane hook label
B Warning decal: Do not step under or on the forks
C Residual lift capacity sticker
D Never reach through
E Identification plate (ID-plate)
F Sticker to read and follow these instructions
G Sign of filling point

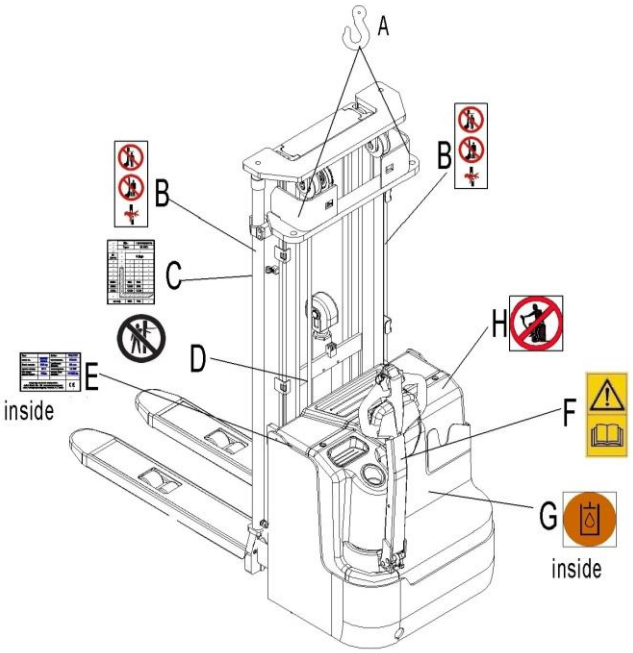


Fig.3: Safety and warning labels

The truck has an emergency button (6) which stops all lifting-, lowering-, driving- functions and engages the failsafe electromagnetic brake when it is pushed. By pulling this button, the truck can be operated after the controller checked the functions. Before operating, insert the key and turn the switch (8) clockwise. To prevent against unauthorized access, turn the key anti-clockwise and remove it, if you not operate this truck. The truck is equipped with a safety (belly) button (3) which switches the driving function away from the operator, if the truck travels towards the operator and the tiller is activated in the tillers operating zone. Follow also the instructions given on the decals. Replace the decals if they are damaged or missing.

d. Identification plate

1 Designation, type
2 Serial number
3 Rated capacity in kg
4 Supply voltage in V
5 Own mass (self-weight) in kg without battery
6 Name and address of manufacturer)
7 Battery weight minimum/ maximum
8 Nominal power in kW
9 Load center distance
10 Manufacturing data
11 Option

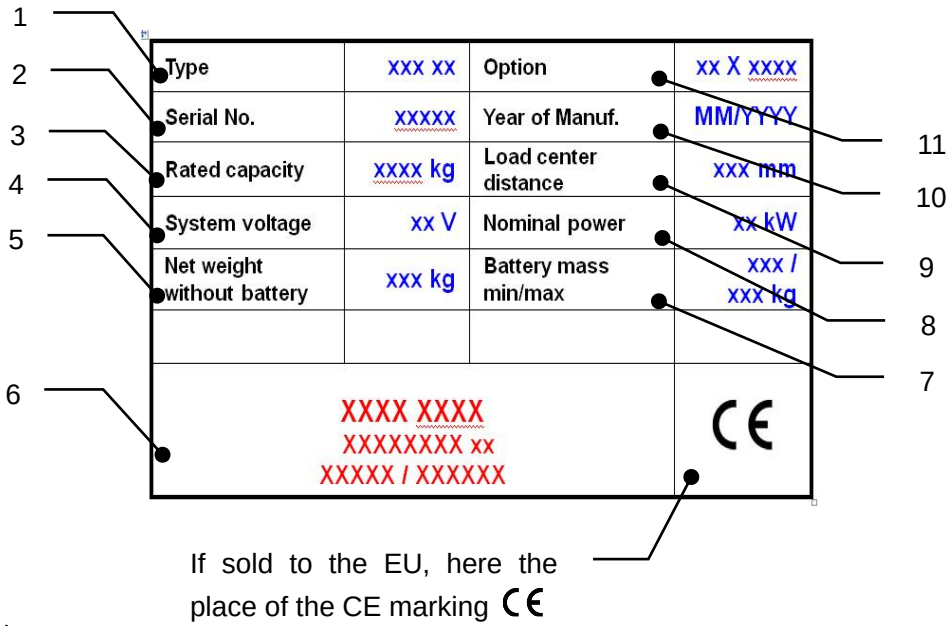


Fig. 4: Identification plate

2. WARNINGS, RESIDUAL RISK AND ASFETY INSTRUCTIONS

DO NOT

- Drive outside the stacking operation with a lifted load higher than the lifting point.
- Put foot or hand under or into the lifting mechanism.
- Allow other person than the operator to stand in front of or behind the truck when it is moving or lifting/lowering.
- Overload the truck.
- Put foot in front of the wheels, injury could result.
- Lift people. People could fall down and suffer severe injury.
- Push or pull loads.
- Use this truck on ramps.
- Use the truck without a removed protective screen (fig.1, pos. 17/ guarding).
- Side or end load. Load must be distributed evenly on the forks.
- Use the truck with unstable, unbalanced not stable load.
- Use truck without manufacturer's written consent.
- Lifted loads could become unstable at wind forces. In the case of wind forces do not lift the load if there is any influence to the stability

Watch difference in floor levels when driving. Load could fall down or the truck could get uncontrollable. Keep watching the condition of load. Stop operating the truck if load becomes unstable. Brake the truck and activate the emergency button (6) by pushing when sliding load on or off the truck. If the truck has any malfunctions, follow chapter 8.

Practice maintenance work according to regular inspection. This truck is not designed to be water resistant. Use the truck under dry condition. Prolonged continuous operation might cause damage of the power pack. Stop operation if temperature of hydraulic oil is too high.

- When operating the truck, the operator has to wear safety shoes.
- The truck is intended to be used for indoor applications with ambient temperatures between +5°C and + 40°C.
- The operating lighting must be minimum 50 Lux.
- It is not allowed to use the truck on ramps.
- To prevent unintended sudden movements when not operating the truck (i.e. from another person, etc.) switch off the truck and remove the key.

3. COMMISSIONING, TRANSPORTING, DECOMMISSIONING

a. Commissioning

Table 2: Commissioning data (For different models, the commissioning weight is marked on the ID-plate)

Type	PS 12L /3600	PS 16L /4600	PS 20L /4600
Commissioning weight [kg]	1082	1415	1660
Version/ Lift [mm]	3600	4600	4600

For different models, the commissioning weight is marked on the ID plate.
After receiving your new truck or for re-commissioning you have to do following before (firstly) operating the truck:

- Check if are all parts included and not damaged
- Eventually installation and charging the batteries (follow chapter 7)
- Do the work according to the daily inspections as well as functional checks.

b. Lifting/ transportation

For transporting, remove the load, lower the forks to the lowest position and fix the truck safe with dedicated lifting gear according to the following figures.

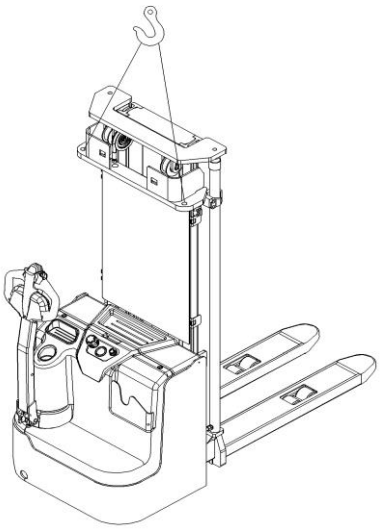


Fig.5: Lifting with a crane

Lifting

USE DEDICATED CRANE AND LIFTING EQUIPMENT
DO NOT STAND UNDER THE SWAYING LOAD
DO NOT WALK INTO THE HAZARDOUS AREA
DURING LIFTING

Lower the forks and park the truck securely.
Fasten the truck according to fig.5 by fixing dedicated lashing belts to each side of the truck's crane hook holes and fasten the other side at the transporting truck.

Transportation

DURING TRANSPORTATION ON A LORRY OR TRUCK ALWAYS FASTEN THE TRUCK SECURELY

Lower the forks and park the truck on the iron plate securely. Fixe the forks by the iron sheet with two screws. Fasten the truck by fixing dedicated lashing belts according to fig. 6 and fasten the other side at the transporting truck.

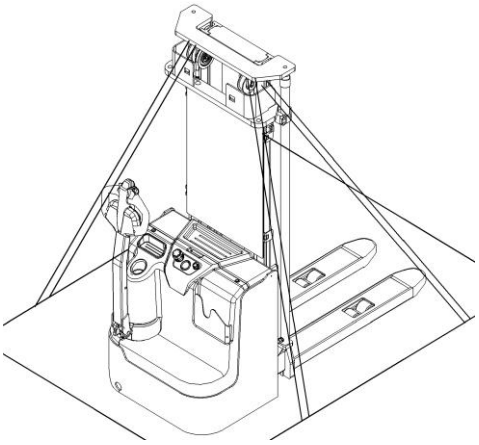


Fig. 6: Fixing points

c. Decommissioning

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

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

4. DAILY INSPECTION

This chapter describes pre-shift checks before putting the truck into operation.
Daily inspection is effective to find the malfunction or fault on this truck. Check the truck on the following points before operation.

Remove load from truck and lower the forks.
DO NOT USE THE TRUCK IF ANY MALFUNCTION IS FOUND.

- Check for scratches, deformation or cracks.
- Check if there is any oil leakage from the cylinder.
- Check the vertical creep of the truck.
- Check the chain and rollers for damages or corrosion.
- Check the smooth movement of the wheels.
- Check the function of the emergency brake by activating the emergency button.
- Check, the tiller arm- switch braking function
- Check the lifting and lowering functions by operating the buttons.
- Check if the protective screen has no damages and that is correctly assembled.
- Check the audio warning signal.
- Check if all bolts and nuts are tightened firmly.
- Check the function of the key switch.
- Check the speed limitation switch.
- Visual check if there are any broken hoses or broken electric wires.
- If supplied with a backrest extension, check it for damages and correct assembling.

5. OPERATING INSTRUCTIONS

BEFORE OPERATING THIS TRUCK, PLEASE FOLLOW THE WARNINGS AND SAFETY INSTRUCTIONS (CHAPTER 3).
BEFORE OPERATING THIS TRUCK, ENSURE THAT THE LOAD OR OTHER EQUIPMENT NOT CAUSES INSUFFICIENT VISIBILITY!

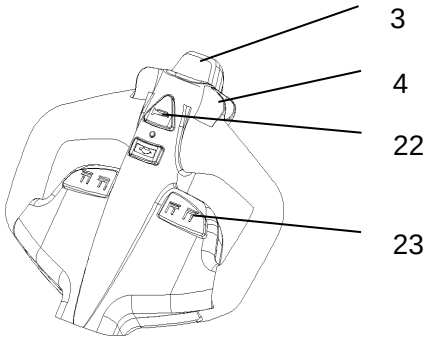


Fig.7: Tiller operating controls

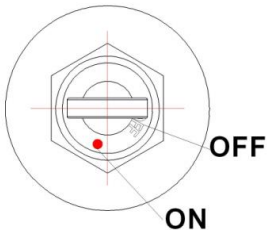


Fig.8: Key switch

Make sure, that the load is palletized and stable and that the daily inspection is carried out. For starting, insert the key and turn it clockwise to the “ON”- position. Eventually before inserting the key switch (8), the emergency button (6) must be pulled carefully.
Press the horn button (22) to activate the audible warning signal.

a. Parking

DO NOT PARK THE TRUCK ON INCLINED SURFACES

The truck is equipped with an electromagnetic failsafe stopping and parking brake.
Always lower the forks fully and drive the truck to a safe area. Turn the key anti- clockwise to the “Off”–position and remove the key.

b. Residual lift diagram

The residual lift diagram indicates the maximum capacity Q [kg] for a given load centre c [mm] and the corresponding lift height H [mm] for the truck with horizontal load. The white markings on the mast indicate if the specific lifting limits reached.
For instance with a load centre of gravity distance c of 600 mm and a maximum lift height H of 4600 mm, the max. capacity Q is 800 kg.

	Type	PS 16L
	Mast	4600
h3 (mm)	Q (kg)	
4600	800	600
4300	850	700
3600	1100	900
3200	1200	1000
2900	1400	1200
2500	1600	1300
c(mm)	600	700

Fig.9: Residual lift diagram

c. Lifting

DO NOT OVERLOAD THE TRUCK! THE MAXIMUM CAPACITY IS 1200/1600/2000kg WHEN THE LOAD CENTER IS 600MM.
LIFT ONLY CAPACITIES ACCORDING TO THE RESIDUAL LIFT DIAGRAM.

Travel with the lowered forks fully underneath the pallet and press the lifting button(fig.7,23) until you reached the desired lifting height.

d. Lowering

If the forks are in the racking, firstly travel out of the racking carefully with or without the pallet. By travelling out of the racking, take care that the forks are not touching the racking.
Press the lowering button(fig.7,23) carefully.
Lower the load until the forks are clear of the pallet, then drive the truck carefully out of the load unit.

e. Travelling

TRAVEL ON INCLINES ONLY WITH THE LOAD FACING UPHILL (Fig.10).
DO NOT TRAVEL ON INCLINES MORE THAN SPECIFIED WITH THE TECHNICAL DATA.
TRAVELLING IS ONLY ALLOWED IF THE FORKS ARE LOWERED DOWN TO THE LIFTING POINT (<300MM).

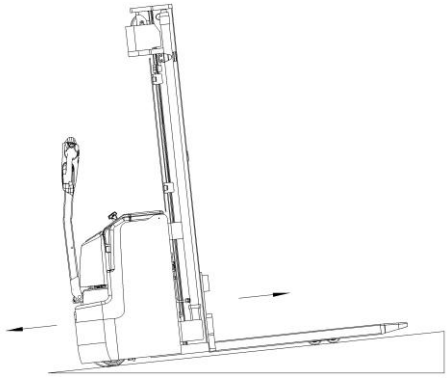


Fig. 10: Load facing uphill

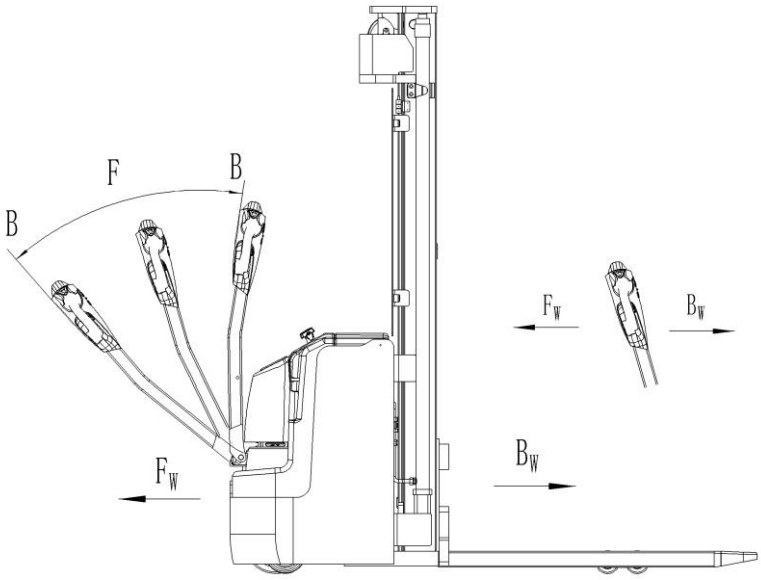


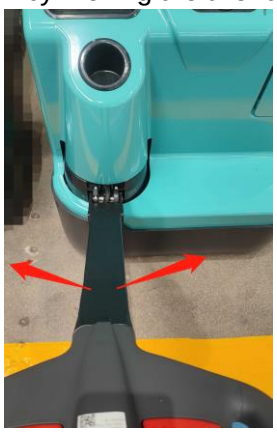
Fig.11: Operating direction

After starting the truck by turning the inserted key to the “ON”-position (fig. 8); and eventually by pulling the emergency button carefully, move the tiller to the operating zone (‘F’, fig.11).
Turn the accelerator button to the desired direction forward ‘Fw.’ Or backwards ‘Bw.’(fig.11).
Control the travelling speed by moving the accelerator button (4) carefully until you reached the desired speed.

If you move the accelerator button back to the neutral position, the controller decelerates the truck until the truck stops. If the truck stopped, the parking brake will be engaged.
Drive carefully the truck to the destination. Watch the route conditions and adjust the travelling speed with the accelerator-button.

f. Steering

Steer the truck by moving the tiller to the left or right side.



g. Braking

THE BRAKING PERFORMANCE DEPENDS ON THE TRACK CONDITONS AND THE LOAD CONDITONS OF THE TRUCK

The braking function can be activated on several ways:

- By moving the accelerator button (4) back to the initial ‘0’ position or by releasing the button, the regenerative braking is activated. The truck brakes until it stops.
- By moving the accelerator button (4) from one driving direction directly to the opposite direction, the truck brakes regenerative until it starts travelling into the opposite direction.
- The truck brakes, if the tiller is moved up or down to the braking zones (‘B’). If the tiller is released, the tiller moves automatically up to the upper baking zone (‘B’). The truck brakes until it stops.
- The safety (belly) button (3) prevents the operator from being crushed. If this button is activated, the truck decelerates and/ or starts travelling into the backwards direction (‘Bw.’) for a short distance and stops. Please consider, that this button also operates, if the truck is not travelling and the tiller is in the operating zone.

h. Malfunctions

If there are any malfunctions or the truck is inoperative, please stop using the truck and activate the emergency button (6) by pushing it. If possible, park the truck on a safe area, turn the key switch (8) anti-clockwise and remove the key. Inform immediately the manager and, or call your service. If necessary, tow the truck out of the operating area by using dedicated towing/ lifting equipment.

i. Emergency

In emergencies or in the event of tip over (or off dock), keep safe distance immediately. If possible push the emergency button (6). All electrical functions will be stopped.

6. BATTERY MAINTENANCE, CHANGING AND REPLACEMENT

- Only qualified personnel are allowed to service or charge the batteries. The instructions of this manual and from the battery- manufacturer must be observed.
- Lead-acid batteries and lithium batteries are allowed.
- Recycling of batteries undergoes national regulations. Please follow these regulations.
- By handling batteries, open fire is prohibited, gases could cause explosion!
- In the area of battery charging neither burning materials nor burning liquids are allowed. Smoking is prohibited and the area must be ventilated.
- Park the truck securely before starting charging or installing/changing the batteries
- Before finishing the maintenance work, make sure, that all cables are connected correctly and that there are no disturbing towards other components of the truck.

Depending on the version, the truck is equipped with different battery types. The following tables show which combinations are intended as standard, indicating the capacity.
The battery weights can be taken from the battery data plate.

Manufacturer`s type designation	Battery type	Capacity	Weight	Dimensions
PS 12L	24V Lead-acid batteries, 2 PzB	180 Ah	165 kg	660x146x657 mm
	24 V Li-Ion battery	100 Ah	54 kg	624x146x590 mm
	24 V Li-Ion battery	150 Ah	59 kg	624x146x590 mm
PS 16L	24V Lead-acid batteries, 3 VBS	270 Ah	230 kg	752x172x657 mm
	24 V Li-Ion battery	150 Ah	72 kg	752x172x657 mm
	24 V Li-Ion battery	200 Ah	81 kg	752x172x657 mm
PS 20L	24V Lead-acid batteries, 3 PzS	350 Ah	288 kg	624x284x627 mm
	24 V Li-Ion battery	150 Ah	83 kg	624x284x627 mm
	24 V Li-Ion battery	200 Ah	90 kg	624x284x627 mm

LEAD-ACID BATTERIES AND LITHIUM BATTERIES ARE ALLOWED.
THE WEIGHT OF THE BATTERIES HAS AN INFLUENCE TO THE TRUCKS OPERATING BEHAVIOR.
PLEASE CONSIDER THE MAXIMUM OPERATING TEMPERATURE OF THE BATTERIES.

Lead-acid battery and lithium battery

a. Replacement

Park the truck securely and switch off the stacker with the key (8) and activate the emergency button (6). Open the battery cover and pull out the hinge, remove the battery cover. Unscrew and remove the battery baffle plate, pull out the battery plug (Fig.13), and take the batteries out with a crane. The installation is in the reverse order of the removal. Please connect the positive terminals firstly. Otherwise the tuck could be damaged.

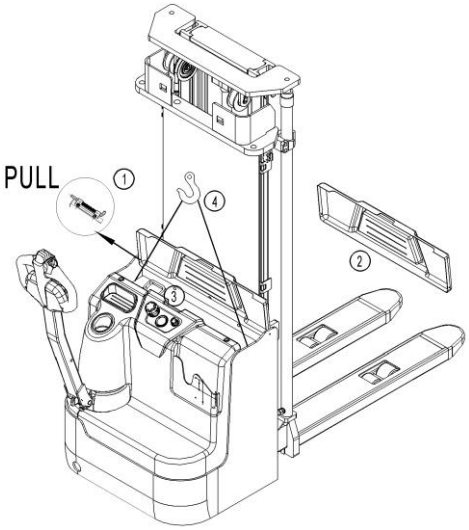
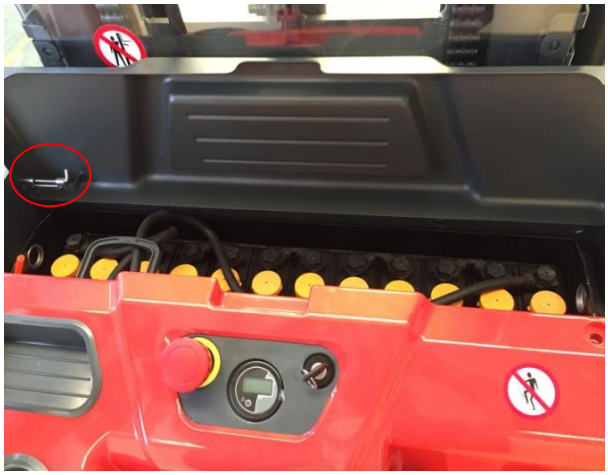
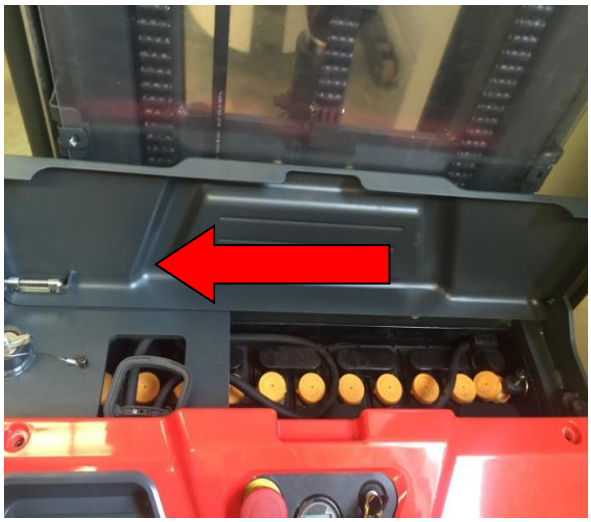


Fig. 12: Battery replacement

a-1. Vertical lifting installation mode

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">1.Pull out the hinge and remove the battery case cover.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>2.Remove battery power plug</td><td>3.Connect here with a tool, such as a hook, and remove the battery</td></tr>
</table>

a-2. Side pulling installation mode

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>1.Open the lid of the battery box</td><td>2.Pull off the power plug</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>3.Unscrew bolts with 5 mm hexagon wrench</td><td>4.Pull out plugs</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">5.Pull the battery out in the direction indicated by the arrow and the installation process is the reverse of the removal process.</td></tr>
</table>

b. Battery indicator

The discharge status is indicated by ten red LED segments.

Battery discharged Battery charged

Fig.13: Battery discharge indicator

Only when the battery is properly charged, the most right LED lit As the battery's state-of-charge decreases, successive LEDs light up, only one on at a time.

- The 2nd from left LED flashes, indicating "energy reserve" (70% depth of discharge).
- The 2 most left LEDs alternately flash, indicating "empty" (80% depth of discharge).

c. Charging

- Before charging ensure that you are using an appropriate charger for charging the installed battery!
- Before using the charger, please fully understand the instructions of the charger instructions.
- Always follow these instructions!
- The room, where you are charging must be ventilated.
- The exactly charge status can be only checked from the dischrge indicator. To control the status, the charging must be interrupted and the truck must be started.

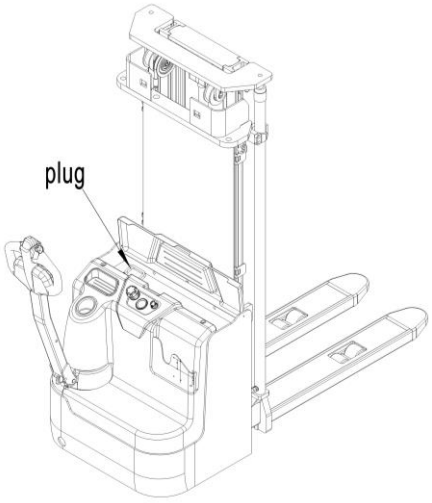


Fig.14: Lead-acid Battery charging

Park the truck at a dedicated secured area with a deidcated power supply. Lower the forks and remove the load.Open the battery cover and let it stay upright.

Lead-acid battery (Fig.14)：Switch the truck off and connect the battery plug to the charging plug of the charger.

Lithium-ion battery (Fig.15)：Switch the truck off and connect the battery charging port to the charging plug of the charger. There is no need to unplug the discharge port.

The charger starts charging the battery if the charger is connected to the main power supply.

Lead-acid battery (Fig.14)：Disconnect the battery plugs after the charger finished charging. Connect the battery plug with the plug at the truck.

Lithium-ion battery (Fig.15)：Disconnect the battery charging port after the charger finished charging. Close the battery cover.

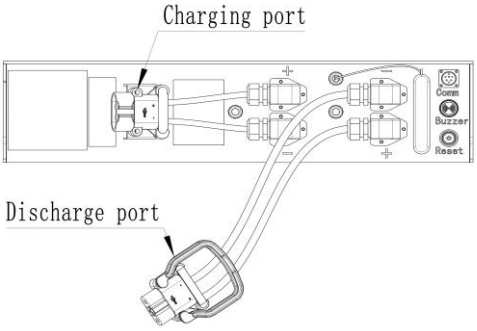


Fig.15: Lithium Battery charging

1.THE PLUG-IN OF THE PRODUCT IS CONNECTED TO THE PLUG-IN OF THE CHARGER AND CAN BE CHARGED.

d. Description of the lithium-ion battery

The Lithium-ion battery is a battery with rechargeable cells, the battery is designed for industrial trucks and is able to withstand related vibrations during operation. The battery is equipped with special connections for charging and discharging operations. Avoid installing the improper battery or connecting the improper chargers to the battery.

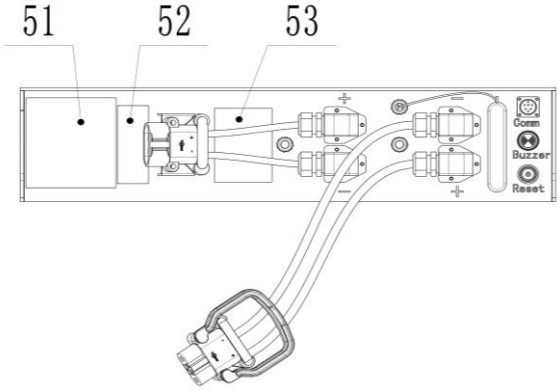
The battery is equipped with BMS–battery management system, which performs the control of battery condition and implements related safety protocols to protect the battery and cells from damages caused by operation or environmental conditions. The BMS controls the following safety functions and conditions: voltage, temperature, undervoltage, overvoltage, overtemperature and overcurrent.

Battery operation and charging temperature ranges

The best battery life can be achieved in the range of 5℃ to 40℃. Low temperature will reduce the available capacity of the battery, high temperature will reduce the service life of the battery. Under running condition, the minimum working temperature of the battery cell is -20℃, and the maximum working temperature is 60℃. Within this temperature range, the truck can operate normally; Under charging state, the minimum working temperature of the battery cell is 0℃, the maximum working temperature is 55℃, within this range, the battery can be charged normally; The temperature difference between the two ends of the battery shall not exceed 5℃.

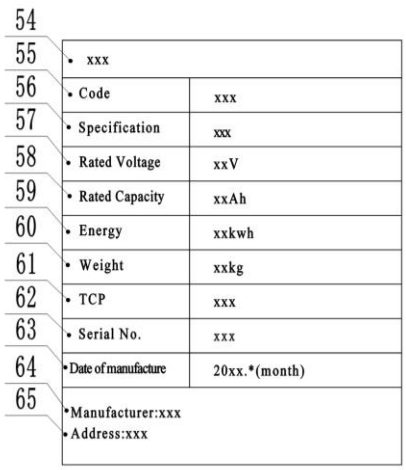
Only approved battery chargers must be used to charge the lithium-ion battery.

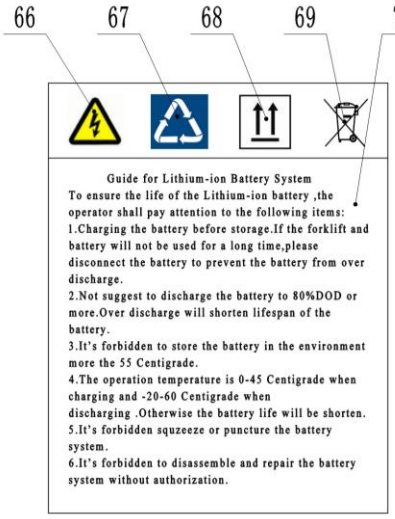
e. Lithium-ion Battery Labels



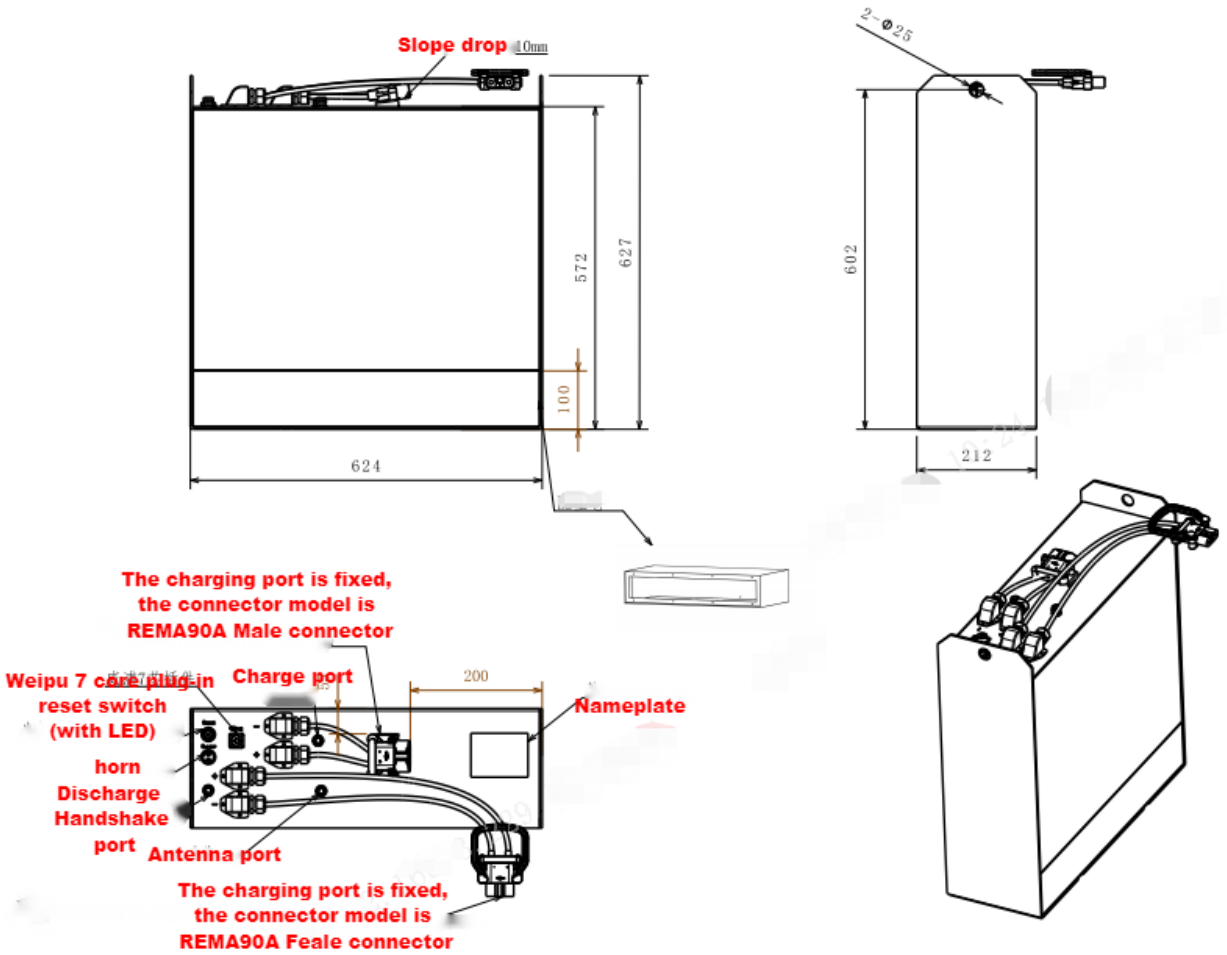
Item	Description
51	Identification plate
52	Bar code and 2Dcode
53	Warning Label

Identification plate and Warning label





Item	Description	Item	Description
54	Manufacturer's mark in English	65	Manufacturer's address
55	Material Code	66	electrical hazard marker
56	Battery specifications	67	Rechargeable logo
57	Rated voltage	68	Vertical upward packing, transportation and use
58	Rated Capacity	69	No putting into ordinary garbage bins
59	Rated Energy	70	Guide to use
60	Weight	71	Production date
61	TCP	72	Battery information bar code
62	Production Serial No.	73	Bar code interpretation
63	Production date	74	Battery information by 2D code
64	Name of manufacturer		



Outline diagram (24V 100Ah)

Technical parameter

Items		Data(PS12/16L)	Note
Specification		24V100Ah	
Nominal voltage		24V	
Nominal capacity		150Ah	0.5C discharge
Weight		72kg	
Discharge	Maximum continuous discharge current	80A	
	Maximum Pulse Discharge Current	180A	Not exceeding 30 seconds
	Discharge cut-off voltage	≥20V	
Charge	Standard charge current	60A	
	Max charge current	75A	
	Charge voltage	29.2V	
Initial impedance		<25mΩ	Between positive and negative poles
Charging temperature		0～55℃	
Discharge temperature		-20～60℃	
Storage temperature range		-20～35℃	

f. Safety Instructions, Warning Indications and other Notes for lithium-ion batteries

Safety regulations for handling lithium-ion batteries

Do not try to make any repairs or maintenances of lithium-ion batteries

Risk of electric shock and burning

The battery's charging and discharging connectors have open terminals, avoid any body contacts, contamination or direct contacts with objects which can cause short circuit connection of terminals. Use necessary pre-cautions and protective caps to secure the open terminals. The connectors should be maintained in clean and dry conditions.

Use only batteries designed and approved by the manufacturer for the truck.
Do not try to modify or alter the battery.

Any damage or defects to the charger can result in accidents. Use only charger approved by the manufacturer of the truck, which is suitable for used battery

In case charger has any damages or defects, remove the charger from operation and contact your service provider. Do not modify or try to repair the charger.

Improper use of charger or use of wrong charger can cause damages to the battery or charger. The operation voltage of the charger shall be subject to the charger specifications; the maximum charging voltage is 29,2V, the charging current is 60 or 80 A depending on battery capacity. If the operation voltage of the charger is out of the applicable voltage range, the charger or battery will be damaged, which may cause serious safety accidents. The charger must only be used for batteries supplied by the manufacturer.

Reversed connection of charging plug is prohibited. Please follow the instruction for correct connection. Use dedicated grip to disconnect the charger from the plug and never pull out the plug with cable.

Stop charging immediately if any abnormalities are detected, e.g. severe temperature increase, deformation of battery case, smoke, noise etc.

Intermediate charging

Lithium-ion batteries support intermediate charging so called opportunity charging. The lithium-ion battery, which is not fully discharged can be charged in any time. However, frequent opportunity charging not to the full charging state and stop of charging process before the appearance of corresponding indication of charger may result in dis-balance voltage of cells. In order to effectively deal with this phenomenon, charge the battery in full allowing the automotive balancing process is to be completed at least once a week.

Potential hazards

If the equipment is used according to its design purpose, following the correct operations procedures, there are no hazards anticipated.

The following hazards can arise in the event of improper use:

- Physical damage to the battery would be caused by falling or be deformed. Mechanical damages may cause leakages of harmful materials, fire or battery explosion.
- Short circuits may be caused by connecting the two battery terminals, for instance caused by water or intentional/unintentional connections.
- The batteries being placed in overheated locations or being exposed to open flame, open sunlight etc. can cause leakages of harmful materials, fire or explosion.

In order to avoid fire, explosion and leakage of harmful materials, a safe place for storing batteries until the qualified personnel arrive must satisfy the following conditions:

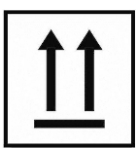
- Do not store in places with human activities.
- Do not store in places with valuable objects and close to valuable objects.
- A Co2 fire extinguisher must be available on demand.
- There should not be any fire or smoke detectors in the storage area in order to ensure that an automatic fire detection system is only activated in the event of actual danger (e.g. open flames).
- No ventilation intake pipes should be in the facility to exclude spreading of discharged substances within a building.

Examples of where to store a non-functional battery:

- Roofed outdoor position.
- Ventilated container.
- Covered fire resistant box with pressure and smoke discharge option.

Symbols-Safety and Warnings

Table 3: Symbols-Safety and Warnings

	Caution! Battery short-circuit is prohibited.
	The battery can be recharged cyclically
	Vertical upward packing, transportation and use
	Used lithium-ion batteries must be treated as hazardous waste. Lithium-ion batteries marked with the recycling symbol and the sign showing a crossed-out waste bin must not be disposed of with ordinary household waste.

Explosion and fire hazard

Physical damage, thermal effects or incorrect storage of a defective battery can result in explosions or fire. Materials of the battery can be flammable.

Particular hazard from combustion products

The lithium-ion batteries may be damaged by a fire. When extinguishing a lithium-ion battery fire, the following information must be taken into consideration.

Contact with combustion products can be hazardous

Fire produces combustion products, which can occur in the form of smoke, through leaking fluids, escaping gases, debris as well decomposition products of certain chemicals. These combustion products which are substances that enter the body through the respiratory tract and/or the skin can produce and adverse effects such as choking.

Avoid contact with combustion products.

Use protective equipment.

Special firefighting protective equipment

Use self-contained breathing apparatus.
Wear protective equipment.

Additional firefighting instructions

To prevent secondary fires, the lithium-ion battery must be cooled from the outside. Fluids or solids must never be directed into the lithium-ion battery.
Suitable extinguishing agents

- Carbon dioxide extinguisher (CO2)
- Water (not on mechanically opened or damaged batteries)

Unsuitable extinguishing agents

- Foam
- Grease fire extinguishing agents
- Powder extinguishers
- Metal fire extinguishers (PM 12i extinguishers)
- Metal fire powder PL-9/78 (DIN EN 3SP-44/95)
- Dry sand

Instructions for cooling an overheated, non-physically damaged battery

This type of damage may be caused by a short circuit inside the battery, which may result in leakage of harmful materials, fire or explosion.

Material discharge

Battery electrolyte fluid can be hazardous

Electrolyte fluid may be discharged if the battery is physically damaged. Avoid its contact with skin or eyes. If that happened:

- Rinse the affected parts with big amount of water and request for medical assistance immediately.
- In case of skin irritation or if any substances are breathed in, request the medical assistance immediately.

Precautionary measures for personnel

- Keep personnel away, avoid any contact with smoke or discharged materials.
- Block off the affected area and ensure its reasonable ventilation.
- Wear personal protective equipment. If vapors, dust or aerosols are presented, use self-contained breathing apparatus.

Precautionary measures for the environment

Do not allow spilled fluids to enter the water system, drainage system or the underground water.

Cleaning measures

The leaked fluid must be removed professionally following the related protocols.

Battery lifetime and maintenance

The lithium-ion batteries are maintenance-free.

Full discharge can damage the battery

Self-discharge can cause the battery to fully discharged state. Full discharge shortens the service life of the battery. When battery will not be able to be charged anymore, deep discharging and activation of related safety protocols might appear in the battery

Before a long period of inactivity, the battery must be charged to at least 50%.
Re-charge the battery at least every 12 weeks.

If the battery is deeply discharged or if the battery temperature is below the permissible level, the battery can not be charged. Deep discharged batteries can never be charged. Due to the risk of condensed water, batteries that have been stored at 0°C or below must only be charged after natural warming up to at least +5°C, and they're forbidden to be heated forcedly.

Storage and safety handling

Storage of batteries

Deep Discharge can damage the battery

If the battery is not used for a long period of time, it can become damaged through discharge.

- Before a long period of inactivity, the battery must be charged to the level of at least 50%.
- Recommended to check and charge, if necessary, the battery every 4 weeks when not in use.
- The storage of fully charged battery reduces its lifetime. Recommended level of charge is in the range of 30% to 70%
- The temperature range for storing the battery is 0°C to 30°C.

Instructions for safety handling

New lithium-ion batteries are transported and stored with a charge state <70%.

- Do not modify the battery.
- Do not open, damage, drop, penetrate or deform the battery.
- Do not throw the battery into a fire.
- Protect the battery from overheating.
- Protect the battery from direct sunlight.
- Follow storage and charging procedures

Failure to comply with these safety instructions can result in fire and explosion or the leakage of harmful materials.

Faults

If any damage is found to the battery or battery charger, contact the service provider immediately.
Do not open the battery.

Disposal and transportation of a lithium-ion battery

Instructions for disposal

Lithium-ion batteries must be disposed of in accordance with the relevant national environmental protection regulations. Batteries must be treated as hazardous waste. Batteries must not be disposed with ordinary waste.

Transportation information

The lithium-ion battery is a hazardous material. The applicable regulations must be observed during transportation.

Transportation of functional batteries

Functional batteries can be transported in accordance with the related regulations

Transportation of Defective batteries

For transportation of defective lithium-ion batteries, contact the service provider. Defective lithium–ion batteries require following of special transporting procedures.

Emergency management

During product storage, installation and use please follow the procedures provided in this section for the following emergencies.

a. Product fire

If the product smokes on fire, please stop the work of the product. Under the premise of ensuring the safety of personnel, we can use class D fire extinguisher or sand soil to extinguish the fire. It is forbidden to disassemble the machine for private maintenance. Please contact our company or authorized dealer to provide technical support as soon as possible.

b. The product is immersed in water

If the product is immersed in water, stay away from the site immediately. It is forbidden to dismantle and repair the machine privately. Please contact our company or authorized distributor to provide technical support as soon as possible.

c. Products produce peculiar smell

If the battery has a distinct odor (similar to liquor flavor), immediately remove the battery pack. Avoid contact with leaking liquids and gases. Once contacted, please clean in time.

d. Necessary safety equipment

Self-contained breathing apparatus and personal protective equipment.
Class D fire extinguishing system.
Other unknown circumstances may contact our company or authorized dealer to provide technical support.

g. Charger

Main product specification Outline dimension: L*W*H

model / item	CBZ3F-25A/24V	CBZ3F-30A/24V	CBZ3F-35A/24 V	CBZ3F-40A/24 V	CBZ3F-45A/24 V	CBZ3F-50A/24 V	CBZ3F-55A/24 V	CBZ3F-30A/36 V	CBZ3F-40A/36 V	CBZ3F-25A/48 V
Input voltage V，HZ	Single phase 220-240V 50-60HZ									
input power KW	0.9	1.1	1.3	1.5	1.7	1.9	2.1	1.7	2.3	1.9
input current A	4.3	5.1	6.0	6.8	7.7	8.5	9.4	7.7	10.2	8.5
output current A	25	30	35	40	45	50	55	30	40	25
Rated voltage V	24	24	24	24	24	24	24	36	36	48
9-12h battery capacity Ah	145-200	175-240	205-280	230-320	260-360	290-400	320-440	175-240	230-320	145-200
Outline dimension mm	240*350*260									
Net Weight kg	21.5		23.5		25.5		23.5	24.5		

model / item	CBZ3F-30A/48V	CBZ3F-35A/48V	CBZ3F-25A/72V	CBZ3F-30A/72V	CBZ3F-65A/24V	CBZ3F-45A/48V	CBZ3F-55A/48V	CBZ3F-65A/48V	CBZ3F-85A/48V
Input voltage V，HZ	Single phase 220-240V 50-60HZ					Dual phase 380V ， 50-60HZ			
Input power KW	2.3	2.6	2.8	3.4	2.4	3.4	4.1	3.9	4.0
output power A	10.2	11.9	12.8	15.3	11.1	8.9	10.9	12.8	15.8
output current A	30	35	25	20	65	40	55	65	80
Rated voltage V	48	48	72	72	21	48	48	48	48
9-12h battery capacity Ah	175-240	205-280	140-200	175-240	375-520	260-360	320-440	375-520	465-640
Outline dimension mm	240*350*260		280*430*310		420*360*602				
Net Weight kg	28		35.5		35	41	45	49	55

7. REGULAR MAINTENANCE

- Only qualified and trained personnel are allowed to do maintenance on this truck.
- Before maintaining, remove the load and lower the forks to the lowest position.
- If you need to lift the truck, follow chapter 4-b by using designated lashing or jacking equipment. Before working, put safety devices (for instance designated lift jacks, wedges or wooden blocks) under the truck to protect against accidental lowering, movement or slipping.
- Please pay attention by maintain the tiller arm. The gas pressure spring is pre-loaded by compression. Carelessness can cause injury.
- Use approved and from your dealer released original spare parts.
- Please consider that oil leakage of hydraulic fluid can cause failures and accidents.
- It is allowed to adjust the pressure valve only from trained service technicians.

If you need to change the wheels, please follow the instructions above. The castors must be round and they should have no abnormal abrasion.
Check the items emphasized maintenance checklist.

a. Maintenance checklist

Table 4: Maintenance checklist		Interval (Month)			
		1	3	6	12
	Hydraulic				
1	Check the hydraulic cylinder, piston for damage noise and leakage		•		
2	Check the hydraulic joints and hose for damage and leakage		•		
3	Inspect the hydraulic oil level, refill if necessary		•		
4	Refill the hydraulic oil (12 month or 1500 working hours)				•
5	Check and adjust the function of the pressure valve (1200kg/1600kg/2000kg +0/+10%)				•
	Mechanical system				
6	Inspect the forks for deformation and cracks		•		
7	Check the chassis for deformation and cracks		•		
8	Check if all screws are fixed		•		
9	Check mast and chain for corrosion, deformation or damages, replace if necessary	•			
10	Check the gearbox for noise and leakage		•		
11	Check the wheels for deformation and damages, replace if necessary		•		
12	Lubricate the steering bearing				•
13	Inspect and lubricate the pivot points		•		
14	Lubricate the grease nipples	•			
15	Replace the guarding and/or protective screen if it is damaged	•			
	Electric system				
16	Inspect the electric wiring for damage		•		
17	Check the electric connections and terminals		•		
18	Test the Emergency switch function		•		

19	Check the electric drive motor for noise and damages		•		
20	Test the display		•		
21	Check if correct fuses are used, if necessary replace.		•		
22	Test the audio warning signal		•		
23	Check the contactors		•		
24	Check the frame leakage (insulation test)		•		
25	Check function and wear of the accelerator		•		
26	Check the electrical system of the drive motor		•		
	Braking system				
27	Check brake performance, if necessary replace the brake disc or adjust the air gap		•		
	Battery				
28	Check the battery voltage		•		
29	Clean and grease the terminals and check for corrosion and damage		•		
30	Check the battery housing for damages		•		
	Charger				
31	Check the main power cable for damages			•	
32	Check the start-up protection during charging			•	
	Function				
33	Test the audio warning signal	•			
34	Check the air gap of the electromagnetic brake	•			
35	Test the emergency braking	•			
36	Test the reverse and regenerative braking	•			
37	Test the safety (belly) button function	•			
38	Check the steering function	•			
39	Check the lifting and lowering function	•			
40	Check the tiller arm switch function	•			
41	Test the key switch of damages and function	•			
42	Test the speed limitation switch (lifting height >~300mm)	•			
	General				
43	Check if all decals are legible and complete	•			
44	Check if the protective screen and or guarding is not damaged	•			
45	Inspect the castor, adjust the height or replace it, if worn out		•		
46	Carry out a test run	•			

b. Lubricating points

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

1 Bearings in wheels
2 Main frame post
3 Chain
4 Hydraulic system
5 Steering bearing

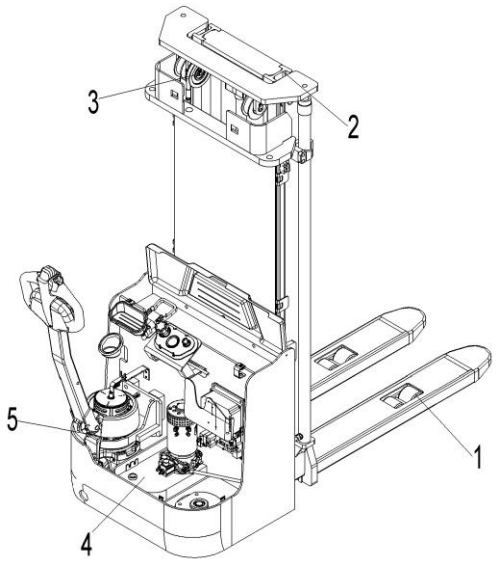


Fig. 16: Lubricating points

c. Check and refill hydraulic oil

It is recommended to use hydraulic oil in connection with average temperature:

Environment temperature	–5℃~25℃	>25℃
Type	HVLP 32，DIN 51524	HLP 46，DIN 51524
Viscosity	28.8-35.2	41.4-47
Amount	9.4L (depend on the actual type)	

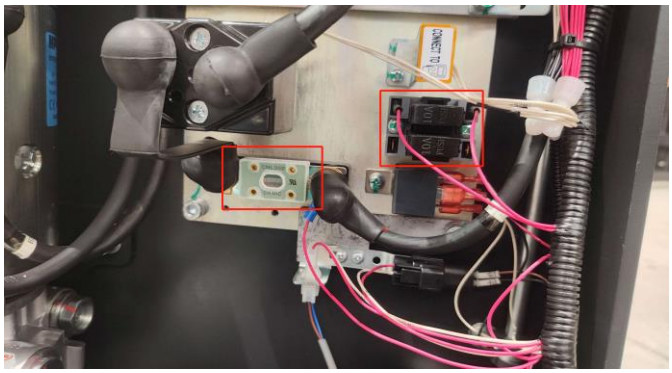
Waste material like oil, used batteries or other must be probably disposed and recycled according to the national regulations and if necessary brought to a recycling company.
The oil level height shall be in the not lifted position min.9.3L to 9.5L.
If necessary add oil at the filling point.

d. Checking electrical fuses

Remove the main cover. The fuses are located according to Table 5.

Table 5: Size of the fuses

	Rate
FU1	10A
FU2	10A
FU 01	350A



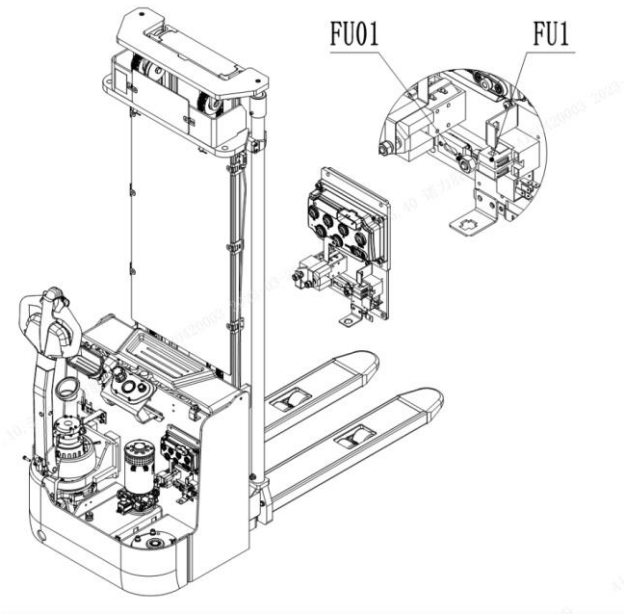
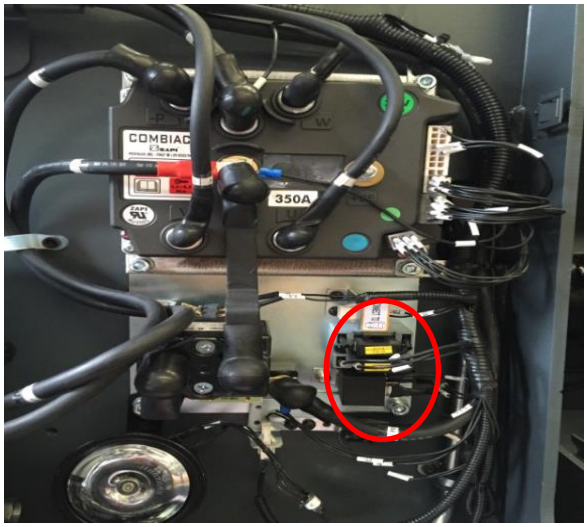
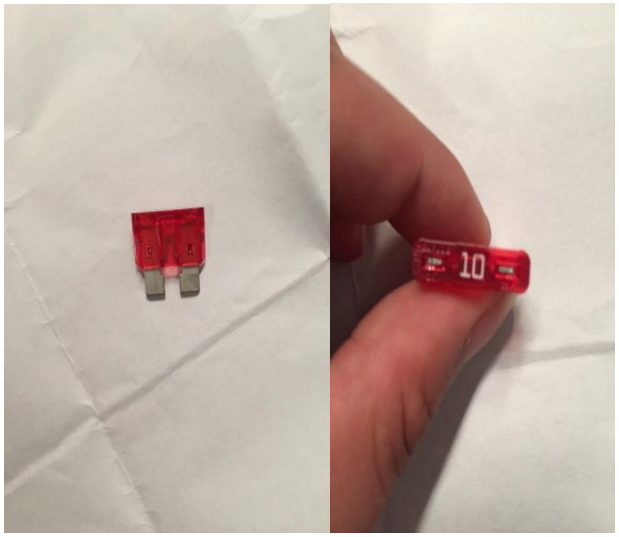


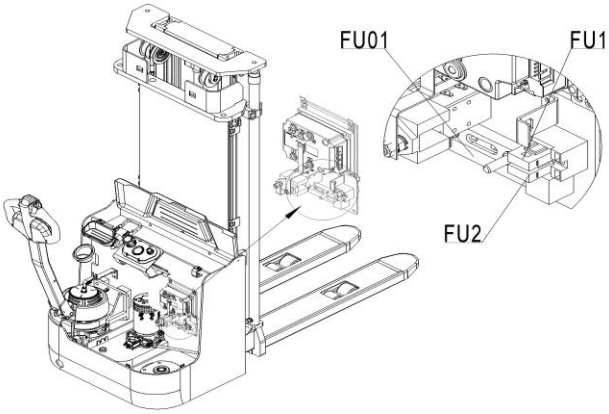
Fig. 17: the size is according to table

Replace fuse 1, fuse 2, fuse 01 (refer to 10.a circuit diagram)

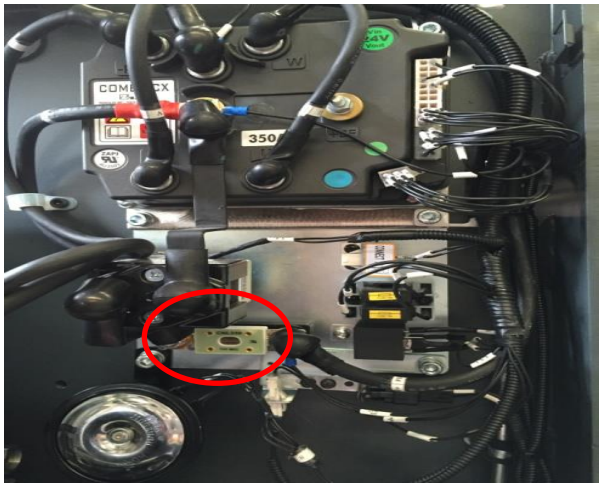
	
1. Open the fuse box	2.After opening the fuse box, take out the old fuse, replace it with a new one, and install it as well as the reverse of the above process.

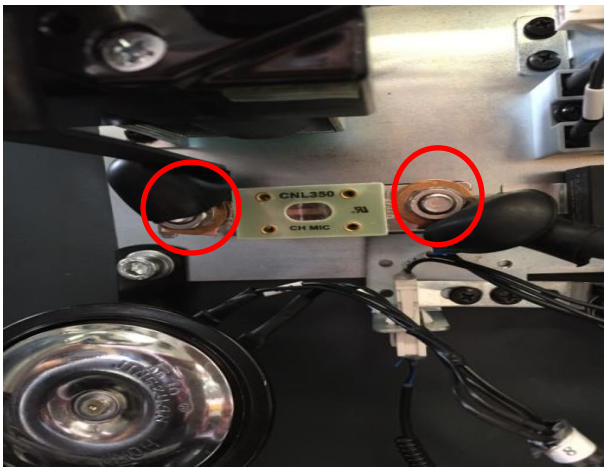


Fuse	Fuse1	Fuse2	Fuse01
specifications	10A	10A	350A



Fuse position





1.Unscrew the nut with a 13mm open-ended wrench, remove the fuse and replace it with a new one. The installation process and the reverse of the above process are described.

e. Removing, reattaching guarding

DO NOT USE THIS TRUCK, IF THE GUARDING IS DAMAGED OR NOT CORRECTLY ASSEMBLED!

If the guarding needs to be removed, unbolt the fixing screws and remove the screen carefully. The screws will remain with the screen. For reattaching place the screen to the right position and fix each screw correctly. If you need to replace parts, please call your next service partner.

Move the clips for the protective screen sideways and remove the screen. Assembling is in the opposite direction. Please make sure that the screen is fixed correctly and that the fixing elements are not damaged.

8. TROUBLE SHOOTING

- If the truck has malfunctions follow the instructions, mentioned in chapter 6.

Table 6: Trouble shooting

TROUBLE	CAUSE	REPAIR
Load can't be lifted	Load weight too high	Lift only the max. capacity, mentioned on the ID-plate
	Battery discharged	Charge the battery
	Lifting fuse faulty	Check and eventually replace the lifting fuse
	Hydraulic oil level too low	Check and eventually refill hydraulic oil
	Oil leakage	Repair the hoses and/or the sealing of the cylinder
	Lifting stops at ~1800mm	Move the protective arms into the downside position
	Lifting stops at ~1800mm	Check the sensor for the protective arm
	Height sensor for 1800mm height defect	Check the height sensor on the mast
Oil leakage from air breathing	Excessive quantity of oil.	Reduce oil quantity.
Stacker not starts operating	Battery is charging	Charge the battery completely and then remove the main power plug form the electrical socket.
	Battery not connected	Connect the battery correctly
	The fuse is faulty	Check and eventually replace fuses
	Battery discharged	Charge the battery
	Combined emergency switch is activated	De-activate the combined emergency switch by insert and pull the knob.
	Tiller in the operating zone	Move the tiller firstly to the braking zone.
	Protective arms in the upright position, platform folded upright	Move the protective arms into the downside position
	Foldable platform or protective arms in one of the allowed positions	Check the proximate sensors for the arms and platform
	Foldable platform or protective arms not in one of the allowed positions	Check the correct function of the arms and/or platform
Only travelling in one direction	The accelerator and the connections are damaged.	Check the accelerator and the connections.
The stacker only travels very slowly	The battery is discharged.	Check the battery status at the discharge indicator
	The electromagnetic brake is engaged.	Check the electromagnetic brake

	The relating tiller cables are disconnected or damaged	Check the tiller cables and connections.
	Defective height sensor for reduced speed at ~300mm height	Check the sensor
	Electric system overheated	Stop using and cool down the truck
	Defective heat sensor	Check and if necessary replace the heat sensor
The stacker starts up suddenly	The controller is damaged.	Replace the controller.
	The accelerator not moves back to its neutral position.	Repair or replace the accelerator.

If the truck has malfunctions and can't be operated out of the working zone, jack the truck up and go with a load handler under the truck and safe the truck securely. Then move the truck out of the aisle.

9. WIRING/ CIRCUIT DIAGRAM

a. Electrical circuit diagram

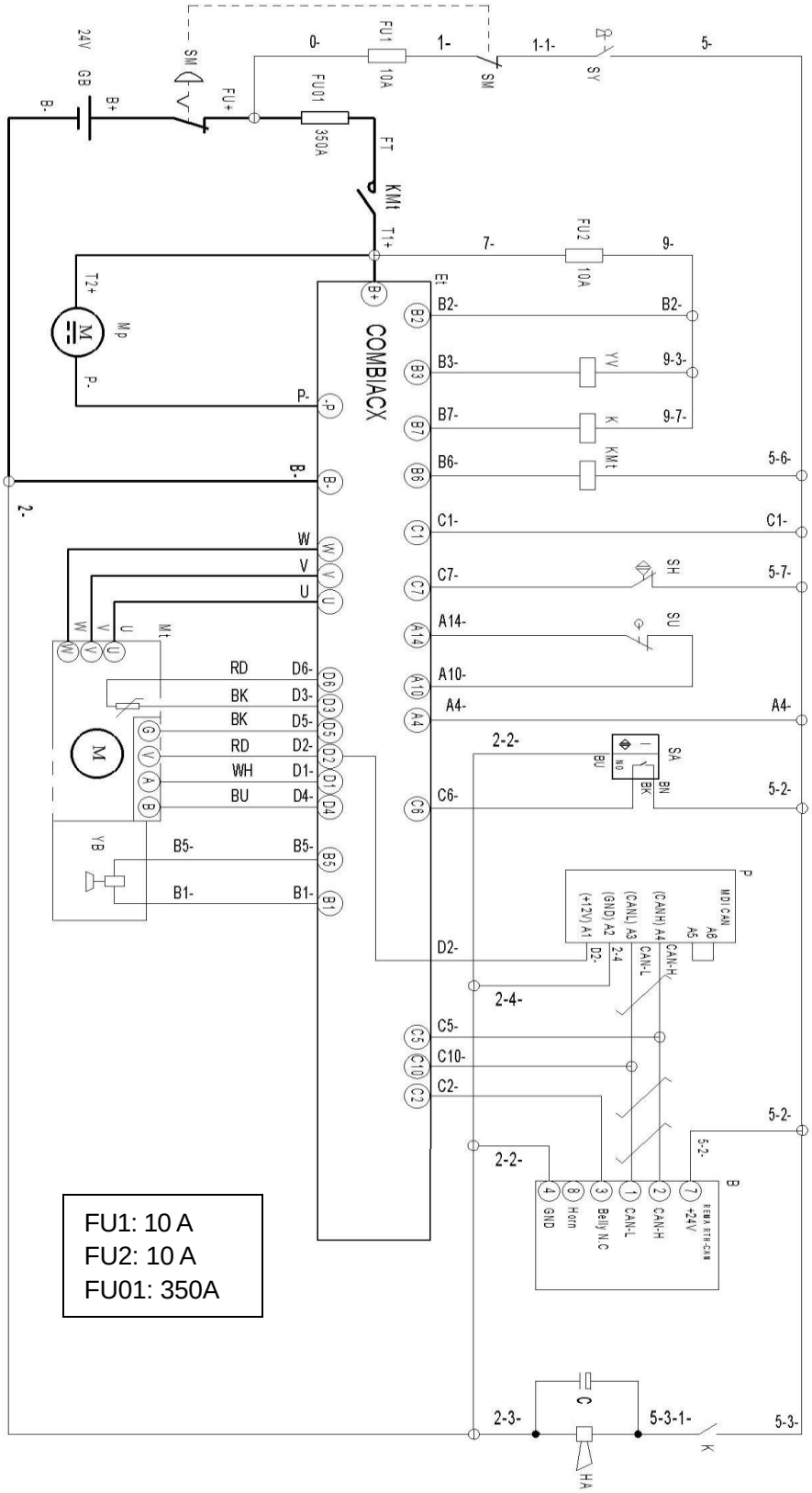


Fig. 18: Electrical diagram(COMBIACX) PS12/16 L

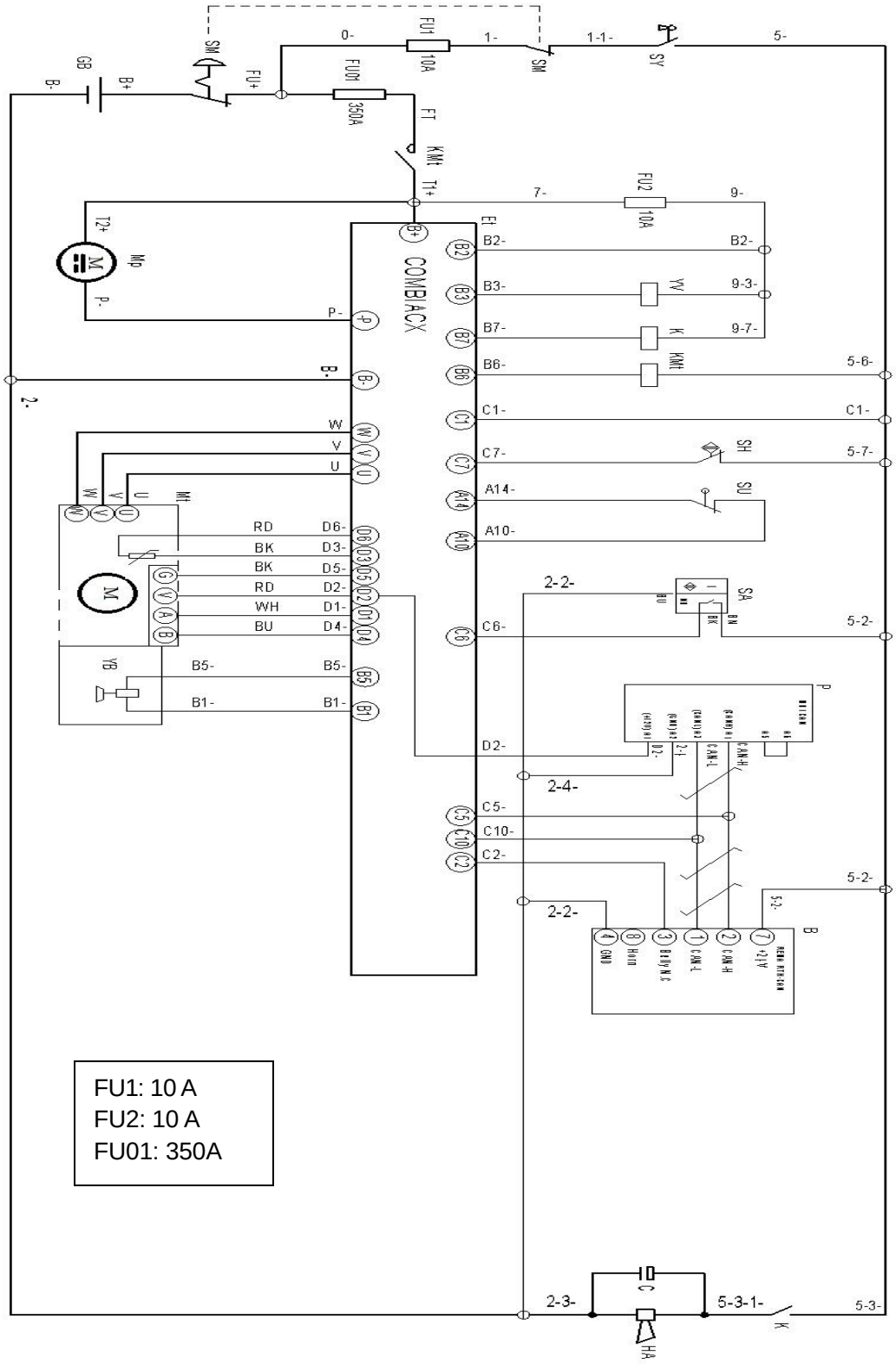


Fig. 19: Electrical diagram(COMBIACX) PS20L

Table 7: Description of electrical diagram

Code	Item	Code	Item
GB	Battery	YB	Electromagnetic brake
SM	DC power switch	VD	Diode
Et	Controller	K	Relay
KM	Main contactor	SA	Proximity switch
FU01	Fuse 350A	B	Tiller
FU1	Fuse 10A	C	Capacitor
FU2	Fuse 10A	HA	Horn
P	Indicator	SH	Magnetic switch
SY	Key switch	SU	Micro switch
KMp	Lifting contactor	YV	Electromagnetic valve
Mp	Pump motor	T1+	Copper bar
Mt	Traction motor	FT	Copper bar

b Electrical circuit diagram (EN1175:2020)

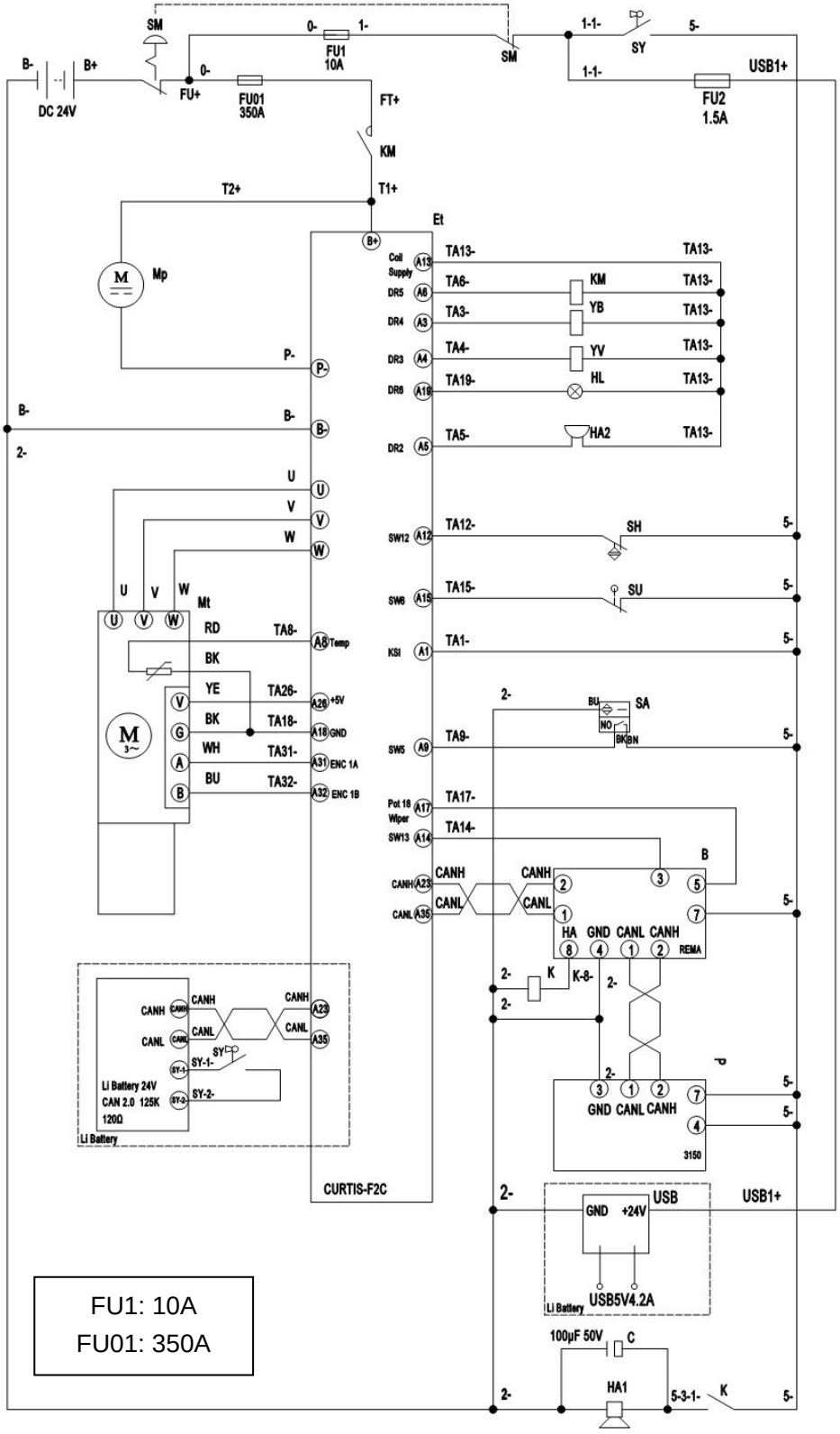


Fig. 20: Circuit diagram (EN1175:2020)

Table 8: Description of electrical diagram

Code	Item	Code	Item
GB	Battery	VD	Diode
SM	DC power switch	K	Relay
Et	Controller	SA	Proximity switch
KM	Main contactor	B	Tiller
FU01	Fuse 350A	C	Capacitor
FU1	Fuse 10A	HA1	Horn
P	Indicator	SH	Magnetic switch
SY	Key switch	SU	Micro switch
KMp	Lifting contactor	YV	Electromagnetic valve
Mp	Pump motor	HL	Blue light
Mt	Traction motor	HA2	Buzzer
YB	Electromagnetic brake	USB	USB power

c. Hydraulic circuit

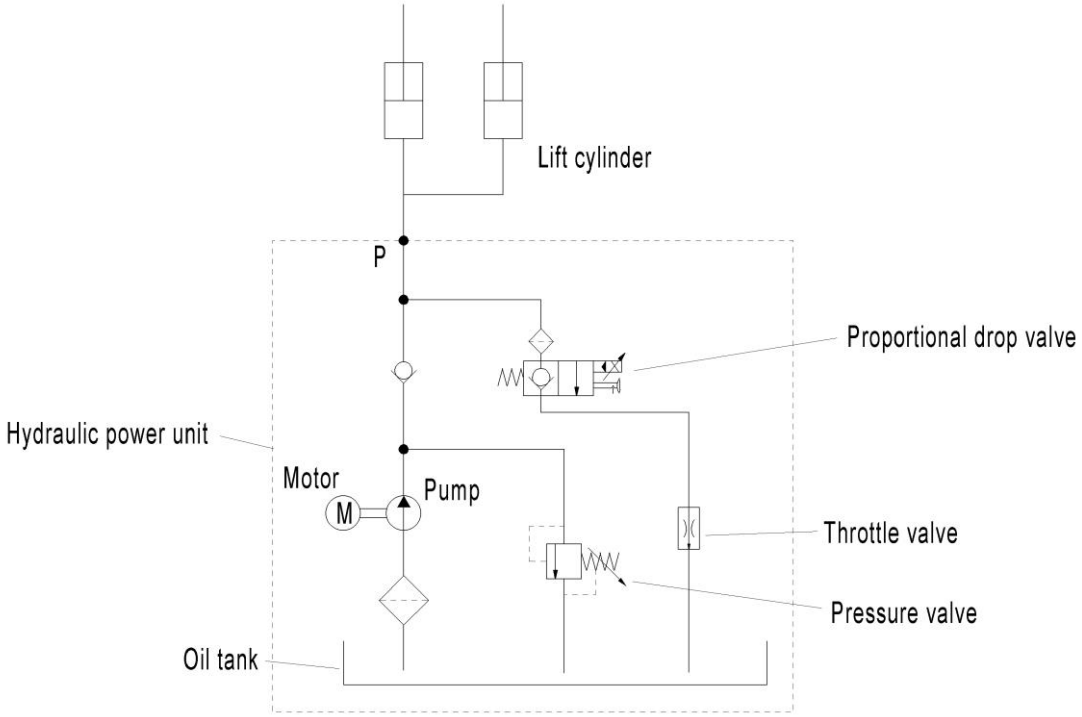


Fig. 20: Hydraulic circuit of PS12L

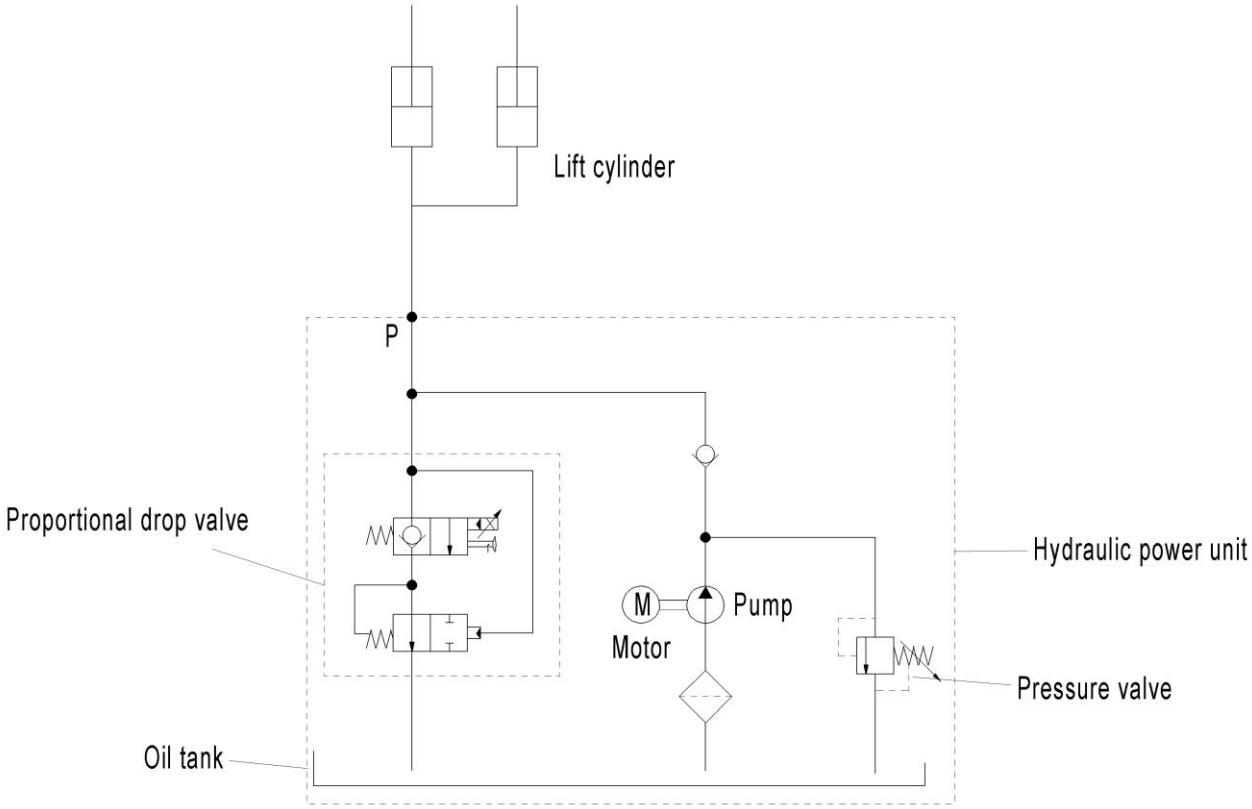


Fig. 21: Hydraulic circuit of PS16/20L

11. Electrical Systems

a. Overview

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

1 The battery supplies power to the electrical system.

2 Press the power switch to turn off all DC and AC circuits in case of emergency.

3 Motors, controllers and associated equipment provide the necessary drive and pump power to the vehicle based on their interactions with sensors, switches, relays and actuators and many parameter settings.

4 Fuses protect all DC loads from overcurrent by cutting off the power to the load when the load is powered at a current above the limit.

5 Other DC loads activated by the operator's direct requirements work independently of the controller. First, they are not regulated by the controller and are not the purpose of their signals. However, they may interact with them in some configuration. These loads include light banks and horns.

6 Handle display gauges monitor the vehicle to inform the user of its condition

b. Emergency switch

b-1Appearance and specifications

b-2Function

The emergency stop switch is used to cut off the current in the electrical system in case of emergency, thus stopping the operation of the vehicle. When pressed, all DC and AC circuits are open.

DC Circuit Open Circuit

Once the emergency stop switch is opened, the positive terminal of the battery is disconnected from the key switch, thus cutting off power to all loads supplied through the key switch. As a result, all DC loads are de-energized.

Disassembly and installation

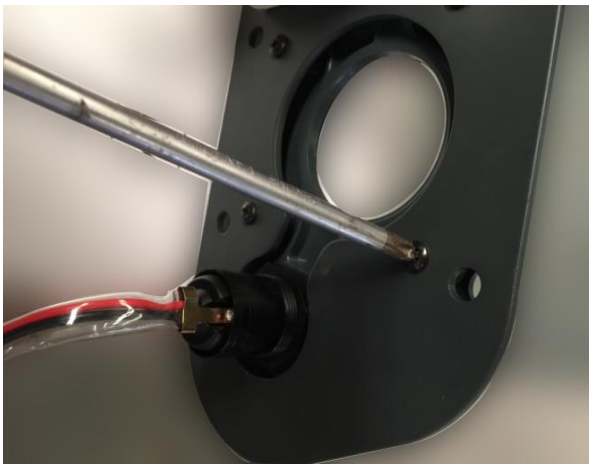
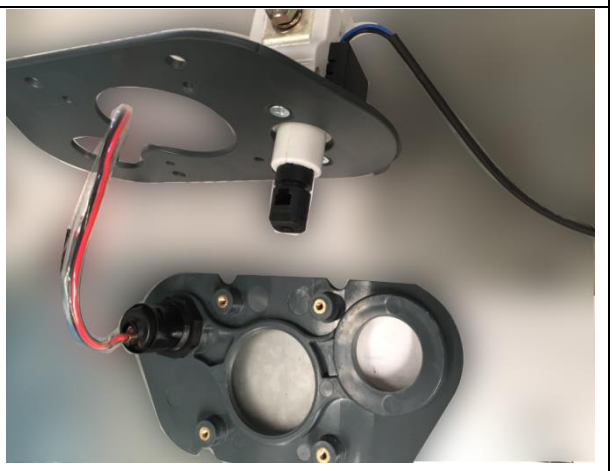
Preliminary Steps

1 Park the vehicle safely and remove the housing.

2 Turn off the key switch.

3 Disconnect the battery connector.

Replace the emergency stop switch

	
1.Use a Phillips screwdriver to unscrew the two screws of the emergency stop switch	2.After removing the screws, the mushroom head can be removed
	
3.Unscrew the screw with a crosshead screwdriver.	4.Separate the integrated blade panel from the instrument retainer panel
	
5.Unscrew two retaining screws with a crosshead screwdriver	6.Remove DC power switch

7. Pull off the microswitch by holding the clips on both sides of the microswitch by hand. The installation process and the reverse process of the above process are described.

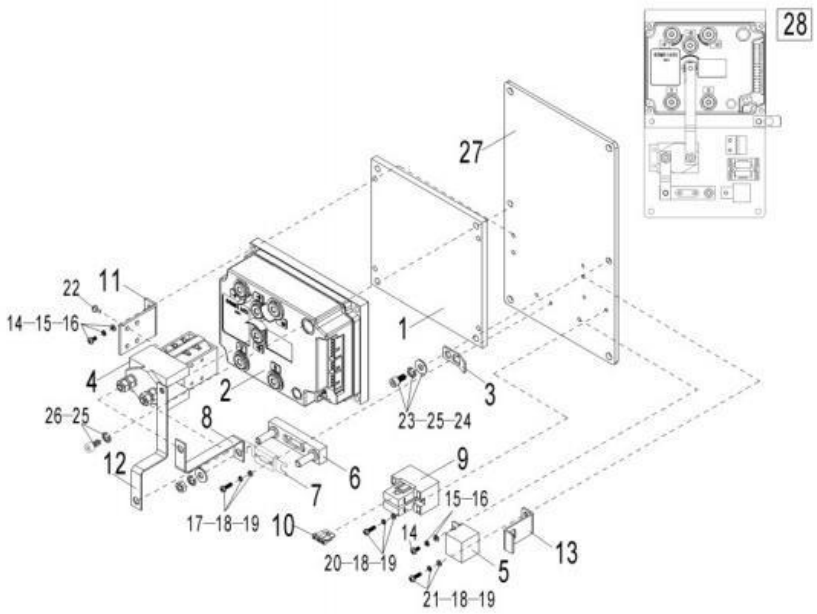
Conversely, installing an emergency stop switch is the reverse process of the above steps.

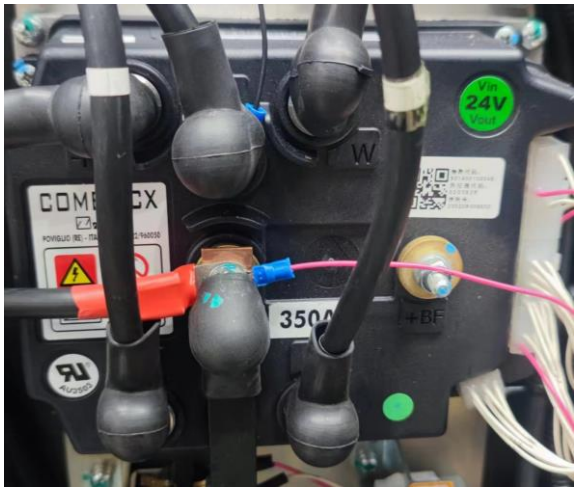
c.Controller and related devices

c-1 Appearance

1) Controller COMBIACX

Controller assembly

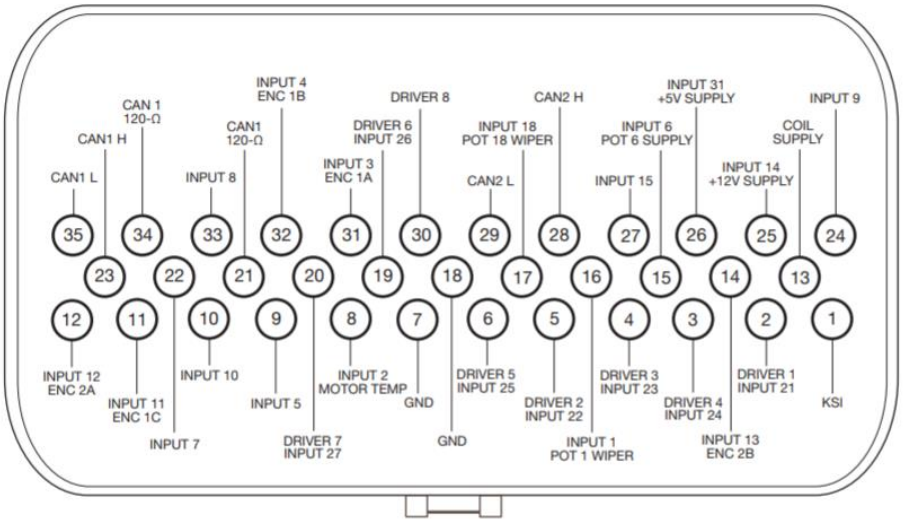




No.	Description	Qty.	Note
1	Aluminium plate	1	
2	Controller	1	COMBIACX24V/240A+270A
3	Line hanging board	3	
4	Contactor	1	SW180B-4 DC24V
5	Relay	1	ACR01F-F- 1AD DC24V
6	Fuse seat	1	SYY
7	Fuse	1	350A
8	Copper bar	1	
9	Fuse seat	1	BD-2X10A-1
10	Plug fuse	2	10A
11	Contactor holder	1	
12	Copper bar	1	
13	Programmer plug-in holder	1	
14	Screw	3	M5x10
15	Washer	3	5
16	Washer	3	5
17	Screw	6	M4x16
18	Washer	6	4
19	Washer	6	4
20	Screw	2	M4x30
21	Screw	6	M4x10
22	Screw	2	M5x8
23	Screw	1	M8x20
24	Washer	1	8
25	Washer	2	8
26	Screw	2	M8x16
27	Controller fixing plate	1	
28	Controller assembly	1	

2) Controller Curtis ACF2-C(20 CE/EN1175)

PINOUT CHART

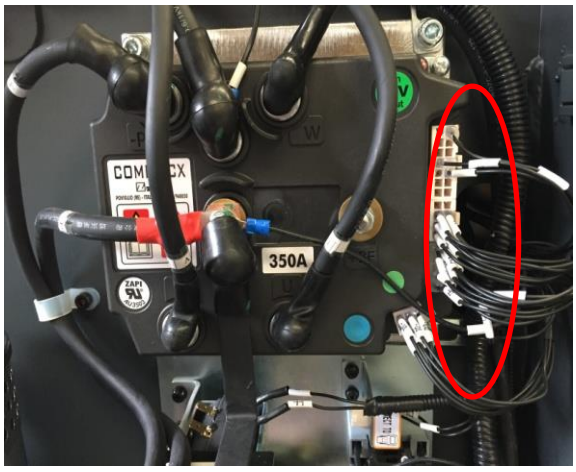
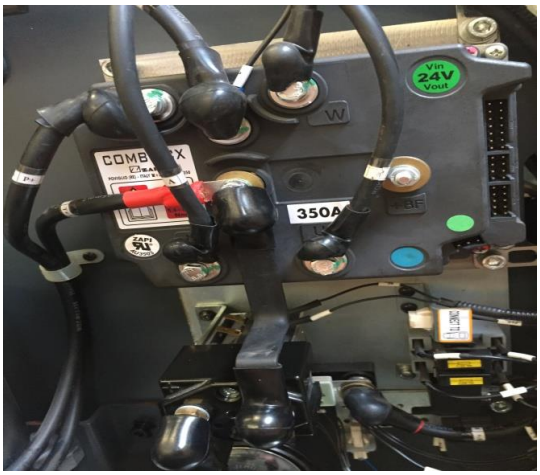


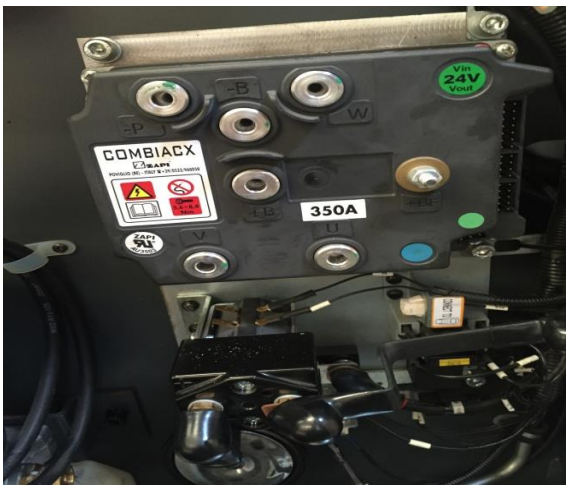
c-2 Functions

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

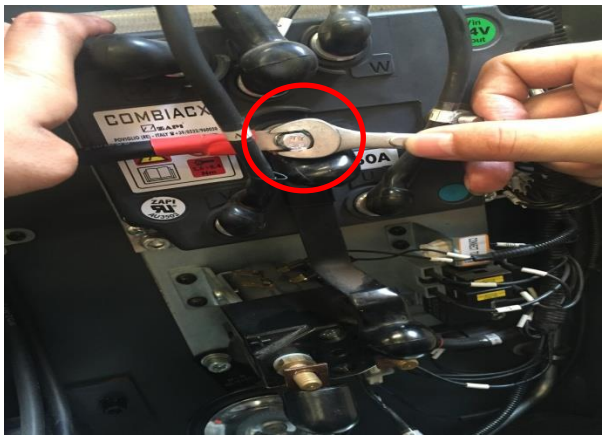
Key switch
Power switch
throttle
tiller proximity switch
Emergency reverse switch
Hydraulic control switches

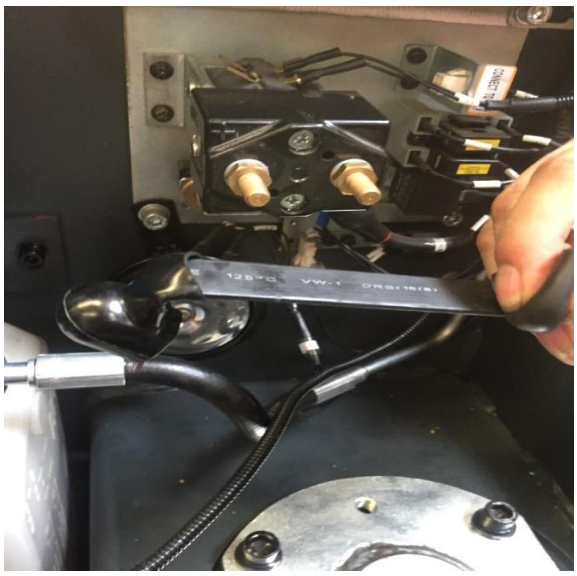
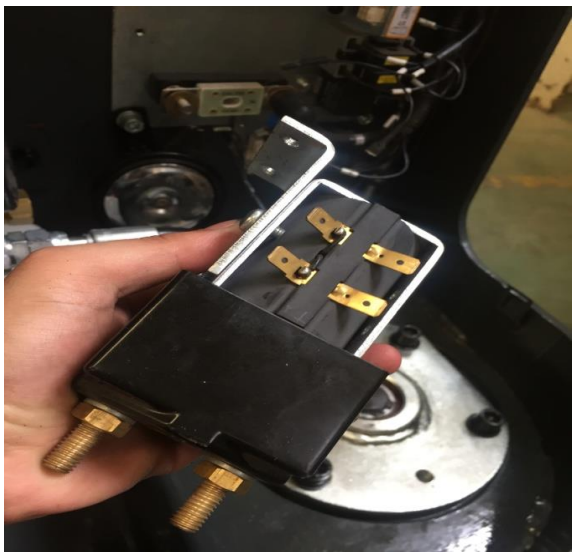
c-3. Replacing Controller(as COMBIACX controller for example)

<table>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
<tr>
<td colspan="2">1. Remove the wiring on the electronic control in turn, pull out the plug-in and note the different ports corresponding to the different wiring</td>
</tr>
</table>

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">2.Unscrew the five screws V, U, W, -P, -B with a 10mm open-ended wrench and remove the wiring in turn</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">3.The controller can be removed by unscrewing the four fixing screws of the controller with a crosshead screwdriver. The installation process is the reverse process of disassembly.</td></tr>
</table>

c-4.Replacing contactors

<table>
<tr><td>  </td><td> 
</td></tr>
<tr><td>1.Unscrew two screws with a 13mm wrench.</td><td>2.Unscrew the screw on the controller with a 10mm open-ended wrench</td></tr>
</table>

	
3 Remove copper bars	4.Unscrew bolts with a 13mm open-ended wrench
	
5.Remove copper bars	6.Unscrew two screws with a crosshead screwdriver
	
7.Remove contactor with mounting frame	8.Unscrew two screws with a screwdriver.

9.Remove mounting bracket and replace contactor. Installation is the reverse of disassembly.

d.Tiller head

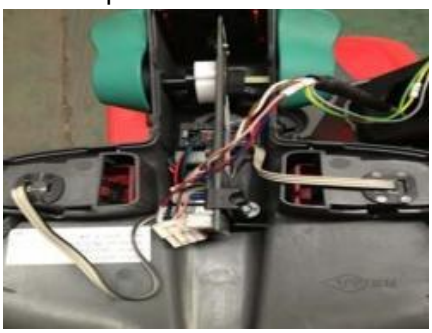
Function

The tiller head controls some of the vehicle's movements through up and down buttons, belly switches, turtle buttons, throttle and combination locks and controller interplay

Tiller Head disassembly and Installation

1).Remove 3 screws fixing the back cover of the handle with Philips screwdriver.

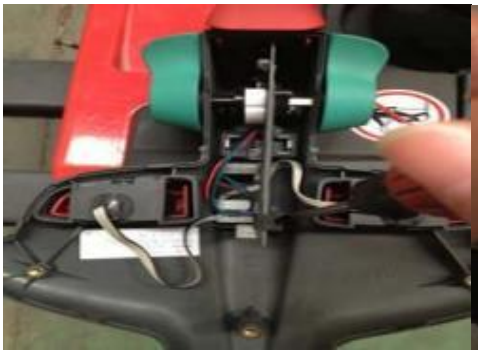
2).Remove apart the front cover of handle

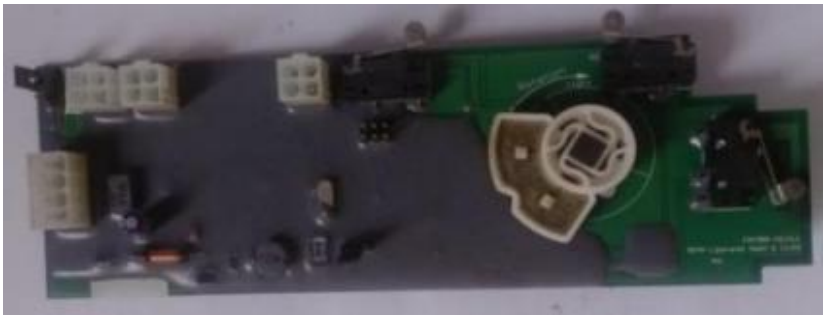


3).Remove the screws fixing the drive switch with Allen wrench.

4).Remove the drive switch and pull out the connectors

5).Unplug connector and then you can remove PCB and replace it.



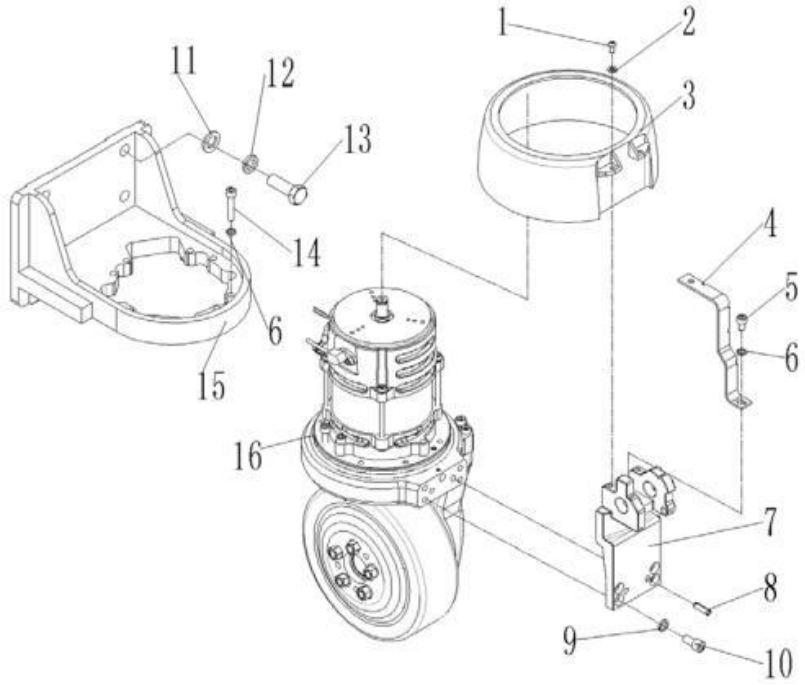


12.Drive/Brake System

a. Overview

The drive/brake system includes the following:
1) The drive motor controlled by the controller transmits the rotational force to the drive shaft (electric power 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 electromagnetic brakes controlled by a controller to generate braking power (friction).
3) The accelerator sends the CAN number to the drive motor controller to accelerate the motor (CAN signal)

a-1 Drive assembly



No.	Description	Qty.	Note
1	Screw	2	M6x12
2	Washer	2	6
3	Driving wheel cover	1	
4	Cable holder	1	
5	Screw	1	M8x12
6	Washer	5	8
7	Handle seat	1	
8	Elastic dowel pin	2	8x26
9	Washer	4	10

10	Screw	4	M10x20
11	Washer	4	16
12	Washer	4	16
13	Bolt	4	M16x45
14	Screw	4	M8x40
15	Driving wheel seat	1	
16	AC vertical drive assembly	1	

Operation

The drive motor operates when the following conditions are met:

1 The key and the emergency stop switch are turned on to supply power to the controller,
2 Move the handle to the operating area,
3 Determine the direction of travel,
4 Twist the accelerator on the handle

Drive Assembly disassembly and Installation

Preliminary steps

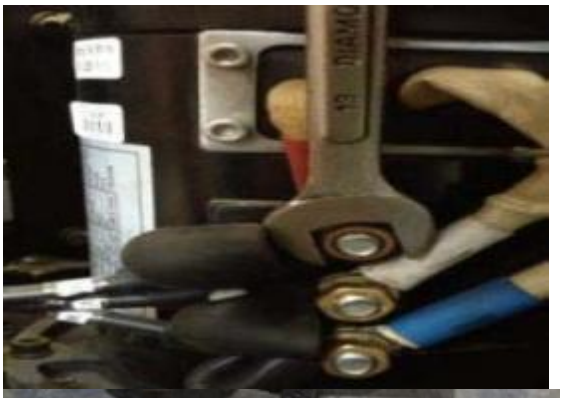
1. Park the vehicle safely and remove the drive wheel cover
2. Turn off the emergency stop switch and key switch
3. Disconnect the battery connector

Procedure

Remove 8 screws, and then remove the cover

Unplug connector

Remove screws，take off the connector



Move 5 screws fixing the PU rim with 17mm wrench, and then you can remove and replace it

b. Brake

Appearance

Brake Disassembly

Move 3 screws fixing the magnetic brake onto the drive wheel with 5mm Allen wrench and then you can remove the brake.

Brake system circuit diagram

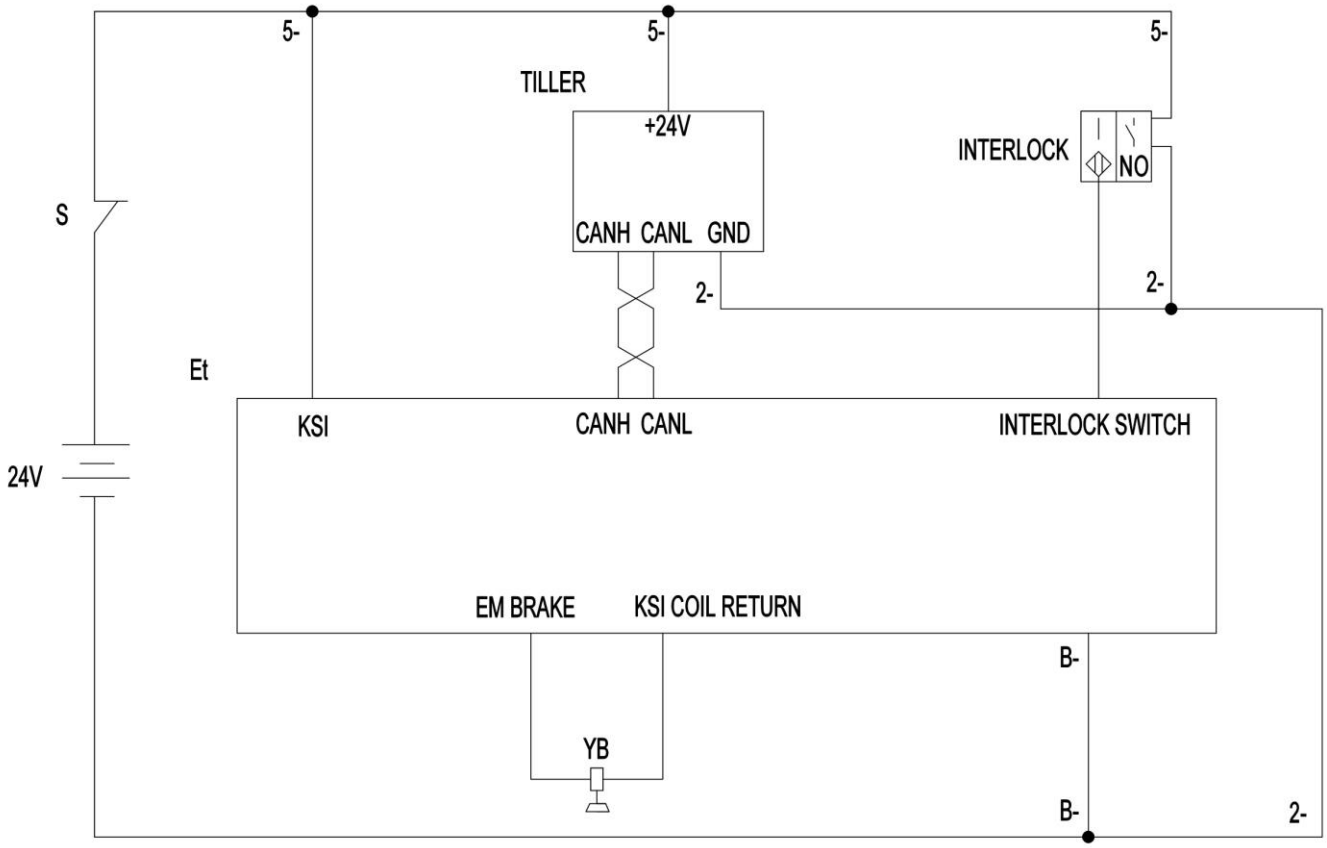
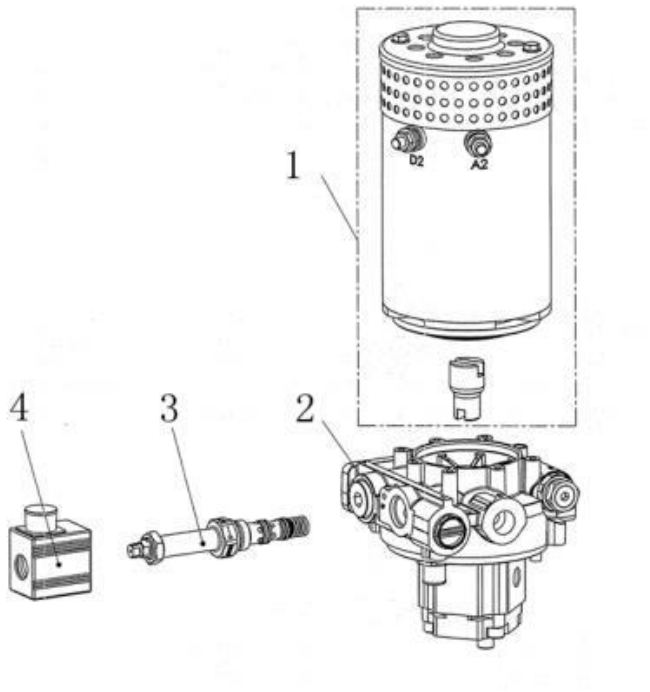


Fig. 22: Brake circuit diagram

13.Hydraulic System

a. Overview

The hydraulic system is composed of working oil pump, lifting cylinder and piping and other components. The hydraulic oil is supplied by the oil pump directly connected to the motor. The oil pump pumps the hydraulic oil to the cylinder.



No.	Description	Qty.
1	Pump motor	1
2	Centre valve	1
3	Solenoid valve core	1
4	Coil	1

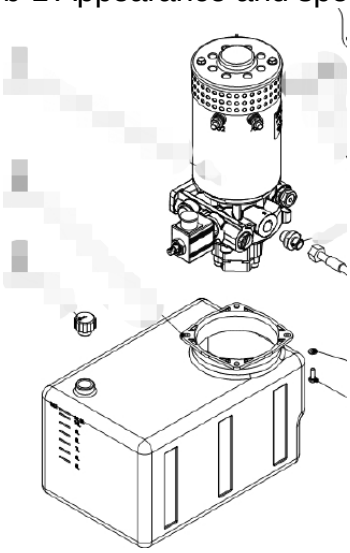
The hydraulic system operates the lifting cylinders by means of pressurized hydraulic oil from the main hydraulic pump and pumps out the oil discharged from these cylinders.
1) The main hydraulic pump is driven by the pump motor controlled by the controller.
2) The main hydraulic pump pressurizes the oil in the hydraulic tank using the rotational force output from the motor and delivers the oil to the lifting cylinders.
3) The hydraulic oil tank stores the hydraulic oil returned from the lifting cylinder. The stored oil is sucked by the main hydraulic pump for reuse.

Hydraulic oil circulation

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

b.Pump station assembly

b-1 Appearance and specifications



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

b-2 Replacing Pump Station

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

Preliminary Steps

1.Drop the fork to the bottom and press the drop button several times to eliminate the residual pressure in the hydraulic system.

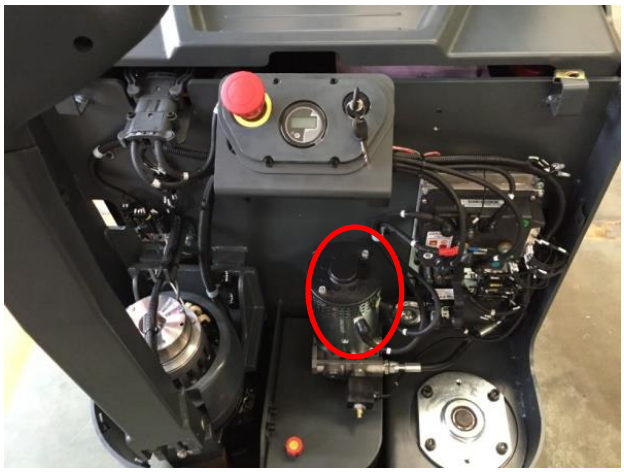
2.Open the chassis and disconnect the battery.

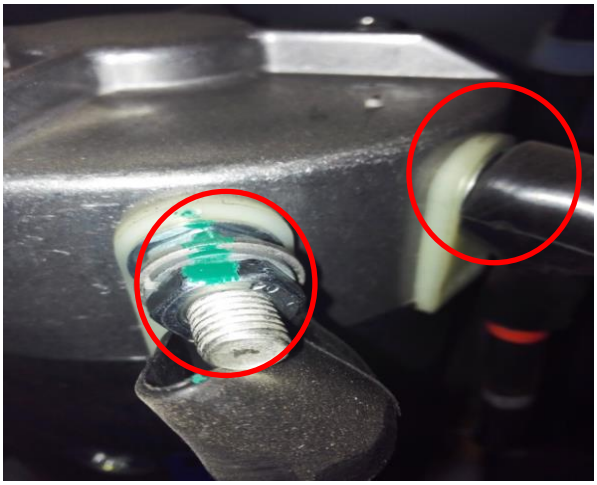
3.Prepare to remove oil pump.

⚠ Danger

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

⚠ The tray holder must be lowered before replacement to return the hydraulic oil in the line to the hydraulic tank in the pump station.





1.Unscrew the screw with a 13mm wrench and remove the wiring

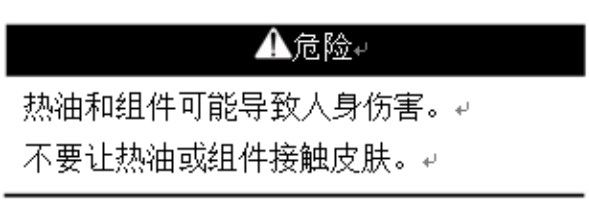
2.Remove the hydraulic line with a 22m and 22mm open-ended wrench, e.g. Note: Hydraulic oil will leak out when removing the oil pipe. It is recommended that the yarn or rag be backed up when removing.

3.Pull plug-in off by hand.

4.Unscrew two fixing screws using a 5mm hex socket to remove the oil pump

b-3 Replacement of hydraulic fluid and filter
Preliminary steps

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



Danger
Hot oil and components may cause personal injury.
Do not let hot oil or components contact with skin.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">1.Take out the oil pump, unscrew the fuel tank cap, and pour out the waste oil. Then, the fuel tank can be installed on the vehicle, which is the reverse process of disassembly.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>2.After installation, unscrew the tank cap</td><td>3.Inject hydraulic fluid through the tubing and screw on the cap</td></tr>
</table>

Checking and refilling hydraulic fluid

The type of hydraulic oil required is:

- _H-LP 46, DIN 51524
- _Viscosity is 41.4 - 47
- Oil quantity is 6.0~9.5L according to model

Waste materials such as waste oil, waste batteries or other materials must be disposed of and recycled in accordance with national laws and regulations and sent to the recycling company for recycling if necessary.

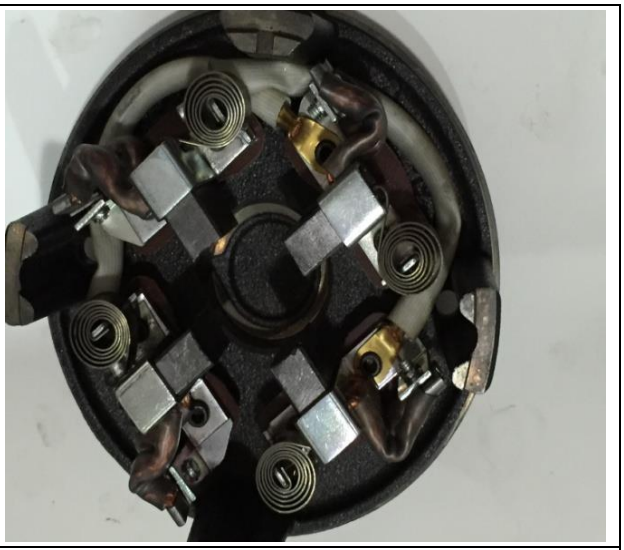
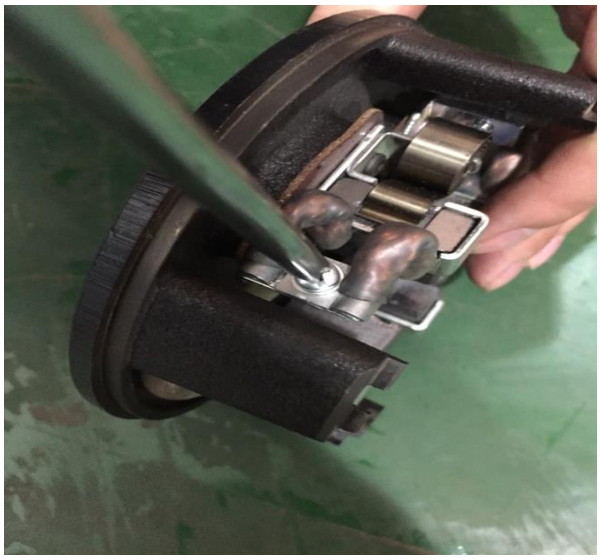
The oil level should not be lower than the minimum amount of oil required to lift the goods.

Fill in oil if necessary.

Program (Replacement of hydraulic filter)

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">1.Unscrew bolts and remove oil pump with 5mm hexagon wrench</td></tr>
<tr><td colspan="2">  </td></tr>
<tr><td colspan="2">2.The filter can be replaced after removing the oil pump.</td></tr>
</table>

b-4 Replacement of Carbon brush for pump motor

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>1.Unscrew bolts with a 10mm open-ended wrench</td><td>2.Open the cover.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">3.Unscrew the screw with a crosshead screwdriver and take out the carbon brush for replacement. Installation process and the reverse of the above process.</td></tr>
</table>

b-5. Troubleshooting
Pump motor

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

Hydraulic pump

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

14.Lifting system

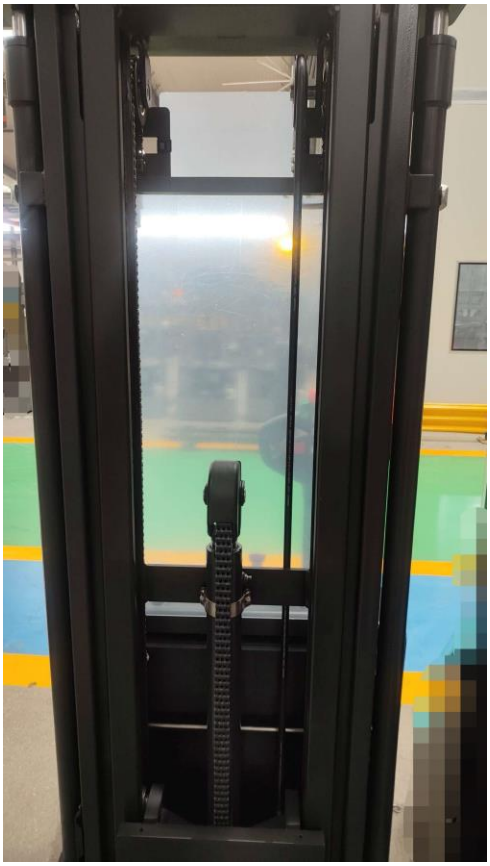
a. Overview

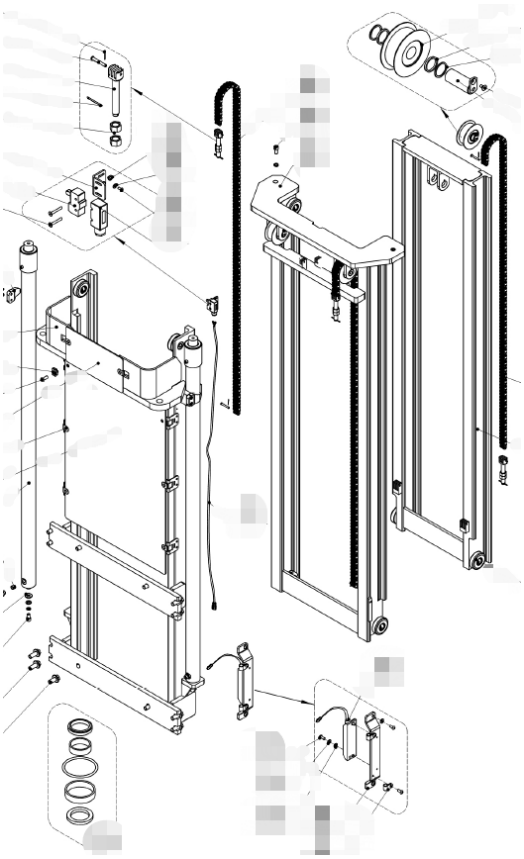
a-1. Component

The lifting system is powered by the main hydraulic pump.
Fork: Two fork-shaped objects to support the load
Chain: the part that lifts the bracket and mast
Lifting cylinder: single-acting cylinder pulls back the chain of the bracket
Mast: the vertical structure at the front of the forklift, which extends and retracts to lift and lower the load

b. Mast

b-1. Appearance





Lifting of mast

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

Oil cylinder

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

Lower

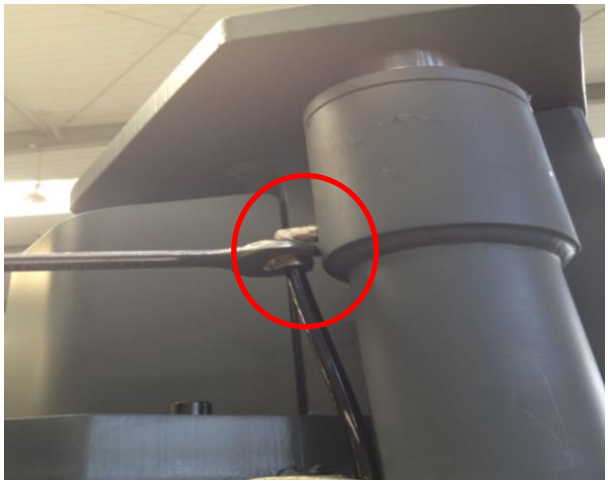
If the operator holds down the drop button, the oil output from the cylinder will begin to flow to the tank through gravity.

When the oil is discharged, the cylinder rod and the attached internal mast will retract. As the inner mast descends, the tension of the lifting chain relaxes and the fork follows.

b-2. Replacement of cylinder

1)Outer cylinder right

1.Remove the oil pipes at the lifting cylinders on both sides with a 19 mm open-ended wrench. Note that hydraulic oil will leak out when removing the oil pipes. It is recommended that the oil pipes be backed up or wiped.



2. Remove both return lines with a 12mm wrench

3.Remove the top bolt of the cylinder with a 12 mm hexagon.

4.Unscrew cylinder pressure plate retaining bolts with 6mm hexagon

5.Remove the cylinder base retaining bolts with a 12mm internal hexagon wrench.

6.Remove cylinder, install process and reverse process of above process

2)Outer cylinder left

1.Remove the bottom line of the cylinder with a 22mm open-ended wrench

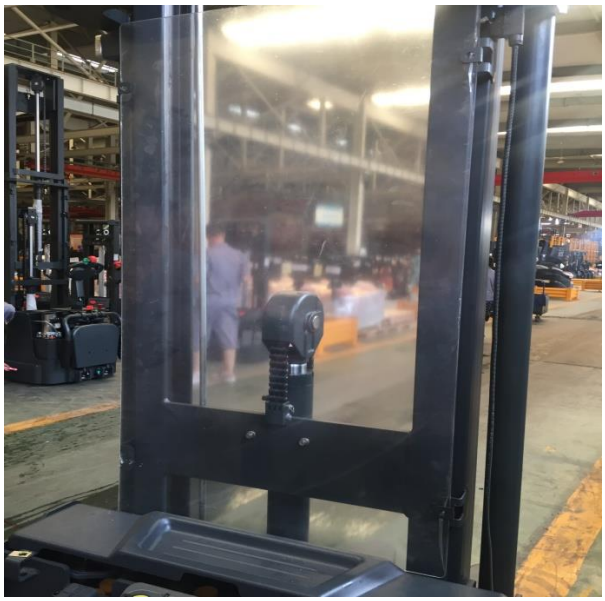
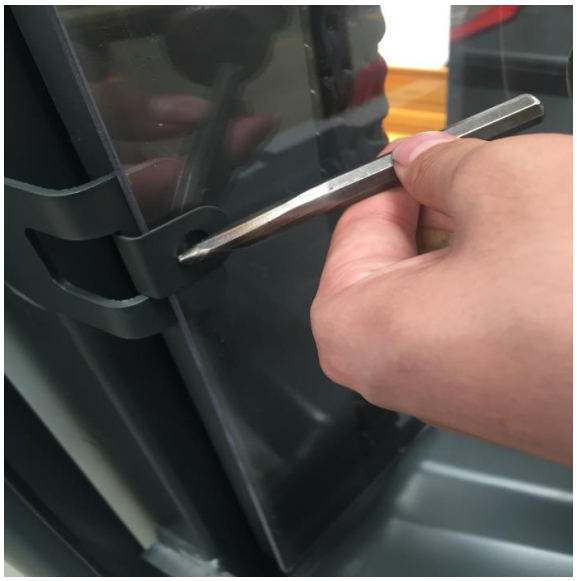
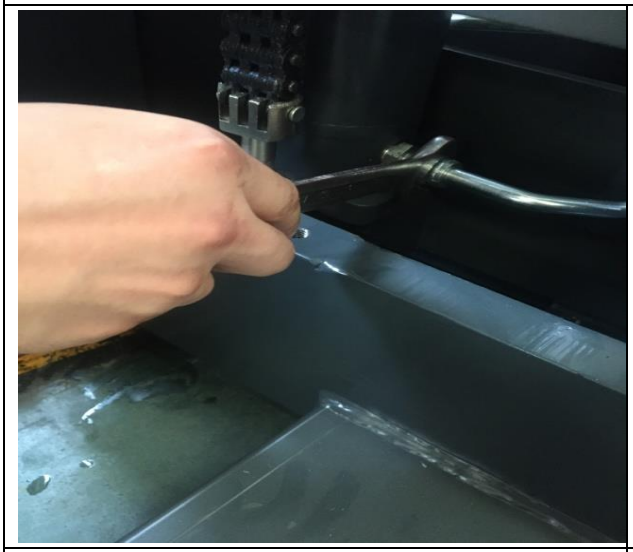
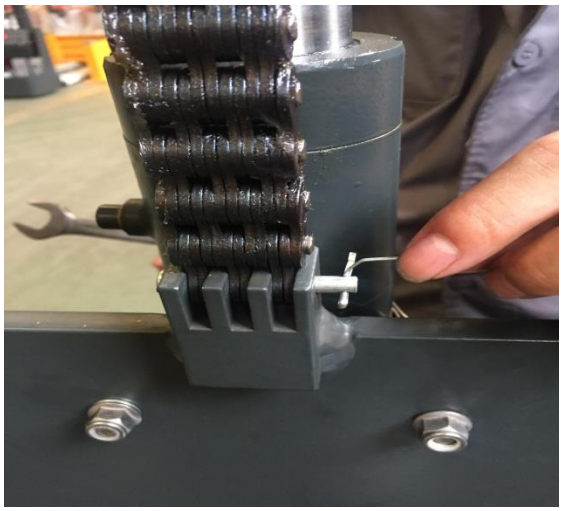
2.Remove top oil line of cylinder with 22mm open-ended wrench

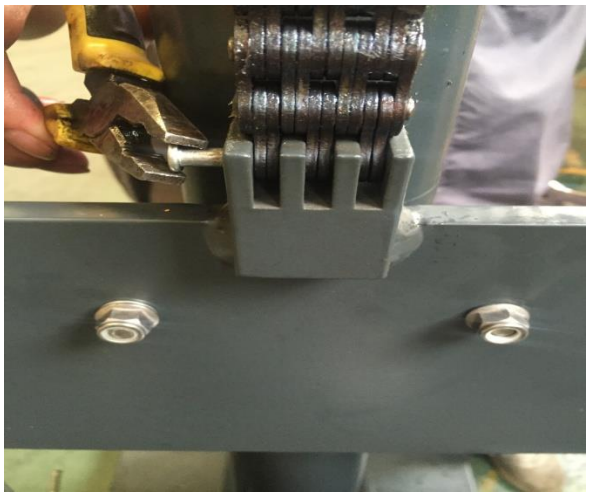
3.Remove the two bolts on the top of the left and right cylinders and the mast with a 12 mm hexagon.

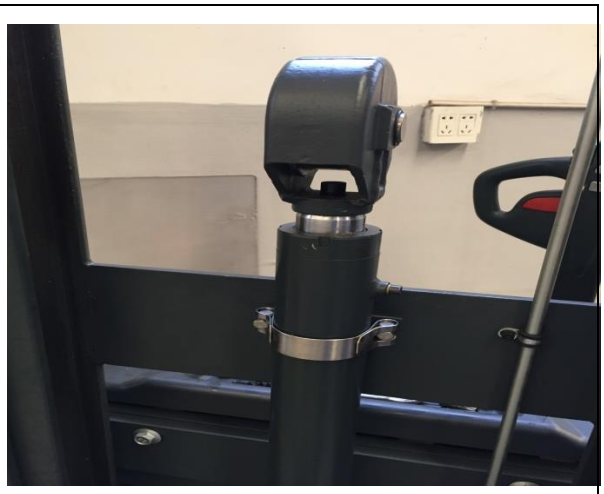
4.Remove the four bolts on the pressure plate of the left and right cylinders with a 6 mm hexagon.

	
5.Remove the cylinder base retaining bolts with a 12mm hexagon wrench	6. Remove the entire cylinder

3)Middle cylinder

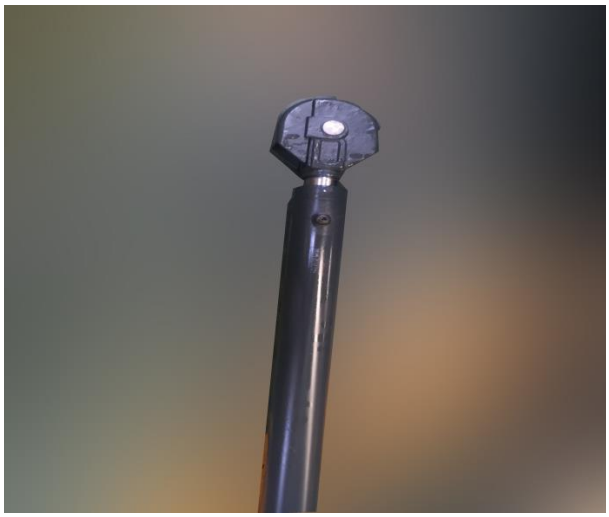
	
1.Knock off spring clip with punch and take off protective plate	
	
2.Unscrew the oil line at the bottom of the middle cylinder with a 22mm open-ended wrench	3.Remove cotter pin

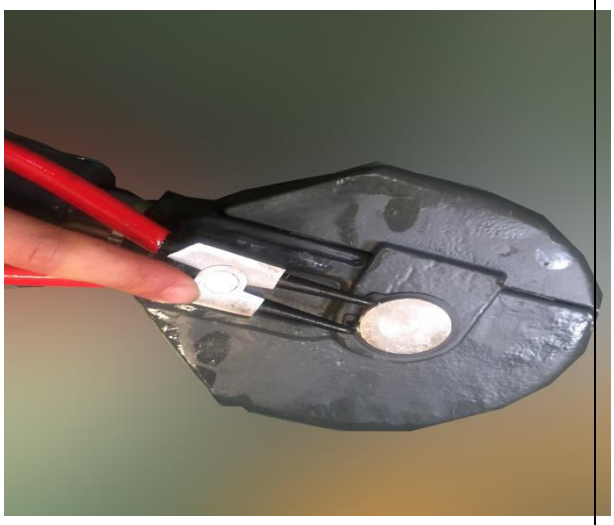




4.Take out the pin shaft and take off the chain.

5.Unscrew the bolt of the clamp and take off the clamp with a 13mm open-ended wrench.





6.Remove the middle cylinder

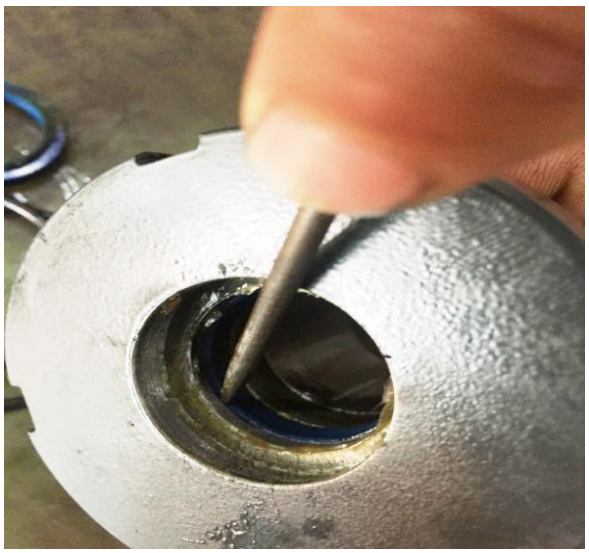
7.Remove the circlip with the circlip pliers

8. Remove sprocket shaft

9.Remove the side cover with a 12mm hexagon wrench and all parts can be removed for replacement and repair. The installation process is the reverse of the removal process.

b-3. Replacement of cylinder sealing ring

1.Remove cylinder head with crescent tool

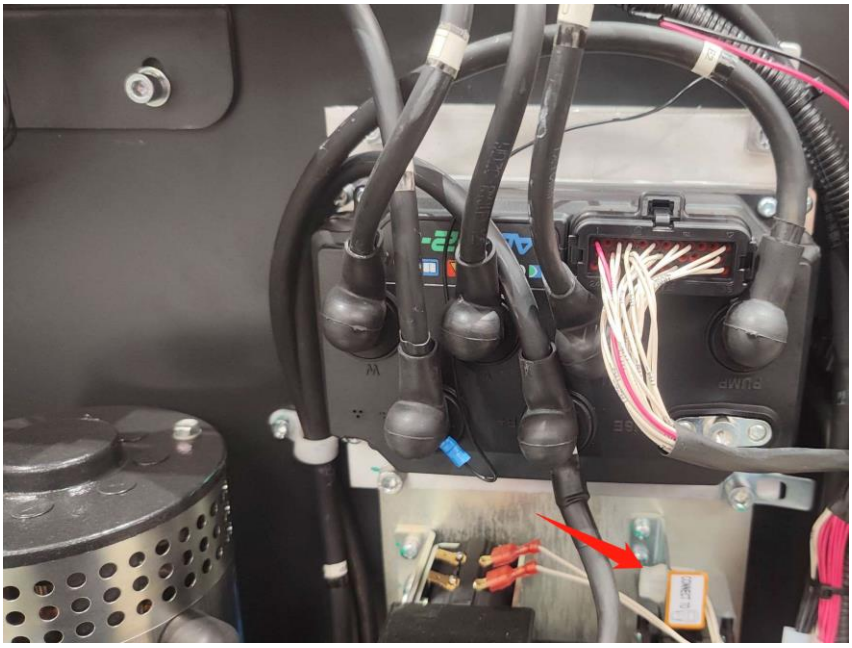
	
2.Remove the new O-ring with a small screwdriver	3.Remove the dust ring with a screwdriver
	
4.Remove sealing ring for shaft	5.The cylinder head sealing ring can be disassembled and replaced by removing the sturdy seal.

15.CURTIS Handheld Console

a. Operation Cautions

The prompt function of the console is designed for the convenience of vehicle inspection and maintenance, Adjustments to the controller parameters are not allowed without the approval of the vehicle manufacturer，so as to avoid vehicle and personal safety accidents.
After modifying the parameters, the handheld unit will automatically save the parameter settings, and the only thing you need to do is just close the key switch and restart.
CURTIS handheld console can be connected when the controller is powered on or off.

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



a-1 Process of Vehicle Fault Reading

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

a-2 Vehicle Signal Detection

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

a-3 Contents of CURTIS Handheld Menu

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

b. INTRODUCTION

The Curtis 1313 Handheld Programmer (1313 HHP) performs programming and troubleshooting tasks for Curtis programmable motor controllers, gauges, and control systems. The 1313 HHP connects to Curtis devices in one of two ways- specific to the device: Either directly via the device's RS232 serial port, or through a Controller Area Network (CAN) connection which can have multiple devices on the CANbus. Cables specific to the connection are supplied with the 1313 HHP.

Model 1313 Handheld programmer.

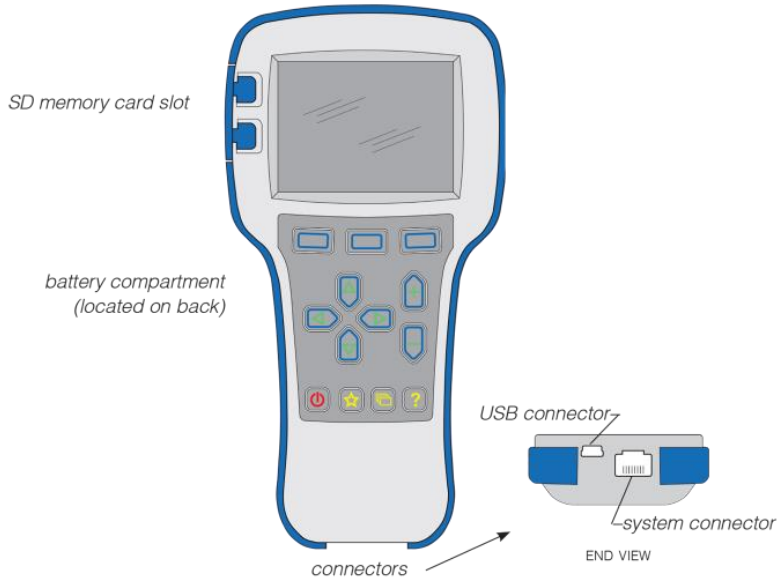
This manual covers the operation for the Serial-connected programmable controllers. Gauges and control systems (devices) operate in a similar fashion.

b-1. 1313 HHP OPERATION

This chapter describes how to use the 1313 HHP for serial-based communication controllers.

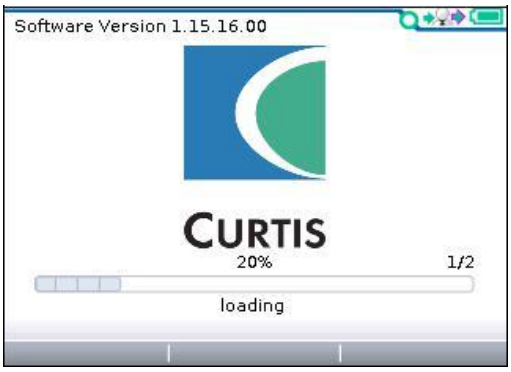
CONNECTIONS

The 1313 HHP has two connectors, one for communicating with the motor controller and one for interfacing with a PC. The 1313 HHP also has a battery compartment and a memory card slot.



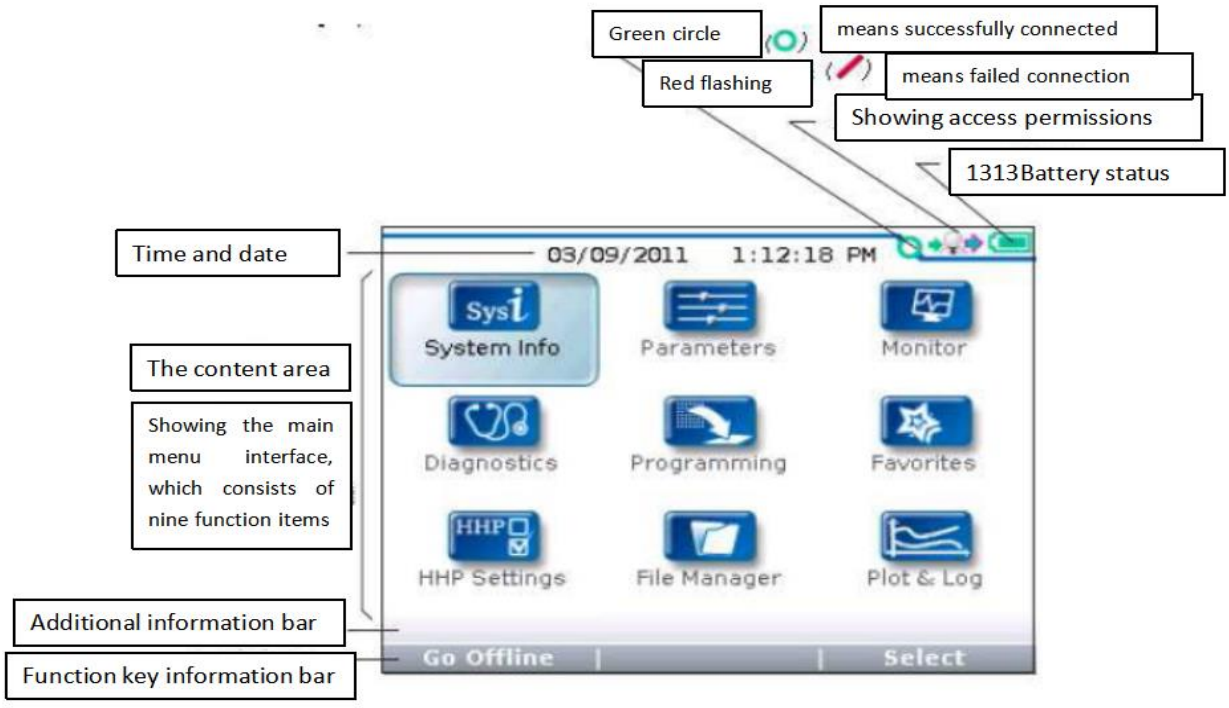
1)Power the console

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



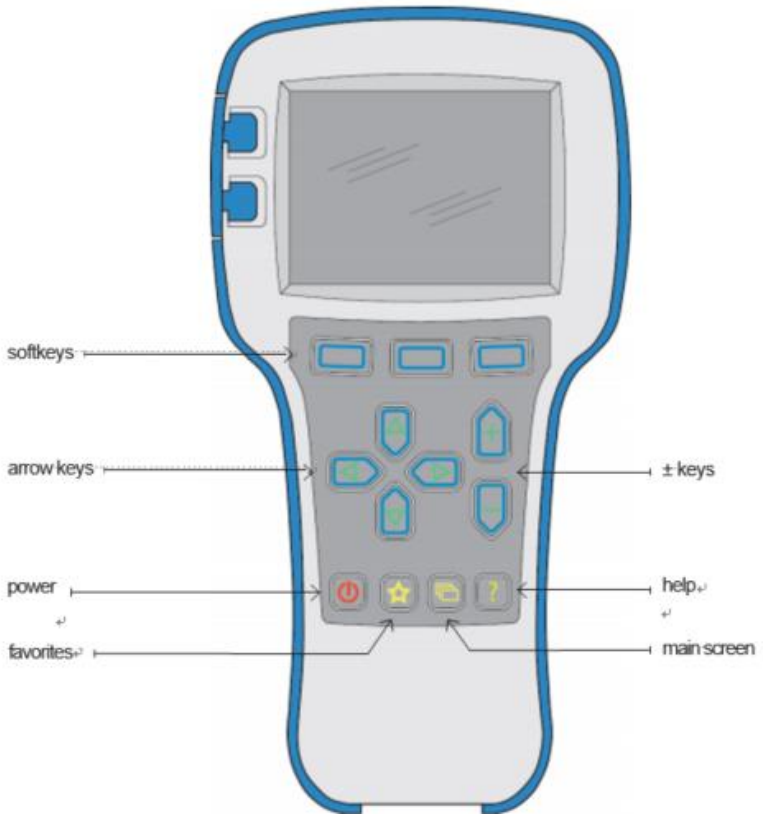
Once the 1313 HHP has uploaded the information from the controller, it displays the Main Screen

DISPLAY FORMAT



KEY FUNCTIONS

The pushbutton keys on the 1313 HHP's keypad allow rapid navigation through the apps.

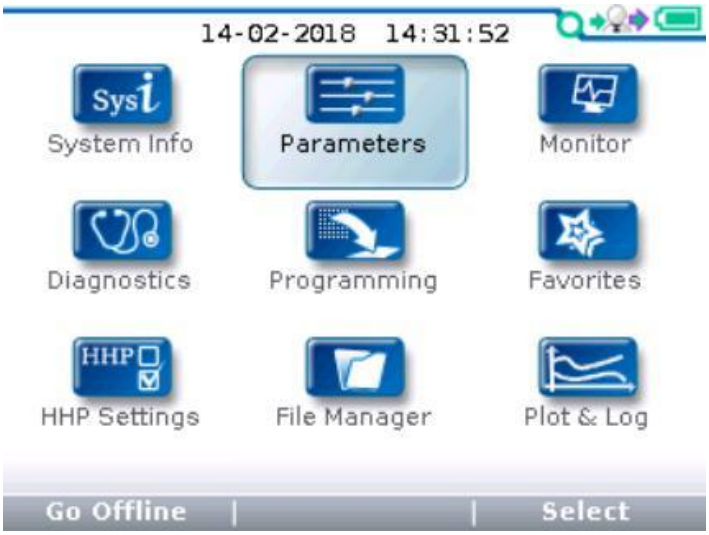


2)Menu structure

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

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

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

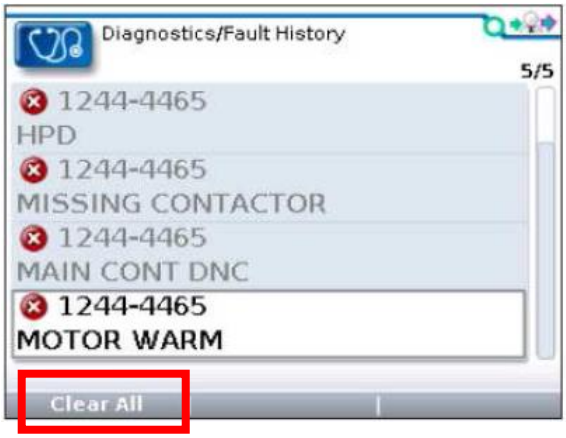


3)Fault diagnosis menu

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

Note: the fault caused by a temporary event captured in the circuit is not a real system fault in some cases. and you can determine if the fault really exists by restarting the system and observing the automatic fault indication. In the history failure folder, the failures listed are all failures encountered after the last history failure was cleared, which can be restarted by clearing the fault content in the entire folder.

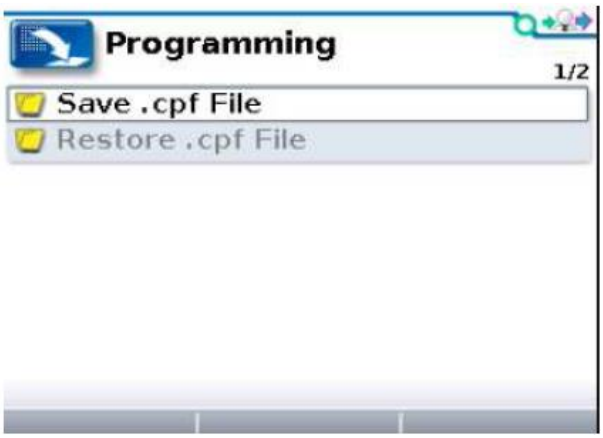
Note: Sometimes the fault circuits catch a temporary event that is not a true fault in the system; it is always a good idea to turn the control system off and back on again to see whether the fault clears by itself.



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

4)Programming edit menu

In the main menu, Select the "Programming" programming icon and press the corresponding function key of "Select" to enter the menu. You can store and restore parameter setting files (.cpf files) through the programming menu.

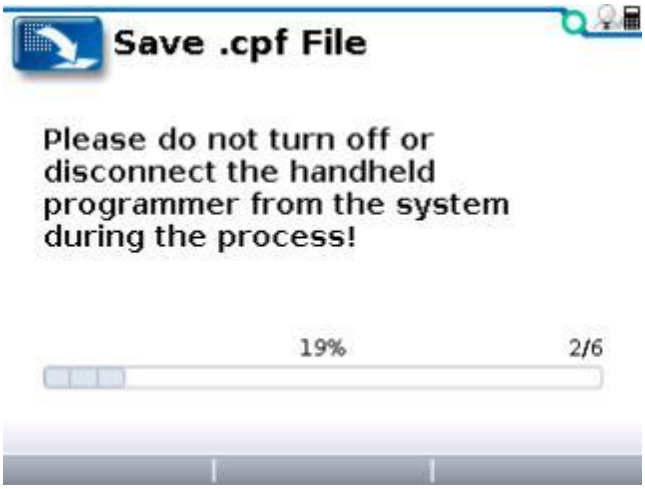


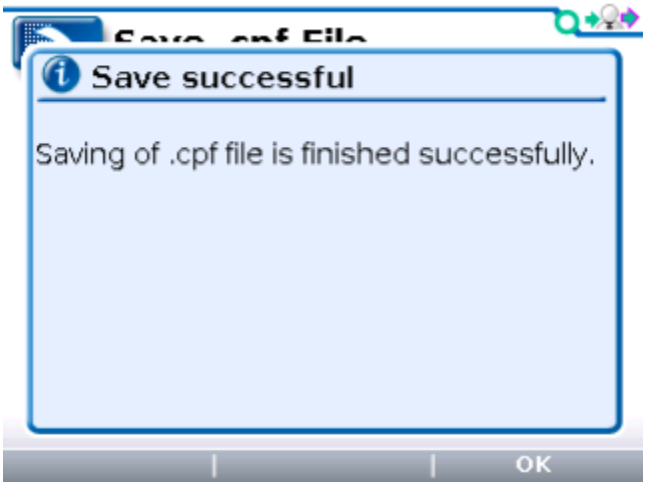
Save.cpf File

Use the save. cpf file function in the programming menu to back up the currently set parameters. You can save as many. cpf files as you need, and you need to name each. cpf file with a different name. Restore. cpf File

Restore. cpf File

You can select the. cpf file saved earlier to replace the. cpf file of the current controller. When the whole data recovery process is completed, a dialog box will pop up on the screen asking for the system to be restarted.



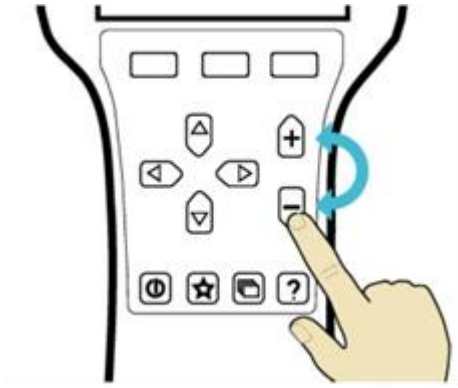


When the process is complete, press the “OK” softkey to return to the 1313 HHP main screen.

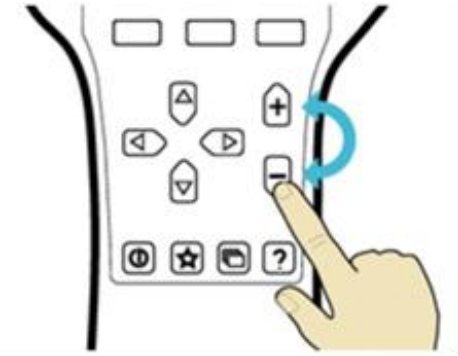
5)Parameter Setting

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

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



The other is through the parameter edit page as shown below



16.Troubleshooting for Each Fault Code

a. Countermeasures of fault codes for COMBIACX controller

Error Code	Description	Effect	Machine status when the test is done	Restart procedure
Capacitor charge - MDI CAN 60	Power capacitors voltage does not increase	Valve, pump, traction stopped, Lc opened, Eb applied	start-up	Valve or pump or traction request
Vmn low - MDI CAN 72	Motor output voltage lower than expected	Valve, pump, traction stopped, Lc opened, Eb applied	start-up, traction	Valve or pump or traction request
Vmn high - MDI CAN 31	Motor output voltage higher than expected	Valve, pump, traction stopped, Lc opened, Eb applied	start-up, traction	Valve or pump or traction request
Power mos short - MDI CAN 89	Short circuit on the power mosfets	Valve, pump, traction stopped, Lc opened, Eb applied	start-up	Valve or pump or traction request
Coil short. MC-EB - MDI CAN 76	Shortcircuit on LC or EB coil	Valve, pump, traction stopped, Lc opened, Eb applied	stby, traction	Valve or pump or traction request
Driver shorted - MDI CAN 74	Driver of LC coil is shorted, so it is not able to open the LC, or LC coil is disconnected	Valve, pump, traction stopped, Lc opened, Eb applied	start-up	Valve or pump or traction request
Contactor Driver - MDI CAN 75	Driver of LC coil is damaged (not able to close)	Valve, pump, traction stopped, Lc opened, Eb applied	stby, traction	Valve or pump or traction request
Contactor Open - MDI CAN 77	The LC coil has been driven but LC does not close	Valve, pump, traction stopped, Lc opened, Eb applied	stby, traction	Valve or pump or traction request
Contactor closed - MDI CAN 75	LC contact is stuck	Valve, pump, traction stopped, Lc opened, Eb applied	start-up	Valve or pump or traction request
Aux driv. Shrt. - MDI CAN 40	When the mos of EB is shorted	Valve, pump, traction stopped, Lc opened, Eb applied	start-up,stby,marcia	Valve or pump or traction request
Aux driver open - MDI CAN 42	Driver of EB coil is damaged (not able to close)	Valve, pump, traction stopped, Lc opened, Eb applied	stby, traction	Valve or pump or traction request
Pos. EB shorted - MDI CAN 86	Output of built in Smart Driver, which supplies Eb coil positive, is high (= +batt) when the tiller switch is opened.	Valve, pump, traction stopped, Lc opened, Eb applied	start-up	Valve or pump or traction request
Logic Failure #1 - MDI CAN 54	Overvoltage/Undervoltage condition has been detected	Valve, pump, traction stopped, Lc opened, Eb applied	start-up	Valve or pump or traction request
Logic Failure #2 - MDI CAN 55	Motor voltage feedback circuits are damaged	Valve, pump, traction stopped, Lc opened, Eb applied	stby, immediately after Lc closing	Valve or pump or traction request
Logic failure #3 - MDI CAN 17	Failure in the high current HW protection circuit	valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby	Valve or pump or traction request
Stby i high - MDI CAN 53	In stby condition (no current applied to the traction motor) the current feedbacks are aout of permitted stby range	Valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby	Valve or pump or traction request
Wrong Battery MDI CAN 41	The battery voltage is too low or too high (< 0,8 Vbatt OR > 1,2 Vbatt)	Valve, pump, traction stopped, Lc opened, Eb applied	start-up, stand-by (only immediately after Lc closing)	Valve or pump or traction request
Analog input - MDI CAN 96	Problem on the A/D conversion of uC	Valve, pump, traction stopped, Lc opened, Eb applied	traction	Valve or pump or traction request
Encoder Error - MDI CAN 82	Problem on the encoder	Valve, pump, traction stopped, Lc opened, Eb applied	traction	Valve or pump or traction request
Tiller error - MDI CAN 64	Input mismatch between hard&soft switch input and tiller input	Valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby, traction	Valve or pump or traction request
Watchdog - MDI CAN 08	One of two (or both) Watchdog circuit outputs becomes high due to an HW or SW problem	Valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby, traction	Key re-cycle

Error code	Description	Effect	Machine status when the test is done	Restart procedure
Smart driver KO - MDI CAN 68	Smart driver is open, not able to provide EB positive	valve, pump, traction stopped, Lc opened	start-up	Key re-cycle
Key-off shorted - MDI CAN 76	Key-off signal is low at Key-on	valve, pump, traction stopped, Lc opened	start-up	Key re-cycle
Evp driv. short - MDI CAN 50	Evp driver is failed shorted (always ON) mismatch between the valve set-point and its feedback	valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby	valve or pump or traction request
Pump Vmn Low - MDI CAN 28	Pump motor output is too low, with respect to pwm applied	valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby, during pump function	valve or pump or traction request
Pump Vmn High - MDI CAN 29	Pump motor output is too high, with respect to pwm applied	valve, pump, traction stopped, Lc opened, Eb applied	during pump function	valve or pump or traction request
Wrong Zero - MDI CAN code alarm 53	The outputs of the amplifiers (used to measure the motor voltage) are cheked this alarm occurs when voltage signals >3V or <2V at the init	valve, pump, traction stopped, Lc opened, Eb applied	init	valve or pump or traction request
Evp coil open - MDI CAN 50	The Evp1 coil is not connected between PAUX and EVP output, and the parameter EVP TYPE in the set-option menu is set Analog or Digital	valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby, traction	valve or pump or traction request
Aux Batt. Short - MDI CAN code alarm 74	When the positive of the AUX OUTPUT is driven by the tiller, the positive is high and the tiller is released.	valve, pump, traction stopped, Lc opened, Eb applied	start-up, stby	
Pev not OK - MDI CAN code alarm 98	The PEV connector (B2) is not connected to the battery or the voltage is different.	valve stopped, (eventually) pump stopped, (eventually) traction stopped, (eventually) Lc opened and MC applied	continuous	
Flash Checksum - MDI CAN 08	The software is corrupted or the flash on the inverter is damaged.	valve, pump, traction stopped, Lc opened, Eb applied	continuous	
Capacitor charge - MDI CAN 60	The capacitors are not charged.	valve, pump, traction stopped, Lc opened, Eb applied	start-up	
Vmn low - MDI CAN 72	Motor output voltage lower than expected.	valve, pump, traction stopped, Lc opened, Eb applied	strat-up, traction	
Controller Mism - MDI CAN 12	The software is not compatible with the controller.	valve, pump, traction stopped, Lc opened, Eb applied	start-up	key-recycle

b. Countermeasures of fault codes for ACF2-C controller(20CE/EN1175:2020)

Fault code	Fault name	Possible cause	Set and Clear conditions	Action
1-2	Controller Overcurrent Fault type:1=U phase overcurrent 2=W-phase overcurrent 3=V phase overcurrent 4=Controller current>135% current limit value	1.External short of phase U, V, or W motor connections. 2.Motor encoder signal is interfered 3.Motor parameters are mistuned. 4.Controller defective.	Set: Phase current exceeded the current measurement limit Clear: Reset Controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake; Shutdown Pump.
1-3	Current Sensor Fault type:1	1.Leakage from U, V or W phase to vehicle body (short circuit in stator) 2.Controller defective	Set: current sensor has invalid offset reading Clear: Reset Controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
1-4	Precharge Failed Failure type: 1.Interruption 2.Energy limitation 3.Time limits	1.The load connected to the Controller B+ terminal suppresses the internal capacitive charging of the Controller 2.check the voltage displayed by Programmer\System Monitor Menu Controller Capacitor Voltage	Set: Controller Capacitor Charging Failed Clear: Break interlock or reset Controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
1-5	Controller Severe Undertemp Fault type:1	1.Controller works in extreme environment 2.Check the temperature displayed by Programmer System Monitor Menu Controller Controller Temperature	Set: radiator temperature is lower than-40°C Clear: The radiator temperature is higher than-40°C, and then reset the controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
1-6	Controller Severe Overtemp Fault type:1	1.Controller works in extreme environment 2.The load is too heavy 3.Controller installation is unreasonable 4.Check the temperature displayed by Programmer System Monitor Menu Controller Controller Temperature	Set: radiator temperature is lower than+95°C Clear: The radiator temperature is lower than+95°C, and then reset the controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;

1-7	Severe B+ Undervoltage Fault type:1	1.Non-controller system consumes photocell 2.The internal resistance of the battery is too high 3.The battery is not connected when driving the motor 4.The fuse connecting B+ is burnt out or the main contactor is not closed 5.Controller battery parameter setting error 6.Check the voltage displayed by Programmer System Monitor Menu Controller Capacity Voltage	Set: After the main contactor is closed and the FET bridge circuit is working, either the current output exceeds 64ms due to low voltage shutdown, or the low voltage shutdown voltage value of the controller is reached Clear: Controller current output>0% exceeds 100ms, or capacitor voltage>low voltage turn-off voltage value	No drive torque output
1-7	Severe KSI Undervoltage Fault type:1	1.Non-controller system consumes photocell 2.KSI input line resistance is too high 3.KSI line is disconnected when driving motor 4.Fuse burnt out 5.Check the voltage displayed by Programmer System Monitor Menu Controller Keyswitch Voltage	Set: KSI voltage is lower than low voltage shutdown voltage for 2 seconds Clear: KSI voltage>low voltage turn-off voltage value	None, except for specific measures in VCL software
1-8	Severe B+ Overvoltage Fault type:1	1.Controller battery parameter setting error 2.During regenerative braking, the internal resistance of the battery is too high when there is a current recharge battery 3.The battery is not connected during regenerative braking 4.Check the voltage displayed by Programmer System Monitor Menu Controller Capacity Voltage	Set: When the FET bridge works, the capacitance voltage exceeds the set value of serious high voltage Clear: reset the controller when the capacitor voltage is lower than the set value of severe high voltage	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;

1-8	Severe KSI Overvoltage Fault type:1	1.The battery voltage to the controller KSI (pin1) end exceeds the critical high voltage setting value 2.Check the voltage displayed by Programmer System Monitor Menu Controller Keyswitch Voltage	Set: KSI voltage exceeds the set value of severe high voltage Clear: reset the controller when the capacitor voltage is lower than the set value of severe high voltage	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
1-9	Speed limit fault detected Fault type:1	1.It is detected that the motor speed exceeds the set value of Max Speed Supervision 2.Max Speed Supervision setting value is incorrect 3.Check the setting value of Programmer Application Setup Max Speed Supervision	Set: the motor speed exceeds the set value and the duration also exceeds the set value Clear: Reset Controller	Shutdown interlock, shutdown EMbrake
1-10	Operation control fault is monitored Fault type:1	1.When the vehicle is stopped, it is detected that the controller output frequency and phase current exceed the parameter setting value under Travel Control Supervision 2.The parameter settings under Travel Control Supervision are incorrect 3.Check the setting value of Programmer Application Setup Travel Control Supervision	Set: the motor frequency and phase current exceed the parameter setting value under Travel Control Supervision in the parking state Clear: Reset Controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
2-2	Controller Overtemp Cutback Fault type:1	1.Controller works in extreme environment 2.The load is too heavy 3.Controller installation is unreasonable 4.Controller performance is limited at this temperature 5.Check the temperature displayed by Programmer System Monitor Menu Controller Controller Temperature	Set: radiator temperature is lower than+85°C Clear: The radiator temperature is lower than+85°C, and then reset the controller	Reduce driving and braking torque

2-3	Undervoltage e Cutback Fault type:1	1.The battery needs to be charged, and the performance of the controller is limited under this voltage 2.Controller battery parameter setting error 3.Non-controller system consumes photocell 4.The internal resistance of the battery is too high 5.The battery is not connected when driving the motor 6.The fuse connecting B+ is burnt out or the main contactor is not closed 7.Check Programmer System Monitor Menu Controller Current Undervoltage Cutback 8.Check the voltage displayed by Programmer System Monitor Menu Controller Capacitor Voltage	Set: After the FET bridge circuit works, the capacitance voltage is lower than the limit value of Undervoltage Cut back Clear: capacitance voltage is higher than the limit value of Undervoltage Cutback	Reduce drive torque
2-4	Overvoltage Cutback Fault type:1	1.During normal operation, the current generated by regenerative braking is recharged to the battery, which is too high to cause failure, and the performance of the controller is limited under this voltage 2.Controller battery parameter setting error 3.During regenerative braking, the internal resistance of the battery is too high when there is a current recharge battery 4.The battery is not connected during regenerative braking 5.Check Programmer System Monitor Menu Controller Current Overvoltage Cutback 6.Check the voltage displayed by Programmer System Monitor Menu Controller Capacity Voltage	Set: After the FET bridge circuit works, the capacitance voltage exceeds the limit value of Overvoltage Cutback Clear: capacitance voltage is higher than the limit value of Overvoltage Cutback	Reduce braking torque Note: this fault is only detected during regenerative braking

2-5	Ext 5V Supply Failure Fault type: 1.The output 5V voltage is out of range The current of 2, 5V voltage is out of range	1.The external 5V load is too small (pin16) 2.Check the voltage and current of 5V output displayed by Programmer System Monitor Menu Outputs	Set:1, 5V output exceeds 5V±10%; 2, 5V current is limited by parameter setting; Clear: reset the controller or VCL	Turn off 5V output
2-6	Ext 12V Supply Failure Fault type: 1.The output 12V voltage is out of range The current of 2,12 voltage is out of range	1.The external 12V load is too small (pin23) 2.Check the 12V output voltage and current displayed by Programmer System Monitor Menu Outputs	Set:1,12V output exceeds 12V±15%; 2,12V current is limited by parameter setting; Clear: reset the controller or VCL	Turn off 12V output
2-8	High temperature reduction of motor Fault type:1	1.The motor temperature is greater than or equal to the temperature hot setting value, resulting in the controller output current limit 2.The motor temperature and sensor parameters are set incorrectly 3.Check Programmer AC Motor Setup Temperature Sensor	Set: motor temperature is greater than or equal to the set value of Temperature Hot Clear: lower the temperature to the normal value	1.Reduce drive torque 2.If Motor Braking Thermal Cut Back Enable=On, reduce braking torque
2-9	Motor Temp Sensor Fault type:1	1.The motor temperature sensor is not connected properly; 2.The sensor polarity connection is incorrect (pin9 and pin12) 3.The motor temperature and sensor parameters are set incorrectly 4.Check Programmer System Monitor Menu AC Motor Temperature	Set: The voltage value converted by the motor temperature sensor input (pin9) is out of range Clear: motor temperature sensor input voltage returns to normal range	Enter the LOS mode, reduce the motor speed, and shut down the high bit reduction function of the motor

3-1	Main Driver Fault type: 1.Driver short circuit 2.Driver overcurrent 3.Open circuit/short circuit (high detected, low expected) 4.Open circuit/short circuit (low detected, high expected) 5.Disconnection	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error	When Set: Main Enable=On, the main contactor drive is open or short-circuited Clear: Reset Controller after repair	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
3-2	Electromagnetic brake driver failure Fault type: 1.Driver short circuit 2.Driver overcurrent 3.Open circuit/short circuit (high detected, low expected) 4.Open circuit/short circuit (low detected, high expected) 5.Disconnection	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error	Set: EM Brake Type>0, the electromagnetic brake (pin4) drive is open or short circuited Clear: Reset Controller after repair	Shutdown EMBrake; Shutdown Throttle; FullBrake;
3-4	Load Hold Diver Fault	Same as Driver 1 Fault	Same as Driver 1 Fault	shutdown currently allocated driver
3-5	Lower Fault	Same as Driver 1 Fault	Same as Driver 1 Fault	shutdown currently allocated driver
3-6	Encoder Fault Fault type: 1.Calibration loss 2.Pulse loss due to overcurrent 3.Speed pulse signal loss 4.Motor matching 5.The power supply part of the encoder is faulty	1.The motor encoder fails 2.Crimping or wrong wiring 3.Check Programmer\System Monitor Menu\AC Motor\Motor RPM 4.Check Programmer\AC Motor Setup\Quadrature Encoder\Encoder Fault Setup	Set: motor encoder signal detection failure Clear: Reset the Controller, or if the parameter LOS Upon Encoder Fault=On, reset the interlock switch to clear the fault, and enter the LOS fault mode (9-3 fault)	Shutdown EMBrake; Shutdown Throttle; FullBrake;
3-7	Motor Open Fault type:1	1.The motor phase is open 2.Crimping or wrong wiring	Set: Detect motor U, V, W phase open circuit Clear: switch KSI	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;

3-8	Main Contactor Welded Fault type:1	1.The contact of the main contactor is stuck normally open 2.Motor V phase or U phase open circuit 3.There is an external voltage directly connected to the Controller B+ terminal	Set: Release the main contactor after it is pulled in, and the capacitor voltage does not drop Clear: Reset Controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
3-9	Main Contactor Did Not Close Fault type: 1.The main contactor does not pull in after there is a control command 2.The main contactor is disconnected during operation	type 1: 1.The main contactor does not pull in 2.The main contactor contact is defective 3.The Controller B+ terminal is connected to a large external load, resulting in the capacitor not being able to charge effectively 4.The large current fuse is blown 5.The main contactor parameter setting is wrong type 2: 1.The main contactor is disconnected during operation 2.The contactor coil is disconnected 3.Contactor failure	Set: After the main contactor is controlled and closed, the capacitor voltage is not charged and rises to the battery voltage Clear: Reset Controller	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
4-2	Throttle Input failure Fault type: 1.The external is too low or too high	1.The Throttle input voltage exceeds the range set by Analog Low and Analog High, and the corresponding analog input is defined as Throttle input 2.check Programmer\Controller Setup\Analog Inputs\Analog 1 Type 3.check Programmer\Controller Setup\Analog Inputs\Configure	Set: Throttle The input voltage exceeds the range of Analog Low and Analog High settings Clear: Throttle The input voltage returns to the normal range, reset the Controller	Shutdown Throttle;
4-4	Brake input failure Fault type:1	Corresponding fault of brake input source Set (assigned analog input)	Note: Input 1 fault diagnosis may also be input voltage out of range	FullBrake

4-6	Memory data read and write failure (NV Memory Failure) Fault type: 1.Invalid verification 2.Data writing error 3.Data read error 4.Data writing is not completed due to power failure	1.Memory data read and write failure 2.Controller internal failure	Set: Controller failed to read and write EEPROM data Clear: Download the correct software and corresponding parameter settings, reset the Controller	shutdown motor, main contactor, electromagnetic brake, Throttle, interlock, drive 1, drive 2, drive 3, drive 4, drive 5, proportional drive, full power brake
4-7	HPD Sequencing Fault type:1	1.Key switch, interlock, direction switch and Throttle input operation sequence is not correct 2.Wiring or crimping errors are broken on the key switch, interlock, direction switch and Throttle input. 3.The key switch, interlock, direction switch and Throttle input are damp 4.Check Programmer\System Monitor Menu\Inputs\Switch Status 5.Check Programmer\System Monitor Menu\Inputs\Throttle Command	Set: Keyswitch, Interlock, Direction Switch, and Throttle inputs operate out of order Set HPD or SRO failure Clear: recount in correct order	shutdown Throttle
4-7	EMR Rev HPD Fault type:1	1.The emergency reverse operation has ended, but the throttle input, direction switch, and interlock do not return to home position	Set: The emergency reverse operation has ended, but the Throttle input, direction switch, and interlock have not returned Clear: If EMR Interlock is set to ON, Clear Throttle, direction switch, and interlock input are required; if EMR Interlock is set to OFF, Clear Throttle, direction switch input is required	shutdown Throttle ,shutdown EMbrake

4-7	Pump HPD Fault type: 1.can only lift 2.can only drop 3.Lifting and lowering	Wrong lifting /lowering Throttle input conditions (>25%) setting parameters wrong: 1.Hydraulic suppression type 2.HPD/SRO judgment time oil pump Throttle hardware failure	Set: 1.Throttle output is high when starting up 2.Drop Throttle output high when starting 3.Throttle output is high when hoisting and descending when starting Clear: Throttle output returns to less than 25% when starting, switch KSI	shutdown pump
4-9	Parameter Change Fault type: CAN ID of the record parameter	1.After the interlock is closed, modify the parameters related to safety, that is, the parameters marked with PCF	Set: Adjust the parameters that need to switch KSI Clear: reset Controller, cycle KSI	Shutdown Motor; Shutdown Main Contactor; Shutdown EMBrake; Shutdown Throttle; FullBrake;
4-10	EMR Switch Redundancy Fault type:1	1,1 or 2 of the two emergency reversing switches do not work, resulting in an invalid state 2. The switch is damp or dirty	Set: emergency reverse switch normally open and normally closed asynchronous Clear: Correct the switch state and reset the Controller	Shutdown Interlock, Shutdown EMbrake
5-1	USER 1 FAULT	PDO Fault Rema-PS16L		
5-2	USER 2 FAULT	User HPD Fault		
5-3	USER 3 FAULT	Throttle Open Fault		
5-4	USER 4 FAULT	BDI Low Liftlock		
5-5	USER 5 FAULT	Display PDO Timeout Fault		
5-6	USER 6 FAULT			
5-7	USER 7 FAULT			
5-8	USER 8 FAULT	Handshake Fault		
5-9	USER 9 FAULT	Interlock SRO		
6-1	USER 10 FAULT	Rema EMR SRO		
6-2	USER 11 FAULT	Throttle supervisor Fault		
6-3	USER 12 FAULT	Unmatched Display Fault		
6-4	USER 13 FAULT	BMS Fault Grade Nonzero		
6-5	USER 14 FAULT	PDO Timeout BMS		
6-6	USER 15 FAULT	BMS Temp High fault		
6-7	USER 16 FAULT	BMS LOW AH		
5-10	USER 17 FAULT	BMS voltage difference		
5-11	USER 18 FAULT	BMS Severe Overvoltage BMS Undervoltage		

		BMS Temp Low fault Battery type mismatch		
5-12	USER 19 FAULT	PDO Fault ECS		
5-13	USER 20 FAULT	Rema EMR SRO		
5-14	USER 21 FAULT	HYD SRO Fault		
5-15	USER 22 FAULT	Throttle ON Without Interlock Fault		
6-10	USER 23 FAULT			
6-11	USER 24 FAULT			
6-12	USER 25 FAULT			
6-13	USER 26 FAULT			
6-14	USER 27 FAULT			
6-15	USER 28 FAULT			
7-10	USER 29 FAULT			
7-11	USER 30 FAULT	Unmatched Display Fault		
7-12	USER 31 FAULT			
7-13	USER 32 FAULT			
6-8	VCL Run Time Error	1. Runtime faults are defined by VCL, refer to system information 2. When using VCL to control the drive, the drive command does not match the drive letter	Set: VCL runtime error detected Clear: modify VCL, reset Controller	Shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, shutdown interlock, shutdown drive1, shutdown drive2, shutdown drive3, shutdown drive4, shutdown drive5, shutdown proportional drive, Fullbrake
7-2	PDO Timeout Fault type:1	1.The time for two adjacent PDOs to receive information exceeds the set PDO timeout	Set: The time for two adjacent PDOs to receive information	shutdown Throttle

		time 2.Adjust PDO settings, see Programmer/Application Setup/CAN Interface/PDO Setups	exceeds the set PDO timeout time Clear: Receive CAN NMT information, or reset the Controller	
7-3	motor stalled （Stall Detected） Fault type:1	1.Motor stalled 2.Motor encoder failure 3.Wrong crimping or wiring 4.The power supply part of the motor encoder is abnormal 5.Check Programmer\System Monitor Menu\AC Motor\Motor RPM	Set: no motor encoder signal change detected Clear: Reset the Controller, or if the parameter LOS Upon Encoder Fault=On, reset the interlock switch to clear the fault, enter the LOS fault mode (9-3 fault), allow to limit the motor output	shutdown motor, shutdown EMbrake, shutdown Throttle, the control mode is changed to LOS, and the motor output is limited
7-7	Supervision Fault type: Curtis monitoring code	1.Controller internal failure	Set: Controller internal failure Clear: Reset Controller	shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, shutdown interlock, shutdown drive 1, shutdown drive 2, shutdown drive 3, shutdown drive 4, shutdown drive 5, shutdown proportional drive, Fullbrake
7-9	Supervision Input Check Fault type:1	1.Controller internal failure	Set: Controller is corrupted Clear: Reset Controller	shutdown motor, main contactor, EMbrake, Throttle, interlock, drive1, drive2, drive3, drive4, drive5, proportional Drive, brake with full power
8-2	PDO Mapping Error Fault type:1	1.Too many data bits are allocated during PDO mapping, or the targets are incompatible 2.Adjust PDO settings, see Programmer/Application Setup/CAN Interface/PDO Setups	Set: Incorrect PDO mapping detected Clear: Reset Controller	shutdown PDO

8-3	Internal Hardware Fault type: Curtis hardware code	1.Internal failure of Controller detected	Set: Controller internal fault detected Clear: Reset Controller	shutdown motor, shutdown main contactor shutdown EMbrake, shutdown Throttle, Fullbrake
8-7	Motor Characterization on Error Fault type: 71.write memory RAM failure 72.temperature sensor failure 73.motor overheating 74.Controller temperature reduction 76.Low pressure relief 77.high pressure reduction 78.No encoder signal 79.current checksum out of range 80.current checksum out of range 81.can detect the encoder signal, but cannot automatically detect the number of pulses per circle (encoder steps) 82.Automatic matching failed 90/98.cannot detect permanent magnet synchronous motor feedback sine/cosine signal 91.permanent magnet synchronous motor does not turn 92.permanent magnet synchronous motor no acceleration or low acceleration 94-97. Permanent magnet synchronous motor delay compensation is out of	The motor matching failed during the matching process	Set: motor matching failed in the process of matching motor Clear: Reset Controller	shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, Fullbrake

	range 99.permanent magnet synchronous motor rotates when starting to match 102.Permanent magnet synchronous motor temperature sensor failure 103.permanent magnet synchronous motor high temperature reduction 104.permanent magnet synchronous motor controller temperature reduction 106.permanent magnet synchronous motor controller low voltage reduction 107.Permanent Magnet Synchronous Motor Controller High Voltage Reduction			
8-8	Encoder Pulse Error Fault type:1	1.The encoder step setting does not match the actual situation 2.Check the parameter settings in Programmer\AC Motor Setup\Quadrature Encoder\Encoder Steps 3.The motor loses IFO control, and the motor accelerates when there is no Throttle signal input	Set: Wrong encoder step setting detected Clear: Confirm that the encoder step setting is consistent with the actual situation, and reset the Controller	shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, Fullbrake
8-9	Parameter Out of Range Fault type: record target CAN ID	1.It is detected that the parameter value is out of range 2.Check and rewrite parameters with CIT tool	Set: A parameter value out of range was detected Clear: rewrite parameters to normal range	shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, Fullbrake
9-1	Bad Firmware Fault type:1	Controller firmware is incorrect: 1.CRC or OS does not match 2.An incompatible OS is used	Set: The downloaded software does not match the Controller hardware Clear: Download the	Controller cannot fully start

			matching software	
9-2	EM Brake Failed to Set Fault type:1	1.When the vehicle is detected, set it in EMbrake after braking 2.EMbrake cannot prevent the motor from rotating after braking	Set: EMbrake After setting the brake and delaying, it is detected that the vehicle is running Clear: 1.Activate Throttle (EM Brake Type=2); 2.Activate Interlock (EM Brake Type=1)	shutdown EMbrake, shutdown Throttle, Set standing slope function after interlock activation
9-3	Encoder LOS Fault type:1	1.Encoder 3-6 failure or 7-3 failure, enter LOS mode 2.The motor encoder fails 3.Crimping or wrong wiring 4.Vehicle stalled	Set: Encoder 3-6 fault or 7-3 fault, if the parameter LOS Upon Encoder Fault=On, after resetting the interlock switch, enter the LOS fault mode (9-3 fault), allowing to limit the motor output Clear: switch KSI, or if LOS has been set, clear after confirming that the encoder is normal, Motor RPM=0, Throttle Command=0	LOS mode
9-4	Emer Rev Timeout Fault type :1	1.Emergency reverse Set and end, because emergency reverse time expires 2.The emergency reverse input is stuck	Set: Set emergency reverse, run to expiration Clear: shutdown emergency reverse input	shutdown Throttle, EMbrake
9-5	Pump Overcurrent Fault type: 1.The pump current sensor value is close to its power supply voltage 2.The pump current sensor value is close to the sensor ground 3.The pump current exceeds the current detection limit	1.External short circuit of pump motor 2.Controller failure	Set: pump current exceeds current detection limit Clear: switch KSI	shutdown pump

9-6	Pump BDI	1.The power is lower than the low battery lock parameter setting value 2.BDI parameter setting error	Set: When the power is lower than the low battery lock parameter setting value, Setpump will act Clear: battery charging	shutdown pump
9-7	Pump Hardware Fault type: 1.The duty cycle has not changed 2.The input and output duty cycle of the pump does not match	1.External short circuit of pump motor 2.Controller failure	Set: 1.The pump duty cycle update failed; 2.Input and output duty cycles do not match Clear: switch KSI	shutdown vehicle operation
9-9	Parameter Mismatch (Parameter Mismatch) Fault type: 1.The dual drive function is turned on in the torque mode 2.SPMSM motor feedback selects the encoder 3.Sine and cosine are selected for AC induction motor feedback	1.Incorrect motor feedback selection for different motor technology applications 2.The dual drive function is turned on in the torque mode 3.The dual drive function is turned on when the single Controller is applied	Set: 1.The dual drive function is turned on in the torque mode 2.SPMSM motor feedback selects the encoder 3.Select Zhengyuxuan for AC induction motor feedback Clear: adjust the parameters to the appropriate value, reset the Controller	shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, Fullbrake
9-10	Interlock Braking Supervision Fault type: 1.The motor speed exceeds the speed limit range of the interlock brake monitoring 2.The interlock is disconnected, and EMbrake does not set the brake within the set time 3.Interlock is broken, EMbrake is not setting the brake, and the rotor position exceeds the RPM position limit	1.During the interlock braking process, the motor speed exceeds the parameters set under Interlock Braking Supervision 2.Check Programmer/Application Setup/Interlock Braking/Supervision Enable. 3.Check Programmer/Application Setup/Interlock Braking/Interlock Braking Supervision	Set: During the interlock braking process, the motor speed exceeds the parameters set under Interlock Braking Supervision Clear: Reset Controller	Shutdown motor ,shutdown EMbrake ,shutdown main contactor

9-11	EMR Supervision Fault type:1	1.During the emergency reverse process, the motor speed exceeds the parameters set under Emergency Reverse Supervision 2.See Programmer/Application Setup/Emergency Reverse/Emergency Reverse Supervision.	Set: During the emergency reverse process, the motor speed exceeds the parameters set under Emergency Reverse Supervision Clear: Reset Controller	shutdown motor ,shutdown EMbrake, shutdown main contactor
10-1	Driver 1 Fault Fault type: 1.Driver short circuit 2.Drive overcurrent 3.Open/short (high detected, should be low) 4.Open/short (low detected, should be high) 5.Disconnection 6.output limit no current Fault type 3-5 requires driver fault detection to be turned on	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.The drive is overcurrent, exceeding the parameter value set by Driver1 Overcurrent 5.Check Programmer/Controller Setup/Outputs/Driver1/Driver1 Overcurrent.	Set: Driver 1 open circuit or short circuit or driver overcurrent exceeds the value set by Driver1 Overcurrent Clear: Reset Controller after repairing short circuit or open circuit	shutdown driver1
10-2	Driver2 Fault Fault type: 1.Driver short circuit 2.Drive overcurrent 3.Open/short (high detected, should be low) 4.Open/short (low detected, should be high) 5.Disconnection 6.output limit no current Fault type 3-5 requires driver fault detection to be turned on	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.The drive is overcurrent, exceeding the parameter value set by Driver2 Overcurrent 5.Check Programmer/Controller Setup/Outputs/Driver2/Driver2 Overcurrent.	Set: Driver 2 open circuit or short circuit or driver overcurrent, exceeding the Driver2 Overcurrent setting parameter value Clear: Reset Controller after repairing short circuit or open circuit	shutdown driver 2
10-3	Driver3 Fault Fault type: 1.Driver short circuit 2.Drive overcurrent 3.Open/short (high detected, should be low) 4.Open/short (low	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.The drive is overcurrent, exceeding the parameter value	Set: Drive open circuit or short circuit or drive overcurrent, exceeding the value set by Driver3 Overcurrent Clear: Reset Controller after	shutdown driver 3

	detected, should be high) 5.Disconnection 6.output limit no current Fault type 3-5 requires driver fault detection to be turned on	set by Driver3 Overcurrent 5.Check Programmer/Controller Setup/Outputs/Driver3/Driver3 Overcurrent.	repairing short circuit or open circuit	
10-4	Driver4 Fault Fault type: 1.Driver short circuit 2.Drive overcurrent 3.Open/short (high detected, should be low) 4.Open/short (low detected, should be high) 5.Disconnection 6.output limit no current Fault type 3-5 requires driver fault detection to be turned on	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.The drive is overcurrent, exceeding the parameter value set by Driver4 Overcurrent 5.Check Programmer/Controller Setup/Outputs/Driver4/Driver4 Overcurrent.	Set: Drive open circuit or short circuit or drive overcurrent, exceeding the value set by Driver 4 Overcurrent Clear: Reset Controller after repairing short circuit or open circuit	shutdown driver 4
10-5	Driver 5 Fault Fault type: 1.Driver short circuit 2.Drive overcurrent 3.Open/short (high detected, should be low) 4.Open/short (low detected, should be high) 5.Disconnection 6.output limit no current Fault type 3-5 requires driver fault detection to be turned on	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.The drive is overcurrent, exceeding the parameter value set by Driver5 Overcurrent 5.Check Programmer/Controller Setup/Outputs/Driver5/Driver5 Overcurrent.	Set: Drive open circuit or short circuit or drive overcurrent, exceeding the value set by Driver 5 Overcurrent Clear: Reset Controller after repairing short circuit or open circuit	shutdown driver 5
10-6	Driver6 Fault Fault type: 1.Driver short circuit 2.Drive overcurrent 3.Open/short (high detected, should be low) 4.Open/short (low detected, should be high)	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.The drive is overcurrent, exceeding the parameter value set by Driver6 Overcurrent 5.Check	Set: Driver 6 open circuit or short circuit or driver overcurrent exceeds the value set by Driver6Overcurrent Clear: Reset Controller after repairing short circuit or open circuit	shutdown Driver 6

	5.Disconnection 6.output limit no current Fault type 3-5 requires driver fault detection to be turned on	Programmer/Controller Setup/Outputs/Driver6/Driver6 Overcurrent.		
10-7	Driver7 Fault Fault type: 1.Driver short circuit 2.Drive overcurrent 3.Open/short (high detected, should be low) 4.Open/short (low detected, should be high) 5.Disconnection 6.output limit no current Fault type 3-5 requires driver fault detection to be turned on	1.The driver load is open or short circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.The drive is overcurrent, exceeding the parameter value set by Driver7Overcurrent 5.Check Programmer/Controller Setup/Outputs/Driver7/Driver7 Overcurrent.	Set: Driver 7 open circuit or short circuit or driver overcurrent exceeds the value set by Driver7Overcurrent Clear: Reset Controller after repairing short circuit or open circuit	Shutdown Driver7
10-8	Driver Assignment Fault type:5 drive serial number caused this fault	1.One driver used as 2 or more functions 2.View Programmer/Controller Setup/IO Assignments/Coil Drivers: main contactor driver, EMbrake drive pump contactor driver	Set: Drive Allocation Conflict Clear: Reset Controller after resolving drive allocation conflicts	shutdown drive
10-9	Coil Supply Fault Fault type: 1.Short circuit with B- or hardware failure 2.The internal short circuit of the drive causes the coil power supply to be cut off 3.Coil power start detection failure 4.Coil power start prohibition detection failure	1.The driver load is short-circuited 2.The pin of the connector or the coil of the contactor is dirty 3.Connector crimping error or wiring error 4.Controller failure	Set: A short circuit was detected after the startup check passed. The short circuit of the low-side part of the driver is detected, and the corresponding fault generated at the same time cannot cut off the driver current Clear: cycle KSI	shutdown Controller all outputs
11-1	Analog 1 Out of Range fault type: 1.Exceeded the upper limit 2.the lower limit is limited to	1.The input voltage of analog 1 is higher than the setting value of Analog1 High 2.The input voltage of analog 1 is lower than the setting value of Analog1 Low	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is	None, unless VCL adds special handling

		3.View Programmer/Controller Setup/Analog Inputs/Analog 1 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog1 Low/Analog1 High	lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	
11-2	Analog 2 Out of Range Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 2 is higher than the setting value of Analog2 High 2.The input voltage of analog 2 is lower than the setting value of Analog2 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog2 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog2 Low/Analog2 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-3	Analog 3 Out of Range Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 3 is higher than the setting value of Analog3 High 2.The input voltage of Analog 3 is lower than the setting value of Analog3 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog3 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog3 Low/Analog3 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-4	Analog 4 Out of Range Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 4 is higher than the setting value of Analog4 High 2.The input voltage of Analog 4 is lower than the setting value of Analog4 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog4 4.Check Programmer/Controller Setup/Analog	Set:1. The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting	None, unless VCL adds special handling

		Inputs/Configure/Analog4 Low/Analog4 High	range, and the Controller is reset	
11-5	Analog 5 Out of Range Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 5 is higher than the setting value of Analog5 High 2.The input voltage of analog 5 is lower than the setting value of Analog5 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog 5 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog5 Low/Analog 5 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-6	Analog 6 Out of Range Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 6 is higher than the setting value of Analog6 High 2.The input voltage of analog 6 is lower than the setting value of Analog6 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog6 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog6 Low/Analog6 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-7	Analog input 7 out of range (Analog 7 Out of Range) Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 7 is higher than the setting value of Analog7 High 2.The input voltage of Analog 7 is lower than the setting value of Analog7 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog7 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog7 Low/Analog7 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-8	Analog 8 Out of Range Fault type:	1.The input voltage of analog 8 is higher than the setting value	Set: 1.The input voltage is	None, unless VCL adds special handling

	1.Exceeded the upper limit 2.The lower limit is limited to	of Analog8 High 2.The input voltage of analog 8 is lower than the setting value of Analog8 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog8 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog8 Low/Analog 8 High	higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	
11-9	Analog 9 Out of Range Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 9 is higher than the setting value of Analog9 High 2.The input voltage of analog 9 is lower than the setting value of Analog9 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog9 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog9 Low/Analog9 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-11	Analog 14 Out of Range Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 14 is higher than the setting value of Analog14 High 2.The input voltage of analog 14 is lower than the setting value of Analog14 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog14 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog14 Low/Analog14 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-12	Analog Assignment Fault type: 9 The serial number of the analog quantity causes the fault	1.One analog quantity is used for 2 or more functions 2.An analog input is out of range 3.View Programmer/Controller Setup/IO Assignments/Controls	Set: An analog quantity is used as 2 or more functions or the input exceeds the range Clear: Reset Controller after	None, unless VCL adds special handling

			resolving drive allocation conflicts	
11-13	Analog input 18 out of range (Analog 18 Out of Range) Fault type: 1.Exceeded the upper limit 2.The lower limit is limited to	1.The input voltage of analog 18 is higher than the setting value of Analog18 High 2.The input voltage of analog 18 is lower than the setting value of Analog18 Low 3.View Programmer/Controller Setup/Analog Inputs/Analog18 4.Check Programmer/Controller Setup/Analog Inputs/Configure/Analog18 Low/Analog18 High	Set: 1.The input voltage is higher than the threshold set by the parameter; 2.The input voltage is lower than the threshold set by the parameter; Clear: The input voltage returns to the parameter setting range, and the Controller is reset	None, unless VCL adds special handling
11-15	Pump Current Sensor Fault type: 1.The pump current sensor value is close to its power supply voltage 2.The pump current sensor value is close to the sensor ground	1.External short circuit of pump motor 2.Controller failure	Set: The sensor is grounded after the pump current sensor value is close to its power supply voltage, and there is no current compensation Clear: switch KSI	shutdown operation
12-1	Branding Error Fault type:1	1.Software and hardware brands do not match 2.Contact the local Curtis technical support to deal with the fault	Set: Software and hardware are not compatible Clear: As available, branded software should be loaded, or use a branded Controller with the correct files and CIT tools configured	shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, Fullbrake
12-3	Hardware Compatibility Fault type:1	OS and Controller are not compatible: 1.The downloaded software is not compatible with the Controller hardware	Set: OS incorrect Clear: Download the matching OS	shutdown motor, shutdown main contactor, shutdown EMbrake, shutdown Throttle, Fullbrake
12-5	Lift Input Fault Fault type:1	Fault diagnosis associated with hoisting input source will set this fault. For example, if the hoisting input source is an analog input, then all faults related to the analog input will	Set: The fault diagnosis associated with the hoisting input source will set the fault Clear: resolves any	shutdown Lifting

		be grouped into this fault and reported	allocation conflicts, or input out of range, and resets the Controller	
12-6	Lower Input Fault Fault type:1	Fault diagnosis associated with falling input source will set this fault. For example, if the falling input source is an analog input, all faults related to the analog input are grouped into this fault and reported	Set: The fault diagnosis associated with the falling input source will set the fault Clear: resolves any allocation conflicts, or input out of range, and resets the Controller	shutdown lowering

17.SPECIALIZED STIPULATIONS FOR THE US-AMERICAN MARKET

a. Description warning labels (only US- market)

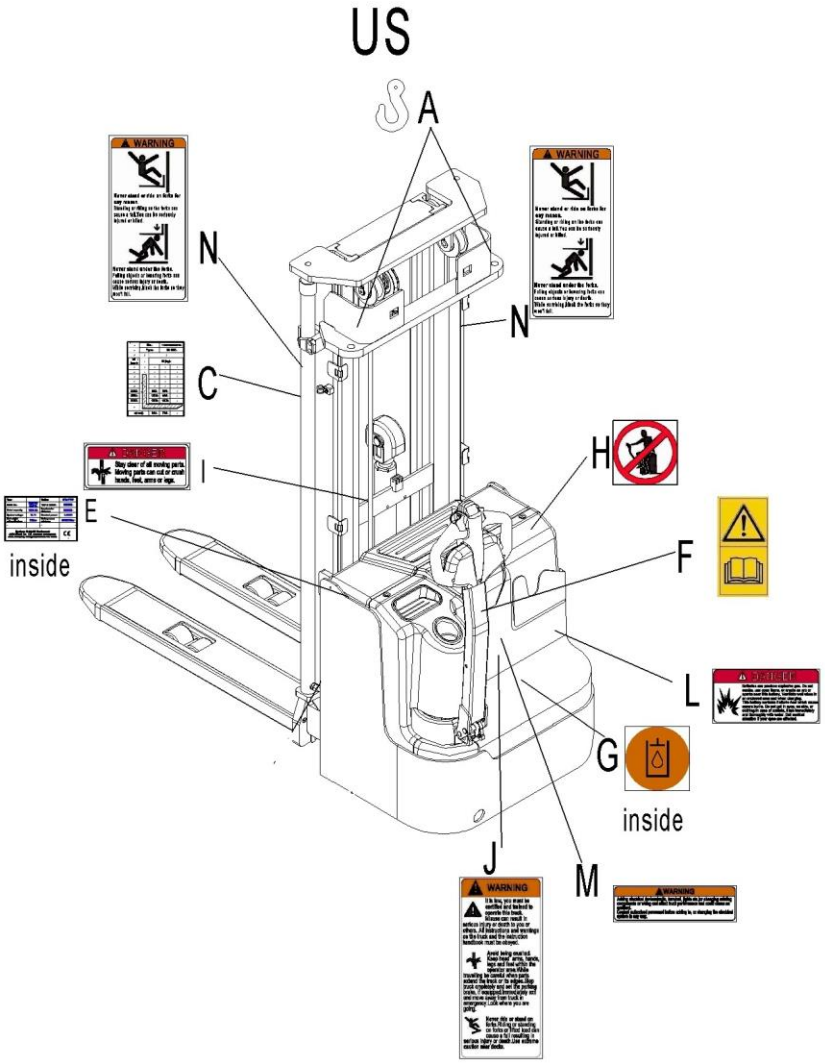


Fig. 22: Warning labels and safety devices (only USA)

A Crane hook label
C Residual lift capacity sticker
E Identification plate (ID-plate)
F Sticker to read and follow these instructions
G Sign oil filling point
H Sign danger not riding
I Sign danger being crushed
J Sign warning stay clear stop truck
L Sign danger battery
M Sign warning electrical devices
N Sign not under, on forks

Sign read and follow this instruction (F)

Sign oil filling point (G)

Sign danger not riding (H)

Sign danger being crushed (I)

Sign warning stay clear stop truck (J)

Sign danger battery (L)

Sign warning electrical devices (M)

Sign not under, on forks (N)

b.Technical data for US market

Drawing see page 7

Table 9: Main technical data for standard version (US market)

	Type sheet for industrial truck acc. to VDI 2198					
Distinguishing mark	1.2	Manufacturer`s type designation		PS 12L (3600)	PS16L (4600)	PS 20L (4600)
	1.3	Power (battery ,diesel, petrol, gas, manual)		Battery		
	1.4	Operator type		Pedestrian		
	1.5	Load Capacity / rated load	Q(lbs)	2640	3520	4400
	1.6	Load centre distance	C(in)	23.6		
	1.8	Load distance ,centre of drive axle to fork	x(in)	25.5		
	1.9	Wheelbase	y(in)	49	51	56
Weight	2.1	Service weight	lbs	2215	2948	3474
	2.2	Axle loading, laden front/rear	lbs	1505/3351	2046/4422	2200/5674
	2.3	Axle loading, unladen front/rear	lbs	1342/873	1870/1078	1980/1494
Tires, chassis	3.1	Tires		Polyurethane (PU)		
	3.2	Tire size, front	∅xW (in)	Φ9×2.95		
	3.3	Tire size, rear	∅xW (in)	Φ3.3×3		
	3.4	Additional wheels(dimensions)	∅xW (in)	Φ5.9x2		
	3.5	Wheels, number front/rear(x=driven wheels)		1x+1/4		
	3.6	Track, front	b_{10} (mm)	20.5		
	3.7	Track, rear	b_{11} (mm)	15.3		
Dimensions	4.2	Lowered mast height	h_1 (mm)	91	83	87.7
	4.3	Free Lift height	h_2 (mm)	69	60	60
	4.4	Lift height	h_3 (mm)	141.7	181	181
	4.5	Extended mast height	h_4 (mm)	161	200	205
	4.9	Height of tiller in drive position min./ max.	h_{14} (mm)	33.5/54.5		
	4.15	Height, lowered	h_{13} (mm)	3.5		
	4.19	Overall length	l_1 (mm)	75.6	77.3	82.7
	4.20	Length to face of forks	l_2 (mm)	30.3	32	37.4
	4.21	Overall width	b_1 (mm)	32.3		
	4.22	Fork dimensions	s/e/l (mm)	2.3/7/45.3		
	4.25	Distance between fork-arms	b_5 (mm)	22.4		
	4.32	Ground clearance, centre of wheelbase	m_2 (mm)	1.1	1.1	0.9
	4.33	Aisle width for pallets 1000X1200 crossways	Ast(in)	92	94.7	99.8
	4.34	Aisle width for pallets 800X1200 lengthways	Ast(in)	96.7	94.2	99.3
	4.35	Turning radius	Wa(in)	56.7	59.4	64.6
Performance data	5.1	Travel speed, laden/ unladen	mph	3.7/3.7	3.5/3.7	3.4/3.7
	5.2	Lift speed, laden/ unladen	fpm	19.7/33.5	25.6/39.4	25.6/39.4
	5.3	Lowering speed, laden/ unladen	fpm	21.7/21.7	39.4/27.6	39.4/27.6

	5.8	Max. grade ability, laden/ unladen	%	6/12	6/12	6/10
	5.10	Service brake		Electromagnetic		
Electric- engine	6.1	Drive motor rating S2 60min	HP	1.7	1.7	2.3
	6.2	Lift motor rating at S3 10%	HP	2.0	4.3	4.3
	6.3	Battery acc. to DIN 43531/35/36 A, B, C, no		2VBS	3VBS	3PZS
	6.4	Battery voltage, nominal capacity K5	V/Ah	24/180	24/270	24/350
	6.5	Battery weight	lbs	385	506	634
	6.6	Energy consumption acc: to VDI cycle	kWh/h	0.95	1.59	1.70
Additio nal data	8.1	Type of drive control		AC- speed control		
	8.4	Sound level at driver`s ear acc. to EN 12053	dB(A)	<70		

Table 9: Mast table

Designation	Lowered mast height h1(in)	Free Lift height h2(in)	Lift height h3(in)	Extended mast height h4(in)
PS 12L				
Two stage mast	77	—	114	133
	83	—	126	144.9
	90.9	—	141.7	160.6
Two stage mast FFL (Full-Free-Lift)	77	55.5	114	133
	83	61.4	126	144.9
	90.9	69.3	141.7	160.6
PS 16L				
Two stage mast	77	—	114	133
	83	—	126	144.9
	90.9	—	141.7	160.6
Two stage mast FFL (Full-Free-Lift)	77	55.5	114	133
	83	61.4	126	144.9
	90.9	69.3	141.7	160.6
Three stage mast	79	—	169.3	188.2
	83	—	181	200
Three stage mast FFL	79	55.9	169.3	188.2
	83	59.8	181	200
PS 20L				
Two stage mast	77	—	114	137.8
	83	—	126	149.6
	90.9	—	141.7	165.4
Two stage mast FFL (Full-Free-Lift)	77	55.5	114	137.8
	83	61.4	126	149.6
	90.9	69.3	141.7	165.4
Three stage mast	79	—	169.3	192.9
	83	—	181	204.7
Three stage mast FFL	79	55.9	169.3	192.9
	83	59.8	181	204.7