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HELI

OPERATION SERVICE MANUAL

G3 Series Lithium Battery Counterbalanced Forklift Trucks

4-5t

E3.00.1-2019

Foreword

This manual briefly introduces the technical parameters of our G3 series 4-5 ton lithium battery counterbalanced forklift truck including the structure, working principle and maintenance of the main parts. It can help operators to use this series of forklift trucks reasonably and make the forklift truck play the most effective role. It is hoped that operators and equipment managers will read the manual carefully before operating the lithium battery forklift truck, strictly abide by the provisions and precautions in the manual, and carefully use it so that your forklift truck will be in the best working condition for a long time and exert its maximum efficiency.

This product is not suitable for cold storage, dusty, electrify dust, high temperature, high corrosion environment. For a small amount of dust (non-conductive) environment, regular cleaning and maintenance of components should be done. This manual content might not correspond with the actual condition because of the improving of our products. Our products are subject to improvements and changes without notice.

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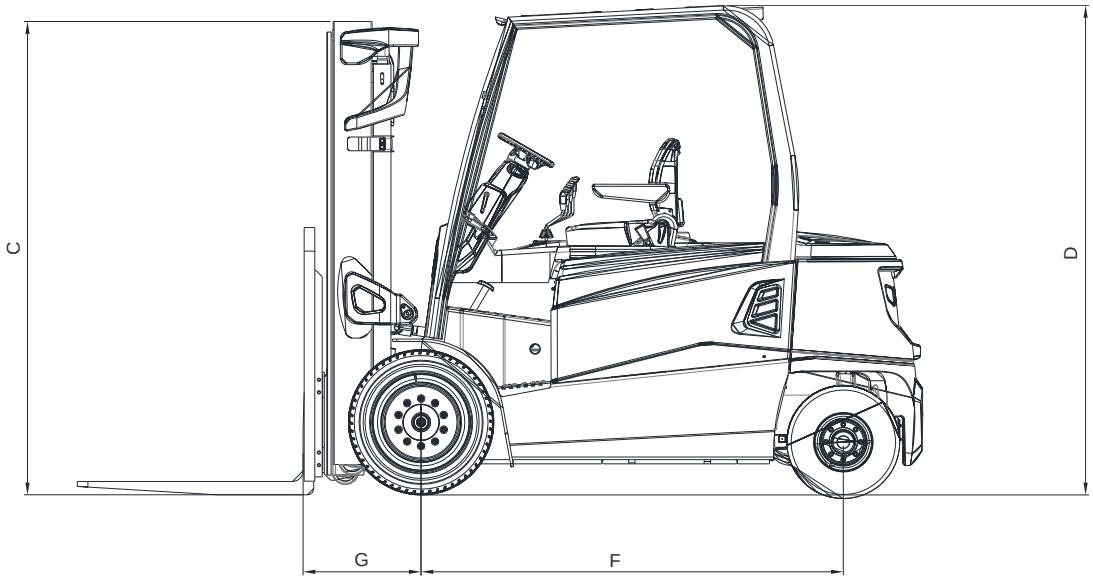
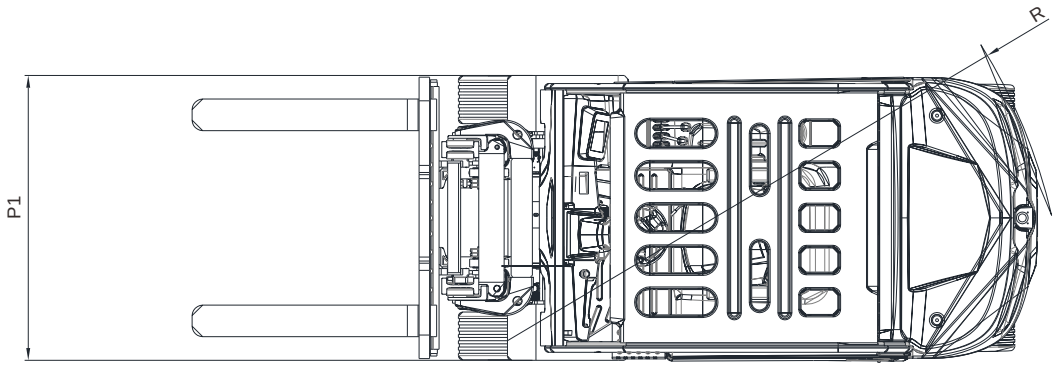
I. Main specifications of forklift trucks

1. External view of the truck





2. Main parameters

NO.	Item		Unit	CPD40	CPD45	CPD50
1	Overall length	With fork	mm	3990	3990	3990
		Without fork		2920	2920	2920
2	Overall width	Front wheel		1350	1350	1500
		Frame		1346	1346	1468
3	Overall height	Mast, lowered		2240	2240	2230
		Overhead guard		2275	2275	2270
		Mast, extended		4235	4235	4225
4	Wheel base			1960	1960	1960
5	Load center distance			500	500	500
6	Tread	Front		1120	1120	1189
		Rear		1070	1070	1070
7	Underground clearance （without load）	Middle of chassis		145	145	135
		Lower end of mast		140	140	130
8	Front overhang			560	560	560
9	Max. lifting height			3000	3000	3000
10	Min. steering radius			2580	2580	2580
11	Max. lowering speed	Unladen	mm/s	450	450	450
		Laden		500	500	500
12	Max. lifting speed	Unladen		450	450	450
		Laden		310	280	260
13	Max. travelling speed	Unladen	km/h	14		
		Laden		13		
14	Max. gradeability (laden)		％	16	15	14
15	Max. drawbar pull (laden)		kN	21	21	21
16	Mast tilting angle (front/rear)		°	6/8	6/8	6/8
17	Fork (length×width×thickness）		mm	1070×150×50		
18	Lithium Battery	Voltage	V	80		
		Capacity	Ah	500	600	600
19	Motor	Travelling motor	kW	20		
		Pump motor Ⅰ		2.5		
		Pump motor Ⅱ		26.5		
20	Tyre	Front		250-15		28x12.5-15
		Rear		21×8-9		
21	Service weight		kg	6670	6835	7210
22	Service weight without lithium battery			6085	6150	6525

3. Size and weight of the main parts that can be disassembled

No.	Parts name	Dimension and weight	Unit	Model		
				CPD40	CPD45	CPD50
1	Overhead guard	Max. dimension	mm	1625×1274×1511		
		Weight	kg	132.3		
2	Mast M300	Max. dimension	mm	540×1334×2250		
		Weight	kg	1015		
3	Drive axle	Max. dimension	mm	ϕ350×1326		
		Weight	kg	240		
4	Balance weight	Max. dimension	mm	1330x750x910	1330x750x910	1330x750x910
		Weight	kg	2215	2280	2550

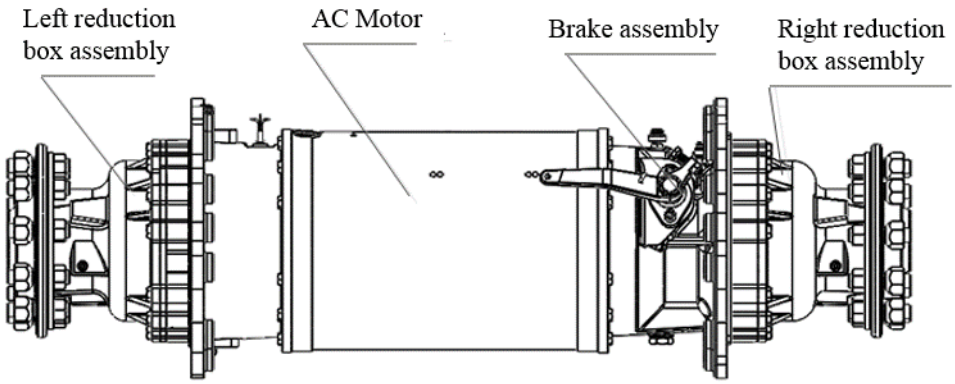
II. Construction, Principle, Adjustment and Maintenance of Forklift Trucks

1. Transmission system

1.1 General description

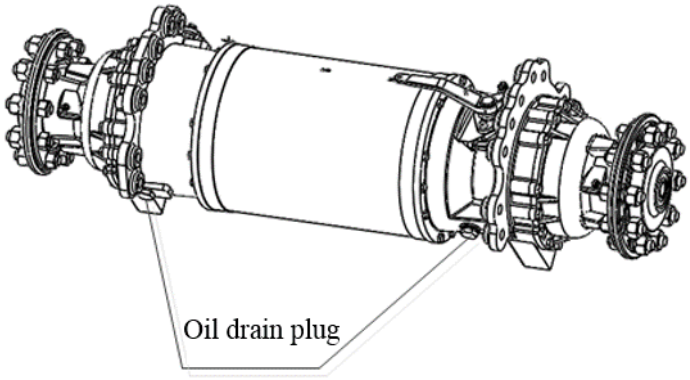
The 5t domestic integrated electrical bridge mainly consists of two reduction box assemblies, a fully enclosed AC motor and a set of brake assemblies.

The reduction box assembly contains a planetary reduction mechanism to increase the output torque of the bridge assembly. The driving gear in the box is connected with the rotor shaft of the motor. The walking speed of the forklift varies with the speed of the motor, and the driving direction is determined by the rotation direction of the motor. The motor adopts IP54 protection grade design and almost completely closed design, with stronger applicability in working conditions, which can be applied to harsh working conditions such as large dust and oil pollution. The whole bridge adopts multi-chip wet friction brake, which is located in a sealed cavity to effectively avoid external pollution, greatly extending the service life of the brake and reducing the maintenance cost. When the brake pedal is pressed, the wet friction plate is compressed, locking both the motor rotor shaft and the wheel for prompt braking.



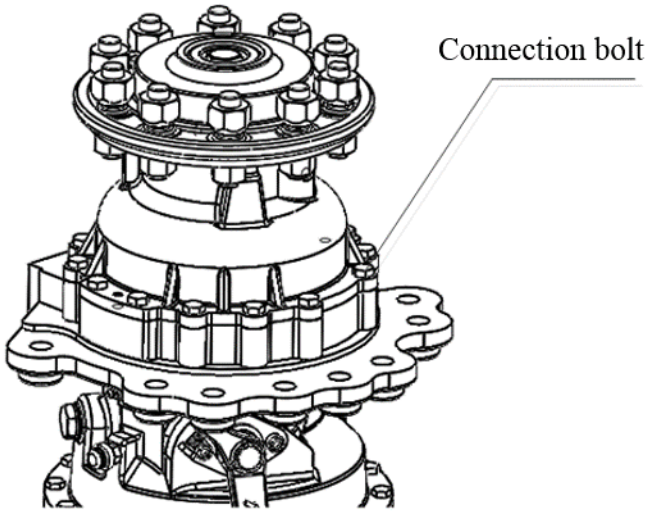
1.2 Disassembly of integrated bridge

When disassembling an integrated bridge, place the bridge assembly in a suitable, clean place. Open the oil drain plug to drain the lubricating oil from the left and right reduction box assembly of the integrated bridge.

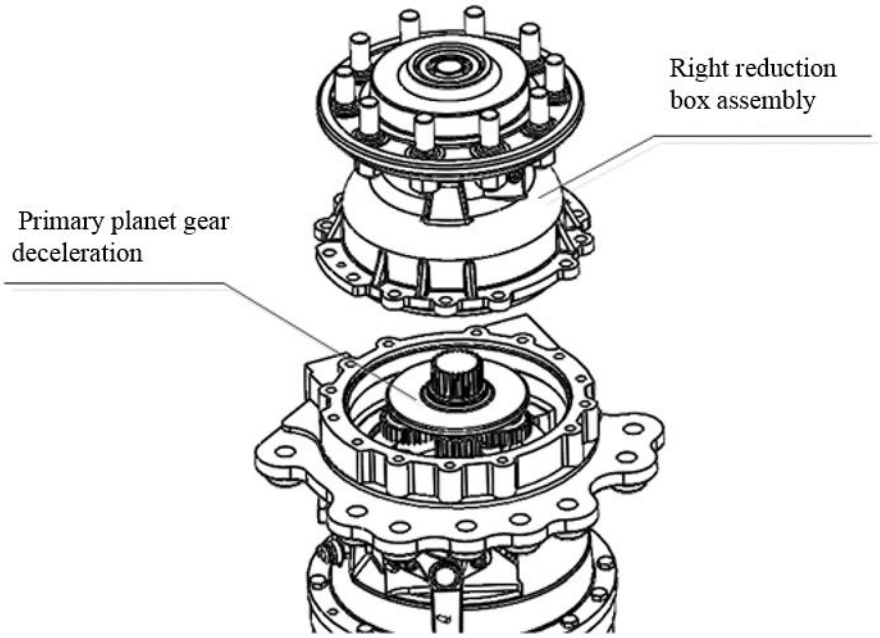


1.2.1 Disassembly and assembly of right reduction box assembly

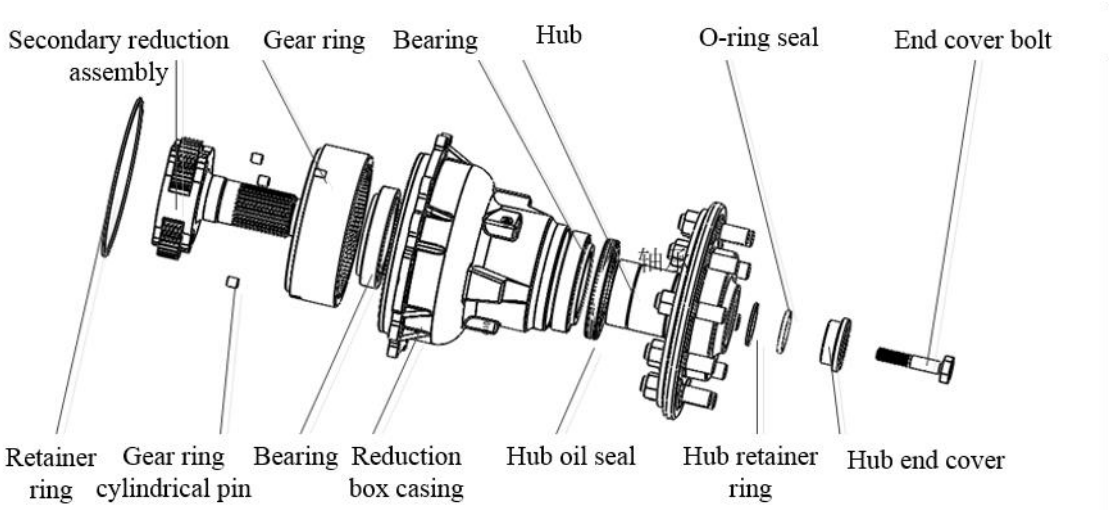
Lift and erect the integrated bridge assembly, remove the connection bolts of the reduction box assembly, specification: 14-M12*1.25. When installed, the bolt torque is 124-165N.m.



Remove the reduction box assembly and the primary planetary reduction assembly.



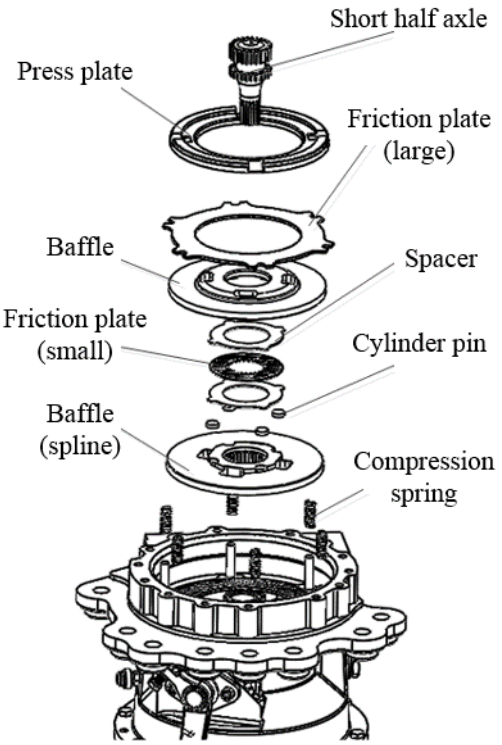
Remove the end cover bolt of the reduction box assembly, remove the hub end cover, O-ring seal and hub retainer ring in turn; Then remove the retainer ring, secondary reduction assembly, gear ring cylindrical pin and gear ring from the other side in turn, and the disassembly complete. The removal of the left reduction box assembly shall be consistent with this.



1.2.2 Disassembly of wet friction plate

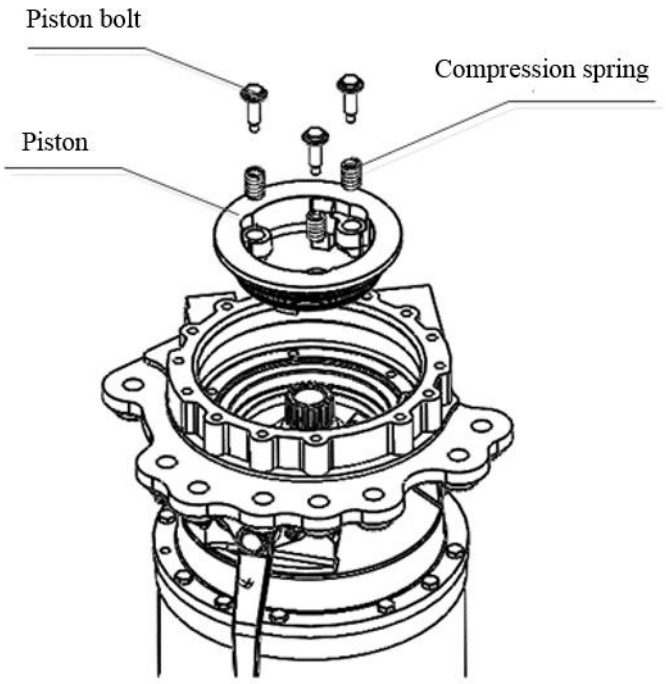
After removing the right reduction box assembly, remove the short axle, press plate,

friction plate (large), baffle, spacer, friction plate (small), cylinder pin, baffle (spline), compression spring, etc. in turn.



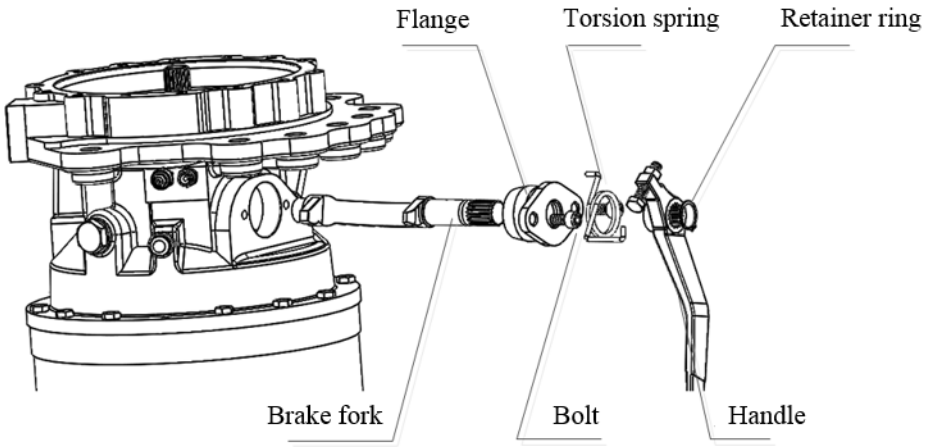
1.2.3 Disassembly of piston assembly

Remove the piston bolt, bolt head specification M17, remove the compression spring, then remove the piston. Torque for piston bolt installation is 22-30N.m.



1.2.4 Brake lever, fork disassembly

After removing the retainer ring, remove the handle and torsion spring in turn, loosen the bolt, remove the flange and brake fork.



1.3 Announcements in daily maintenance

1）Replace the brake pull lock or adjust the brake structure

When the hand brake pull lock is released completely, the wheel is suspended and the wheel hub of the disk-rotating drive axle can make it rotate freely. If it is found that the

wheel cannot rotate freely, it is forbidden to use, so the hand brake pull lock mechanism needs to be readjusted to make the wheel hub rotate freely, otherwise the friction disc will be sintered in a short time and the brake will fail.

2）Fuel quantity of Integrated electrical bridge

Model: HELI dedicated 85w/90

Brake side: 1.6-1.7L

No brake side: 1-1.1L

Every 10-15 days, it is necessary to check the integrated electrical bridge for no oil leakage, if necessary to find out the cause, and timely fill oil.

Replace gear oil of wheel side reducer every 1200 hours, oil type should be consistent with requirements.

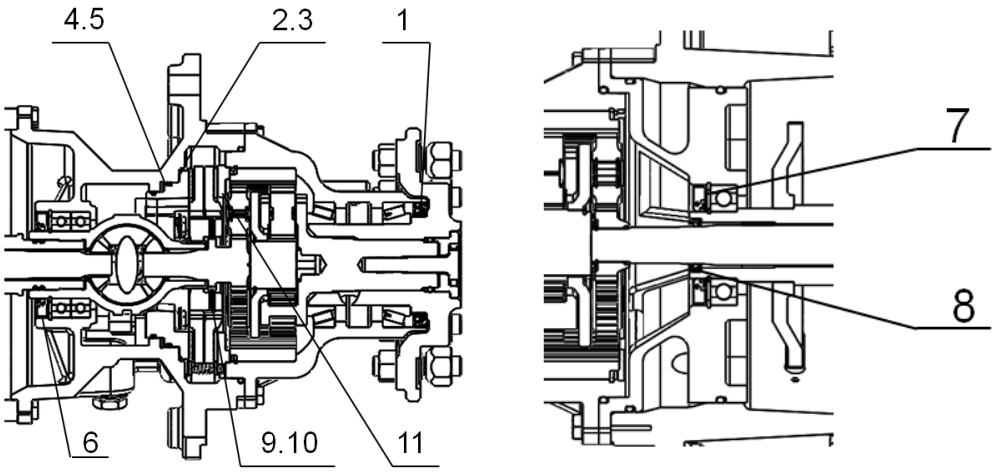
If the dust and oil in the working environment are large, dust and oil on the motor surface need to be cleaned regularly to ensure the normal heat dissipation of the motor.

3）Brake maintenance

Wet braking is a completely closed structure, which is maintenance free and has a design life of ≥6000h. When the braking failure occurs, relevant investigations should be conducted to further ensure the cause.

4）Vulnerable parts of Integrated electrical bridge

NO.	Figure Code	Name	Unit Amount
1	A71Z3-02051	Combination oil seal	2
2	A71Z3-02431	X-ring 164.4x3.53	1
3	A71Z3-02451	Retainer ring 164.4x3	1
4	A71Z3-02441	Retainer ring 146.4x3	1
5	A71Z3-02421	X-ring 146.4x3.53	1
6	A71Z3-02501	Oil seal 70x110	1
7	A71Z3-02511	Oil seal 50x90	1
8	A71Z3-02521	Oil seal 28x40	1
9	A71Z3-02311	Spacer	2
10	A71Z3-02341	Friction plate (small)	1
11	A71Z3-02331	Friction plate (large)	1



2. Brake system

2.1 General description

The brake system includes service brake and parking brake.

Full hydraulic braking mode is adopted for driving brake, and the power source for brake is hydraulic gear pump. The service brake system is mainly composed of brake pedal, brake pump, brake valve and oil-cooled disc brake. The driving brake schematic diagram is shown in Fig. 2-1.

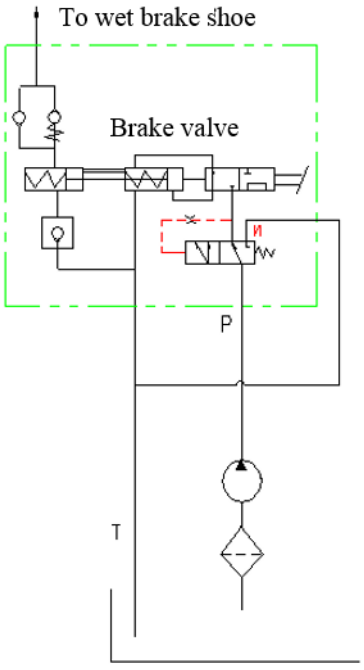


Figure 2-1principle diagram of service brake

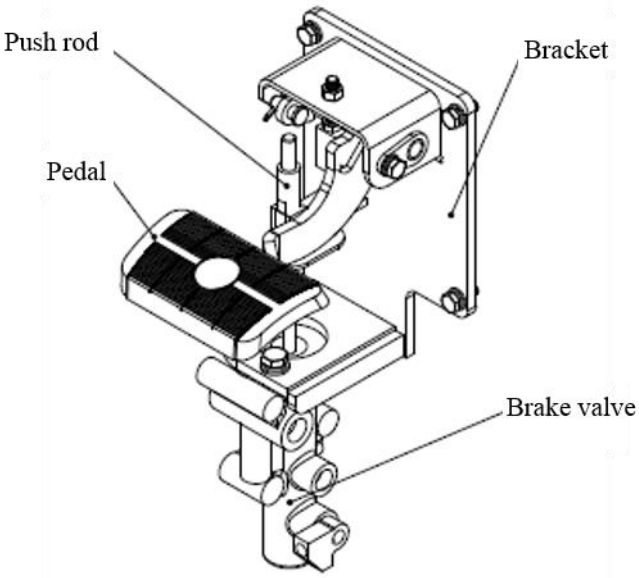


Figure 2-2 Brake pedal

2.1.1 Brake pedal

The installation of brake pedal is suspension type. Specific structure is shown in Figure 2-2. The force acting on the pedal is converted to the brake oil pressure by the push rod of the brake valve, and the wet disc brake of the driving axle is acted on to realize braking.

2.1.2 Brake valve

The shape of the brake valve and the position of each interface are shown in Fig. 2-3.

Brake valve mainly consists of seat, safety stem, support, piston, reaction piston, slide valve and so on.

The main principle of brake valve is introduced in hydraulic system.

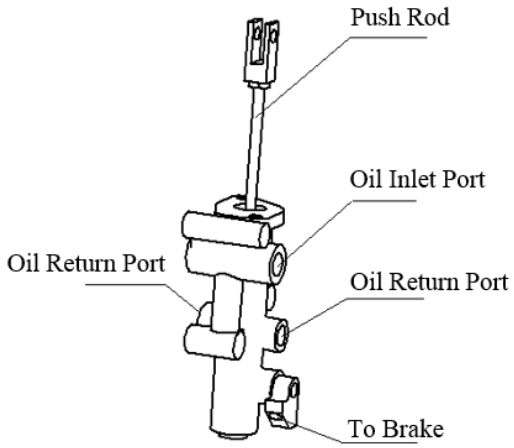


Figure 2-3 Shape of the brake valve and the position of each interface

2.1.3 Connection between brake system and drive axle

There are two connections between the brake system and the driving axle, one is the connection between the brake oil outlet of the vehicle and the other is the connection of the parking brake cable.

（1）The connection of service brake

The brake hose from the brake valve to the driving axle is connected with the service brake connection port shown in Figure 2-4 ①. The pre-tightening torque is 12-16Nm. Note: The bending radius of the brake hose shall be as large as possible to reduce the recovery resistance when the pedal is loosened.

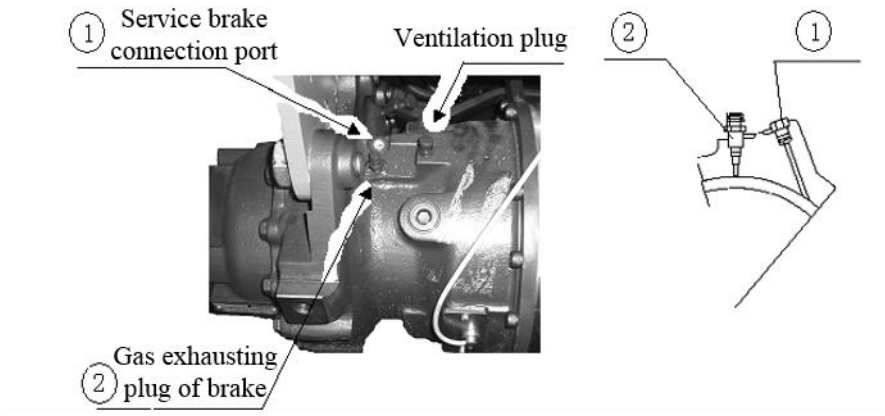


Figure 2-4

（2）The connection of parking brake

The parking brake push rod on the driving axle is connected with one end of the brake rod through the brake cable, and the parking brake is realized by changing the working state of the brake push rod. Note: The bending radius of brake cables shall be as large as possible.

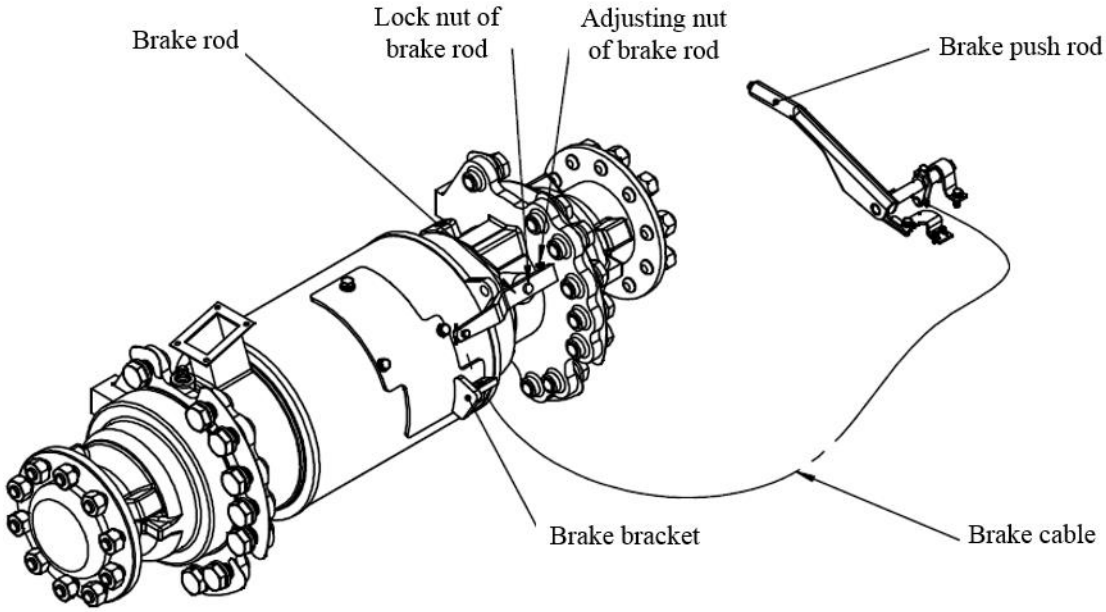


Figure 2-5

2.1.4 Gas exhausting of brake system

When the braking system is installed, the air mixed in the braking system must be discharged to achieve a good braking effect. The specific steps are as follows:

1) As shown in Figure 2-4, open the gas exhaust plug (part ②) of brake from the discharge valve to the appropriate position so that the hydraulic oil can just flow out.

2) Repeatedly press down the brake pedal, so that the hydraulic pressure can discharge the mixed gas in the brake system.

3) When the air is exhausted and the exhaust plug ejects completely hydraulic oil, press the brake pedal and tighten the gas exhaust plug, and the pre-tightening torque should reach 10N m.

4) Release the pedal and check the braking effect. If the braking effect is not ideal, the exhaust operation can be repeated until the braking effect meets the requirements.

2.1.5 Operation of brake system

When the service brake and parking brake are installed and debugged, the service brake is realized by pressing the brake pedal normally; the parking brake handle is placed on the right side of the seat, and it is engaged with the laminated disc brake in the driving unit by the brake cable. The parking brake can be realized through pulling down the parking brake handle by hand.

2.2 Maintenance and adjusting of brake system

This section mainly describes the inspection and maintenance of the brake system and the adjustment method of the brake pedal.

2.2.1 Inspection and maintenance of brake system

(1) Inspection of parking braking performance (Daily inspection)

First check whether the parking braking performance is in good condition, and then check whether the inching switch works when the hand brake is pulled down (that is, whether the circuit is disconnected).

(2) Inspection of service braking performance (Daily Inspection)

Before driving, check whether the brake pedal has the function of return, that is, whether the spring works.

(3) Leakage inspection

If you step on the brake pedal, the braking effect is not ideal. At this time, we should carefully check the assembly of parts and components in the braking system, check whether

there is hydraulic oil leakage, so as to eliminate potential safety hazards.

2.2.2 Adjustment of brake pedal

(1) Shortening Push Rod

1) Adjust the stop bolt to make the brake pedal height appropriate;

2) Press the brake pedal down and lengthen the push rod until the front end of the push rod contacts the piston of the main pump.

3) Tighten the lock nut of push rod.

(2) Adjustment of brake switch:

1) After adjusting the height of the brake pedal, loosen the lock nut of the brake switch;

2) Pull the plug to separate the wires;

3) Turn the switch to make the clearance A=1mm.

4) Make sure that the brake lamp should be on when the brake pedal is down.

3. Steering system

3.1 General description

The steering control mechanism of G3 series 4-5t forklift trucks is mainly composed of steering wheel, pipe column, coupling shaft, steering unit and installation bracket (as shown in Figure 3-1). They are fixed on the panel of instrument bracket by installation bracket. The steering wheel, pipe column and coupling shaft are connected together. The steering gear is fixed at the lower end of the coupling shaft, and the rotation of steering wheel will drive the steering gear to rotate. The steering wheel can be adjusted to the comfortable position that the driver feels by adjusting the handle.

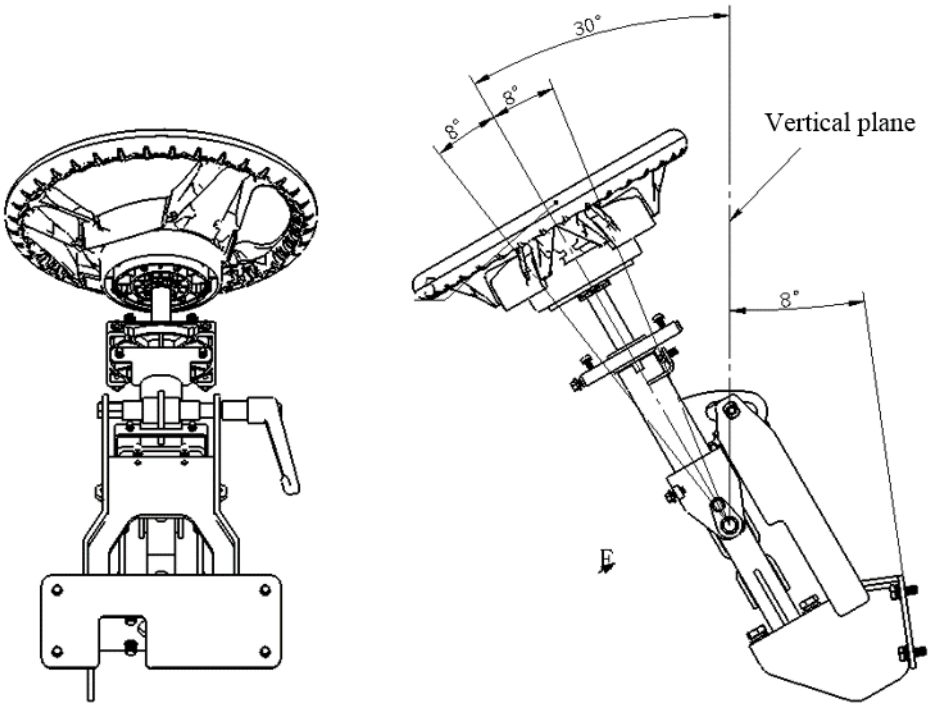


Figure 3-1 Steering operation device

3.1.1 Steering wheel and its function

The steering wheel is the most direct component for the driver to control the driving direction of forklift truck. During the normal driving process of forklift truck, the driver turns the steering wheel to the left or right, so that the forklift truck can drive to the left or right. In order to meet ergonomics, the forklift truck is designed to turn left when turning the steering wheel to the left and right when turning the steering wheel to the right. The turning radius of forklift truck varies according to the turning angle of steering wheel. During the driving of forklift truck, the driver should hold the steering wheel with both hands.

In order to facilitate the rapid steering of the driver, there is a handle ball on the steering wheel of the forklift truck. The driver can turn the steering wheel quickly by holding the handle ball in one hand. The driver can also grasp the handle ball in one hand and control the multi-way valve in one hand to realize the joint operation. However, special attention should be paid to the above two kinds of manipulation: when a driver makes a quick turn with only one hand holding the steering wheel handle ball, he should fully consider the safety of the operation at this time. He should not steer suddenly when driving in a fast straight line, or when loaded. The other hand must grasp the handles, handrails or other joysticks of the car to

maintain his body balance. During these operations, the speed of forklift driving and steering should not be too high to avoid accidents

There is a horn in the center of the steering wheel. When the driver wants to prompt the pedestrians, he can use his hand to press down the cover of the box marked with horn.

3.1.2 Oil can for steering

The oil can for steering (Fig. 3-2) serves as a common fuel tank for steering and braking, and integrates an oil gauge, a breather and a return oil filter.

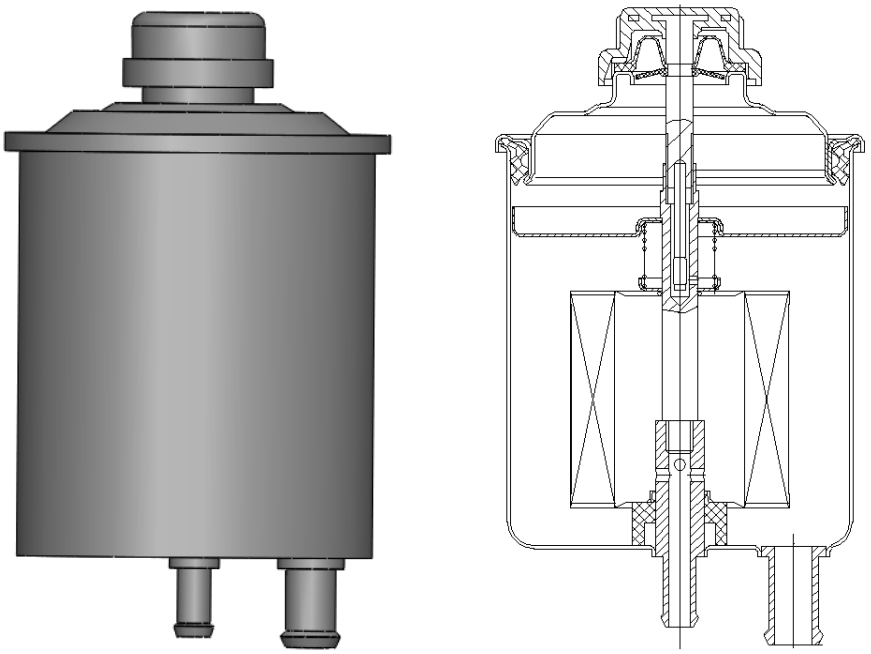


Figure 3-2 Oil can for steering

3.1.3 Duplex pump

The steering pump and brake pump are combined to form a duplex pump, which is driven by a single motor. The duplex pump sucks oil from the crude oil pipe and the front pump supplies the steering gear. The pressure oil from the back pump enters the driving axle through the brake valve to meet the requirements of dynamic braking. The oil from the duplex pump returns to the oil can through the internal filter when the operations are in neutral condition. The principle of the hydraulic steering system is shown in Figure 3-3.

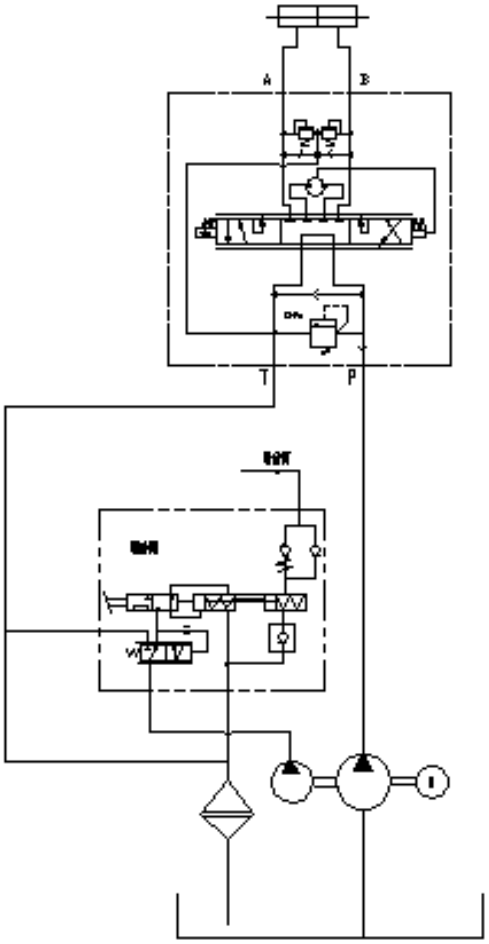


Figure 3-3 Principle diagram of the hydraulic steering system

3.1.4 Full hydraulic steering unit

Full hydraulic steering gear (Figure 3-4) transmits pressure hydraulic oil to the steering cylinder according to the rotation angle of steering wheel. The hydraulic oil drives the piston rod of the steering cylinder to move left and right, and realizes steering through the steering mechanism. If the steering pump fails to work properly due to faults, the driver needs to turn the steering wheel directly with force to achieve steering, which is also called manpower steering.

The steering unit on the truck adopts priority distribution technology. When there is steering operation, the hydraulic system first meets the needs of the steering system. When there is no steering or only minor steering action, the remaining hydraulic oil is directly returned to the tank through the pipeline through multiple valves. In the course of steering, when steering resistance exceeds the maximum set pressure of the steering system, the

steering system will automatically overflow in order to protect the components of the system from damage, so as to realize self-protection. The output pressure of the steering gear has been adjusted according to different models before leaving the factory. The user can not adjust it by himself to avoid damaging the hydraulic components. The steering system pressure of the truck is set at 9MPa.

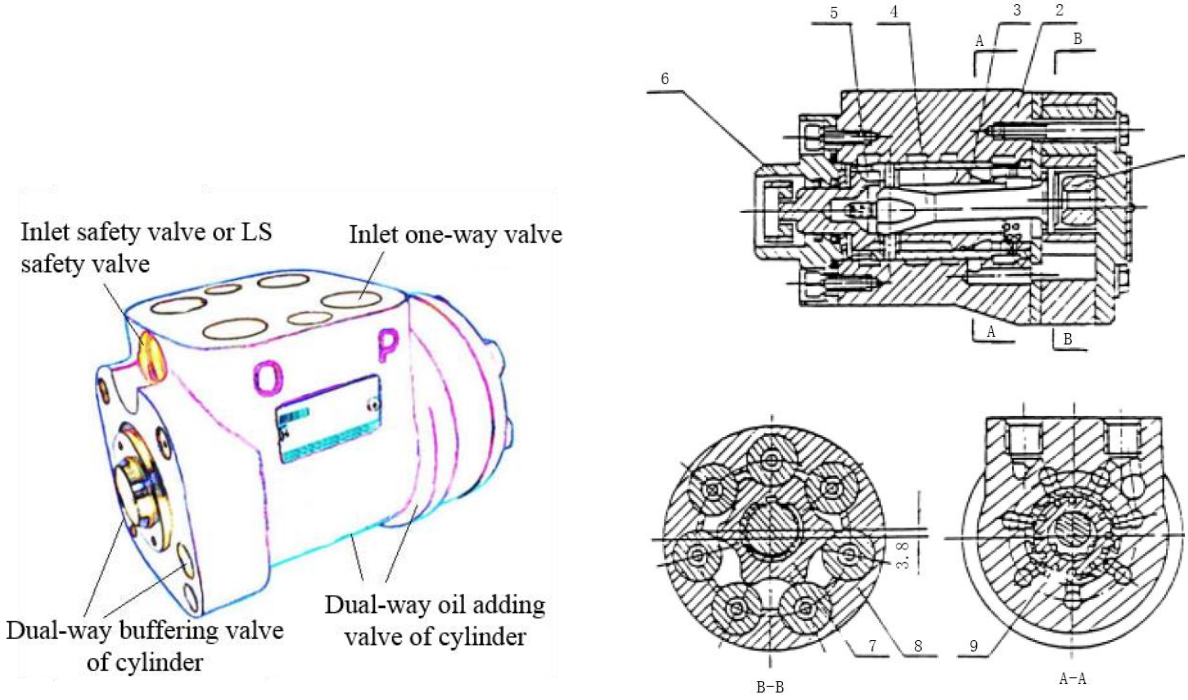


Figure 3-4 full hydraulic steering unit

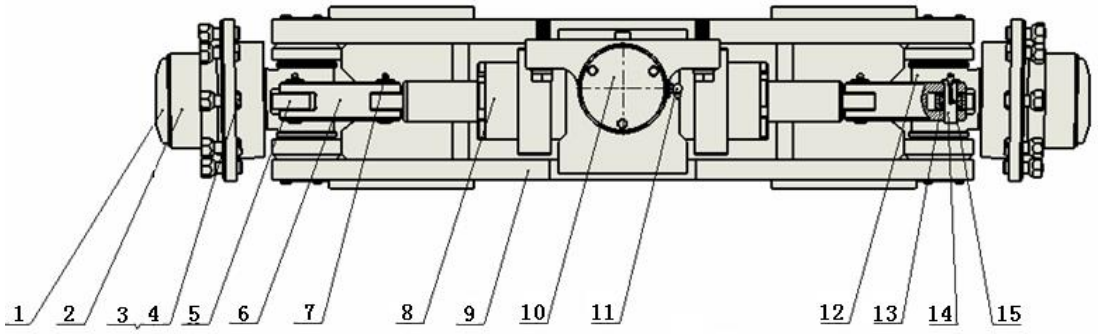
1.Limit post 2.Valve body 3.Valve core 4.Universal driving shaft 5.Spring 6.Connection block 7.Rotor 8.Stator 9.Valve bush

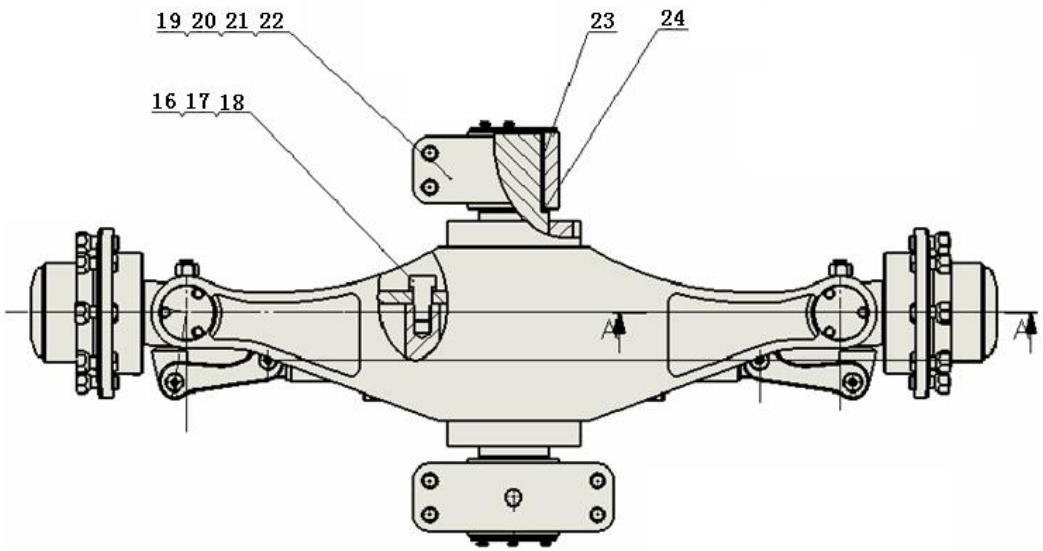
3.1.5 Steering axle

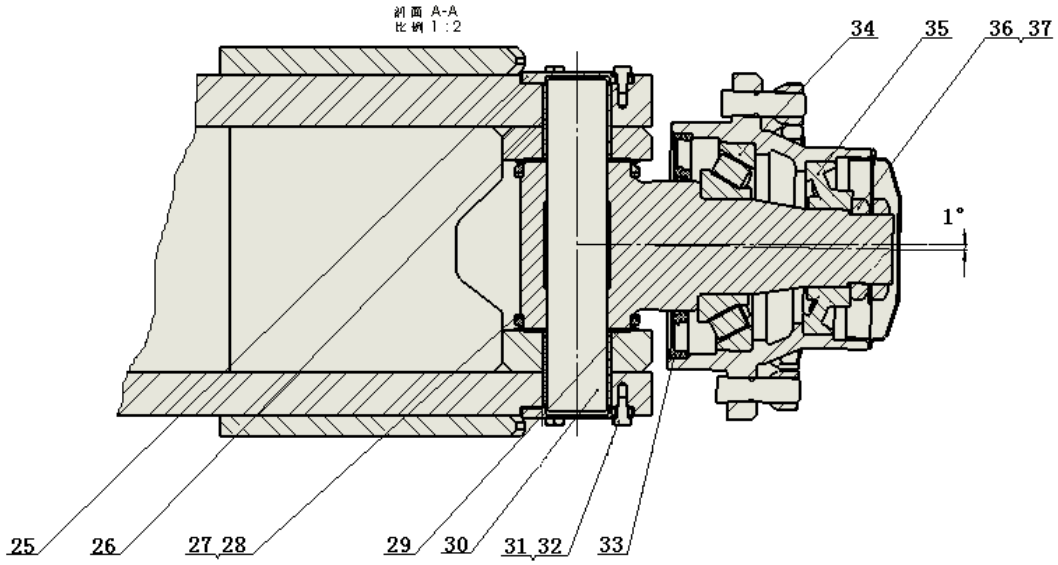
The steering axle (Fig. 3-5) consists of steering axle body, steering cylinder, connecting rod, steering knuckle assembly, steering hub and steering wheel. The steering axle drives the connecting rod motion by moving of steering cylinder’s piston rod. The motion of the connecting rod drives the steering knuckle assembly to rotate around the main pin connected to the steering axle, thus realizing the steering. The steering wheel is mounted on the steering hub, which is connected with the steering knuckle assembly through two tapered roller bearings. The main pin is matched with the steering axle body through two pin holes on the upper and lower axle body. The upper and lower radial directions of the main pin are supported by two self-lubricating axle sleeves installed on the bridge axle. The axial direction

is supported by thrust gaskets on the inner side of the steering upper and lower axle plates. The thrust gaskets are also self-lubricating as the axle sleeves. The connection between the main pin and the steering knuckle assembly is achieved by tightening the screw, and the main pin and the steering knuckle assembly are relatively fixed.

Note: There is no need to add grease (oil) to the sleeves and thrust gaskets, as they are self-lubricating bearings







1.hub cover
2.hub
3.hub bolt
4.hub nut
5.left steering knuckle
6.link rod
7.straight through type grease nipple
8.steering cylinder assembly
9.steering axle assembly
10.baffle
11.bending type grease nipple
12.right steering knuckle
13.ES type knuckle bearing
14.link pin
15.retainer ring 16
16.locating pin
17.washer 20
18.bolt M20x1.5x40
19.bolt M16x1.5x65
20.washer 16
21.washer 16
22.support seat of steering axle
23.sleeve
24.shim
25.end cover
26.sleeve
27.V type seal ring
28.washer
29.thrust washer
30.main pin
31.washer 6
32.bolt M6x12
33.oil seal
34.bearing 31311
35.bearing 31309
36.nut M40x1.5
37.washer 40

Figure 3-5 Steering axle

3.1.6 Steering cylinder

Steering cylinder is a double-acting piston cylinder (fig. 3-4). Both ends of piston rod are connected with steering knuckle assembly through connecting rod. The output pressure oil of full hydraulic steering gear enters the steering cylinder through high-pressure rubber tube, and the hydraulic oil drives the piston rod to move left and right parallel to realize steering. Piston and piston rod are fixed axially by steel ball, the seal between piston and

piston rod is realized by O-ring, and the seal between piston and cylinder inner wall is realized by lattice ring. The cylinder head and cylinder are connected by threads. There are two supporting rings in the cylinder head. The dust-proof seal between the cylinder head and the piston rod adopts the El seal ring. The steering cylinder is installed on the steering axle body by bolts and threaded hole.

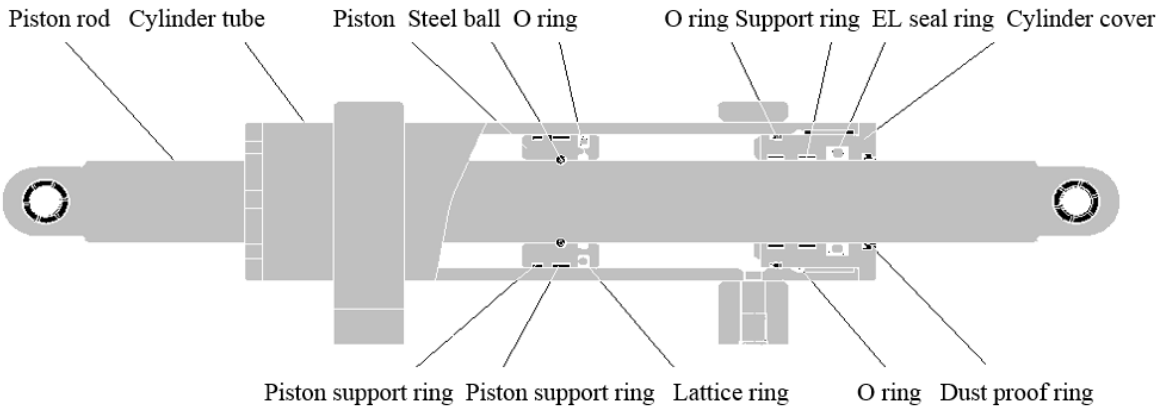


Figure 3-6 Steering cylinder

3.1.7 Steering knuckle

The steering knuckle is one of the important parts of the steering axle, and its connection on the steering axle see Fig. 3-7. The axial clearance of the two bearings connected with the hub can be adjusted by a round nut for the axial fixing of the bearing. The main pin and the steering knuckle assembly can be joined by tightening screws and rotate together with the steering knuckle assembly. Axial clearance of hub bearing in steering knuckle assembly has been adjusted before the whole vehicle leaves the factory. Unless there are other special circumstances, please do not adjust bearing clearance at will, such improper adjustment of bearing clearance will directly affect the service life of bearings. In order to ensure your normal use, please regularly add enough grease to the bearing chamber of the hub.

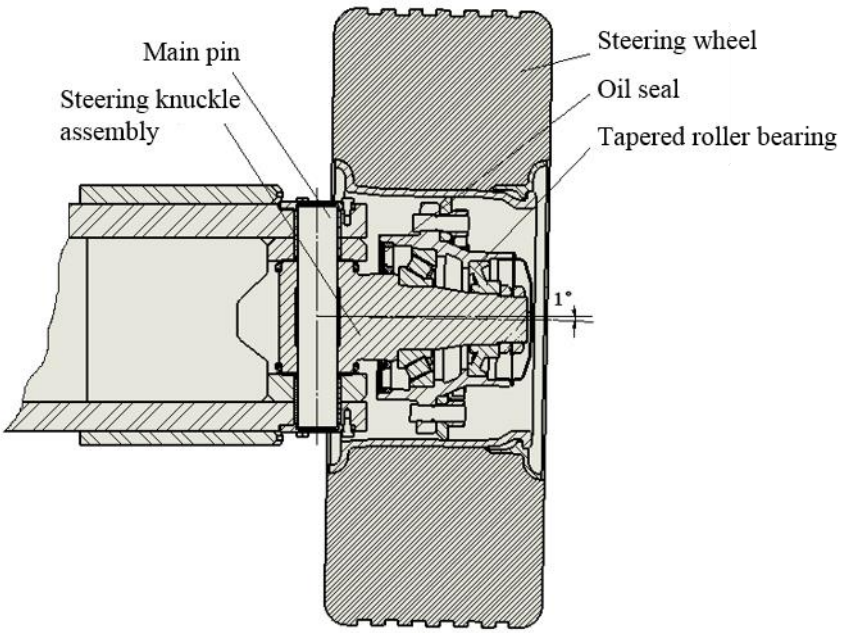


Figure 3-7 Connection between steering knuckle and axle

3.1.8 Hub

The hub is used to connect the steering wheel with the steering knuckle assembly. There are two tapered roller bearings in the hub. The inner ring is mounted on the steering knuckle body, the outer ring is mounted in the hub, and there is grease in the hub. The steering wheel is connected with the bolts on the hub through rim.

3.2 Adjusting and fault diagnosis

3.2.1 Pre-tightening adjusting of hub's bearing

(1) As shown in Fig. 3-8, grease should be added to the inner cavity of hub, hub bearing and hub cover, and some grease should also be applied to the lip of oil seal.

(2) Install the outer ring of hub bearing on the hub and install the hub on the steering knuckle assembly;

(3) Add shims and tighten the first round nut. The tightening torque is 206-235N.m (about 21-24kg.m), loosen the round nut, and then tighten the nut. The torque is 90-100N.m (9-10kg.m).

(4) Tape the wheel hub lightly with a wooden hammer and rotated by hand for 3-4 turns to ensure the smooth rotation of the wheel hub. Measure the required torque for the rotation of the wheel hub. The value is 2.94-7.8N.m (0.3-0.8kg·m).

(5) When the torque is higher than the prescribed value, retreat the round nut close to the end face of the bearing by 1/24-1/12 turn, and then measure the hub's torque until the hub's rotational torque reaches the prescribed value. Similarly, when the torque is lower than the prescribed value, retreat the round nut close to the bearing by 1/24-1/12 turn, and then measure the hub's torque.

(6) When the torque reaches the specified value, put in the stop gasket and the second round nut a, and tighten the round nut to align the groove with the stop gasket.

(7) Press the stop gasket into the slots of the first round nut and the second round nut respectively.

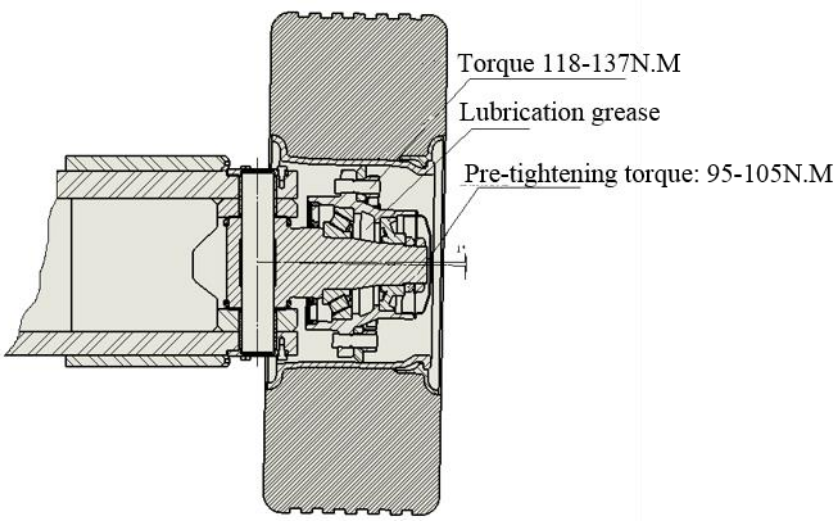


Figure 3-8 pre-tightening adjusting of bearing

3.2.2 Inspect after reassembling the steering system

(1) Turning the steering wheel right and left, inspect whether the force applied is proper and the steering power is smooth.

(2) Check if the layout of hydraulic circuit is proper and the installation of left and right hoses is right.

(3) Lift up the rear wheels and slowly turn the steering wheel right and left several times to limit position so as to exhaust air from the hydraulic pipeline and the steering cylinder.

3.2.3 Steering system troubleshooting

Problem	Analyses of trouble	Remedies
Fail to turn hand-wheel	Pump damaged or breaking down.	Replace
	Hose or joint damaged or pipeline blocked.	Clean or replace
Difficult to turn hand-wheel	The pressure of the safety valve is too low.	Adjust the pressure
	Air in steering oil circuit.	Exhaust air
	Steering unit fail to recover due to spring piece damaged or elasticity-insufficient.	Replace spring piece
	Oil leakage in the steering cylinder.	Inspect the seal of the piston
Truck's snacking or moving with oscillation	Spring damaged or elasticity-insufficient.	Replace
Excessive noise	Too low oil level in the oil tank.	Refill oil
	Suction pipeline or oil filter blocked.	Clean or replace
Oil leakage	Seals of guide sleeve, pipeline or joint damaged.	Replace

When the accelerator pedal or brake pedal is pressed, the steering system is in working state. When eliminating the gas in the steering pipeline, the steering system should be in working state, turning the steering wheel slowly to the left and right limit positions, so that the steering wheel can be deflected to the left and right limit positions. (Note: If abnormal phenomena occur at this time, the power should be switched off immediately to find out the reasons for eliminating the fault), so that the gas in the pipeline can be exhausted by rotating left and right repeatedly several times.

4. Electric system

4.1 General description

The standard configuration of the electric system of this series of balanced forklift trucks is a high performance AC control system, which can realize a silent, high efficient, smooth and safe control of the truck.

The electrical system is mainly composed of color screen instrument, control system, traction motor, pump motor, steering motor, battery, control switch, acousto-optic system and connecting wire harness.

🕮 Note

The manufacturer reserves the right to continuous improvement of the product. If there is any discrepancy between the physical object and the instructions, please consult the manufacturer. The principle diagram of the electrical system is shown in Fig. 4-1 and Fig. 4-2.

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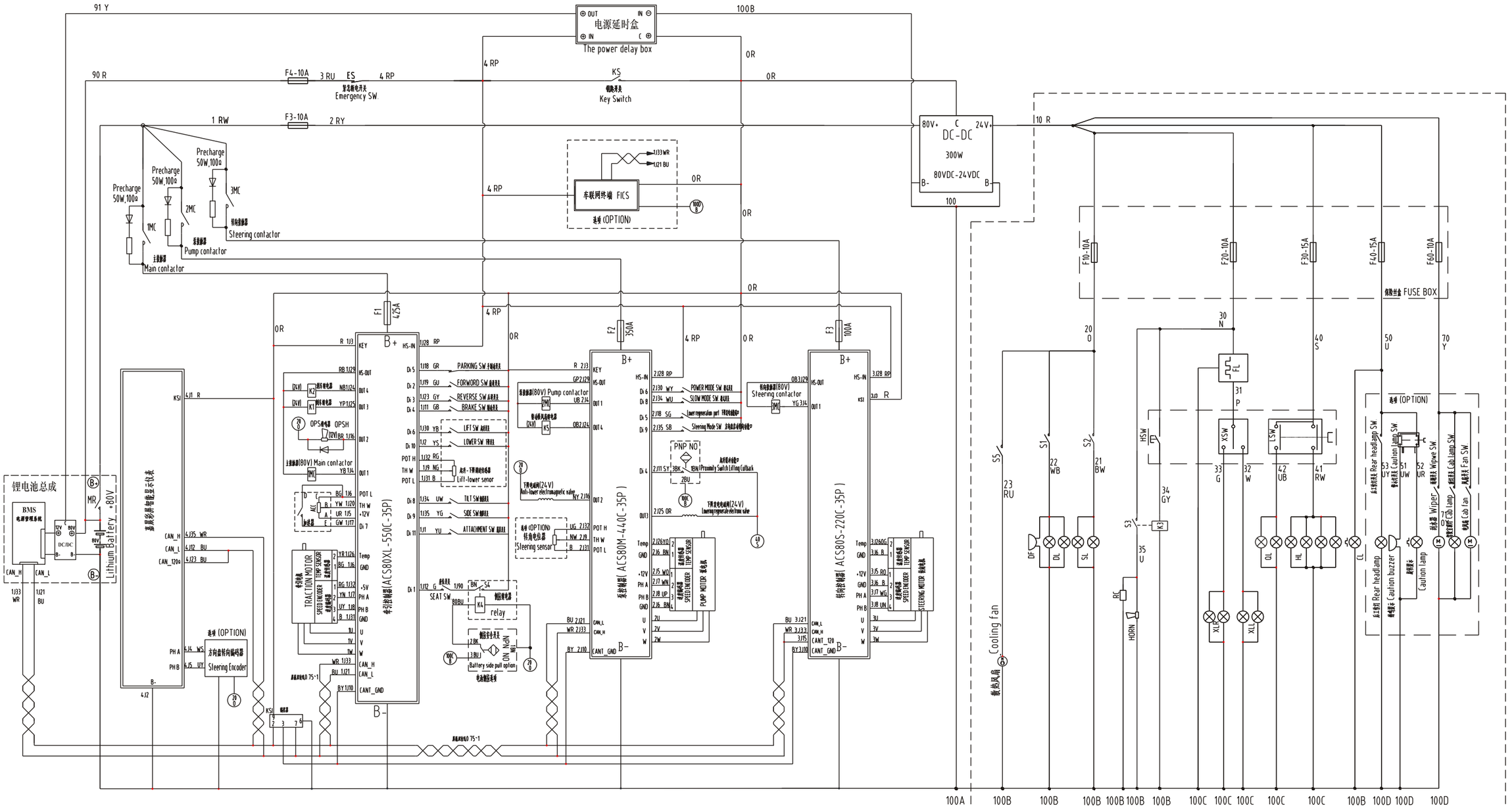

HL	示宽灯	QL	前大灯	RC	喇叭滤波器	SSW	刹车灯开关		
SL	刹车灯	CL	警示灯	FL	闪光器	LSW	二档灯开关	HBS	手制动开关
XLL	左转向灯	DL	倒车灯	HORN	喇叭	XSW	转向灯开关	PMSW	强劲模式开关
XLR	右转向灯	DF	倒车蜂鸣器	HSW	喇叭按钮	OPSH	离开座位未拉手制动蜂鸣警示	SMSW	慢速模式开关
K1,S1	倒车继电器线包及触点	K2,S2	刹车继电器线包及触点	K3,S3	喇叭继电器线包及触点	K4,S4	侧拉继电器线包及触点	K5,S5	风扇继电器线包及触点

Figure 4-1 Principle diagram of electric system（CPD40～50-GB3Li）

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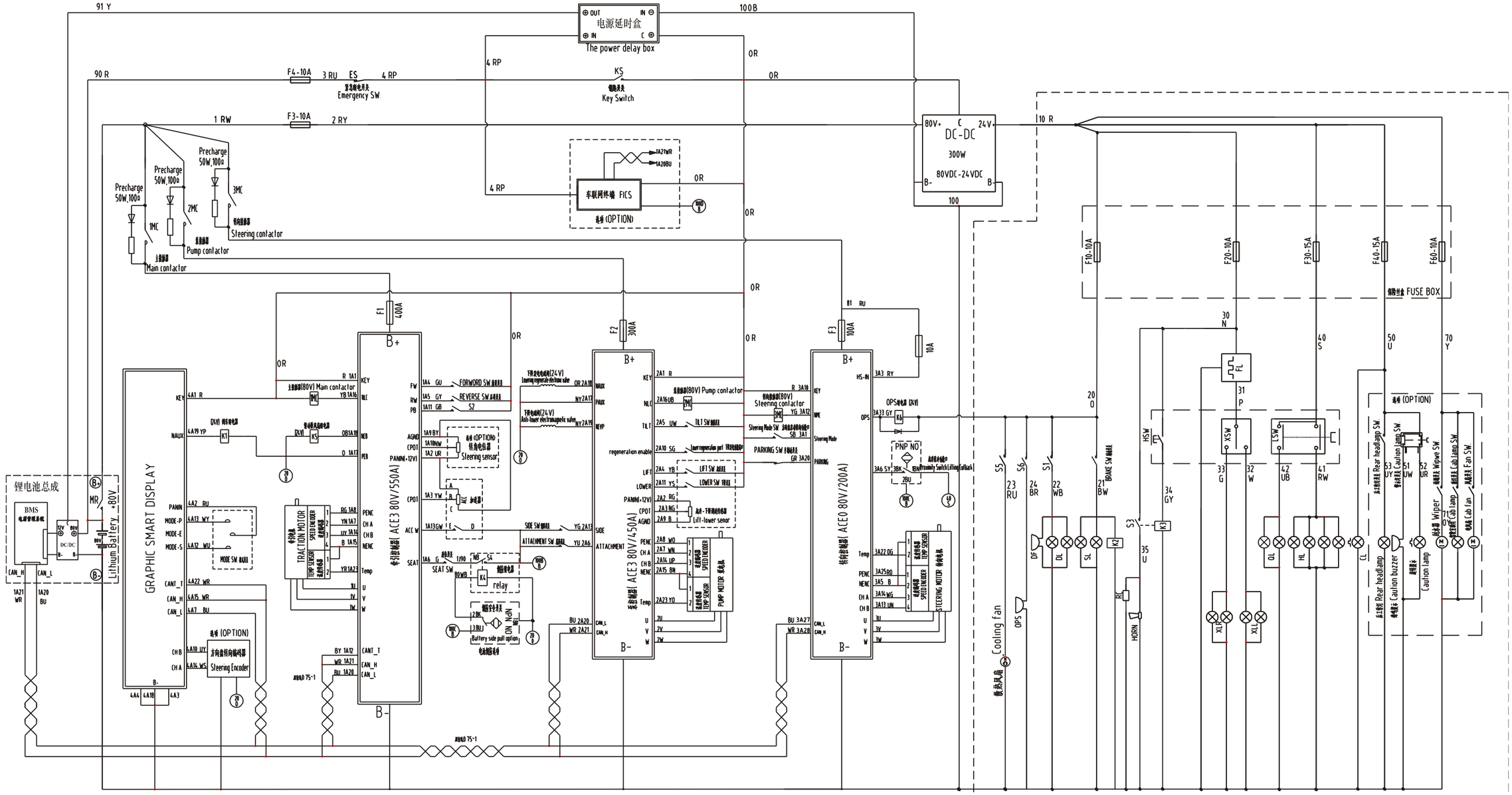


HL	示宽灯	QL	前大灯	RC	喇叭滤波器	SSW	刹车灯开关		
SL	刹车灯	CL	警示灯	FL	闪光器	LSW	二档灯开关	HBS	手制动开关
XLL	左转向灯	DL	倒车灯	HORN	喇叭	XSW	转向灯开关	PMSW	强劲模式开关
XLR	右转向灯	DF	倒车蜂鸣器	HSW	喇叭按钮	OPSH	离开座位未拉手制动蜂鸣警示	SMSW	慢速模式开关
K1,S1	倒车继电器线包及触点	K2,S2	刹车继电器线包及触点	K3,S3	喇叭继电器线包及触点	K4,S4	倒拉继电器线包及触点	K5,S5	风扇继电器线包及触点

Figure 4-2 Principle diagram of electric system（CPD40～50-GB2Li）

4.2 Instrument

4.2.1 Jiachen color screen instrument

4.2.1.1 General description

(1) It is a color screen instrument connected to the vehicle system by CAN bus. The color screen instrument can display the running state of the vehicle and has diagnostic function.

(2) Instruments can read or modify the settings of all control modules connected to CAN bus network. Its node definition is shown in the following table.

Figures in CAN bus	Module
08	Traction controller
07	Pump controller
05	Steering controller
16	Instrument

（3）The instrument is suitable for CPD40～50-GB3Li.

4.2.1.2 Panel layout

Fig.4-3 Introduction of Panel layout

4.2.1.3 Display interface

Fig. 4-4 Instrument interface display information introduction

Fig. 4-5 Instrument interface-fault display

4.2.1.4 Functions and applications

(1) Hour meter

The number shows the cumulative working time of the current truck. The key switch is connected to the power supply. After the truck starts to work, the working timer starts to count.

(2) Direction indication

Indicates whether the current truck is in forward or backward gear.

(3) Indicator of electric quantity

Display the current battery electric quantity. The current electric quantity is displayed at the top of the battery icon.

(4) Travelling mode

Display the current working mode, there are "P", "E", "S" three levels.

(5) Steering wheel Angle indicator

Represents the direction of the steering wheel.

(6) Steering angle indicator

The arrow represents the direction of the steering wheel.

(7) Travelling speed

Display the current vehicle speed, the unit is km/h.

(8) Fault code display

It shows the current fault code of the truck.

(9) LED lights

When operating mode is in S mode, the turtle speed light is on;

When the direction switch is in the middle position, the neutral light is on;

When the battery electric quantity is less than or equal to 20%, the low power indicator turns on;

When the power is less than or equal to 10%, the lifting lock indicator turns on;

When the driver leaves the seat, the seat indicator turns on;

When the parking brake switch closes, the parking brake indicator turns on.

4.2.2 ZAPI GRAPHIC SMART instrument

4.2.2.1 General description

(1) It is a color screen instrument connected to the truck system through CAN bus. The color screen instrument can display the travelling state of the truck and has the diagnostic function.

(2) The instrument can read or modify the Settings of all the control modules connected

to the CAN bus network. Its node definition is shown in the following table:

CAN bus network related figures	Module
Traction main CPU2.0: Traction main CPU2.1	Traction controller
Pump main CPU5.0: Pump main CPU5.1	Pump controller
Independent steering CPU13.0: Independent steering CPU13.1	Steering controller
Instrument 16.0: Instrument 16.1	Instrument

(3) The instrument is suitable for **CPD40～50-GB2Li** truck models.

4.2.2.2 Panel layout

Fig. 4-6 Instrument panel introduction

4.2.2.3 Display interface

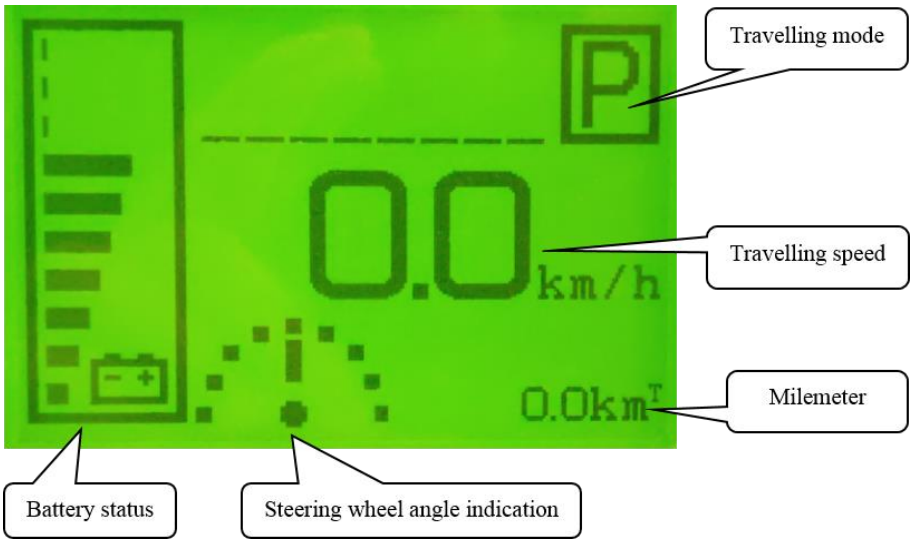


Fig. 4-7 Instrument interface display information introduction

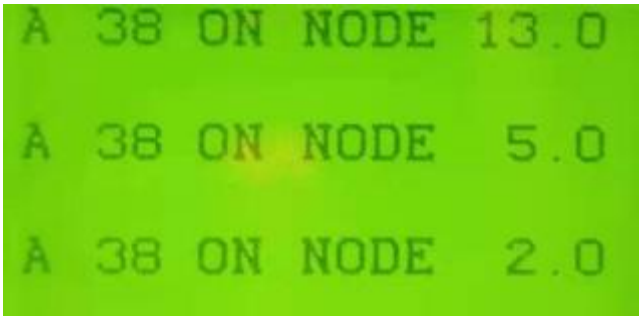


Fig. 4-8 Instrument interface - fault display

4.2.2.4 Functions and applications

(1) Milemeter

The number shows the total mileage of the current truck.

(2) Battery status

Display the current battery power icon, the top of the battery icon shows the current power value.

(3) Travelling mode

Display the current working mode, there are "P", "E", "S" three types.

(4) Steering wheel angle indication

Represents the direction of the steering wheel.

(5) Travelling speed

Display the current vehicle driving speed, with unit km/h.

(6) Fault code display

Display vehicle current fault code.

(7) LED indicator light

When the battery power is less than or equal to 20%, the low power indicator is on;

Fault warning light; when there is a fault, this LED light will always flash;

Controller high temperature warning light; When the temperature of any controller is high (generally higher than 85 ℃), the LED light is always on;

The seat indicator is on when the driver leaves the seat;

When parking brake switch is closed, parking brake indicator light is on;

Seat belt light, reserved function, this LED light is temporarily not in use.

4.3 Control system

4.3.1 Introduction to Control System

This series of balanced weight forklift adopts Swedish INMOTION AC motor controller or Italian ZAPI AC motor controller, controller is a three-phase AC asynchronous motor inverter, which controls traction motor, pump motor and steering motor. It has regenerative braking function, CAN BUS interface and digital control of microprocessor (based on motor speed feedback).

The allowable working ambient temperature range is -40℃～+50℃, and the maximum allowable working temperature is 85℃.

Protection functions of AC motor controller:

a) Battery polarity protection b) Incorrect connection protection

c) Over heat protection; overload protection; short circuit protection

d) Mis-starting protection; e) Out of control protection

f) Battery over discharging protection

The instrument can be used as a programmer, and the following functions can be conveniently realized:

a) On line inspection and adjusting on traction, steering and lifting control system

b) Fault detection and inquiry on traction, steering and lifting control system

4.3.2 INMOTION Control system composition

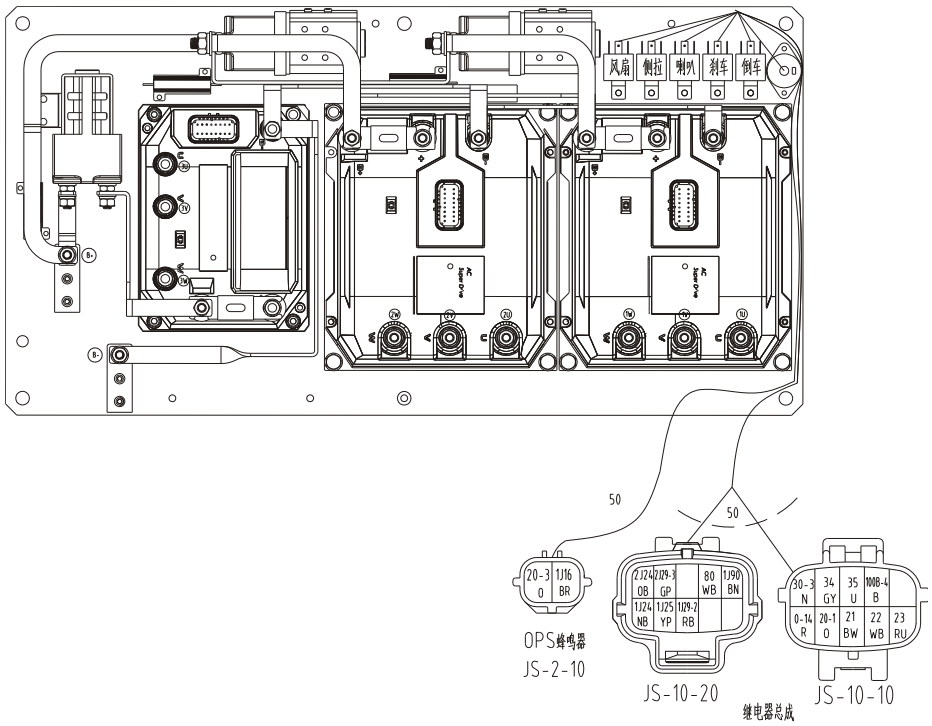


Figure 4-9 Assembly of control device（**CPD40～50-GB3Li**）

Model of traction controller：Inmotion ACS80XL-550C-35P 80V/550A

Model of pump controller： Inmotion ACS80L-440C-35P 80V/440A

Model of steering controller：Inmotion ACS80S-220C-35P 80V/220A

4.3.3 ZAPI Control system composition

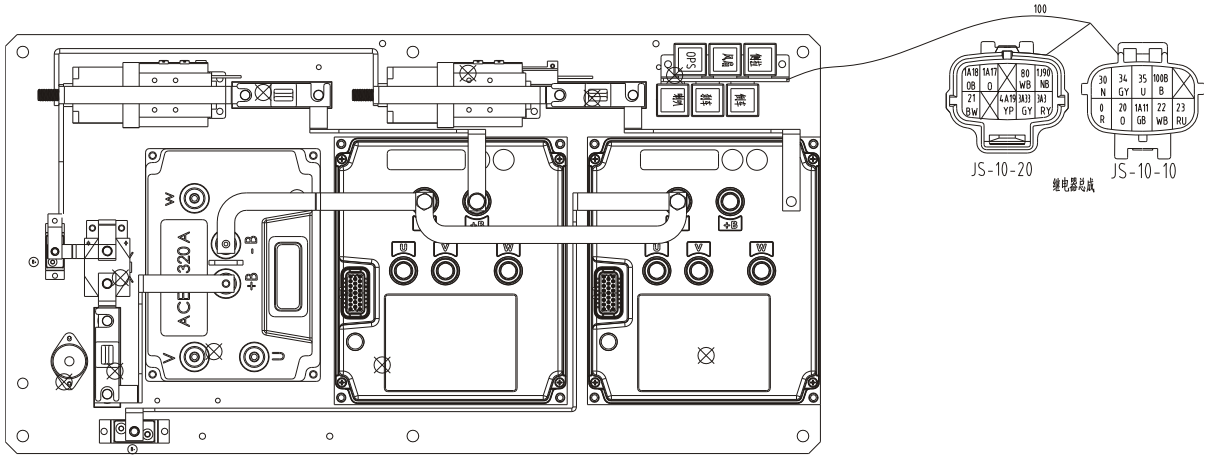


Figure 4-10 Assembly of control device（CPD40～50-GB2Li）

Model of traction controller: ZAPI ACE3（80V/550A）

Model of pump controller: ZAPI ACE3（80V/450A）

Model of steering controller: ZAPI ACE0（80V/200A 2uc）

Note:

◆ **Test the truck with four wheels raised (off the ground) after the controller being fixed, in that case there will be no danger even the connection is in error.**

◆ **A certain amount of voltage will remain in filter capacitance after the turn off of the electric switch. Cut off the battery and make the remained voltage short circuit by connecting the 10-100ohm resistance to the inverter before checking the inverter.**

◆ **Do not connect the controller to a battery that has a different voltage. The high voltage will cause power unit error, while the low voltage will not make the logic card work.**

◆ **The quality is assured by the producer. When there is a fault, inform the producer of the after-sale service. Do not repair as will unless getting the permission from the producer. Or the user should bear the personal and property damage caused by the unauthorized repair by oneself.**

4.4 Motor

Motor type: three phase AC type induction motor (free from maintenance)

Table 4-1 Motor specification

	Traction motor	Pump motor	Steering motor
Model	JXQ-20	TSA200-200-242	JXQ-2.5-HL
Power	20KW	26.5KW	2.5KW
Rated voltage	54V	53V	52V
Rated current	252A	340A	39.7A
Rated speed	1720rpm	2260rpm	1600rpm

Note: Cut off the electricity before checking and maintaining the motors to avoid accident.

4.5 Lithium battery

4.5.1 Lithium battery specification

Table 4-2 Lithium battery specification (Standard configuration)

Model / Item	CPD40-GB2/3Li	CPD45-GB2/3Li	CPD50-GB2/3Li
Model	3.2V/252Ah	3.2V/200Ah	3.2V/200Ah
Capacity	500Ah	600Ah	600Ah
Voltage	80V		
Monadelphous number	50	75	75

4.5.2 Lithium battery usage

The usage and routine maintenance of the lithium battery will influent lithium battery life and performance. So the operator should maintain the lithium battery according to the manual and actual conditions.

4.5.3 Lithium battery maintenance

(1) Please ensure that specified lithium charging device is used for charging, and the charging current should not exceed 2C;

(2) Lithium batteries should be transported by vehicles under the state of 10% ~ 50% electricity;

(3) Do not use or place lithium batteries near heat sources, such as fire and heaters;

(4) It is prohibited to flush lithium batteries with water, and to contact them by other means such as throwing, gravity, or laying them non – horizontal;

(5) Keep the temperature of lithium battery at around -5 ~ 50℃ during use. It is forbidden to store it under -25℃ or above 55℃ and operate for a long time;

(6) If there is leakage, flatulence, exposed wiring, battery scratches, edge and corner deformation, should stop using.

4.5.4 Lithium battery storage and keep

(1) In the use of lithium battery, the voltage is not allowed to be less than 85% of the rated voltage, and over discharge is strictly prohibited;

(2) Lithium batteries must be recharged within 24 hours after use. Charging should be sufficient, but overcharging is strictly prohibited;

(3) If the vehicle needs to be stored for a long time, 50% ~ 80% of the power should be saved. Please do not charge it fully. Charge it fully before use , can effectively avoid the phenomenon of battery inflation;

(4) The temperature of lithium battery is strictly prohibited to exceed 55℃, and lithium battery is absolutely prohibited to be access to open flame;

(5) The surface of the battery should be kept dry and clean.

4.5.5 Lithium battery error and resolution

The cause that made the Lithium battery error is various, except the effect of the quality manufacture and transport storage, mostly due to the improper maintenance. Find out the faults and analyze the causation as soon as possible to exclude.

4.5.6 Daily maintenance

(1) Check the wear status on the contact point; Replace the contact point when they are worn. Check contact point of the contactor once every three months.

(2) Check the pedal or handle microswitch; Measure the voltage drop at both ends of the microswitch. There should be no resistance when the microswitch is closed and a clear sound when it is released. Check once every three months.

(3) Check the main circuit: connection cable between battery, inverter and motor. Make sure the cable is well insulated and the circuit connection is tight. Check once every three months.

(4) Check the mechanical movement of the pedal or handle. See if the spring can deform normally, and if the potentiometer spring can expand to the maximum or setting level. Check once every three months.

(5) Check the mechanical movement of the contactor; It should move freely and not stick, and the mechanical action of the contactor should be checked every three months. If any damage or safety hazard is found during the inspection, the agent shall be notified immediately and the agent shall determine the safety of the vehicle.

Note: after the chopper is installed, the truck wheels should be lifted (off the ground) for testing, so that there is no danger even if there is a connection error.

After the electric lock switch is disconnected, the filter capacitor still has a certain voltage for a period of time. If you want to overhaul the inverter at this time, you must first cut off the battery, and then use a resistance of 10-100 ohms to connect to the positive and negative electrode of the inverter to short-circuit the residual voltage on the capacitor.

4.6 Diagnosis

4.6.1 General instruction

The traction control system, loading control system, steering control system and color screen instrument system assembled in the truck are continually monitoring micro-processor controller. They all have a diagnosis program to a main function. The program includes the following point:

(1) Diagnosis when the key switch being off: the circuit of the watching dog, current censor, charging of the capacity, phase voltage, driving of the connector, CAN-bus connector, the order of the switch operation, the output of the acceleration, the synchronism of the two micro-processor, the input of the hardware that having something to do with the safety.

(2) The alternate check； The circuit of the watch dog, phase voltage, current censor, driving of the connector, can-bus connector

(3) Check when working: the circuit of the watch dog, the driving of the connector, the current sensor, can-bus connector

(4) Continuously check: inverter temperature, motor temperature

The information is transmitted through CAN-bus and the fault code and module node are displayed on the color screen instrument meter.

4.6.2 Fault diagnosis of INMOTION

Table 4-3 Troubleshooting

Fault code	**Description**	**Remedy**
20	Acceleration switch active at key on	Loose the acceleration pedal
21	Direction switch active at key on	Place the direction switch on neutral gear
22	Application Direction switch both on error	1）Fault of direction switch 2）Fault of harness; short circuit of direction signal
23	Application traction pot value out of range error	1）Fault of acceleration pedal or the analog quantity needs to be demarcated. 2）Fault of harness; the output signal of accelerator is broken.
24	Application traction switch off and pot value more than 30%	1）Fault of acceleration pedal or the analog quantity needs to be demarcated.

		2）Fault of harness; fault of accelerator signal
31	CAN error	Check if the controller and CAN bus has fault.
32	Battery low voltage	Charge the battery
36	Pump speed 1 switch active at key on	Reset the tilting switch
37	Pump speed 2 switch active at key on	Reset the tilting switch
38	Pump speed 3 switch active at key on	Reset the attachment switch
39	Lift switch active at key on	Reset lifting switch
40	Application pump pot value out of range error	Damage of lifting analog quantity or it needs to be re-demarcated.
43	Steer Pot error	Damage of steering analog quantity or it needs to be re-demarcated.
44	Main contactor off Motor speed out of range	1）Alarm of over high speed 2）Check the wire of encoder 3）Change the encoder of motor speed
81	ACS low temperature	1）Make the temperature of driver to be higher than -20℃； 2）Change the controller.
82	ACS high temperature	1）Make the temperature of driver to be lower than 85℃； 2）Change the controller.
83	ACS temperature sensor error	Change the driver
84	Motor temperature low	1）The temperature of traction motor is over low. 2）Check the motor temperature sensor and connection.
85	Motor temperature high	1）The temperature of traction motor is over high. 2）Check the motor temperature sensor and connection.
86	Motor temperature sensor error	The temperature sensor of motor is damaged or harness is broken.
87	Traction speed sensor error	The temperature sensor of motor is damaged or harness is broken.
88	DC bus high	1）The battery voltage is high. 2）The gradient is high and brake regeneration is too strong.
89	DC bus low	1）The battery voltage is too low. 2）Charge the battery or check the harness of power.
90	DC bus Default values loaded	Restart the key.
91	Traction power reduced	The battery dump energy is low, the speed is limited and lifting is locked.
97	Traction Open Drain output error	Check if there is short circuit or open circuit of output harness of driver (such as main contactor, backward

		relay.)
98	average execution time out of range	Restart the key.
101	Short circuit	Check the harness of power and motor.
102	ACS temp high	The temperature of traction driver is over high and it needs to be cooled down.
103	Motor temp high	1）The temperature of traction motor is over high and it needs to be cooled down； 2）The temperature sensor of motor has fault or the harness is broken.
104	Over current	Check if the traction motor and cable has short circuit.
105	Charging timeout	1）Change the pre-charging resistance. 2）Low voltage 3）Fault of harness
110	DC bus low	1）Check battery voltage; 2）Check battery parameters; 3）Check if the contactor is connected.
111	DC bus high	1）Check battery voltage; 2）Check the set of driver’s voltage.
112	DC bus high HW detected	1）Check battery voltage; 2）Check the set of driver’s voltage.
114	Internal supply error	1）Check the load and harness of controller at 5V and 12V ports. 2）Fault of temperature sensor;
121	ACS low temperature	Over low temperature of controller
122	ACS high temperature	Over high temperature of controller
123	ACS temperature sensor error	Fault of controller’s temperature sensor
124	Motor temperature low	1）Over low temperature of pump motor 2）Fault of motor temperature sensor or harness
125	Motor temperature high	1）Over low temperature of pump motor 2）Fault of motor temperature sensor or harness
126	Motor temperature sensor error	Fault of motor temperature sensor or harness
127	Feedback Sensor error	Fault of motor temperature sensor or harness
128	DC bus high	Check battery voltage or harness
129	DC bus low	Charge the battery or check power harness.
130	DC bus Default values loaded	Restart the key.
132	Pump Power Reduced	Charge the battery
137	Pump Open Drain output error	Check if there is short circuit or open circuit at the output port of driver
138	Motor speed out of range	1）Check the power harness and motor； 2）Check motor speed sensor .
141	Short circuit	Check the harness of power and motor.
142	ACS temp high	Over high temperature of pump driver

143	Motor temp high	1）Over high temperature of motor 2）Fault of motor temperature sensor or harness
144	Over Current Error	Check if there is short circuit of pump motor and cable.
145	Charging error	1）Change pre-charging resistance. 2）Low battery voltage 3）Fault of harness
150	DC bus low	1）Check battery voltage; 2）Check the set of battery parameters. 3）Check if the contactor is connected.
151	DC bus high	1）Check battery voltage; 2）Check battery parameters.
152	DC bus high HW detected	1）Check battery voltage; 2）Check the set of driver's voltage.
153	Internal supply error	1）Check the load and harness of controller at 5V and 12V port. 2）Fault of temperature sensor.
154	Motor speed control error	Check the harness and terminals of motor's speed sensor.
201	Short circuit	Phase short circuit or short circuit to B+ or B-
202	ACS temp high	Over high temperature of steering driver
203	Motor temp high	1）Over high temperature of steering motor. 2）Fault of motor temperature sensor or harness
205	Charging error	1）Change pre-charging resistance； 2）Low battery voltage； 3）Fault of harness.
206	DC bus low	1）Check battery voltage. 2）Check battery parameters. 3）Check if the contactor is connected.
207	DC bus high HW detected	1）Check battery voltage. 2）Check battery parameters.
210	Feedback Sensor error	Fault of motor temperature sensor or harness
211	Motor temperature sensor error	Fault of motor temperature sensor or harness
212	ACS temperature sensor error	Over high or low temperature of steering driver
217	Pump Open Drain output error	Check if the harness of driver's output has short circuit or open circuit.
218	Motor temperature low	1）Over low temperature of steering motor. 2）Fault of motor temperature sensor or harness
219	Motor temperature high	1）High temperature of steering motor 2）Fault of motor temperature sensor or harness
220	ACS low temperature	Low temperature of controller
221	ACS high temperature	High temperature of controller
222	DC bus high	The voltage of controller is higher than warning

		voltage. Check battery parameters.
223	DC bus low	1）Check battery voltage； 2）Check battery voltage； 3）Check if main contactor is connected.
234	Internal supply error	1）Restart the key； 2）Check the load and harness of controller at 5V and 12V port.
156	BMS temperature protection	Check the lithium battery temperature
157	BMS temperature high	Check the lithium battery temperature
158	BMS monocell over-discharge	Need to charge or check CAN communication harness of lithium battery
159	BMS monocell overvoltage	Check the voltage of single lithium battery
163	BMS overcurrent protection	Check the discharge current of lithium battery
164	BMS charging protection	Check whether the lithium battery under the charging state
168	BMS current-limiting protection	Check the discharge current of lithium battery
169	BMS current chopping	Check the discharge current of lithium battery
181	BMS communication failure	Check CAN communication harness of lithium battery
161	Instrument CAN communication failure	Check CAN communication wiring harness and data between instrument and controller
251	Authentication failed	Use the correct authentication information
252	Primary lock	Unlock primary lock
253	Secondary lock	Unlock secondary lock
254	Remote terminal communication is down	Check the CAN communication line between the control system and IDT module

4.6.3 Fault diagnosis of ZAPI

Table 4-4 Fault list of Main pump, main traction

CODE	**ALARM NAME**	**ACE3 traction master alarms （node 2.0）and ACE3 pump master alarms （node 5.0）**
8	WATCHDOG	Cause: This is a safety related test. It is a self-diagnosis test that involves the logic between master and supervisor microcontrollers
		Troubleshooting: This alarm could be caused by a CAN bus malfunctioning, which blinds master-supervisor communication
17	LOGIC FAILURE #3	Cause A hardware problem in the logic board due to high currents (overload). An overcurrent condition is triggered even if the power bridge is not driven.
		Troubleshooting The failure lies in the controller hardware. Replace the controller.
18	LOGIC	Cause

	FAILURE #2	Fault in the hardware section of the logic board which deals with voltage feedbacks of motor phases.
		Troubleshooting The failure lies in the controller hardware. Replace the controller.
19	LOGIC FAILURE #1	Cause This fault is displayed when the controller detects an undervoltage condition at the key input . Undervoltage threshold is 11V for 36/48V controllers and 30 V for 80V controllers.
		Troubleshooting (fault at startup or in standby) - Fault can be caused by a key input signal characterized by pulses below the undervoltage threshold, possibly due to external loads like DC/DC converters starting-up, relays or contactors during switching periods, solenoids energizing or de-energizing. Consider to remove such loads. - If no voltage transient is detected on the supply line and the alarm is present every time the key switches on, the failure probably lies in the controller hardware. Replace the logic board. Troubleshooting (fault displayed during motor driving) - If the alarm occurs during motor acceleration or when there is a hydraulic-related request, check the battery charge, the battery health and power-cable connections.
28	PUMP VMN LOW	Cause: The pump motor output is lower than expected, considering the PWM duty cycle applied.
		Troubleshooting: A) If the problem occurs at start up (the LC does not close at all), check: - Motor internal connections; - Motor power cables connections; - If the motor connection are OK, the problem is inside the controller. B) If the problem occurs after closing the LC (the LC closes and then opens back again), check: - Motor internal connections; - If motor windings/cables have leakages towards truck frame; - If no problem are found on the motors, the problem is inside the controller. C) If the alarm occurs during motor running, check: - Motor internal connections; - If motor windings/cables have leakages towards truck frame; - That the LC power contact closer properly, with a good contact; - If no problem are found on the motors, the problem is inside the controller, it is necessary to replace the logic board.
29	PUMP VMN HIGH	Cause: This test is carried out when the pump motor is turning (PWM applied). The pump motor output is higher than expected, considering the PWM applied.

		Troubleshooting: - Motor internal connections - If motor windings/cables have leakages towards truck frame - If no problem are found on the motors, the problem is inside the controller, it is necessary to replace the logic board.
30	VMN LOW	Cause 1 Start-up test. Before switching the LC on, the software checks the power bridge: it turns on alternatively the high-side power MOSFETs and expects the phase voltages increase toward the positive rail value. If one phase voltage is lower than a certain percentage of the rail voltage, this alarm occurs.
		Cause 2 Motor running test. When the motor is running, the power bridge is on and the motor voltage feedback tested; if it is lower than expected value (a range of values is considered), the controller enters in fault state.
		Troubleshooting - If the problem occurs at start up (the LC does not close at all), check: - motor internal connections (ohmic continuity); - motor power-cables connections;
31	VMN HIGH	Cause 1 Before switching the LC on, the software checks the power bridge: it turns on alternatively the low-side power MOSFETs and expects the phase voltages decrease down to -B. If the phase voltages are higher than a certain percentage of the nominal battery voltage, this alarm occurs.
		Cause 2 This alarm may also occur when the start-up diagnosis has succeeded and so the LC has been closed. In this condition, the phase voltages are expected to be lower than half the battery voltage. If one of them is higher than that value, this alarm occurs.
		Troubleshooting - If the problem occurs at start-up (the LC does not close), check: - motor internal connections (ohmic continuity); - motor power cables connections; - if the motor connections are OK, the problem is inside the controller. Replace it. - If the alarm occurs while the motor is running, check: - motor connections; - that the LC power contact closes properly, with a good contact; - if no problem is found, the problem is inside the controller. Replace it.
37	CONTACTOR CLOSED	Cause Before driving the LC coil, the controller checks if the contactor is stuck. The controller drives the power bridge for several dozens of milliseconds, trying to discharge the capacitors bank. If the capacitor voltage does not decrease by more than a certain percentage of the key voltage, the alarm is raised.
		Troubleshooting It is suggested to verify the power contacts of LC; if they are stuck, is necessary to

		replace the LC.
38	CONTACTOR OPEN	Cause The LC coil is driven by the controller, but it seems that the power contacts do not close. In order to detect this condition the controller injects a DC current into the motor and checks the voltage on power capacitor. If the power capacitors get discharged it means that the main contactor is open.
		Troubleshooting - LC contacts are not working. Replace the LC. - If LC contacts are working correctly, contact a Zapi technician.
52	PUMP I=0 EVER	Cause: While the pump motor is running, the current feedback is constantly stuck to zero.
		Troubleshooting: - Check the motor connection, that there is continuity. If the motor connection is opened, the current cannot flow, so the test fails and the error code is displayed; - If everything is ok for what it concerns the motor, the problem could be in the current sensor or in the related circuit.
53	STBY I HIGH	Cause In standby, the sensor detects a current value different from zero.
		Troubleshooting The current sensor or the current feedback circuit is damaged. Replace the controller.
60	CAPACITOR CHARGE	Cause When the key is switched on, the inverter tries to charge the power capacitors through the series of a PTC and a power resistance, checking if the capacitors are charged within a certain timeout. If the capacitor voltage results less than 20% of the nominal battery voltage, the alarm is raised and the main contactor is not closed.
		Troubleshooting - Check if an external load in parallel to the capacitor bank, which sinks current from the capacitors-charging circuit, thus preventing the caps from charging well. Check if a lamp or a dc/dc converter or an auxiliary load is placed in parallel to the capacitor bank. - The charging resistance or PTC may be broken. Insert a power resistance across line-contactor power terminals; if the alarm disappears, it means that the charging resistance is damaged. - The charging circuit has a failure or there is a problem in the power section. Replace the controller.
62	TH. PROTECTION	Cause: The temperature of the controller base plate is above 85 ° C. The maximum current is proportionally decreased with the temperature excess from 85 ° C up to 105 ° C. At 105° C the current is limited to 0 A.

		Troubleshooting: It is necessary to improve the controller cooling. To realize an adequate cooling in case of finned heat sink important factors are the air flux and the cooling-air temperature. If the thermal dissipation is realized by applying the controller base plate onto the truck frame, the important factors are the thickness of the frame and the planarity and roughness of its surface. If the alarm occurs when the controller is cold, the possible reasons are a thermal-sensor failure or a failure in the logic board. In the last case, it is necessary to replace the controller.
65	MOTOR TEMPERAT.	Cause: This warning occurs when the temperature sensor is open (if digital) or if it has overtaken the MAX MOTOR TEMP threshold (if analog) (see paragraph 7.2.3).
		Troubleshooting: - Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function. - Check the sensor ohmic value and the sensor wiring. - If the sensor is OK, improve the cooling of the motor. - If the warning is present when the motor is cool, replace the controller.
66	BATTERY LOW	Cause: The battery charge is evaluated to be lower than 10% (10% with lithium battery ,15% with lead-acid battery) of the full charge and the BATTERY CHECK setting is other than 0 (refer to SET OPTION menu).
		Troubleshooting: - Check the battery charge and charge it if necessary. - If the battery is actually charged, measure the battery voltage through a voltmeter and compare it with the value in the BATTERY VOLTAGE reading in the TESTER function. If they are different, adjust the ADJUST BATTERY parameter with the value measured through the voltmeter. - If the problem is not solved, replace the logic board.
74	DRIVER SHORTED	Cause The driver of the LC coil is shorted.
		Troubleshooting - Check if there is a short or a low impedance pull-down between NLC and – BATT. - The driver circuit is damaged; replace the logic board.
75	CONTACTOR DRIVER	Cause The LC coil driver is not able to drive the load. The device itself or its driver circuit is damaged.
		Troubleshooting This type of fault is not related to external components; replace the logic board.
78	VACC NOT OK	Cause: At key-on and immediately after that, the travel demands have been turned off. This alarm occurs if the ACCELERATOR reading (in TESTER function) is more than 1 V above the minimum value acquired during the PROGRAM VACC

		procedure.
		Troubleshooting: - Check the wirings. - Check the mechanical calibration and the functionality of the accelerator potentiometer. - Acquire the maximum and minimum potentiometer value through the PROGRAM VACC function. - If the problem is not solved, replace the logic board.
79	INCORRECT START	Cause: Incorrect starting sequence. Possible reasons for this alarm are: - A travel demand active at key-on. - Man-presence sensor active at key on.
		Troubleshooting: - Check wirings. - Check microswitches for failures. - Through the TESTER function, check the state of the inputs are coherent with microswitches states. - If the problem is not solved, replace the logic board.
80	FORW + BACK	Cause: This alarm occurs when both the travel requests (FW and BW) are active at the same time.
		Troubleshooting: - Check that travel requests are not active at the same time. - Check the FW and BW input states through the TESTER function. - Check the wirings relative to the FW and BW inputs. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.
82	ENCODER ERROR	Cause This fault occurs in the following conditions: the frequency supplied to the motor is higher than 40 Hz and the signal feedback from the encoder has a jump higher than 40 Hz in few tens of milliseconds. This condition is related to an encoder failure.
		Troubleshooting - Check the electrical and the mechanical functionality of the encoder and the wires crimping. - Check the mechanical installation of the encoder, if the encoder slips inside its housing it will raise this alarm. - Also the electromagnetic noise on the sensor can be the cause for the alarm. In these cases try to replace the encoder. - If the problem is still present after replacing the encoder, the failure is in the controller.
86	PEDAL WIRE KO	This is not implemented in ACE3. Troubleshooting: - Ask for help to a Zapi technician.

131	BMS10	Cause： Lithium battery alarm ; Current cut-out protection . when this alarm appears , the truck should stop to work , inhibit traction and lifting and tilt ,only steering function can work as normal
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
132	BMS9	Cause： Lithium battery alarm ; Current limiting protection . when this alarm appears , traction speed will be reduced to 50% of maximum speed and traction current also will be reduced to 50% of maximum current , pump current also will be reduced to 50% of maximum current , tilt and steering function can work as normal
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
133	BMS8	Cause： Lithium battery alarm ;Battery is charging .when this alarm appears ,the controller should inhibited all functions and open the all the contactors,include traction contator ,main pump contator and hydrosteer pump contator
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
134	BMS7	Cause： Lithium battery alarm ;Battery warning temperature . when this alarm appears , traction speed will reduce to 50% of the maximum speed and traction max current also will be reduced to 50% of the maximum current, pump current also will be reduced to 50% of maximum current , tilt and steering function can work as normal .
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
135	BMS6	Cause： Lithium battery alarm ;Battery stop temperature ,battery temperature is high ,when this alarm appears , the truck should stop to work , inhibit traction and lifting and tilt ,only steering function can work as normal
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
136	BMS5	Cause：Lithium battery alarm ; High current . when this alarm appears , the truck should stop to work , inhibit traction and lifting and tilt ,only steering function can work as normal
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
137	BMS4	Cause： Lithium battery alarm ; The cell of battery undervoltage .when this alarm appears , traction speed will reduce to 50% of the maximum speed and traction max current also will be reduced to 50% of the maximum current , inhibit lifting and tilt function , only steering function can work as normal .
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
138	BMS3	Cause： Lithium battery alarm ; Communication interruption .when this alarm appears , the truck should stop work , inhibit traction and lifting and tilt ,only steering function can work as normal .
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery

		manufacturer
139	BMS2	Cause： Lithium battery alarm ; The cell of battery over-discharge .when this alarm appears , the truck should stop work , inhibit traction and lifting and tilt ,only steering function can work as normal
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
140	BMS1	Cause： Lithium battery alarm ; battery total voltage high . when this alarm appears, the truck should stop work , inhibit traction and lifting and tilt ,only steering function can work as normal
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
141	2F1 TIMEOUT	Cause： Lithium battery alarm ; when key switch is closed, traction inverter received the 2F1 message from the lithium battery,if inveter lost this message, this alarm will appears,and truck should stop work , inhibit traction and lifting and tilt , only steering function can work as normal
		Troubleshooting:Check the lithium battery,recycle the key switch,or ask for help to the lithium battery manufacturer
142	2F0 TIMEOUT	Cause： Lithium battery alarm ; the traction inverter lost the 2F0 message,and the inverter can't receive this message again within 800ms , when this alarm will appears, truck should stop work , inhibit traction and lifting and tilt , only steering function can work as normal
		Troubleshooting:Check the lithium battery,recycle the key switch ,or ask for help to the lithium battery manufacturer
143	2F0 INIT. ERR.	Cause：Lithium battery alarm ; when key switch is closed, traction inverter will try to receive the 2F0 message from the lithium battery,if inverter can't receive this message within 1500ms, this alarm will appears,and truck should stop work , inhibit traction and lifting and tilt , only steering function can work as normal
		Troubleshooting:Check the lithium battery,ask for help to the lithium battery manufacturer
144	2ND LEV INHIBIT	Cause：Networking alarm ; the traction inverter received the "2ND LEV INHIBIT" request (1AA message) from the remote device,then truck should inhibit lifting , but tilt , side shift , attachment , steering function can work as normal . Traction speed is reduced to 50% of maximum speed .
		Troubleshooting: Stop to send the "2ND LEV INHIBIT" request,or set traction parameter "NETWORKING" to "OFF" (in set options menu).
145	1ST LEV INHIBIT	Cause：Networking alarm ; the traction inverter received the "1ST LEV INHIBIT" request (1AA message) from the remote device,then truck should inhibit all the functions .
		Troubleshooting: Stop to send the "1ST LEV INHIBIT " request,or set traction parameter "NETWORKING" to "OFF" (in set options menu).
146	AUTH. FAILED	Cause：Networking alarm ; the truck can not read card correct , so all functions are inhibited.
		Troubleshooting:Ask for help to the networking device manufacturer ,or set traction parameter "NETWORKING" to "OFF" (in set options menu).

147	0X1AA TIMEOUT	Cause：Networking alarm ; the traction inverter received the 1AA message from the networking device,if the inverter lost this message,this alarm will appears, the truck should inhibit lifting and traction function , but tilt , side shift , attachment , steering function can work as norma
		Troubleshooting:Check the networking device if works properly,or ask for help to the networking device manufacturer ,or set traction parameter "NETWORKING" to "OFF" (in set options menu).
148	REM DEV INIT ERR	Cause： Networking alarm ; when key switch is closed, the traction inverter try to receive the 1AA message from the remote device, if the inverter can't receive this message,this alarm will appears, the truck should inhibit lifting and traction function , but tilt , side shift , attachment , steering function can work as norma
		Troubleshooting:Check the networking device if works properly,or ask for help to the networking device manufacturer ,or set traction parameter "NETWORKING" to "OFF" (in set options menu).
149	WR. SET TEMP MOT	Cause:“SET MOTOR TEMP.” Parameter out of range (-20, +20),
		Troubleshooting:Try to adjust the motor temperature.
150	ENCODER PHASES	Cause:Encoder phases signals not consistent
		Troubleshooting:Try to recycle the key, or change the encoder.
151	POT MISMATCH	Cause:Twin potentiometer signals not consistent (only with twin potentiometer)
		Troubleshooting:check the signals of the twin potentiometer
153	OFFSET SPD. SENS.	Cause:It is necessary to acquire the offset angle between the stator and the speed sensor, i.e. they mutual angular misalignment. An automatic function is dedicated to this procedure
		Troubleshooting:Perform the teaching procedure: in OPTIONS, select ABS.SENS.ACQUIRE.
155	WAIT MOTOR STILL	Cause:The controller is waiting for the motor to stop rotating. This warning can only appear in ACE2 for brushless motors.
161	RPM HIGH	Cause: This alarm occurs in Gen. Set versions when the speed exceeds the threshold speed.
162	BUMPER STOP	Cause The two digital inputs dedicated to the bumper functionality are high at the same time.
		Troubleshooting - Turn off one or both inputs dedicated to the bumper functionality; - If the alarm occurs even if the inputs are in the rest position, check if the microswitches are stuck. - In case the problem is not solved, replace the logic board.
163	ED SLIP MISMATCH	Cause The control detects a mismatch between the expected slip and the evaluated one. This diagnostic occurs only if ED COMPENSATION = TRUE,this alarm is not

		implemented in this truck
164	PWM ACQ. ERROR	Cause This alarm occurs only when the controller is configured to drive a PMSM and the feedback sensor selected in the HARDWARE SETTINGS list is ENCODER ABI + PWM. The controller does not detect correct information on PWM input at start-up
		Troubleshooting - Re-cycle the key. - Check the sensor in order to verify that it works properly. - Check the wiring. - If the problem occurs permanently it is necessary to substitute logic board
165	SHORT CIRCUIT KO	Cause The HW dedicated to detect faults on power bridge does not work properly
		Troubleshooting - Replace the controller.
166	SHORT CIRCUIT	Cause The controller continuously checks that the Three-phase bridge works properly and that a short-circuit between motor phases is not present.
		Troubleshooting - Check that motor phases are correctly connected. - Verify that motor phases are not shot-circuited. - Replace the controller. - In case the problem is not solved, replace the motor.
167	IMS ERROR	Cause At start-up, the controller checks the presence of IMS board. If the IMS board is not well connected, this alarm appears.
		Troubleshooting - Replace the controller.
168	SIN/COS D.ERR.XX	Cause: This alarm occurs only when the controller is configured as PMSM and the feedback sensor selected is sin/cos. The signal coming from sin/cos sensor has a wrong direction. The hexadecimal value “XX” facilitates Zapi technicians debugging the problem
		Troubleshooting: Check the wirings. If the motor direction is correct, swap the sin and cos signals. If the motor direction is not correct, swap two of the motor cables. If the problem is not solved, contact a Zapi technician
169	ENCODER D.ERR.X	Cause: This alarm occurs only when the controller is configured as PMSM and the feedback sensor selected is the encoder. The A and B pulse sequence is not correct

	X	Troubleshooting: - Check the wirings. - If the motor direction is correct, swap A and B signals. - If the motor direction is not correct, swap two of the motor cables. - If the problem is not solved, contact a Zapi technician
170	WRONG KEY VOLT.	Cause: The inverter key voltage is wrong .
		Troubleshooting: Check the battery level if is correct.
171	ACQUIRING A.S.	Cause: Controller is acquiring data from the absolute feedback sensor.
		Troubleshooting: The alarm ends when the acquisition is done.
172	ACQUIRE ABORT	Cause: The acquiring procedure relative to the absolute feedback sensor aborted.
173	ACQUIRE END	Cause: Absolute feedback sensor acquired.
175	SPEED FB. ERROR	Cause This alarm occurs if the absolute position sensor is used also for speed estimation. If signaled, it means that the controller measured that the engine was moving too quick.
		Troubleshooting - Check that the sensor used is compatible with the software release. - Check the sensor mechanical installation and if it works properly. - Also the electromagnetic noise on the sensor can be a cause for the alarm. - If no problem is found on the motor or on the speed sensor, the problem is inside the controller, it is necessary to replace the logic board.
176	HOME SNES. ERR XX	Cause The controller detected a difference between the estimated absolute orientation of the rotor and the position of the index signal (ABI encoder). It is caused by a wrong acquisition of the angle offset between the orientation of the rotor and the index signal
		Troubleshooting Repeat the auto-teaching procedure.
177	COIL SHOR. EB.	Cause This alarm occurs when an overload of the EB driver occurs
		Troubleshooting - Check the connections between the controller outputs and the loads. - Collect information about characteristics of the coil connected to the driver and ask for assistance to a Zapi technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced
178	MOTOR TEMP.	Cause: The temperature sensor has overtaken the STOP MOTOR TEMP. threshold (if

	STOP	analog, see paragraph 7.2.3).
		Troubleshooting: - Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function. - Check the sensor ohmic value and the sensor wiring. - If the sensor is OK, improve the cooling of the motor. - If the warning is present when the motor is cool, replace the controller.
179	STEER SENSOR KO	Cause: The voltage read by the microcontroller at the steering-sensor input is not within the STEER RIGHT VOLT ÷ STEER LEFT VOLT range, programmed through the STEER ACQUIRING function
		Troubleshooting: - Acquire the maximum and minimum values coming from the steering potentiometer through the STEER ACQUIRING function. If the alarm is still present, check the mechanical calibration and the functionality of the potentiometer. - If the problem is not solved, replace the logic board
180	OVERLOAD	Cause The motor current has overcome the limit fixed by hardware.
		Troubleshooting Reset the alarm by switching key off and on again. If the alarm condition occurs again, ask for assistance to a Zapi technician. The fault condition could be affected by wrong adjustments of motor parameters.
181	WRONG ENC SET	Cause Mismatch between “ENCODER PULSES 1” parameter and “ENCODER PULSES 2” parameter (see paragraph 7.2.5).
		Troubleshooting Set the two parameters with the same value, according to the adopted encoder.
182	EVP2 COIL OPEN	Cause: No load is connected between the EVP2 output and the electrovalve positive terminal
		Troubleshooting: - Check the EVP2 condition. - Check the EVP2 wiring - If the problem is not solved, replace the logic board.
183	EVP2 DRIV. SHORT	Cause - The EVP2 driver is shorted. - The microcontroller detects a mismatch between the valve set-point and the feedback of the EVP2 output

		Troubleshooting - Check if there is a short circuit or a low-impedance conduction path between the negative of the coil and -B. - Collect information about: o the voltage applied across the EVP2 coil, o the current in the coil, o features of the coil. Ask for assistance to Zapi in order to verify that the software diagnoses are in accordance with the type of coil employed. - If the problem is not solved, it could be necessary to replace the controller
184	EVP2 DRIVER OPEN	Cause: The EVP2 driver is not able to drive the EVP2 coil. The device itself or its driving circuit is damaged
		Troubleshooting: This fault is not related to external components. Replace the logic board.
185	TILLER ERROR	Cause: Input mismatch between Hard&Soft input and tiller input : the two inputs are activated at the same time.
		Troubleshooting: - Check if there is wrong connection in the external wiring. - Using the “Tester” menu of the controller verify that what the controller sees in input is in accordance with the actual state of the external switch inputs. - Check if there is short circuit between A6 and A1 - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
186	WAIT MOT.P STILL	Cause: If DC Pump option is set to ON, the software expects the voltage on -P output to be at a “steady state” value, before switching the LC on. If the voltage is different, it could be due to the fact that the motor connected to -P is not still. For this reason, the software waits 30 seconds for the voltage to be at the “steady state” value (and for the pump motor to be still). After this time, the software assumes that the problem is not due to the fact that the pump motor is not still, and show the PUMP VMN NOT OK alarm.
		Troubleshooting: - If the motor connected to -P is still moving, just wait for it to be still. - If not, in 30 seconds the alarm PUMP VMN NOT OK will appear.
187	LIFT+LOWER	Cause: Both the pump requests (LIFT and LOWER) are active at the same time.
		Troubleshooting: - Check that LIFT and LOWER requests are not active at the same time. - Check the LIFT and LOWER input states through the TESTER function. - Check the wirings. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.

188	PUMP VACC NOT OK	Cause: The minimum voltage of the lift potentiometer is not correctly set.
		Troubleshooting: It is suggested to repeat the acquiring procedure of MIN LIFT and MAX LIFT (see paragraph 9.2).
189	PUMP INC START	Cause: Man-presence switch is not enabled at pump request.
		Troubleshooting: - Check wirings. - Check microswitches for failures. - Through the TESTER function, check the states of the inputs are coherent with microswitches states. - If the problem is not solved, replace the logic board.
190	PUMP VMN NOT OK	Cause: Switching the LC on, the software checks the output voltage on -P connector, and expects that it is at a “steady state” value (if DC PUMP option is set to ON, see paragraph 8.2.1 – HYDRO SETTINGS). If the voltage is too low, this alarm occurs.
		Troubleshooting: Please check: - The motor connected to -P must be completely still before this alarm occurs. The software waits 30 seconds before showing this alarm. During this time it shows the WAIT MOTOR STILL warning. - Motor internal connections - Motor power cables connections - Motor leakage to truck frame - If the motor connections are ok, the problem is inside the controller it is necessary to replace the logic board.
191	PUMP I NO ZERO	Cause: In standby condition (pump motor not driven), the feedback coming from the current sensor in the pump chopper gives a value out of a permitted range, because the pump current is not zero.
		Troubleshooting: This type of fault is not related to external components; replace the controller.
192	PUMP VACC RANGE	Cause: The voltage on A30 is outside of the parameters range.
		Troubleshooting: If the EVP TYPE parameter is set to ANALOG , please acquire again the values of MIN LOWER and MAX LOWER. If the controller is in configuration COMBI and lifting is proportional, please acquire again also the values of MIN LIFT and MAX LIFT.
193	SMART DRIVER KO	Cause: There is a hardware problem in the smart driver circuit . The driver is set to be ON but the output voltage does not increase

		Troubleshooting: - Verify that the EB coil is connected correctly . - Verify that the parameter POSITIVE E.B.is set in accordance with the actual configuration . The software, in fact, depending on specific parameter value, makes a proper diagnosis; a wrong configuration of this parameter could generate a false fault. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced
194	AUX BATT. SHORT.	Cause: The voltage on PEB output is at high value even if it should not. For the versions where the smart driver is not installed (36/48V), it is possible to decide where the positive supply for pin A27 comes from by choosing a dedicated hardware configuration. The parameter POSITIVE E.B. has to be set in accordance with the hardware configuration , because the software makes a proper diagnosis depending on the parameter; a wrong setting could generate a false fault. The available choices are:0 = PEB is managed by the smart driver (available for 24V version only). 1 = PEB comes from the TILLER input . 2 = PEB comes from PAUX . PAUX must be connected to terminal +B of the controller. This is the default configuration for 36/48V and 80V version. This alarm can only appear if POSITIVE E.B. is set as 1 TILLER/SEAT.
		Troubleshooting: Verify that the parameter POSITIVE E.B. is set in accordance with the actual coil positive supply (see paragraph 8.2.5). In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
195	POS. EB. SHORTED	Cause: The voltage on terminal PEB is at the high value even if the smart driver is turned OFF.
		Troubleshooting: Verify that the parameter POSITIVE EB is set in accordance with the actual coil positive supply . Since the software makes a proper diagnosis depending on the parameter, a wrong setting could generate a false fault. Check if there is a short or a low impedance path between PEB and the positive battery terminal +B. In case no failures/problems can be found, the problem is in the controller, which has to be replaced.
196	MOT.PHASE SH.（36/37/38）	Cause Short circuit between two motor phases. The number that follows the alarm identifies where the short circuit is located: - 36 àU – V short circuit - 37 àU – W short circuit - 38 àV – W short circuit

		Troubleshooting - Verify the motor phases connection on the motor side - Verify the motor phases connection on the inverter side - Check the motor power cables. - Replace the controller. - If the alarm does not disappear, the problem is in the motor. Replace it.
197	WRONG SLAVE VER.	Cause: Wrong software version on supervisor uC.
		Troubleshooting: Upload the correct software version or ask for assistance to a Zapi technician.
198	M/S PAR CHK MISM	Cause: At start-up there is a mismatch in the parameter checksum between the master and the supervisor microcontrollers.
		Troubleshooting: Restore and save again the parameters list.
199	PARAM TRANSFER	Cause: Master uC is transferring parameters to the supervisor.
		Troubleshooting: Wait until the end of the procedure. If the alarm remains longer, re-cycle the key.
200	VDC OFF SHORTED	Cause The logic board measures a key voltage value that is constantly out of range, above the maximum allowed value.
		Troubleshooting - Check that the battery has the same nominal voltage of the inverter. - Check the battery voltage, if it is out of range replace the battery. - In case the problem is not solved, replace the logic board.
201	TORQUE PROFILE	Cause: There is an error in the choice of the torque profile parameters.
		Troubleshooting: Check in the HARDWARE SETTING menu the value of those parameters.
202	VDC LINK OVERV.	Cause This fault is displayed when the controller detects an overvoltage condition. Overvoltage threshold is 65 V for 36/48V controllers and 116 V for 80V controllers. As soon as the fault occurs, power bridge and MC are opened. The condition is triggered using the same HW interrupt used for undervoltage detection, uC discerns between the two evaluating the voltage present across DC-link capacitors: - High voltage à Overvoltage condition - Low/normal voltage à Undervoltage condition
		Troubleshooting If the alarm happens during the brake release, check the line contactor contact and the battery power-cable connection.

203	HW FAULT MC	Cause: At start-up, the hardware circuit dedicated to enable and disable the MC driver is found to be faulty. The hexadecimal value “XX” facilitates Zapi technicians debugging the problem
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
204	BRAKE RUN OUT	Cause: The CPOT BRAKE input read by the microcontroller is at its maximum value without the hand-brake request.
		Troubleshooting: Check the mechanical calibration and the functionality of the brake potentiometer. If the alarm is still present, replace the logic board.
205	EPS RELAY OPEN	Cause: The controller receives from EPS information about the safety contacts being open.
		Troubleshooting: Verify the EPS functionality.
206	INIT VMN HIGH	Cause Before switching the LC on, the software checks the power-bridge voltage without driving it. The software expects the voltage to be in a “steady state” value. If it is too high, this alarm occurs.
		Troubleshooting - Check the motor power cables; - Check the impedance between U, V and W terminals and -Batt terminal of the controller. - Check the motor leakage to truck frame. - If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.
207	INIT VMN LOW	Cause Before switching the LC on, the software checks the power-bridge voltage without driving it. The software expects the voltage to be in a “steady state” value. If it is too low, this alarm occurs.
		Troubleshooting - Check the motor power cables. - Check the impedance between U, V and W terminals and -Batt terminal of the controller. - Check the motor leakage to truck frame. - If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.
208	EEPROM KO	Cause: A HW or SW defect of the non-volatile embedded memory storing the controller parameters. This alarm does not inhibit the machine operations, but it makes the truck to work with the default values.

		Troubleshooting: Execute a CLEAR EEPROM procedure (refer to the Console manual). Switch the key off and on to check the result. If the alarm occurs permanently, it is necessary to replace the controller. If the alarm disappears, the previously stored parameters will be replaced by the default parameters.
209	PARAM RESTORE	Cause: The controller has restored the default settings. If a CLEAR EEPROM has been made before the last key re-cycle, this warning informs you that EEPROM was correctly cleared.
		Troubleshooting: - A travel demand or a pump request cancels the alarm. - If the alarm appears at key-on without any CLEAR EEPROM performed, replace the controller.
210	WRONG RAM MEM.	Cause The algorithm implemented to check the main RAM registers finds wrong contents: the register is “dirty”. This alarm inhibits the machine operations.
		Troubleshooting Try to switch the key off and then on again, if the alarm is still present replace the logic board.
211	STALL ROTOR	Cause: The traction rotor is stuck or the encoder signal is not correctly received by the controller.
		Troubleshooting: - Check the encoder condition. - Check the wiring. - Through the TESTER function, check if the sign of FREQUENCY and ENCODER are the same and if they are different from zero during a traction request. - If the problem is not solved, replace the logic board.
212	POWER MISMATCH	Cause The error between the power setpoint and the estimated power is out of range.
		Troubleshooting Ask for assistance to a Zapi technician about the correct adjustment of the motor parameters.
213	POSITIVE LC OPEN	Cause The voltage feedback of LC driver is different from expected, i.e. it is not in accordance with the driver operation.
		Troubleshooting - Verify LC coil is properly connected. - Verify CONF. POSITIVE LC parameter is set in accordance with the actual coil positive supply Software, depending on the parameter value, makes a proper diagnosis; a mismatch between the hardware and the parameter configuration could generate a false fault. - In case no failures/problems have been found, the problem is in the controller,

		which has to be replaced.
214	EVP COIL OPEN	Cause: No load is connected between the NEVP output and the electrovalve positive terminal.
		Troubleshooting: - Check the EVP condition. - Check the EVP wiring. - If the problem is not solved, replace the logic board.
215	EVP DRIV. SHORT.	Cause - The EVP driver is shorted . - The microcontroller detects a mismatch between the valve set-point and the feedback of the EVP output.
		Troubleshooting - Check if there is a short circuit or a low-impedance conduction path between the negative of the coil and -BATT.
216	EB. COIL OPEN	Cause: No load is connected between the NEB output and the EB positive terminal PEB
		Troubleshooting: Check the EB coil. Check the wiring. If the problem is not solved, replace the logic board.
217	PEV NOT OK	Cause: The PEV connector (B1, only for ACE3 Premium version) is not connected to the battery or the voltage is different from expected. This alarm occurs if one output among EVP, EV1, EV2, EV3, EV4 and EV5 is present or the AUX OUT function is active (POSITIVE EB = 1 or 2).
		Troubleshooting: Check connector B1: it must be connected to the battery voltage (after the main contactor).
218	SENS MOT TEMP KO	Cause: The output of the motor thermal sensor is out of range.
		Troubleshooting: - Check if the resistance of the sensor is what expected measuring its resistance. - Check the wiring. - If the problem is not solved, replace the logic board.
219	PEB-PEV P NOT OK	Cause: The voltage of traction A17 pin is wrong, A17 pin voltage is +24V, from DC-DC output, if the voltage is wrong,this alarm will appears
		Troubleshooting: - Check if the DC-DC works properly, if still has +24V output. - Check the wiring,if A17 connected well? - Check the fuse box if works properly,maybe the fuse is burned.

220	VKEY OFF SHORTED	Cause The logic board measures a key voltage that is constantly out of range, below the minimum allowed value.
		Troubleshooting - Check that the battery has the same nominal voltage of the inverter. - Check the battery voltage, if it is out of range replace the battery. - In case the problem is not solved, replace the logic board.
221	HANDBRAKE	Cause: Handbrake input is active.
		Troubleshooting: - Check that handbrake is not active by mistake. - Check the SR/HB input state through the TESTER function. - Check the wirings. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.
222	SEAT MISMATCH	Cause This alarm can appear only in a Traction + Pump configuration. There is an input mismatch between the traction controller and the pump controller relatively to the seat input: the two values recorded by the two controllers are different.
		Troubleshooting - Check if there are wrong connections in the external wiring. - Using the TESTER function verify that the seat inputs are in accordance with the actual state of the external switch. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
223	COIL SHOR. MC	Cause This alarm occurs when an overload of the MC driver occurs.
		Troubleshooting - Check the connections between the controller outputs and the loads. - Collect information about characteristics of the coil connected to the driver and ask for assistance to a Zapi technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
224	WAITING FOR NODE	Cause: The controller receives from the CAN bus the message that another controller in the net is in fault condition; as a consequence the controller itself cannot enter into an operative status, but it has to wait until the other node comes out from the fault status.
		Troubleshooting: Check if any other device on the CAN bus is in fault condition.
226	VACC OUT RANGE	Cause: The CPOT input read by the microcontroller is not within the MIN VACC ÷ MAX VACC range, programmed through the PROGRAMM VACC function (see

		paragraph 9.1). The acquired values MIN VACC and MAX VACC are inconsistent.
		Troubleshooting: Acquire the maximum and minimum potentiometer values through the PROGRAM VACC function. If the alarm is still present, check the mechanical calibration and the functionality of the accelerator potentiometer. If the problem is not solved, replace the logic board.
227	HW FAULT	Cause1: At each start-up the supervisor microcontroller checks that the hardware circuit for enabling and disabling of the power bridge works properly.
		Cause2:At each start-up the supervisor microcontroller checks that the hardware circuit intended to enable and disable the LC driver works properly.
		Troubleshooting This type of fault is not related to external components. Replace the logic board
228	TILLER OPEN	Cause: Tiller/seat input has been inactive for more than 30 seconds.
		Troubleshooting: - Activate the tiller/seat input. - Check the tiller/seat input state through the TESTER function. - Check the wirings. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.
229	HW FAULT EB.	Cause: At start-up, the hardware circuit dedicated to enable and disable the EB driver is found to be faulty. The hexadecimal value “XX” facilitates Zapi technicians debugging the problem.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
230	LC COIL OPEN	Cause This fault appears when no load is connected between the NLC output and the positive voltage (for example +KEY).
		Troubleshooting - Check the wiring, in order to verify if LC coil is connected to the right connector pin and if it is not interrupted. - If the alarm is still present, than the problem is inside the logic board; replace it.
232	CONT. DRV. EV	Cause: One or more on/off valve drivers are not able to drive the load. For the meaning of code “XX”, refer to paragraph 0.
		Troubleshooting: The device or its driving circuit is damaged. Replace the controller.
233	POWER MOS	Cause The DC-link voltage drops to zero when a high-side MOSFET is turned on.

	SHORTED	Troubleshooting - Check that motor phases are correctly connected. - Check that there is no dispersion to ground for every motor phases. - In case the problem is not solved, replace the controller.
234	DRV. SHOR. EV	Cause: One or more on/off valve drivers are shorted.
		Troubleshooting: Check if there is a short circuit or a low impedance path between the negative terminals of the involved coils and -B. If the problem is not solved, replace the logic board.
235	CTRAP THRESHOLD	Cause This alarm occurs when a mismatch is detected between the setpoint for the overcurrent detection circuit (dependent on parameter DUTY PWM CTRAP) and the feedback of the actual threshold value.
		Troubleshooting The failure lies in the controller hardware. Replace the logic board.
236	CURRENT GAIN	Cause: The maximum current gain parameters are at the default values, which means the maximum current adjustment procedure has not been carried out yet.
		Troubleshooting: Ask for assistance to a Zapi technician in order to do the adjustment procedure of the current gain parameters.
237	ANALOG INPUT	Cause This alarm occurs when the A/D conversion of the analog inputs returns frozen values, on all the converted signals, for more than 400 ms. The goal of this diagnosis is to detect a failure in the A/D converter or a problem in the code flow that skips the refresh of the analog signal conversion.
		Troubleshooting If the problem occurs permanently it is necessary to replace the logic board.
238	HW FAULT EV.	Cause: At start-up, the hardware circuit dedicated to enable and disable the EV drivers is found to be faulty. The hexadecimal value “XX” facilitates Zapi technicians debugging the problem.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
239	CONTROLLER MISM.	Cause: The software is not compatible with the hardware. Each controller produced is “signed” at the end of line test with a specific code mark saved in EEPROM according to the customized Part Number. According with this “sign”, only the customized firmware can be uploaded.
		Troubleshooting - Upload the correct firmware. - Ask for assistance to a Zapi technician in order to verify that the firmware is correct.

240	EVP DRIVER OPEN	Cause: The EVP driver is not able to drive the EVP coil. The device itself or its driving circuit is damaged.
		Troubleshooting: This fault is not related to external components. Replace the logic board.
241	COIL SHOR. EVAUX	Cause: This alarm occurs when there is an overload of one or more EV driver. As soon as the overload condition has been removed, the alarm disappears by releasing and then enabling a travel demand.
		Troubleshooting: - Check the EVs conditions. - Check the wiring. - Collect information about characteristics of EV coils and ask assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
242	OPEN COIL EV.	Cause: This fault appears when no load is connected between the NAUX1 output and the positive terminal PCOM .
		Troubleshooting: - Check the EB coil. - Check the wiring. - If the problem is not solved, replace the logic board.
243	THROTTLE PROG.	Cause: A wrong profile has been set in the throttle profile.
		Troubleshooting: Set properly the throttle-related parameters.
244	WARNING SLAVE	Cause: Warning on supervisor uC.
		Troubleshooting: Connect the Console to the supervisor uC and check which alarm is present.
245	IQ MISMATCHED	Cause The error between the Iq (q-axis current) setpoint and the estimated Iq is out of range.
		Troubleshooting Ask for assistance to a Zapi technician in order to do the correct adjustment of the motor parameters.
246	EB. DRIV.OPEN	Cause: The EB driver is not able to drive the load. The device itself or its driving circuit is damaged.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
247	DATA ACQUISI	Cause: Controller in calibration state.

	TION	Troubleshooting: The alarm ends when the acquisition is done.
248	NO CAN MSG.	Cause: This is a safety related test. It is a self-diagnosis test that checks the communication between master and supervisor microcontrollers.
		Troubleshooting: This alarm could be caused by a CAN bus malfunctioning, which blinds master-supervisor communication
249	CHECK UP NEEDED	Cause: This is a warning to point out that it is time for the programmed maintenance.
		Troubleshooting: Turn on the CHECK UP DONE option after that the maintenance service.
250	THERMI C SENS. KO	Cause: The output of the controller thermal sensor is out of range.
		Troubleshooting: This kind of fault is not related to external components. Replace the controller.
251	WRONG SET BAT.	Cause At start-up, the controller checks the battery voltage (measured at key input) and it verifies that it is within a range of ±20% around the nominal value.
		Troubleshooting - Check that the SET BATTERY parameter inside the ADJUSTMENT list matches with the battery nominal voltage. - Through the TESTER function, check that the KEY VOLTAGE reading shows the same value as the key voltage measured with a voltmeter on pin A1. If it does not match, then modify the ADJUST BATTERY parameter according to the value read by the voltmeter. - Replace the battery.
252	WRONG ZERO	Cause: At start-up the amplifiers used to measure the motor voltage sense voltages above 3 V or below 2 V.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
253	FIELD ORIENT. KO	Cause The error between the Id (d-axis current) setpoint and the estimated Id is out of range.
		Troubleshooting Ask for assistance to a Zapi technician in order to do the correct adjustment of the motor parameters.
254	EB. DRIV.SH RT.	Cause: - The EB driver is shorted. - The microcontroller detects a mismatch between the valve setpoint and the feedback at the EB output.

		Troubleshooting: - Check if there is a short or a low impedance path between the negative coil terminal and -BATT. - Check if the voltage applied is in accordance with the parameters set . - If the problem is not solved, replace the controller.

Table 4-5 Fault list of auxiliary pump, auxiliary traction

CODE	**ALARM NAME**	**ACE3 traction slave alarms （node 2.1）and ACE3 pump slave alarms （node 5.1）**
8	WATCHDOG	Cause: This is a safety related test. It is a self-diagnosis test that involves the logic between master and supervisor microcontrollers
		Troubleshooting: This alarm could be caused by a CAN bus malfunctioning, which blinds master-supervisor communication
17	LOGIC FAILURE #3	Cause An hardware problem in the logic board due to high currents (overload). An overcurrent condition is triggered even if the power bridge is not driven.
		Troubleshooting The failure lies in the controller hardware. Replace the controller.
19	LOGIC FAILURE #1	Cause: This fault is displayed when the controller detects an undervoltage condition at the key input . Undervoltage threshold is 11V for 36/48V controllers and 30 V for 80V controllers. - Fault can be caused by a key input signal characterized by pulses below the undervoltage threshold, possibly due to external loads like DC/DC converters starting-up, relays or contactors during switching periods, solenoids energizing or de-energizing. Consider to remove such loads. - If no voltage transient is detected on the supply line and the alarm is present every time the key switches on, the failure probably lies in the controller hardware. Replace the logic board.
		Troubleshooting (fault displayed during motor driving) - If the alarm occurs during motor acceleration or when there is a hydraulic-related request, check the battery charge, the battery health and power-cable connections.
199	BUMPER STOP	Cause The two digital inputs dedicated to the bumper functionality are high at the same time.
		Troubleshooting - Turn off one or both inputs dedicated to the bumper functionality; - If the alarm occurs even if the inputs are in the rest position, check if the microswitches are stuck. - In case the problem is not solved, replace the logic board.

200	STEER SENSOR KO	Cause: The voltage read by the microcontroller at the steering-sensor input is not within the STEER RIGHT VOLT ÷ STEER LEFT VOLT range, programmed through the STEER ACQUIRING function .
		Troubleshooting: Acquire the maximum and minimum values coming from the steering potentiometer through the STEER ACQUIRING function. If the alarm is still present, check the mechanical calibration and the functionality of the potentiometer. If the problem is not solved, replace the logic board.
201	WRONG ENC SET	Cause Mismatch between “ENCODER PULSES 1” parameter and “ENCODER PULSES 2” parameter .
		Troubleshooting Set the two parameters with the same value, according to the adopted encoder.
202	VDC LINK OVERV.	Cause This fault is displayed when the controller detects an overvoltage condition. Overvoltage threshold is 65 V for 36/48V controllers and 116 V for 80V controllers. As soon as the fault occurs, power bridge and MC are opened. The condition is triggered using the same HW interrupt used for undervoltage detection, uC discerns between the two evaluating the voltage present across DC-link capacitors: - High voltage àOvervoltage condition - Low/normal voltage àUndervoltage condition
		Troubleshooting If the alarm happens during the brake release, check the line contactor contact and the battery power-cable connection.
208	EEPROM KO	Cause: A HW or SW defect of the non-volatile embedded memory storing the controller parameters. This alarm does not inhibit the machine operations, but it makes the truck to work with the default values.
		Troubleshooting: Execute a CLEAR EEPROM procedure (refer to the Console manual). Switch the key off and on to check the result. If the alarm occurs permanently, it is necessary to replace the controller. If the alarm disappears, the previously stored parameters will be replaced by the default parameters.
209	PARAM RESTORE	Cause: The controller has restored the default settings. If a CLEAR EEPROM has been made before the last key re-cycle, this warning informs you that EEPROM was correctly cleared.
		Troubleshooting: - A travel demand or a pump request cancels the alarm. - If the alarm appears at key-on without any CLEAR EEPROM performed, replace the controller.

210	WRONG RAM MEM.	Cause: The algorithm implemented to check the main RAM registers finds wrong contents: the register is “dirty”. This alarm inhibits the machine operations.
		Troubleshooting Try to switch the key off and then on again, if the alarm is still present replace the logic board.
212	W.SET. TG-EB XX	Cause: Supervisor microcontroller has detected that the master microcontroller has imposed a wrong setpoint for TG or EB output
		Troubleshooting: - Check the matching of the parameters between master and supervisor. - Ask for the assistance of a Zapi technician. - If the problem is not solved, replace the logic board.
213	INPUT MISMAT CH	Cause: The supervisor microcontroller records different input values with respect to the master microcontroller.
		Troubleshooting: - Compare the values read by master and slave through the TESTER function. - Ask for the assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
227	OUT MISMAT CH XX	Cause: This is a safety related test. Supervisor µC has detected that master µC is driving traction motor in a wrong way (not corresponding to the operator request).
		Troubleshooting: - Checks the matching of the parameters between Master and Supervisor. - Ask for assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
229	NO CAN WR MSG.XX	Cause: CANbus communication does not work properly. The hexadecimal value “XX” identifies the faulty node.
		Troubleshooting Verify the CANbus network (external issue). Replace the logic board (internal issue).
230	SOFTWA RE ERROR	Cause:The software of the slave microcontroller is wrong,ask help to the inveter manufacturer
235	CTRAP THRESH OLD	Cause This alarm occurs when a mismatch is detected between the setpoint for the overcurrent detection circuit (dependent on parameter DUTY PWM CTRAP) and the feedback of the actual threshold value.
		Troubleshooting The failure lies in the controller hardware. Replace the logic board.

237	ANALOG INPUT	Cause: This alarm occurs when the A/D conversion of the analog inputs returns frozen values, on all the converted signals, for more than 400 ms. The goal of this diagnosis is to detect a failure in the A/D converter or a problem in the code flow that skips the refresh of the analog signal conversion.
		Troubleshooting If the problem occurs permanently it is necessary to replace the logic board.
239	CONTROLLER MISM.	Cause The software is not compatible with the hardware. Each controller produced is "signed" at the end of line test with a specific code mark saved in EEPROM according to the customized Part Number. According with this "sign", only the customized firmware can be uploaded.
		Troubleshooting - Upload the correct firmware. - Ask for assistance to a Zapi technician in order to verify that the firmware is correct.
240	OUT MISMATCH PU	Cause: This is a safety related test. Supervisor µC has detected that the Master µC is driving DC motor in a wrong way (not correspondent to the status of operator commands).
		Troubleshooting: - Checks the correspondence of the parameters between Master and Supervisor - Ask the assistance of a Zapi technician. - If the problem is not solved it is necessary to replace the logic board.
241	SP MISMATCH PUMP	Cause: This is a safety related test. The Master µC has detected a Supervisor µC wrong set point for DC Pump motor.
		Troubleshooting: - Checks the correspondence of the parameters between Master and Supervisor - Ask the assistance of a Zapi technician. - If the problem is not solved it is necessary to replace the logic board.
242	SP MISMATCH XX	Cause: This is a safety related test. The master µC has detected a supervisor µC wrong set point.
		Troubleshooting: - Check the matching of the parameters between master and supervisor. - Ask for assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
248	NO CAN MSG. XX	Cause CANbus communication does not work properly. The hexadecimal value "XX" identifies the faulty node.
		Troubleshooting - Verify the CANbus network (external issue). - Replace the logic board (internal issue).

Table 4-6 Fault list of steering pump main CPU

CODE	ALARM NAME	**ACE0 independent steering pump master alarms （node 13.0）**
8	WATCHDOG	Cause: This is a safety related test. It is a self-diagnosis test that involves the logic between master and supervisor microcontrollers
		Troubleshooting: This alarm could be caused by a CAN bus malfunctioning, which blinds master-supervisor communication
17	LOGIC FAILURE #3	Cause An hardware problem in the logic board due to high currents (overload). An overcurrent condition is triggered even if the power bridge is not driven.
		Troubleshooting The failure lies in the controller hardware. Replace the controller.
18	LOGIC FAILURE #2	Cause Fault in the hardware section of the logic board which deals with voltage feedbacks of motor phases.
		Troubleshooting The failure lies in the controller hardware. Replace the controller.
19	LOGIC FAILURE #1	Cause: This fault is displayed when the controller detects an undervoltage condition at the key input (A1). Undervoltage threshold is 11V for 36/48V controllers and 30 V for 80V controllers. - Fault can be caused by a key input signal characterized by pulses below the undervoltage threshold, possibly due to external loads like DC/DC converters starting-up, relays or contactors during switching periods, solenoids energizing or de-energizing. Consider to remove such loads. - If no voltage transient is detected on the supply line and the alarm is present every time the key switches on, the failure probably lies in the controller hardware. Replace the logic board.
		Troubleshooting (fault displayed during motor driving) - If the alarm occurs during motor acceleration or when there is a hydraulic-related request, check the battery charge, the battery health and power-cable connections.
30	VMN LOW	Cause 1 Start-up test. Before switching the LC on, the software checks the power bridge: it turns on alternatively the high-side power MOSFETs and expects the phase voltages increase toward the positive rail value. If one phase voltage is below 66% of the rail voltage, this alarm occurs.
		Cause 2 Motor running test. When the motor is running, the power bridge is on and

		the motor voltage feedback tested; if it is lower than expected value (a range of values is considered), the controller enters in fault state.
		Troubleshooting - If the problem occurs at start up (the LC does not close at all), check: o motor internal connections (ohmic continuity); o motor power-cables connections; o if the motor connections are OK, the problem is inside the controller; replace it. - If the alarm occurs while the motor is running, check: o motor connections; o that the LC power contact closes properly, with a good contact; o if no problem is found, the problem is inside the controller. Replace it.
31	VMN HIGH	Cause 1 Before switching the LC on, the software checks the power bridge: it turns on alternatively the low-side power MOSFETs and expects the phase voltages decrease down to -BATT. If the phase voltages are higher than 10% of the nominal battery voltage, this alarm occurs.
		Cause 2 This alarm may also occur when the start-up diagnosis has succeeded and so the LC has been closed. In this condition, the phase voltages are expected to be lower than half the battery voltage. If one of them is higher than that value, this alarm occurs.
		Troubleshooting - If the problem occurs at start-up (the LC does not close), check: o motor internal connections (ohmic continuity); o motor power cables connections; o if the motor connections are OK, the problem is inside the controller. Replace it. - If the alarm occurs while the motor is running, check: o motor connections; o that the LC power contact closes properly, with a good contact; o if no problem is found, the problem is inside the controller. Replace it.
37	CONTACTOR CLOSED	Cause Before driving the LC coil, the controller checks if the contactor is stuck. The controller drives the power bridge for several dozens of milliseconds, trying to discharge the capacitors bank. If the capacitor voltage does not decrease by more than 20% of the key voltage, the alarm is raised.
		Troubleshooting It is suggested to verify the power contacts of LC; if they are stuck, is necessary to replace the LC.
38	CONTACTOR OPEN	Cause The LC coil is driven by the controller, but it seems that the power contacts do not close. In order to detect this condition the controller injects a DC current into the motor and checks the voltage on power capacitor. If the

		power capacitors get discharged it means that the main contactor is open.
		Troubleshooting - LC contacts are not working. Replace the LC. - If LC contacts are working correctly, contact a Zapi technician.
53	STBY I HIGH	Cause In standby, the sensor detects a current value different from zero.
		Troubleshooting The current sensor or the current feedback circuit is damaged. Replace the controller.
60	CAPACITOR CHARGE	Cause When the key is switched on, the inverter tries to charge the power capacitors through the series of a PTC and a power resistance, checking if the capacitors are charged within a certain timeout. If the capacitor voltage results less than 20% of the nominal battery voltage, the alarm is raised and the main contactor is not closed.
		Troubleshooting - Check if an external load in parallel to the capacitor bank, which sinks current from the capacitors-charging circuit, thus preventing the caps from charging well. Check if a lamp or a dc/dc converter or an auxiliary load is placed in parallel to the capacitor bank. - The charging resistance or PTC may be broken. Insert a power resistance across line-contactor power terminals; if the alarm disappears, it means that the charging resistance is damaged. - The charging circuit has a failure or there is a problem in the power section. Replace the controller.
62	TH. PROTECTION	Cause: The temperature of the controller base plate is above 85 ° C. The maximum current is proportionally decreased with the temperature excess from 85 ° C up to 105 ° C. At 105° C the current is limited to 0 A.
		Troubleshooting: It is necessary to improve the controller cooling. To realize an adequate cooling in case of finned heat sink important factors are the air flux and the cooling-air temperature. If the thermal dissipation is realized by applying the controller base plate onto the truck frame, the important factors are the thickness of the frame and the planarity and roughness of its surface. If the alarm occurs when the controller is cold, the possible reasons are a thermal-sensor failure or a failure in the logic board. In the last case, it is necessary to replace the controller.
65	MOTOR TEMPERAT.	Cause: This warning occurs when the temperature sensor is open (if digital) or if it has overtaken the MAX MOTOR TEMP threshold (if analog) .

		Troubleshooting: - Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function. - Check the sensor ohmic value and the sensor wiring. - If the sensor is OK, improve the cooling of the motor. - If the warning is present when the motor is cool, replace the controller.
66	BATTERY LOW	Cause: The battery charge is evaluated to be lower than 10% of the full charge and the BATTERY CHECK setting is other than 0 (refer to SET OPTION menu).
		Troubleshooting: - Check the battery charge and charge it if necessary. - If the battery is actually charged, measure the battery voltage through a voltmeter and compare it with the value in the BATTERY VOLTAGE reading in the TESTER function. If they are different, adjust the ADJUST BATTERY parameter with the value measured through the voltmeter. - If the problem is not solved, replace the logic board.
74	DRIVER SHORTED	Cause The driver of the LC coil is shorted.
		Troubleshooting - Check if there is a short or a low impedance pull-down between NLC and －BATT. - The driver circuit is damaged; replace the logic board.
75	CONTACTOR DRIVER	Cause The LC coil driver is not able to drive the load. The device itself or its driver circuit is damaged.
		Troubleshooting This type of fault is not related to external components; replace the logic board.
78	VACC NOT OK	Cause: At key-on and immediately after that, the travel demands have been turned off. This alarm occurs if the ACCELERATOR reading (in TESTER function) is more than 1 V above the minimum value acquired during the PROGRAM VACC procedure.
		Troubleshooting: - Check the wirings. - Check the mechanical calibration and the functionality of the accelerator potentiometer. - Acquire the maximum and minimum potentiometer value through the PROGRAM VACC function. - If the problem is not solved, replace the logic board.
79	INCORRECT START	Cause: Incorrect starting sequence. Possible reasons for this alarm are: - A travel demand active at key-on. - Man-presence sensor active at key on.

		Troubleshooting: - Check wirings. - Check microswitches for failures. - Through the TESTER function, check the state of the inputs are coherent with microswitches states. - If the problem is not solved, replace the logic board.
80	FORW + BACK	Cause: This alarm occurs when both the travel requests (FW and BW) are active at the same time.
		Troubleshooting: - Check that travel requests are not active at the same time. - Check the FW and BW input states through the TESTER function. - Check the wirings relative to the FW and BW inputs. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.
82	ENCODER ERROR	Cause This fault occurs in the following conditions: the frequency supplied to the motor is higher than 40 Hz and the signal feedback from the encoder has a jump higher than 40 Hz in few tens of milliseconds. This condition is related to an encoder failure.
		Troubleshooting - Check the electrical and the mechanical functionality of the encoder and the wires crimping. - Check the mechanical installation of the encoder, if the encoder slips inside its housing it will raise this alarm. - Also the electromagnetic noise on the sensor can be the cause for the alarm. In these cases try to replace the encoder. - If the problem is still present after replacing the encoder, the failure is in the controller.
164	PWM ACQ. ERROR	Cause This alarm occurs only when the controller is configured to drive a PMSM and the feedback sensor selected in the HARDWARE SETTINGS list is ENCODER ABI + PWM. The controller does not detect correct information on PWM input at start-up
		Troubleshooting - Re-cycle the key. - Check the sensor in order to verify that it works properly. - Check the wiring. - If the problem occurs permanently it is necessary to substitute logic board
170	WRONG KEY VOLT.	Cause: The inverter key voltage is wrong .
		Troubleshooting: Check the battery level if is correct.

171	ACQUIRING A.S.	Cause: Controller is acquiring data from the absolute feedback sensor.
		Troubleshooting: The alarm ends when the acquisition is done.
175	SPEED FB. ERROR	Cause This alarm occurs if the absolute position sensor is used also for speed estimation. If signaled, it means that the controller measured that the engine was moving too quick.
		Troubleshooting - Check that the sensor used is compatible with the software release. - Check the sensor mechanical installation and if it works properly. - Also the electromagnetic noise on the sensor can be a cause for the alarm. - If no problem is found on the motor or on the speed sensor, the problem is inside the controller, it is necessary to replace the logic board.
177	COIL SHOR. EB.	Cause This alarm occurs when an overload of the EB driver occurs
		Troubleshooting - Check the connections between the controller outputs and the loads. - Collect information about characteristics of the coil connected to the driver and ask for assistance to a Zapi technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced
178	MOTOR TEMP. STOP	Cause: The temperature sensor has overtaken the STOP MOTOR TEMP. threshold (if analog).
		Troubleshooting: - Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function. - Check the sensor ohmic value and the sensor wiring. - If the sensor is OK, improve the cooling of the motor. - If the warning is present when the motor is cool, replace the controller.
179	STEER SENSOR KO	Cause: The voltage read by the microcontroller at the steering-sensor input is not within the STEER RIGHT VOLT ÷ STEER LEFT VOLT range, programmed through the STEER ACQUIRING function
		Troubleshooting: - Acquire the maximum and minimum values coming from the steering potentiometer through the STEER ACQUIRING function. If the alarm is still present, check the mechanical calibration and the functionality of the potentiometer. - If the problem is not solved, replace the logic board

180	OVERLOAD	Cause The motor current has overcome the limit fixed by hardware.
		Troubleshooting Reset the alarm by switching key off and on again. If the alarm condition occurs again, ask for assistance to a Zapi technician. The fault condition could be affected by wrong adjustments of motor parameters.
181	WRONG ENC SET	Cause: Mismatch between “ENCODER PULSES 1” parameter and “ENCODER PULSES 2” parameter .
		Troubleshooting Set the two parameters with the same value, according to the adopted encoder.
182	EVP2 COIL OPEN	Cause: No load is connected between the EVP2 output (A23) and the electrovalve positive terminal.
		Troubleshooting: - Check the EVP2 condition. - Check the EVP2 wiring. - If the problem is not solved, replace the logic board.
185	TILLER ERROR	Cause Input mismatch between Hard&Soft input (A11) and tiller/seat input (A6): the two inputs are activated at the same time.
		Troubleshooting - Check if there are wrong connections in the external wiring. - Using the TESTER function verify that inputs are in accordance with the actual state of the external switches. - Check if there is a short circuit between A11 and A6. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
186	WAIT MOT.P STILL	Cause: If DC Pump option is set to ON, the software expects the voltage on －P output to be at a “steady state” value, before switching the LC on. If the voltage is different, it could be due to the fact that the motor connected to －P is not still. For this reason, the software waits 30 seconds for the voltage to be at the “steady state” value (and for the pump motor to be still). After this time, the software assumes that the problem is not due to the fact that the pump motor is not still, and show the “PUMP VMN NOT OK” alarm
		Troubleshooting: AIf the motor connected to －P is still moving, just wait for it to be still. If not, in 30 seconds the alarm “PUMP VMN NOT OK” will appear (See Paragraph 10.1).
187	LIFT+LOWER	Cause: Both the pump requests (LIFT and LOWER) are active at the same time.

		Troubleshooting: - Check that LIFT and LOWER requests are not active at the same time. - Check the LIFT and LOWER input states through the TESTER function. - Check the wirings. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.
188	PUMP VACC NOT OK	Cause: The minimum of the lift potentiometer is not correctly set.
		Troubleshooting: It is suggested to repeat the acquiring procedure.
189	PUMP INC START	Cause: This is a warning for a pump incorrect starting sequence.
		Troubleshooting: The possible reasons for this alarm are: o Pump request active at keyon. o Pump request active without man presence. - Check the wirings. - Check the micro-switches. - It could also be an error sequence made by the operator. - A failure logic is possible too. When all of the above conditions were checked and nothing was found, replace the controller.
190	PUMP VMN NOT OK	Cause: Before switching the LC on, the software checks the output voltage on －P connector, and expects it to be at a “steady state” value (if DC PUMP options is set to ON) If the voltage is too low, this alarm occurs.
		Troubleshooting: Please check - The motor connected to －P must be completely still before this alarm occurs. The software waits 30 seconds before showing this alarm. During this time it shows the “WAIT MOTOR STILL” warning (see in the warnings chapter) - Motor internal connections - Motor power cables connections - Motor leakage to truck frame - If the motor connections are ok, the problem is inside the controller it is necessary to replace the logic board.
191	PUMP I NO ZERO	Cause: In standby condition (pump motor not driven), the feedback coming from the current sensor in the pump chopper gives a value out of a permitted range, because the pump current is not zero.
		Troubleshooting: This type of fault is not related to external components; replace the controller.
192	PUMP VACC RANGE	Cause: The voltage on A30 is outside of the parameters range.

		Troubleshooting: If the EVP TYPE parameter is set to ANALOG (See paragraph 8.1.1), please acquire again the values of MIN LOWER and MAX LOWER. If the controller is in configuration COMBI and lifting is proportional, please acquire again also the values of MIN LIFT and MAX LIFT.
193	SMART DRIVER KO	Cause: There is a hardware problem in the smart driver circuit . The driver is set to be ON but the output voltage does not increase
		Troubleshooting: - Verify that the EB coil is connected correctly between pin A2 and pin A4. - Verify that the parameter POSITIVE E.B.is set in accordance with the actual configuration (see paragraph 8.2.5). The software, in fact, depending on specific parameter value, makes a proper diagnosis; a wrong configuration of this parameter could generate a false fault. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced
194	AUX BATT. SHORT.	Cause: The voltage on pin A2 is at high value even if it shouldn’t. For the version where the Smart Driver is not installed (36/48V and 80V) it is possible to decide where the positive supply for pin A2 is taken from by dedicated hardware configuration: - pin A3 (PAUX) - pin A1 (TILLER) - externally from other module (i.e. EPS) The parameter “Positive EB” has to be set in accordance with hardware configuration :
		Troubleshooting: - Verify that the parameters “Positive EB” is set in accordance with the actual coil positive supply . The software, in fact,depending by specific parameter value, makes a proper diagnosis; a wrong configuration of the parameter could generate a false fault. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
195	POS. EB. SHORTED	Cause: The voltage on terminal PEB is at the high value even if the smart driver is turned OFF.
		Troubleshooting: Verify that the parameter POSITIVE EB is set in accordance with the actual coil positive supply . Since the software makes a proper diagnosis depending on the parameter, a wrong setting could generate a false fault. Check if there is a short or a low impedance path between PEB and the positive battery terminal +B. In case no failures/problems can be found, the problem is in the controller, which has to be replaced.

196	MOT.PHASE SH. （36/37/38）	Cause Short circuit between two motor phases. The number that follows the alarm identifies where the short circuit is located: - 36 àU – V short circuit - 37 àU – W short circuit - 38 àV – W short circuit
		Troubleshooting - Verify the motor phases connection on the motor side - Verify the motor phases connection on the inverter side - Check the motor power cables. - Replace the controller. - If the alarm does not disappear, the problem is in the motor. Replace it.
197	WRONG SLAVE VER.	Cause: Wrong software version on supervisor uC.
		Troubleshooting: Upload the correct software version or ask for assistance to a Zapi technician.
198	M/S PAR CHK MISM	Cause: At start-up there is a mismatch in the parameter checksum between the master and the supervisor microcontrollers.
		Troubleshooting: Restore and save again the parameters list.
199	PARAM TRANSFER	Cause: Master uC is transferring parameters to the supervisor.
		Troubleshooting: Wait until the end of the procedure. If the alarm remains longer, re-cycle the key.
200	VDC OFF SHORTED	Cause The logic board measures a key voltage value that is constantly out of range, above the maximum allowed value.
		Troubleshooting - Check that the battery has the same nominal voltage of the inverter. - Check the battery voltage, if it is out of range replace the battery. - In case the problem is not solved, replace the logic board.
201	TORQUE PROFILE	Cause: There is an error in the choice of the torque profile parameters.
		Troubleshooting: Check in the HARDWARE SETTING menu the value of those parameters.
202	VDC LINK OVERV.	Cause This fault is displayed when the controller detects an overvoltage condition. Overvoltage threshold is 65 V for 36/48V controllers and 116 V for 80V controllers. As soon as the fault occurs, power bridge and MC are opened. The condition is triggered using the same HW interrupt used for undervoltage detection, uC discerns between the two evaluating the voltage present across DC-link

		capacitors: - High voltage àOvervoltage condition - Low/normal voltage àUndervoltage condition
		Troubleshooting If the alarm happens during the brake release, check the line contactor contact and the battery power-cable connection.
203	HW FAULT MC	Cause: At start-up, the hardware circuit dedicated to enable and disable the MC driver is found to be faulty. The hexadecimal value “XX” facilitates Zapi technicians debugging the problem
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
204	BRAKE RUN OUT	Cause: The CPOT BRAKE input read by the microcontroller is at its maximum value without the hand-brake request.
		Troubleshooting: Check the mechanical calibration and the functionality of the brake potentiometer. If the alarm is still present, replace the logic board.
205	EPS RELAY OPEN	Cause: The controller receives from EPS information about the safety contacts being open.
		Troubleshooting: Verify the EPS functionality.
206	INIT VMN HIGH	Cause Before switching the LC on, the software checks the power-bridge voltage without driving it. The software expects the voltage to be in a “steady state” value. If it is too high, this alarm occurs.
		Troubleshooting - Check the motor power cables; - Check the impedance between U, V and W terminals and -Batt terminal of the controller. - Check the motor leakage to truck frame. - If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.
207	INIT VMN LOW	Cause Before switching the LC on, the software checks the power-bridge voltage without driving it. The software expects the voltage to be in a “steady state” value. If it is too low, this alarm occurs.

		Troubleshooting - Check the motor power cables. - Check the impedance between U, V and W terminals and -Batt terminal of the controller. - Check the motor leakage to truck frame. - If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.
208	EEPROM KO	Cause: A HW or SW defect of the non-volatile embedded memory storing the controller parameters. This alarm does not inhibit the machine operations, but it makes the truck to work with the default values.
		Troubleshooting: Execute a CLEAR EEPROM procedure (refer to the Console manual). Switch the key off and on to check the result. If the alarm occurs permanently, it is necessary to replace the controller. If the alarm disappears, the previously stored parameters will be replaced by the default parameters.
209	PARAM RESTORE	Cause: The controller has restored the default settings. If a CLEAR EEPROM has been made before the last key re-cycle, this warning informs you that EEPROM was correctly cleared.
		Troubleshooting: - A travel demand or a pump request cancels the alarm. - If the alarm appears at key-on without any CLEAR EEPROM performed, replace the controller.
210	WRONG RAM MEM.	Cause The algorithm implemented to check the main RAM registers finds wrong contents: the register is “dirty”. This alarm inhibits the machine operations.
		Troubleshooting Try to switch the key off and then on again, if the alarm is still present replace the logic board.
211	STALL ROTOR	Cause: The traction rotor is stuck or the encoder signal is not correctly received by the controller.
		Troubleshooting: - Check the encoder condition. - Check the wiring. - Through the TESTER function, check if the sign of FREQUENCY and ENCODER are the same and if they are different from zero during a traction request. - If the problem is not solved, replace the logic board.
212	POWER MISMATCH	Cause The error between the power setpoint and the estimated power is out of range.
		Troubleshooting Ask for assistance to a Zapi technician about the correct adjustment of the

		motor parameters.
213	POSITIVE LC OPEN	Cause The voltage feedback of LC driver (A16) is different from expected, i.e. it is not in accordance with the driver operation.
		Troubleshooting - Verify LC coil is properly connected. - Verify CONF. POSITIVE LC parameter is set in accordance with the actual coil positive supply (see paragraph 7.2.5). Software, depending on the parameter value, makes a proper diagnosis; a mismatch between the hardware and the parameter configuration could generate a false fault. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
214	EVP COIL OPEN	Cause: No load is connected between the NEVP output (A19) and the electrovalve positive terminal.
		Troubleshooting: - Check the EVP condition. - Check the EVP wiring. - If the problem is not solved, replace the logic board.
215	EVP DRIV. SHORT.	Cause - The EVP driver is shorted . - The microcontroller detects a mismatch between the valve set-point and the feedback of the EVP output.
		Troubleshooting - Check if there is a short circuit or a low-impedance conduction path between the negative of the coil and -BATT. - Collect information about: - the voltage applied across the EVP coil, - the current in the coil, - features of the coil. Ask for assistance to Zapi in order to verify that the software diagnoses are in accordance with the type of coil employed. - If the problem is not solved, it could be necessary to replace the controller.
216	EB. COIL OPEN	Cause: This fault appears when no load is connected between the NEB output and the EB positive terminal PCOM .
		Troubleshooting: - Check the EB coil. - Check the wiring. - If the problem is not solved, replace the logic board.
217	PEV NOT OK	Cause: The PEV connector (B1, only for ACE3 Premium version) is not connected to the battery or the voltage is different from expected. This alarm occurs if one output among EVP, EV1, EV2, EV3, EV4 and EV5 is present or the AUX

		OUT function is active (POSITIVE EB = 1 or 2).
		Troubleshooting: Check connector B1: it must be connected to the battery voltage (after the main contactor).
218	SENS MOT TEMP KO	Cause: The output of the motor thermal sensor is out of range.
		Troubleshooting: - Check if the resistance of the sensor is what expected measuring its resistance. - Check the wiring. - If the problem is not solved, replace the logic board.
219	PEB-PEVP NOT OK	Cause: The voltage of traction A17 pin is wrong, A17 pin voltage is +24V, from DC-DC output, if the voltage is wrong,this alarm will appears
		Troubleshooting: - Check if the DC-DC works properly, if still has +24V output. - Check the wiring,if A17 connected well? - Check the fuse box if works properly,maybe the fuse is burned.
220	VKEY OFF SHORTED	Cause The logic board measures a key voltage that is constantly out of range, below the minimum allowed value.
		Troubleshooting - Check that the battery has the same nominal voltage of the inverter. - Check the battery voltage, if it is out of range replace the battery. - In case the problem is not solved, replace the logic board.
221	HANDBRAKE	Cause: Handbrake input is active.
		Troubleshooting: - Check that handbrake is not active by mistake. - Check the SR/HB input state through the TESTER function. - Check the wirings. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.
222	SEAT MISMATCH	Cause This alarm can appear only in a Traction + Pump configuration. There is an input mismatch between the traction controller and the pump controller relatively to the seat input (A6): the two values recorded by the two controllers are different.
		Troubleshooting - Check if there are wrong connections in the external wiring. - Using the TESTER function verify that the seat inputs are in accordance with the actual state of the external switch.

		- In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
223	COIL SHOR. MC	Cause This alarm occurs when an overload of the MC driver occurs.
		Troubleshooting - Check the connections between the controller outputs and the loads. - Collect information about characteristics of the coil connected to the driver and ask for assistance to a Zapi technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
226	VACC OUT RANGE	Cause: The CPOT input read by the microcontroller is not comprised in the range Vacc_min ÷ Vacc_max, programmed through the “PROGRAMM VACC” function
		Troubleshooting: - Acquire the maximum and minimum potentiometer value through the PROGRAM VACC function. If the alarm is still present, check the mechanical calibration and the functionality of the potentiometer. - If the problem is not solved it is necessary to replace the logic board.
227	HW FAULT	Cause1: At each start-up the supervisor microcontroller checks that the hardware circuit for enabling and disabling of the power bridge works properly.
		Cause2:At each start-up the supervisor microcontroller checks that the hardware circuit intended to enable and disable the LC driver works properly.
		Troubleshooting This type of fault is not related to external components. Replace the logic board
228	TILLER OPEN	Cause: Tiller/seat input has been inactive for more than 30 seconds.
		Troubleshooting: - Activate the tiller/seat input. - Check the tiller/seat input state through the TESTER function. - Check the wirings. - Check if there are failures in the microswitches. - If the problem is not solved, replace the logic board.
229	HW FAULT EB.	Cause: At start-up, the hardware circuit dedicated to enable and disable the EB driver is found to be faulty. The hexadecimal value “XX” facilitates Zapi technicians debugging the problem.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.

230	LC COIL OPEN	Cause This fault appears when no load is connected between the NLC output and the positive voltage (for example +KEY).
		Troubleshooting - Check the wiring, in order to verify if LC coil is connected to the right connector pin and if it is not interrupted. - If the alarm is still present, than the problem is inside the logic board; replace it.
232	CONT. DRV. EV	Cause: One or more on/off valve drivers are not able to drive the load. For the meaning of code “XX”, refer to paragraph 0.
		Troubleshooting: The device or its driving circuit is damaged. Replace the controller.
233	POWERMOS SHORTED	Cause The DC-link voltage drops to zero when a high-side MOSFET is turned on.
		Troubleshooting - Check that motor phases are correctly connected. - Check that there is no dispersion to ground for every motor phases. - In case the problem is not solved, replace the controller.
234	DRV. SHOR. EV	Cause: One or more on/off valve drivers are shorted. For the meaning of code “XX”, refer to paragraph 0.
		Troubleshooting: Check if there is a short circuit or a low impedance path between the negative terminals of the involved coils and -B. If the problem is not solved, replace the logic board.
235	CTRAP THRESHOLD	Cause This alarm occurs when a mismatch is detected between the setpoint for the overcurrent detection circuit (dependent on parameter DUTY PWM CTRAP,) and the feedback of the actual threshold value.
		Troubleshooting The failure lies in the controller hardware. Replace the logic board.
236	CURRENT GAIN	Cause: The maximum current gain parameters are at the default values, which means the maximum current adjustment procedure has not been carried out yet.
		Troubleshooting: Ask for assistance to a Zapi technician in order to do the adjustment procedure of the current gain parameters.
237	ANALOG INPUT	Cause This alarm occurs when the A/D conversion of the analog inputs returns frozen values, on all the converted signals, for more than 400 ms. The goal of this diagnosis is to detect a failure in the A/D converter or a problem in the code flow that skips the refresh of the analog signal conversion.

		Troubleshooting If the problem occurs permanently it is necessary to replace the logic board.
238	HW FAULT EV.	Cause: At start-up, the hardware circuit dedicated to enable and disable the EV drivers is found to be faulty. The hexadecimal value “XX” facilitates Zapi technicians debugging the problem.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
239	CONTROLLER MISM.	Cause: The software is not compatible with the hardware. Each controller produced is “signed” at the end of line test with a specific code mark saved in EEPROM according to the customized Part Number. According with this “sign”, only the customized firmware can be uploaded.
		Troubleshooting - Upload the correct firmware. - Ask for assistance to a Zapi technician in order to verify that the firmware is correct.
240	EVP DRIVER OPEN	Cause: The EVP driver is not able to drive the EVP coil. The device itself or its driving circuit is damaged.
		Troubleshooting: This fault is not related to external components. Replace the logic board.
241	COIL SHOR. EVAUX	Cause: This alarm occurs when there is an overload of one or more EV driver. As soon as the overload condition has been removed, the alarm disappears by releasing and then enabling a travel demand.
		Troubleshooting: - Check the EVs conditions. - Check the wiring. - Collect information about characteristics of EV coils and ask assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
242	OPEN COIL EV.	Cause: This fault appears when no load is connected between the NAUX1 output and the positive terminal PCOM .
		Troubleshooting: - Check the EB coil. - Check the wiring. - If the problem is not solved, replace the logic board.
243	THROTTLE PROG.	Cause: A wrong profile has been set in the throttle profile.
		Troubleshooting: Set properly the throttle-related parameters .

244	WARNING SLAVE	Cause: Warning on supervisor uC.
		Troubleshooting: Connect the Console to the supervisor uC and check which alarm is present.
245	IQ MISMATCHED	Cause The error between the Iq (q-axis current) setpoint and the estimated Iq is out of range.
		Troubleshooting Ask for assistance to a Zapi technician in order to do the correct adjustment of the motor parameters.
246	EB. DRIV.OPEN	Cause: The EB driver is not able to drive the load. The device itself or its driving circuit is damaged.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
247	DATA ACQUISITION	Cause: Controller in calibration state.
		Troubleshooting: The alarm ends when the acquisition is done.
248	NO CAN MSG.	Cause: This is a safety related test. It is a self-diagnosis test that checks the communication between master and supervisor microcontrollers.
		Troubleshooting: This alarm could be caused by a CAN bus malfunctioning, which blinds master- supervisor communication
249	CHECK UP NEEDED	Cause: This is a warning to point out that it is time for the programmed maintenance.
		Troubleshooting: Turn on the CHECK UP DONE option after that the maintenance service.
250	THERMIC SENS. KO	Cause: The output of the controller thermal sensor is out of range.
		Troubleshooting: This kind of fault is not related to external components. Replace the controller.
251	WRONG SET BAT.	Cause At start-up, the controller checks the battery voltage (measured at key input) and it verifies that it is within a range of ±20% around the nominal value.
		Troubleshooting - Check that the SET BATTERY parameter inside the ADJUSTMENT list matches with the battery nominal voltage. - Through the TESTER function, check that the KEY VOLTAGE reading shows the same value as the key voltage measured with a voltmeter on pin A1. If it does not match, then modify the ADJUST BATTERY parameter

		according to the value read by the voltmeter. - Replace the battery.
252	WRONG ZERO	Cause: At start-up the amplifiers used to measure the motor voltage sense voltages above 3 V or below 2 V.
		Troubleshooting: This type of fault is not related to external components. Replace the logic board.
253	FIELD ORIENT. KO	Cause The error between the Id (d-axis current) setpoint and the estimated Id is out of range.
		Troubleshooting Ask for assistance to a Zapi technician in order to do the correct adjustment of the motor parameters.
254	EB. DRIV.SHRT.	Cause: - The EB driver is shorted. - The microcontroller detects a mismatch between the valve setpoint and the feedback at the EB output.
		Troubleshooting: - Check if there is a short or a low impedance path between the negative coil terminal and -BATT. - Check if the voltage applied is in accordance with the parameters set . - If the problem is not solved, replace the controller.

Table 4-7 Fault list of steering pump auxiliary CPU

CODE	**ALARM NAME**	**ACE0 independent steering pump slave alarms （node 13.1）**
8	WATCHDOG	Cause: This is a safety related test. It is a self-diagnosis test that involves the logic between master and supervisor microcontrollers
		Troubleshooting: This alarm could be caused by a CAN bus malfunctioning, which blinds master-supervisor communication
17	LOGIC FAILURE #3	Cause An hardware problem in the logic board due to high currents (overload). An overcurrent condition is triggered even if the power bridge is not driven.
		Troubleshooting The failure lies in the controller hardware. Replace the controller.
200	STEER SENSOR KO	Cause: The voltage read by the microcontroller at the steering-sensor input is not within the range from STEER RIGHT VOLT to STEER LEFT VOLT, programmed through the STEER ACQUIRING function .

		Troubleshooting: - Acquire the maximum and minimum values from the steering potentiometer through the STEER ACQUIRING function. - Check the mechanical calibration and the functionality of the potentiometer. - If the problem is not solved, replace the logic board.
201	WRONG ENC SET	Cause Mismatch between “ENCODER PULSES 1” parameter and “ENCODER PULSES 2” parameter .
		Troubleshooting Set the two parameters with the same value, according to the adopted encoder.
202	VDC LINK OVERV.	Cause This fault is displayed when the controller detects an overvoltage condition. Overvoltage threshold is 65 V for 36/48V controllers and 116 V for 80V controllers. As soon as the fault occurs, power bridge and MC are opened. The condition is triggered using the same HW interrupt used for undervoltage detection, uC discerns between the two evaluating the voltage present across DC-link capacitors: - High voltage àOvervoltage condition - Low/normal voltage àUndervoltage condition
		Troubleshooting If the alarm happens during the brake release, check the line contactor contact and the battery power-cable connection.
208	EEPROM KO	Cause: A HW or SW defect of the non-volatile embedded memory storing the controller parameters. This alarm does not inhibit the machine operations, but it makes the truck to work with the default values.
		Troubleshooting: Execute a CLEAR EEPROM procedure (refer to the Console manual). Switch the key off and on to check the result. If the alarm occurs permanently, it is necessary to replace the controller. If the alarm disappears, the previously stored parameters will be replaced by the default parameters.
209	PARAM RESTORE	Cause: The controller has restored the default settings. If a CLEAR EEPROM has been made before the last key re-cycle, this warning informs you that EEPROM was correctly cleared.
		Troubleshooting: - A travel demand or a pump request cancels the alarm. - If the alarm appears at key-on without any CLEAR EEPROM performed, replace the controller.
210	WRONG RAM MEM.	Cause The algorithm implemented to check the main RAM registers finds wrong contents: the register is “dirty”. This alarm inhibits the machine operations.

		Troubleshooting Try to switch the key off and then on again, if the alarm is still present replace the logic board.
212	W.SET. TG-EB XX	Cause: Supervisor microcontroller has detected that the master microcontroller has imposed a wrong setpoint for TG or EB output
		Troubleshooting: - Check the matching of the parameters between master and supervisor. - Ask for the assistance of a Zapi technician. - If the problem is not solved, replace the logic board.
213	INPUT MISMATCH	Cause: The supervisor microcontroller records different input values with respect to the master microcontroller.
		Troubleshooting: - Compare the values read by master and slave through the TESTER function. - Ask for the assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
227	OUT MISMATCH XX	Cause: This is a safety related test. Supervisor µC has detected that master µC is driving traction motor in a wrong way (not corresponding to the operator request).
		Troubleshooting: - Checks the matching of the parameters between Master and Supervisor. - Ask for assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
229	NO CAN WR MSG.XX	Cause CANbus communication does not work properly. The hexadecimal value “XX” identifies the faulty node.
		Troubleshooting - Verify the CANbus network (external issue). - Replace the logic board (internal issue).
230	SOFTWARE ERROR	Cause:The software of the slave microcontroller is wrong,ask help to the inveter manufacturer
235	CTRAP THRESHOLD	Cause This alarm occurs when a mismatch is detected between the setpoint for the overcurrent detection circuit (dependent on parameter DUTY PWM CTRAP) and the feedback of the actual threshold value.
		Troubleshooting The failure lies in the controller hardware. Replace the logic board.
237	ANALOG INPUT	Cause This alarm occurs when the A/D conversion of the analog inputs returns frozen values, on all the converted signals, for more than 400 ms. The goal of this diagnosis is to detect a failure in the A/D converter or a problem in the

		code flow that skips the refresh of the analog signal conversion.
		Troubleshooting If the problem occurs permanently it is necessary to replace the logic board.
239	CONTROLLER MISM.	Cause: The software is not compatible with the hardware. Each controller produced is “signed” at the end of line test with a specific code mark saved in EEPROM according to the customized Part Number. According with this “sign”, only the customized firmware can be uploaded.
		Troubleshooting - Upload the correct firmware. - Ask for assistance to a Zapi technician in order to verify that the firmware is correct.
240	OUT MISMATCH PU	Cause: This is a safety related test. Supervisor µC has detected that the Master µC is driving DC motor in a wrong way (not correspondent to the status of operator commands).
		Troubleshooting: - Checks the correspondence of the parameters between Master and Supervisor - Ask the assistance of a Zapi technician. - If the problem is not solved it is necessary to replace the logic board.
241	SP MISMATCH PUMP	Cause: This is a safety related test. The Master µC has detected a Supervisor µC wrong set point for DC Pump motor.
		Troubleshooting: - Checks the correspondence of the parameters between Master and Supervisor - Ask the assistance of a Zapi technician. - If the problem is not solved it is necessary to replace the logic board.
242	SP MISMATCH XX	Cause: This is a safety related test. The master µC has detected a supervisor µC wrong set point.
		Troubleshooting: - Check the matching of the parameters between master and supervisor. - Ask for assistance to a Zapi technician. - If the problem is not solved, replace the logic board.
248	NO CAN MSG. XX	Cause CANbus communication does not work properly. The hexadecimal value “XX” identifies the faulty node.
		Troubleshooting - Verify the CANbus network (external issue). - Replace the logic board (internal issue).

5. Hydraulic system

The truck adopts load-sensitive hydraulic system (as shown in the figure), which mainly consists of working oil pump, multi-way valve, lifting cylinder, tilting cylinder and pipeline. The working oil pump is driven by motor, and the hydraulic oil is distributed to working cylinder by multi-way valve through gear oil pump. The schematic diagram of the hydraulic system is shown in the following figure.

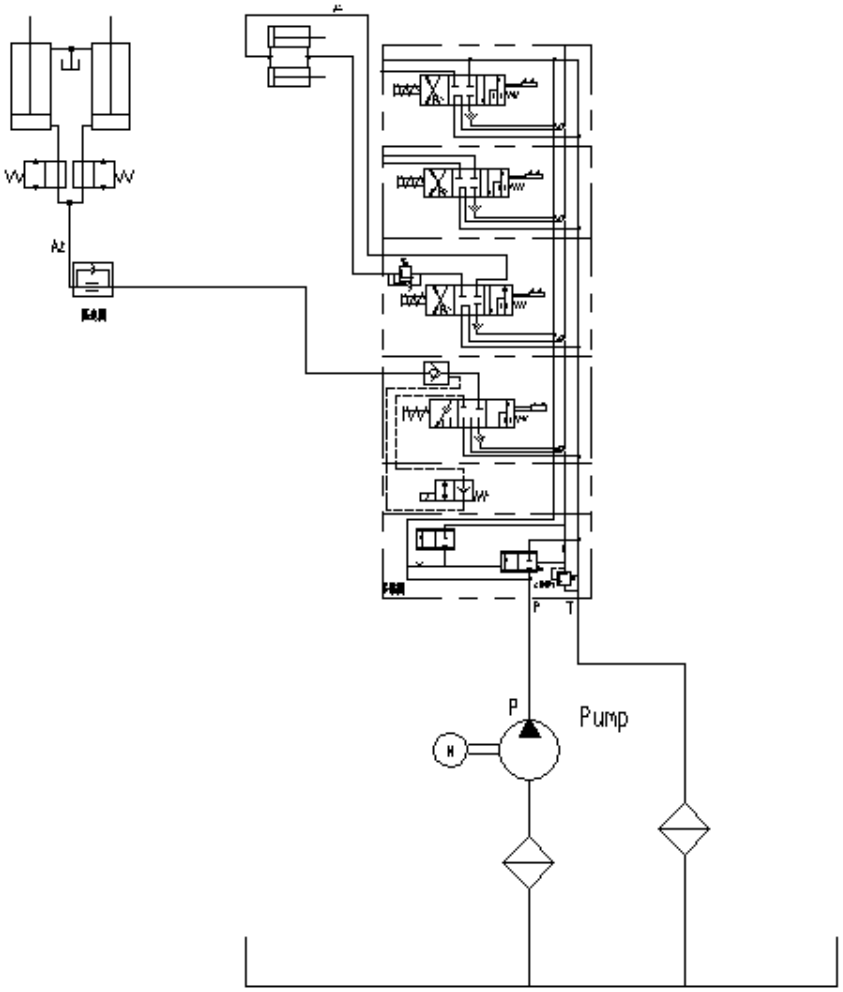


Figure 5-1 Principle diagram of hydraulic system

5.1 Main pump

The main pump is a gear pump with low noise. It is driven by motor. The hydraulic oil from the main pump driven by motor enters the multi-way valve, and is distributed to each working cylinder by the multi-way valve.

5.2 Multi-way control valve

The multi-way valve is a piecewise multi-way valve. The hydraulic oil from the working oil pump is controlled by a multi-way valve lever, which distributes the high pressure oil to the lifting or tilting cylinder and returns the oil to the tank. The shape of the multi-way valve is shown in the following figure.

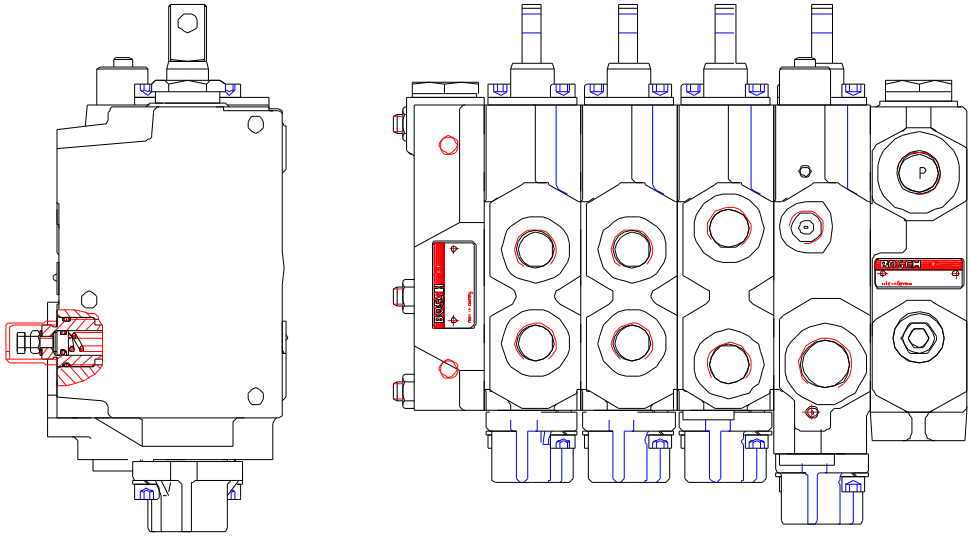


Figure 5-2 Multi-way control valve

This multi-way valve has a pressure compensator and a system safety valve built in the oil intake piece. The balance valve is built in tilting piece for overload control. Its main function is to prevent the vibration caused by negative pressure inside the tilting cylinder and to prevent the serious consequences of load movement caused by misoperation of the valve stem in the case of no pressure source. Each valve is equipped with shuttle valves, whose function is to feed back the sampled instantaneous load signals to the pressure compensator. Pressure compensator continuously regulates the flow through the valve core, and maintains a constant pressure difference between the pump and the working oil port side of the valve core, which makes a constant flow to the working device corresponding to a certain rod stroke, and is not affected by the load pressure, and has good operation comfort. The multi-way valve is equipped with a displacement sensor (as shown in the figure below), and the tilt piece and the auxiliary piece are equipped with a stroke switch (remove the end cover of the end of the stem and install the stroke switch, as shown in the figure below).

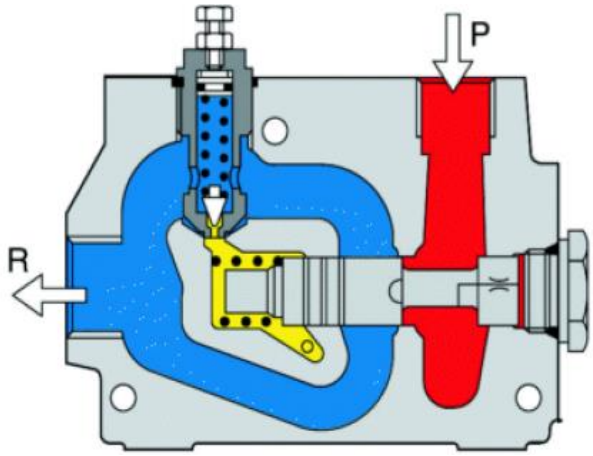


Figure 5-3 Oil inlet piece of multi-way control valve

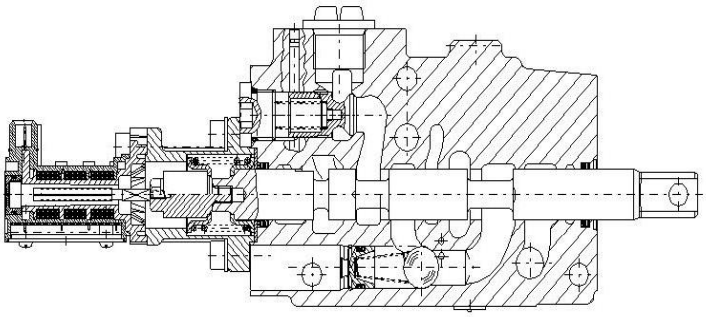


Figure 5-4 Lifting and lowering piece of multi-way control valve

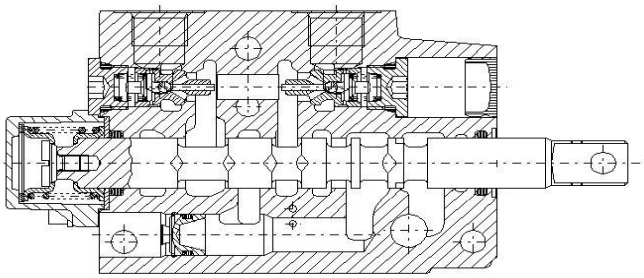


Figure 5-5 Tilting piece of multi-way control valve

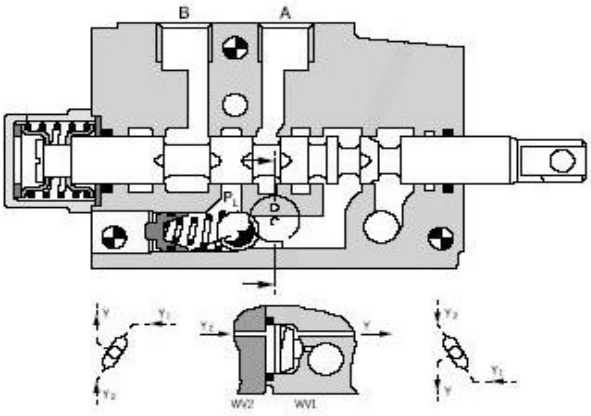


Figure 5-6 Auxiliary piece of multi-way control valve

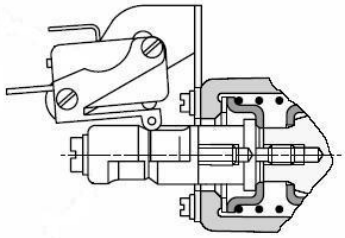
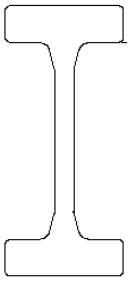
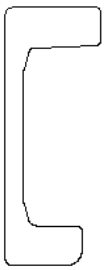
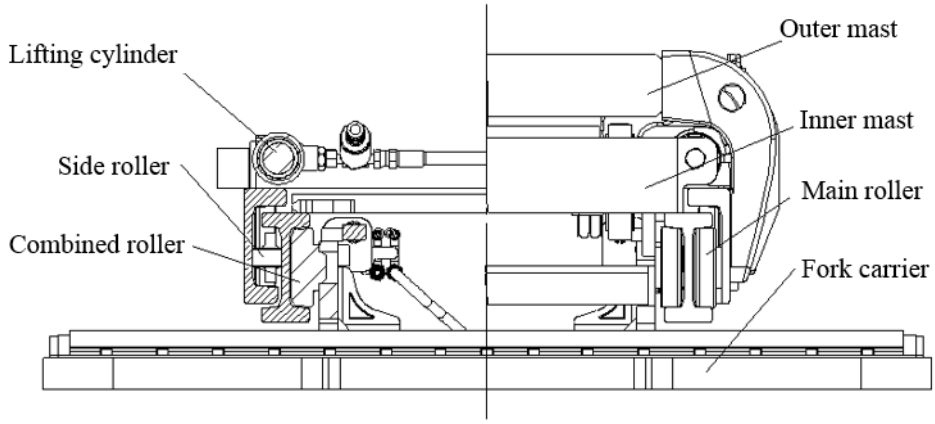


Figure 5-7 Stroke switch built at the end of the covers of tilting piece and auxiliary piece

6. Lifting system

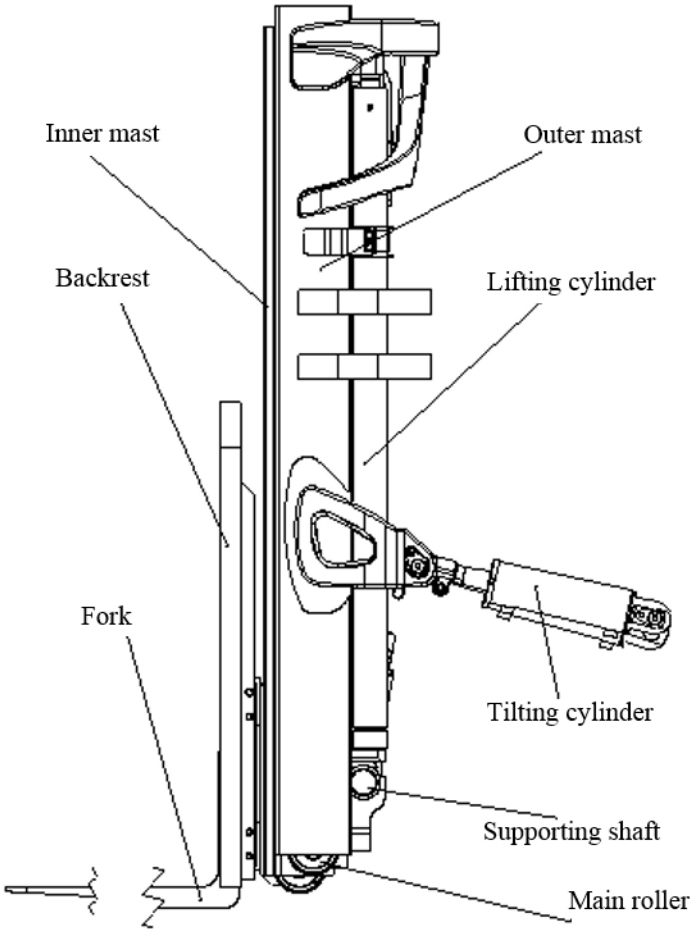
Table 6-1 Main parameters

Item		Content
Mast type		Rolling type, weld mast with free lift, two-stage telescopic type
Cross section of inner mast		
Cross section of outer mast		
Max. lifting height （standard mast）		3000mm
Height, mast lowered L （standard mast）		2230mm
Tilting angle (front/rear)		6 ⁄8 °
Roller	Outer diameter of main roller	Φ128
	Outer diameter of side roller	Φ58
	Outer diameter of combined roller (fork carrier)	Φ128
Lifting chain		HRLH1644011-N，pitch 25.4
Lifting mode of fork		Hydraulic type
Tilting mode of mast		Hydraulic type
Adjusting mode of fork space		Manual operation



6.1 General description

The lifting system is of the two-stage roller type with vertical up and down. It consists of the inner mast, the outer mast, two rear lifting cylinder, fork carrier, backrest and fork.



6.2 Inner and outer mast

The inner and outer portal frames are welded parts, and the whole mast is mounted on the frame by supporting axle. The middle part of the outer mast is connected with the frame

through the tilting cylinder. Under the action of the tilting cylinder, it can tilt forward and backward, with a forward tilt of 6 degrees and a backward tilt of 8 degrees. The channel of outer mast is C type, and one pair of rollers is installed in its upper end; the channel of inner mast is H type, and its lower part is installed with a pair of rollers. The inner mast keeps the relative position of the inner mast and the outer mast throughout the movement process by rolling the main and side rollers.

Take care when maintaining the upper main roller and the side roller of the outer mast.

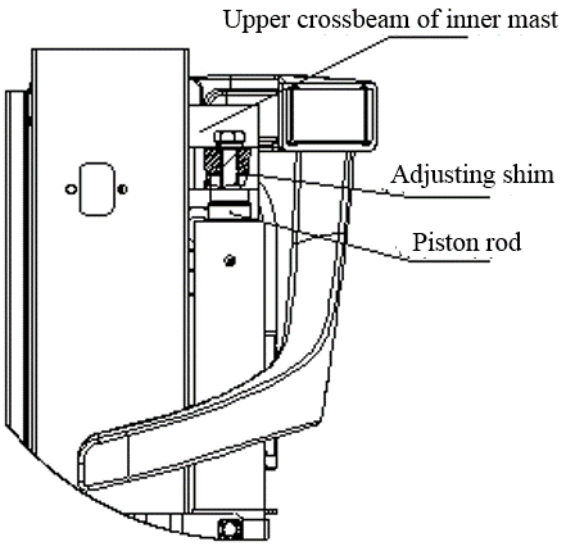
6.3 Fork carrier

A roller shaft is welded on fork carrier, and the main roller rolling along the inner surface of the inner mast and its elastic retaining ring are mounted on the rolling shaft. The side rollers rolling along the inner side of the inner mast are fixed by bolts and adjusted through shim. The longitudinal load is borne by the main roller. When the fork rises to the maximum lifting height, the main roller mounted on the top of the mast is exposed. At this time, the combined roller bears both lateral load and longitudinal load. Rigidity and strength as well as smooth operation shall be taken into consideration when designing the mast and fork carrier.

In addition, the upper and lower crossbeams of the fork carrier are made of high strength steel, and integrated type of fork carrier ensures its durability. The installation grade meets the ISO standard. The backrest and removable attachment can be installed on the fork carrier to meet the needs of different customers. The two forks are installed on the fork carrier, and the spacing between the two forks can be adjusted manually.

6.4 Repair and maintenance

6.4.1 Adjusting of shims at the lifting cylinder’s head



Readjust the stroke of the lift cylinder when the lift cylinder, the inner mast or the outer mast is replaced. As following:

(1) Place piston rod heads into the upper beam of the inner mast without shims.

(2) Slowly lift the mast to the maximum stroke of the cylinder, check whether the two cylinders are synchronized. When the motion stops at different times, the stroke of the left and right cylinders is different. By adding adjusting shims to make sure that the two cylinders are synchronization. (The thickness of shim is 0.2mm and 0.5mm).

(3) Slowly lower the inner mast and observe whether the two cylinder travel terminals are synchronized, referring to the adjustment method of rising synchronization.

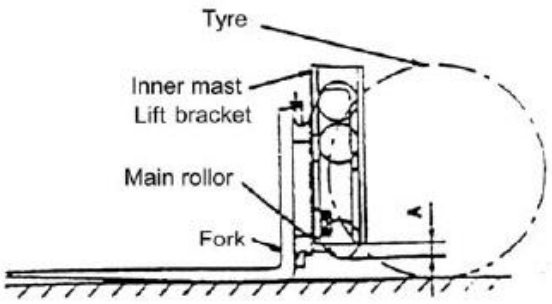
(4) Adjust the tension of the chain.

Take care when adjusting the lifting cylinder.

6.4.2 Adjustment of fork carrier’s height

(1) Park the truck on a level ground and ensure the mast is vertical.

(2) Make the bottom of the fork touch the ground, adjust the adjusting nut of the upper end joint of the chain so that there is an A distance between the main roller and the fork shelf (1/4-1/3 of the diameter of the main roller), as shown in the figure.



(3) Lift the fork to the highest point and confirm that the clearance B between the fork carrier's limit block and the inner mast's limit block is 5-10 mm.

(4) Make the fork carrier fall to the ground and tilt back in place, adjust the adjusting nut of the upper end joint of the chain, so that the tension of the two chains is the same.

6.4.3 Replacing rollers of the fork carrier

(1) Place a pallet on the forks and make the forklift stop on the horizontal ground.

(2) Make the forks and pallet descend to the ground.

(3) Take down the connector on top of the chains. And take out chains from chain wheel.

(4) Make the inner mast rise.

(5) The forklift can be reversed when the fork carrier disengaged from the outer mast.

(6) Replacing main rollers

a) Take apart all of snap ring from the fork carrier and take out main rollers. Take care to keep the shims inside of combined roller.

b) Fit the new main roller (the same type as the old one) on the fork carrier and fastened with snap ring.

6.4.4 Replacing rollers of masts

(1) Take apart the fork carrier from the inner mast, then replace the main roller follows the way as 6.4.3.

(2) Park the truck on the horizontal ground and lift up the front-wheel 250～300mm from the ground.

(3) Pull parking brake level fully, and use a wedge to make back-wheel stationary.

(4) Take apart bolts which fastened lift cylinders and the inner mast. Hang up the inner mast without losing shims of the piston rod heads carefully.

(5) Take apart bolts which jointed lift cylinders and the bottom of outer mast and take apart the oil-pipe between two lift cylinders without loosing the nipple.

(6) Lay down the inner mast and remove the main roller at the bottom of the inner mast.

(7) When the main rollers on the upper outer mast will come out from the inner mast top end, then the main roller can be removed.

(8) Replacing main rollers

a) Take apart the upper main rollers without losing shims.

b) Fit the new main roller and shims together on the outer mast.

(9) Hang up the inner masts and let all rollers in the inner mast.

(10) Assembly the lift cylinder and the fork carrier as disassembly contrarily.

III. Lithium battery changing

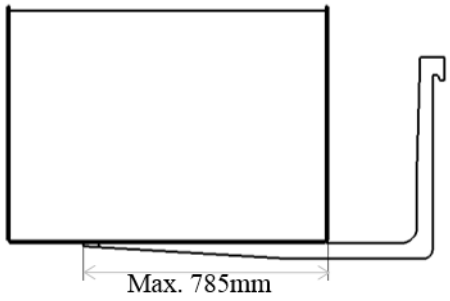
1. General description

Lithium battery is the energy source of the truck. When the working intensity is high and the operation duration is long, the lithium battery needs to be replaced. The lithium battery can be changed from the right side of the truck body by forklift, electric pallet truck, pallet stacker and other tools. The replacement efficiency is high, as shown in the following figure.

2. Truck selection for lithium battery changing

The following factors should be taken into account when selecting the truck for picking up lithium batteries:

(1) Limited by the lithium battery compartment, when the fork picking up the lithium battery, the maximum fork intake L9 is 785 mm. As shown in the figure below, the larger the fork intake is, the better the fork intake is.



(2) Lithium Battery weight Q1(including auxiliary counterweight block)：80V/500Ah: About 1085kg; 80V/600Ah: About 1185kg; 80V/800Ah: About 1300kg

(3) Fork length for trucks picking up the lithium battery L4

(4) Front overhang for trucks picking up the lithium battery L2（see the brochure for distance from the center of front wheel to fork front surface of the selected truck.）

(5) Load center C (lithium battery: 488mm)

The rated capacity of selected truck picking up lithium batteries shall be more than the calculated result Q2.

$$\frac{L4 - L9 + L2 + C}{C + L2} xQ1 = Q2$$

For example, we want to check whether the 80V/600Ah lithium batteries equipped on the H3 series 2.5 t electric forklift truck can be picked up by another H3 series 2.5 t electric forklift truck. It is known that the fork length L4 of the 2.5 t electric forklift truck of Heli H3 series is 1070 mm. The front overhang L2 of the truck is 465 mm, the fork feed L9 is about 720 mm, and the lithium battery weight Q1 of 80V/600Ah is 1185 kg.

Substitute the above data are into the formula to calculate:

$$\frac{1070 - 720 + 465 + 488}{488 + 465} x1185 = 1620$$

The calculation results show that Q2 is 1620 kg and the rated lifting weight Q of H3 series 2.5 t electric forklift truck is 2500 kg.

Check that: Q > Q2, so the H3 series 2.5 t electric forklift can be used to pick up the 80V/600Ah lithium battery.

3. Steps to change the lithium battery

Change the lithium battery according to the following steps:

（1）Open the side door.

（2）Disconnect the lithium battery connections.

（3）Loose and remove the lithium battery limit block.

（4）Pick up the lithium battery with forklift truck, electric pallet truck or pallet stacker.

（5）Remove the lithium battery from the compartment and place the lithium battery on pre-prepared carrier. Please reserve enough space for fork in and out.

（6）Use the crane to separate the lithium battery pack from the bottom counterweight

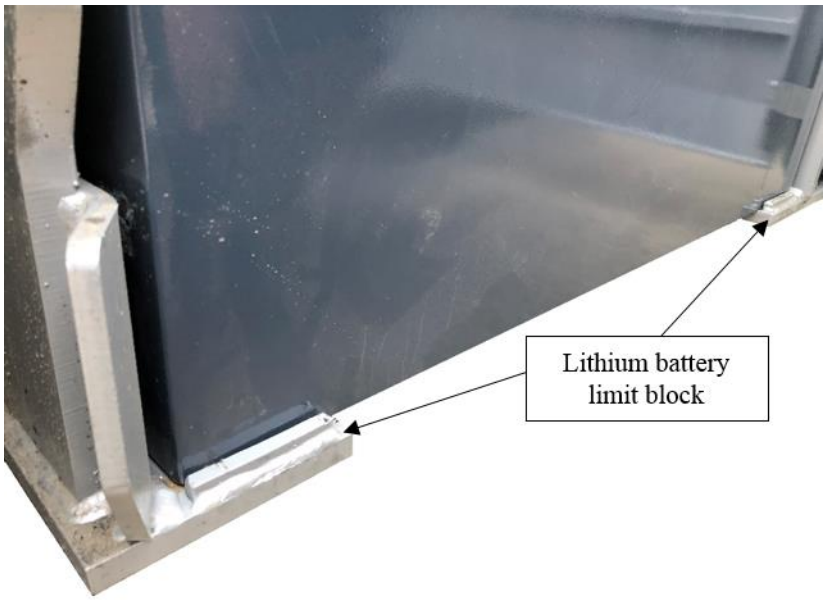
4. Steps to install the lithium battery

Please install the lithium battery according to following steps:

（1）Install the lithium battery pack together with the auxiliary counterweight by crane.

（2）Transport the lithium battery pack to the battery warehouse by pallet truck or forklift truck.

（3）Put down the lithium battery until the right side of lithium battery coincide with the inner side of lithium battery limit block.



（4）Put down lithium battery limit block and adjust the limit screw to the end face of the lithium battery box.

（5）Connect the battery.

（6）Close the side door.

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