

NOBLELIFT

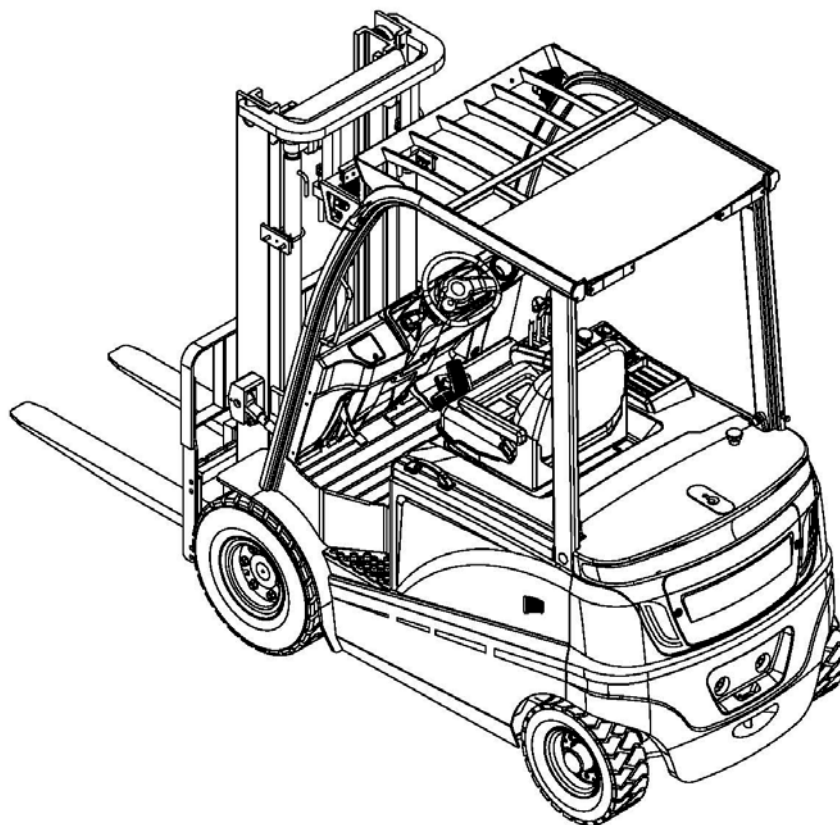


FE4P16-35N-SMS-001

**⚠ WARNING**

Do not use the forklift before reading and understanding the operating instructions as well as the warning decals on the truck.

Keep for future reference.



**Service & Maintenance Manual**

**FE3P16-35 N Battery counterbalanced forklift truck**

NOBLELIFT INTELLIGENT EQUIPMENT CO., LTD.

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## Safety

### General maintenance rules

- ✧ To ensure safety, when jacking up the vehicle, the vehicle should be parked on a level surface and the front and rear wheels in a braking state.
- ✧ After the vehicle is supported on the chassis frame, the support point is pressed against the axle and the frame by the jack, the vehicle is jacked up and maintenance work is performed.
- ✧ Before performing maintenance work, remove the battery to avoid wire damage and burnout caused by short circuit.
- ✧ The body, seat and floor should be covered with a protective cover to prevent damage and contamination.
- ✧ Brake fluid can easily damage the paint surface, so be careful when handling
- ✧ Use the prescribed tools and special tools.
- ✧ Use Noblelift original accessories.
- ✧ Used cotter pins, gaskets, O-rings, oil seals, lock washers and self-locking nuts must be discarded and new ones should be prepared for reassembly. If these parts are reused, they will not guarantee normal function.
- ✧ In order to ensure the correct and smooth reassembly work, the disassembled parts should be neatly grouped and stored.
- ✧ Parts should be legible before inspection and reassembly. In addition, the oil port should be purged with compressed air to confirm that these parts are not blocked.
- ✧ Prior to assembly, the rotating and sliding surfaces of the parts must be lubricated with oil or grease.
- ✧ If necessary, sealant should be used on the gasket to avoid leakage.
- ✧ To fully understand the torque specifications of all bolts and nuts.

When the repair work is finished, be sure to check that the repair work is performed correctly.

### Maintenance

- Please use a jack or a stop. Confirm the surrounding safety conditions. The rope used to lift heavy objects must have a sufficient safety factor. Before using a power tool to remove parts, make sure the bolts, nuts, tubes, and harness are completely separated.
- When transporting heavy items, use certain equipment or tools and do not move them by hand.
- When servicing hydraulic systems and other dust-proof components, use clean tools and work in a clean, dust-proof area.
- Before servicing or soldering electrical system components, be sure to remove the battery terminals.
- Take care to prevent oil, gas and flammable materials from entering the work area. Organize the broken parts and tools.
- A warning sign is hung on the joystick during maintenance.
- Do not stand directly under the fork or fork. Use the stop to block the equipment and the fork frame during maintenance.
- The repair tools are placed in order, checked regularly, and used correctly.

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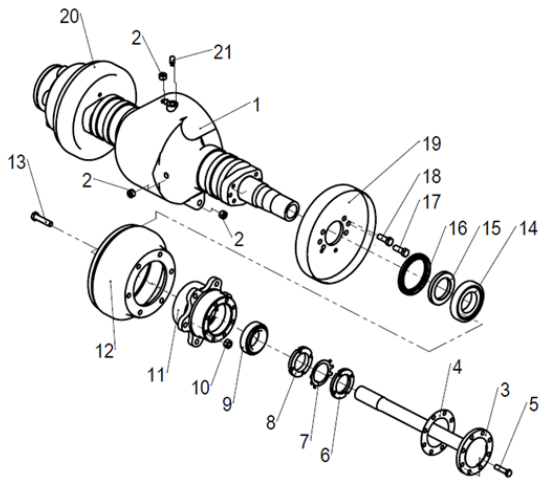
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物料搬运·系统集成

Drive system and break system

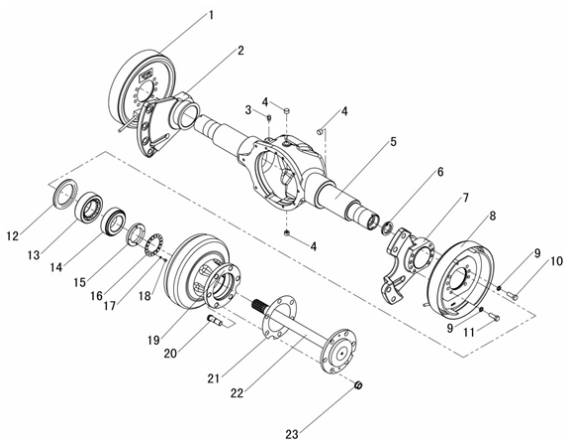
4P-N series counter balance forklift 's gearbox and drive axle

16-18N



No.	Name	Qty	No.	Name	Qty
1	Housing	1	11	Hub	2
2	Blocking	3	12	Breaking hub	2
3	Half shaft	2	13	Hub connecting bolt	12
4	Half shaft seal washer	2	14	Bearing 30213E	2
5	Hub connecting bolt	16	15	Bearing	2
6	Nut	4	16	Oil seal SG100*125*12	2
7	Washer	2	17	Brake bolt	4
8	Spacer	5	18	Brake bolt M14*1.5*40	12
9	Bearing 33012A	2	19	Left brake assembly	1
10	Rim nut M14*1.5	12	20	Right brake assembly	1
			21	Air hole assembly	1

20-25N



No.	Name	Qty	No.	Name	Qty
1	Left brake assembly	1	13	Bearing 30615	2
2	Drive axle left bearing plate	1	14	Bearing 33115	2
3	Air hole assembly	1	15	Nut seat	2
4	Blocking	3	16	Nut seat criclip	2
5	Drive axle housing	1	17	Spring washer 6	4
6	Oil seal SD45*62*12	2	18	Bolt M6*12-4.8	4
7	Drive axle right bearing plate	1	19	Hub	2
8	Right brake assembly	1	20	Hub connecting bolt	12
9	Spring washer 14	16	21	Half connecting bolt	2
10	Brake bolt	4	22	Half shaft seal washer	1
11	Brake bolt	12	23	Rim nut	12
12	Oil seal SD100*140*12	2			

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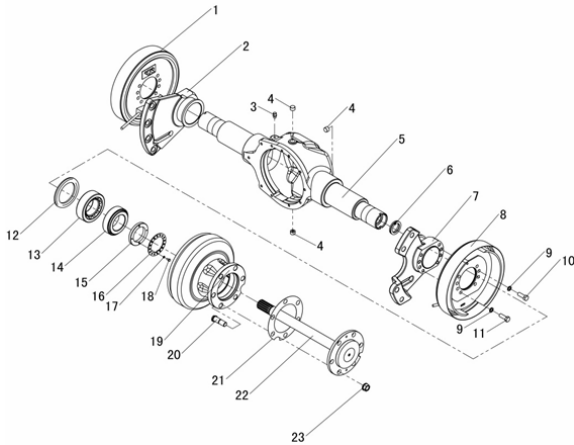
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30-35N



No.	Name	Qty	No.	Name	Qty
1	Left brake assembly	1	13	Bearing 30615	2
2	Drive axle left bearing plate	1	14	Bearing 33115	2
3	Air hole assembly	1	15	Nut seat	2
4	Blocking	3	16	Nut seat criclip	2
5	Drive axle housing	1	17	Spring washer 6	4
6	Oil seal SD45*62*12	2	18	Bolt M6*12-4.8	4
7	Drive axle right bearing plate	1	19	Hub	2
8	Right brake assembly	1	20	Hub connecting bolt	12
9	Spring washer 14	16	21	Half connecting bolt	2
10	Brake bolt	4	22	Half shaft seal washer	1
11	Brake bolt	12	23	Rim nut	12
12	Oil seal SD100*140*12	2			

**Troubleshooting**

Trouble	Cause	Method
Noise	Loose bolts connecting the drive axle to the frame	Fastening
	Loose rim bolt	Fastening
	Wear or damage to bearings in the hub	Replace
	Half shaft spline is worn	Replace
	Lack of lubrication	Refuel
Unstable Drive	Loose rim bolt	Fastening
	Wheel deformation	Replace
	Wear or damage to bearings in the hub	Replace
	Wear or damage to bearings in the hub	Fastening
	Wrong tire pressure	Adjusting

**Drive axle maintenance**

Apply grease to the tapered roller bearing. When tightening the tapered roller bearing lock nut in the hub, it should be noted that after tightening, turn the hub forward and backward for 2~3 turns. Check whether the torque of the wheel meets the standard. The torque of the hub is 9.8~29.4NM. The tightening torque of the semi-axle mounting bolt is 96~111NM. The tightening torque of the wheel nut is 470~550NM. The tightening torque of the bottom plate mounting bolt is 210~230NM.

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### Drive axle and frame connection bolt replace precautions

When the drive axle and the frame connecting bolt are replace, the screw fastening rubber is used for relaxation. When the drive axle and the workshop connecting bolt are loosened and the drive axle is re-installed, the adhesive layer attached to the bolt should be cleaned, and the thread glue drops a few drops to the thread. Engagement and tighten to the specified torque

## Steering system

### Technical data

Model		Real axle Turing with power steering	
Steering wheel			
Cycloid type hydraulic steering gear	16-18N	BZZ5-E80BCF-H6	
	20-35N	BZZ5-E100BCF-H6	
Steering bridge		Type	Central winch support
		Turing angle	80° inside wheel, 55° outside wheel
		Wheel bearing load	The torque of the hub is 2-10NM
Wheel	Type	16-18N	5.00-8-10PR
		20-35N	18*7-8-14PR
	Pneumatic tire pressure		

### Overview

The steering system consists of a steering wheel, a pipe string, a coupling shaft, a steering gear, a mounting bracket and a steering axle.

### Steering mechanism

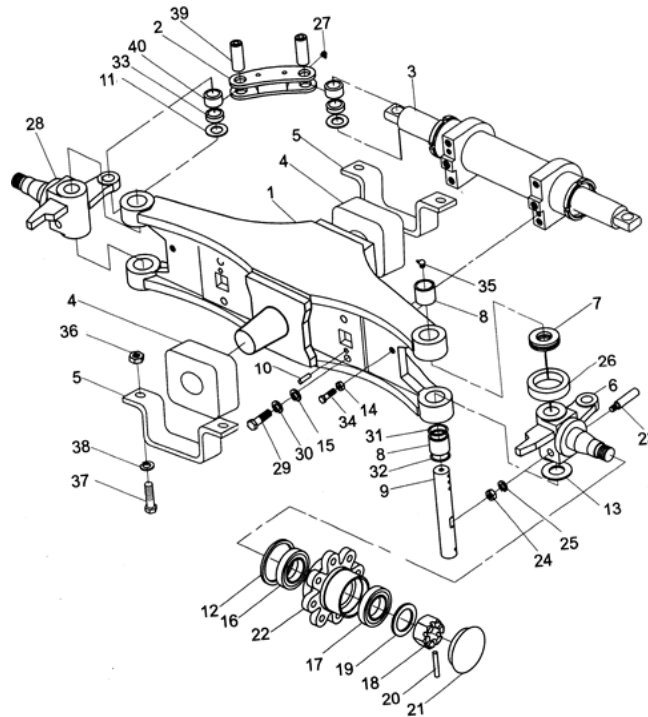
The steering bracket, the pipe string and the coupling shaft are coupled together by the mounting bracket, and the steering gear is fixed at the lower end of the coupling shaft. The rotation of the steering wheel will drive the steering gear to rotate, and the diverter valve is measured according to the angle of the steering wheel rotation. The pressure oil is transferred to the steering cylinder through the hydraulic hose. The steering wheel can be adjusted to the comfort position felt by the driver by adjusting the handle.

### Steering cylinder

The steering cylinder is a double-acting through type. The piston rod is driven by the gear and the steering shaft. The pressure oil from the hydraulic steering gear moves the piston rod to the left and right through the steering cylinder to realize the steering.

Steering bridge structure diagram see drawing

16-18N



No.	Name	Qty	No.	Name	Qty	No.	Name	Qty
1	Steering bridge assembly	1	15	Washer GB97.1-12	4	29	Nut M12*40	4
2	Linking rod	2	16	Bearing 30208	2	30	Washer GB93-12	4
3	Steering cylinder assembly	1	17	Bearing 30206	2	31	O ring	2
4	Anti-vibration pad	2	18	Nut M24*2	2	32	Oil seal	4
5	Fixing plate	2	19	Washer GB97.1-24	2	33	Bushing $\Phi 26 * \Phi 24 * 6.5$	4
6	Left Knuckle assembly	1	20	Pin 5*45	2	34	Bolt M12*40-8.8	2
7	Bearing	2	21	Wheel hub cover	2	35	Grease nipple (90°)	2
8	Bearing 942/25	2	22	Steering wheel hub	2	36	Nut M16	4
9	Pin	2	23	Pin	2	37	Bolt M16*45-8.8	4
10	Dowel pin 8*20	2	24	Nut GB6170-M10	2	38	Washer 16	4
11	Circlip	8	25	Washer GB97.1-10	2	39	Linking pin	4
12	Y seal ring	2	26	Bushing	2	40	Bearing GE1515ES	4
13	Pad	4	27	Grease nipple	4			
14	Nut GB6170-M10	12	28	Right knuckle assembly	1			

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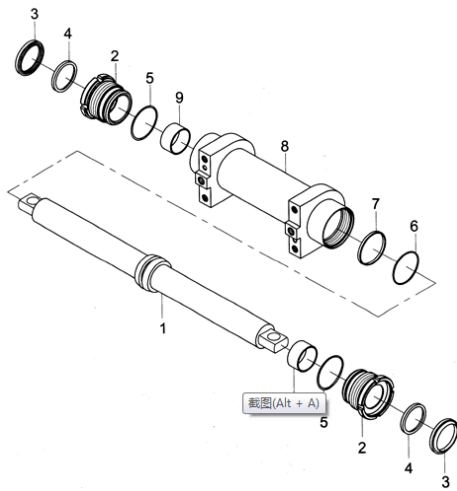
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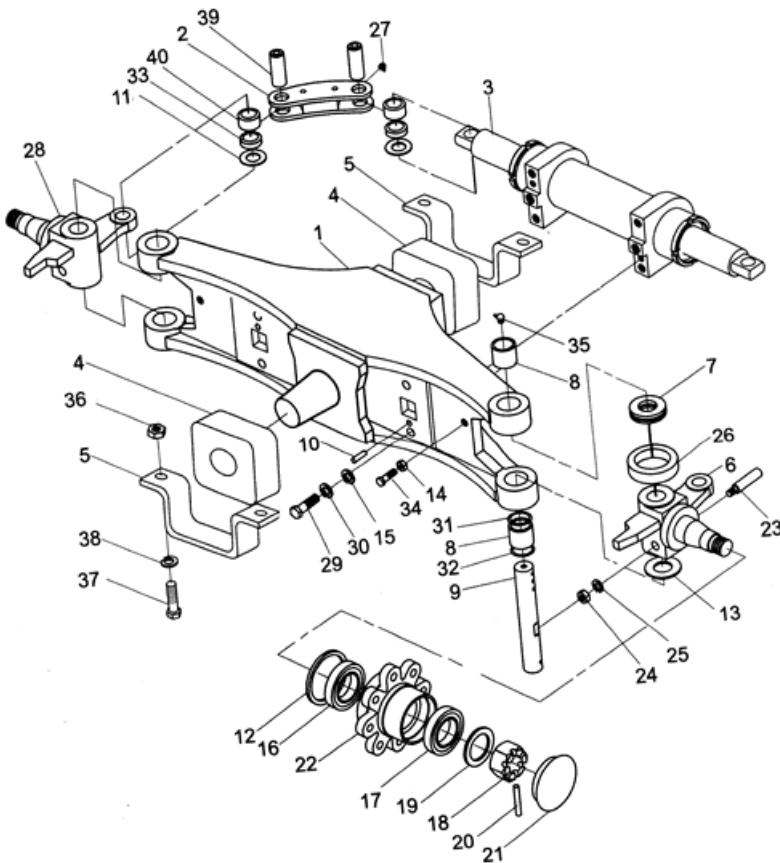
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No.	Name	Qty
1	Piston rod assembly	1
2	Cylinder cover	2
3	Dust ring DH40	2
4	U ring UN40	2
5	O ring 53*3.55	2
6	O ring 50*3.55	1
7	Support ring	1
8	Cylinder assembly	1
9	Bearing	2

20-35N



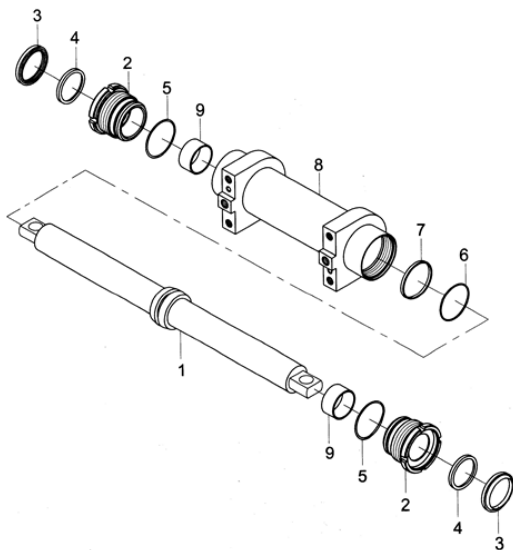
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No.	Name	Qty	No.	Name	Qty	No.	Name	Qty
1	Steering bridge assembly	1	15	Washer GB97.1-14	4	29	Nut M14*40	4
2	Linking rod	2	16	Bearing 32209	2	30	Washer GB93-14	4
3	Steering cylinder assembly	1	17	Bearing 30207	2	31	O ring	2
4	Anti vibration pad	2	18	Nut M30*2	2	32	Oil seal	4
5	Fixing plate	2	19	Washer GB97.1-30	2	33	Bushing $\Phi 26*\Phi 24*6.5$	4
6	Left Knuckle assembly	1	20	Pin 5*65	2	34	Bolt M14*40-8.8	2
7	Bearing	2	21	Wheel hub cover	2	35	Grease nipple (90°)	2
8	Bearing 943/25	2	22	Steering wheel hub	2	36	Nut M16	4
9	Pin	2	23	Pin	2	37	Bolt M16*45-8.8	4
10	Dowel pin 10*20	2	24	Nut GB6170-M10	2	38	Washer 16	4
11	Circlip	8	25	Washer GB97.1-10	2	39	Linking pin	4
12	Y seal ring	2	26	Bushing	2	40	Bearing GE1515ES	4
13	Pad	4	27	Grease nipple	4			
14	Nut M12	12	28	Right knuckle assembly	1			



No.	Name	Qty
1	Piston rod assembly	1
2	Cylinder cover	2
3	Dust ring DH40	2
4	U ring UN40	2
5	O ring 53*3.55	2
6	O ring 50*3.55	1
7	Support ring	1
8	Cylinder assembly	1
9	Bearing	2

Inspection after re-installation of steering system

Turn the steering wheel to the left and right, and check if the left and right force is even and the rotation is stable.

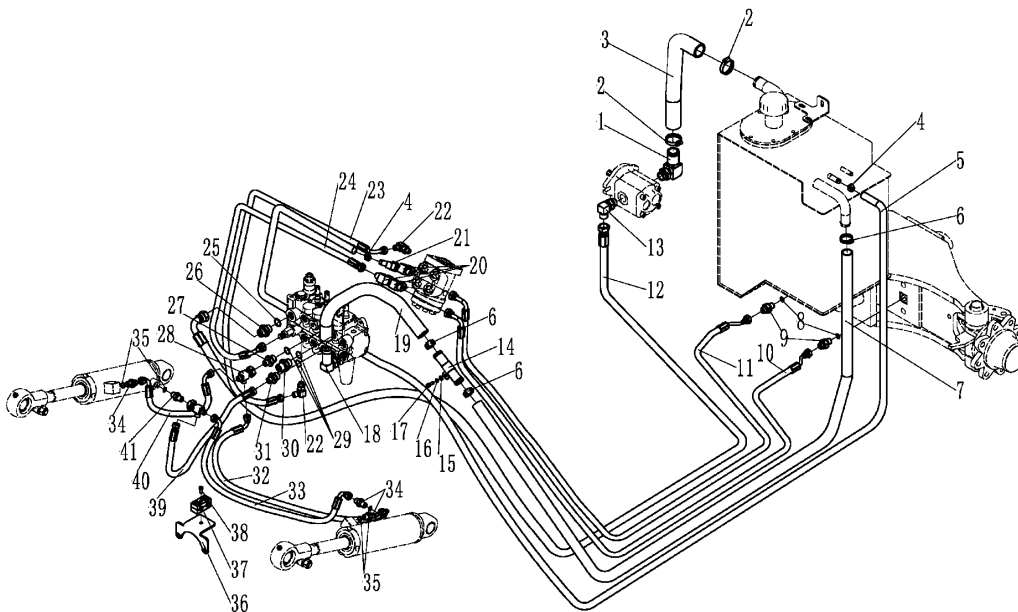
Check that the hydraulic piping is neatly arranged and that the left and right steering is reversed.

Lift the rear wheel and slowly turn the steering wheel left and right repeatedly several times to remove air from the hydraulic lines and cylinders.

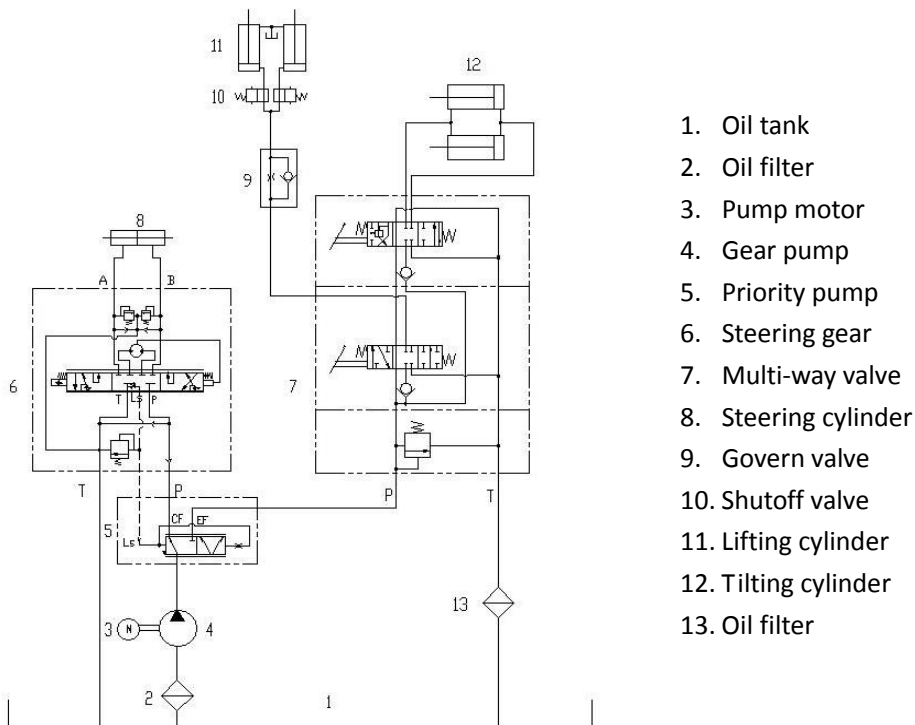
#### Troubleshooting

Trouble	Cause	Method
<b>Steering wheel locked</b>	Oil pump damage	Replace
	Shunt valve blocked or damaged	Clear or replace
	Hose, joint damage or pipe block	Clear or replace
<b>Steering wheel heavy to turn</b>	Shunt valve pressure is too low	Adjust pressure
	Air in oil loop	Release air
	Steering gear reset failure, positioning spring piece broken or insufficient elasticity	Replace spring
	Leakage of steering cylinder	Check cylinder seal
<b>Vehicle swing</b>	Steering flow is too large	Adjust the flow rate of the diverter valve
	Spring break or no spring force	Replace
<b>Noise</b>	Oil level low	Refuel
	Suction tube or oil filter plugged	Clear or replace
<b>Leakage</b>	Steering cylinder guide sleeve seal is damaged or pipe or joint is damaged	Replace

Hydraulic system



Schematic



- 1. Oil tank
- 2. Oil filter
- 3. Pump motor
- 4. Gear pump
- 5. Priority pump
- 6. Steering gear
- 7. Multi-way valve
- 8. Steering cylinder
- 9. Govern valve
- 10. Shutoff valve
- 11. Lifting cylinder
- 12. Tilting cylinder
- 13. Oil filter

The hydraulic system consists of a main oil pump, a multi-way valve, a lift cylinder, a tilt cylinder and an oil circuit, and the main oil pump is directly driven by the oil pump motor.

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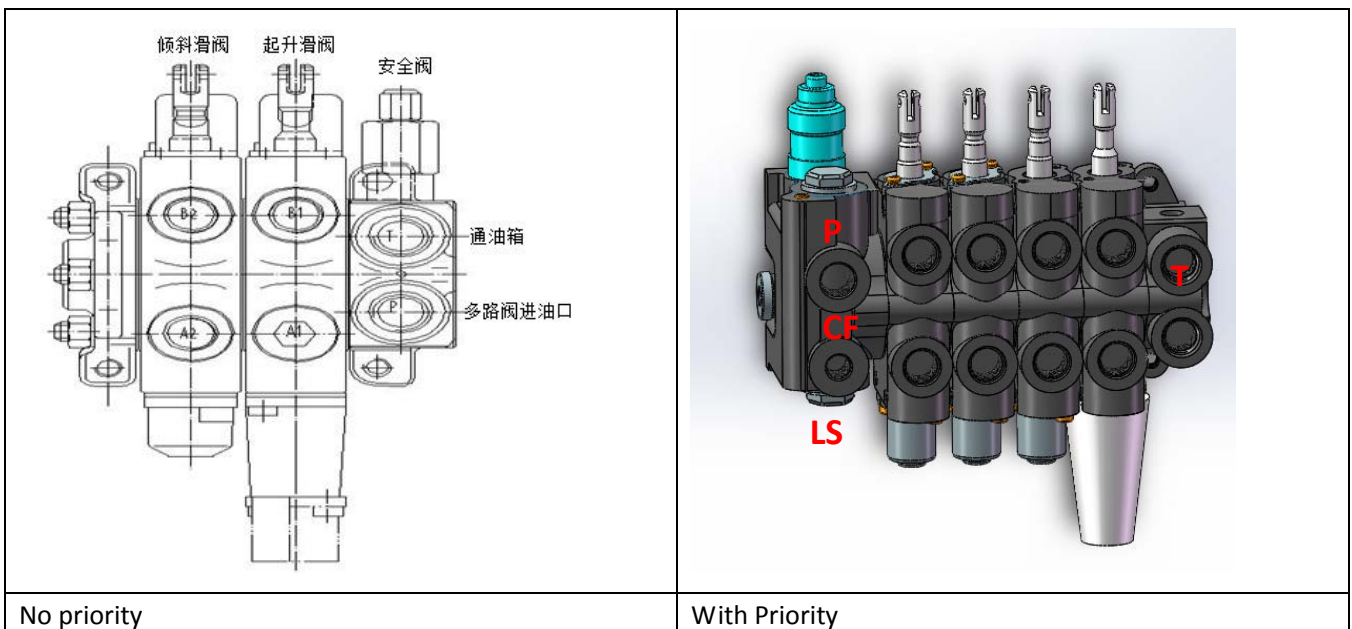
**Main oil pump**

The main oil pump is a gear pump, which is mainly composed of a pump body, a pump cover, a pair of bearings and a sealing ring. The main oil pump adopts a load-balanced bearing and a special lubrication method to obtain a minimum clearance of the gear end face. On one side of the starter shaft, an oil seal is mounted on the pump body to ensure sealing performance. The seal between the pump body and the pump cover is ensured by a special-shaped seal ring.

**Multi-way valve**

The multi-way valve adopts two-piece four-body type, and the hydraulic oil from the working oil pump is controlled by the multi-way valve stem to distribute the high-pressure oil to the lifting cylinder or the tilting cylinder. There are safety valves and self-locking valves inside the multi-way valve. The safety valve is arranged on the upper side of the multi-way valve inlet to control the system pressure; the self-locking valve is arranged on the inclined valve plate, which is mainly used to prevent the tilting cylinder from causing serious consequences due to malfunction of the operating lever without a pressure source. A check valve is installed between the oil inlet port and the suction port of the lifting valve and between the inlet port of the lifting valve piece and the oil inlet of the inclined valve piece. The pressure of the main safety valve has been adjusted before leaving the factory, and the user is not allowed to adjust it at will.

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



Priority valve

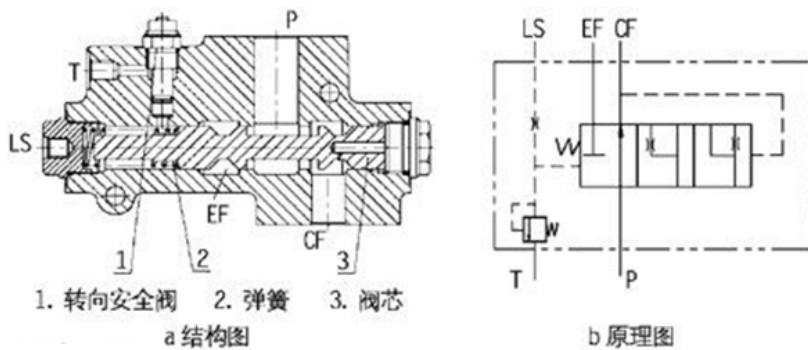


图 1 优先阀

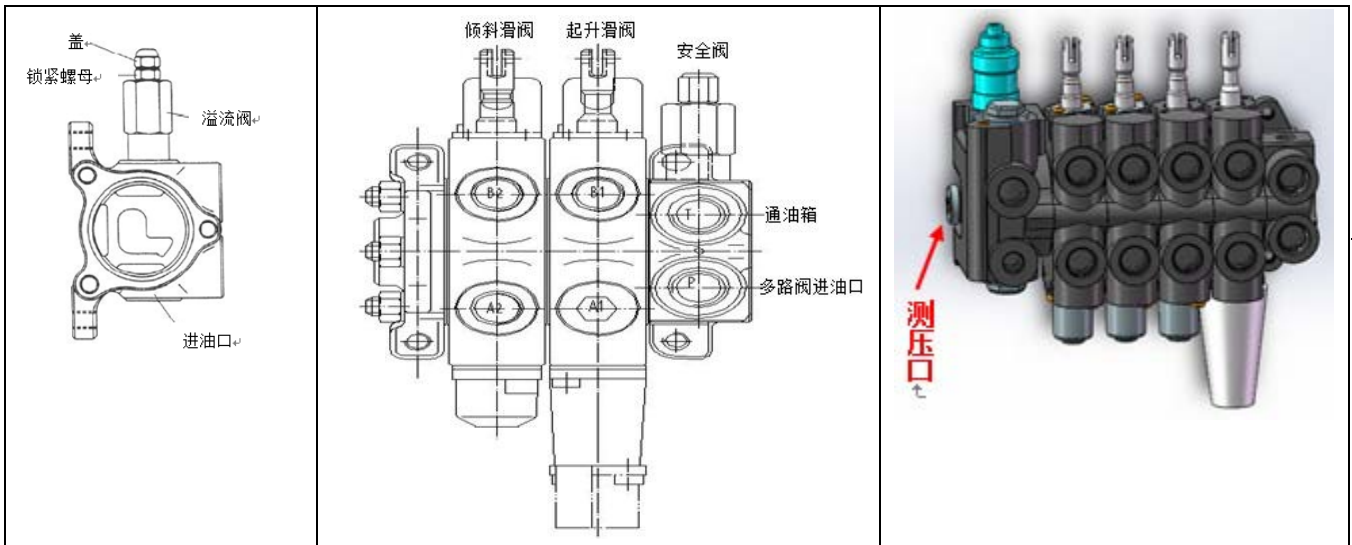
The priority valve is mainly composed of a steering safety valve, a spring, a valve core and a valve body as shown in the figure. The working principle P port is the steering pump inlet port, the CF port is connected with the steering oil inlet port, the EF port is connected with the multi-way valve inlet port of the working system, the LS port is connected with the steering port of the steering gear, and the T port is safe. The return port of the valve. When the P port is filled with oil, the hydraulic oil is preferentially supplied to the CF port through the spool 3. When the steering gear is not working, the CF port is in a closed state. At this time, the pressure of the LS port is zero, the right end of the valve core is oiled, and the hydraulic pressure acts on the right end of the valve core to overcome the preload of the spring 2, so that the spool moves to the left. At this time, the P port communicates with the EF port to realize functions such as lifting, tilting, and side shifting. When the steering gear is working, the CF port is connected to the steering cylinder via the steering gear, and the gear pump oil first enters the steering cylinder to achieve steering.

**Multi-way valve pressure adjustment**

Safety valve pressure adjustment method:

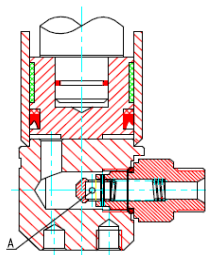
The pressure of the safety valve must not be adjusted arbitrarily. If it must be adjusted, please follow the steps below.

- a) Unscrew the measuring hole screw plug at the inlet of the multi-way valve and install a hydraulic gauge that can measure 25 MPa.
- b) Operate the tilt handle to measure the pressure at which the cylinder stroke is at the end.
- c) When the oil pressure is different from the specified value, loosen the lock nut of the relief valve and turn the adjustment screw to the left and right to the specified value. When the pressure is high, turn to the left, and when the pressure is low, turn to the right.
- d) Tighten after adjustment

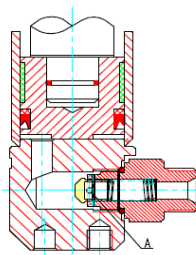


Shut-off valve

The shut-off valve is installed at the bottom of the lift cylinder to prevent the cargo from drastically falling when the high-pressure pipe suddenly breaks. When the oil from the lifting cylinder returns to the fuel tank, it must pass through the A hole on the outer circumference of the valve core. If the flow rate of the oil passing through the hole is less than the set value of the valve, the pressure difference between the front and the back of the valve core is less than the spring force, and the spool does not move and slides. The valve does not work. If the flow rate through the spool hole exceeds the set value when the high pressure pipe is broken or for other reasons, the pressure difference between the front and rear of the spool will be greater than the spring force to move the spool to the left. Thus, the hole A is closed, and only a small amount of oil flows out from the small gap of the valve core and the valve sleeve, and the cargo is slowly lowered.



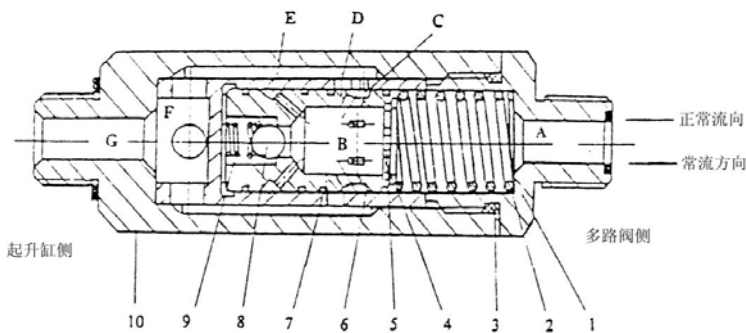
流量小于设定值时



流量大于设定值时

- 1) Govern valve connector
- 2) Spring
- 3) Seals
- 4) collar
- 5) Threshold
- 6) spool
- 7) Valve sleeve
- 8) Steel ball
- 9) One-way valve spring
- 10) valve body

Govern valve



The govern valve is installed in the hoisting oil line to limit the speed of the fork when it is heavy. The mechanism is shown in Figure 5-18. When the multi-way spool valve is in the "lift" position, the high pressure oil from the multi-way valve flows through the chambers A, B and holes C, D, E, F and chamber G without throttling. When the multi-way valve slide valve is in the "down" position, the oil from the lift cylinder passes through the cavity G, the oil holes F, E, D, C and B, the A cavity flows through the entire valve, at this time in the A cavity a pressure difference is generated between the chamber B and the ball valve (key 8). When the pressure difference exceeds the spring force of the spring 2, the spool 7 moves to the right, so that the flow rate of the oil is reduced due to the D and C holes. Dropping also reduces the flow through the orifice.

Lifting cylinder, tilting cylinder sketch (with seal ring, etc.)

16-18N Tilting cylinder				
	Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 118$ (6/10)		For 3m mask	
	Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 88$ (6/6)		For 4-5m mask	
	Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 67$ (3/6)		For 5.5-6m mask	
	Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 45$ (3/3)		For 6.5m mask	
	1	Grease mouth Z1/8	2	
	2	Earring	2	
	3	Bearing GE30ES	2	
	4	Circlip 47	2	
	5	Nut M14	2	
6	Washer 14	2		
7	Bolt M14x55	2		
8	Piston body assembly	2		
9	Yx seal ring D63x60x6	2		

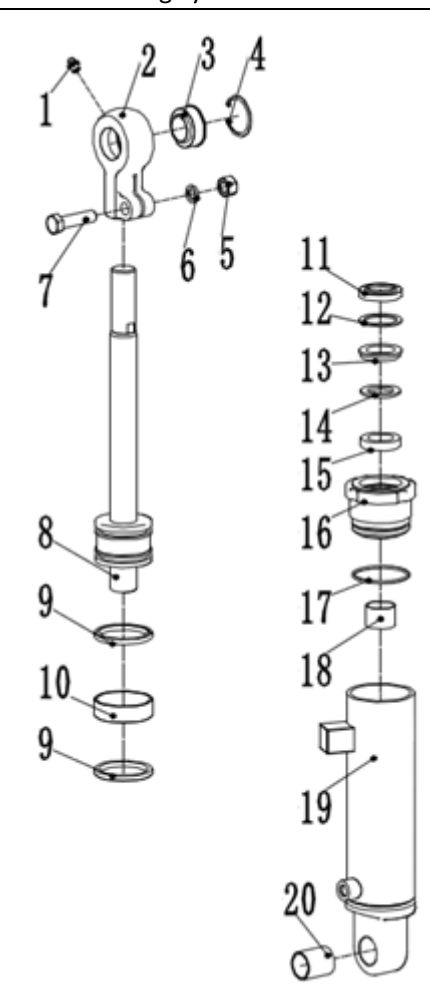


	10	Support ring D63x20x2.5	2
	11	Dust cover 52x30x8/9	2
	12	Circlip52	2
	13	Circlip	2
	14	Catch 48x30x3	2
	15	U seal ring 48x30x10	2
	16	Guide sleeve	2
	17	O seal ring 63x3.1	2
	18	Bearing 3025	2
	19	Cylinder barrel assembly	2
	20	Seal kits3040	2

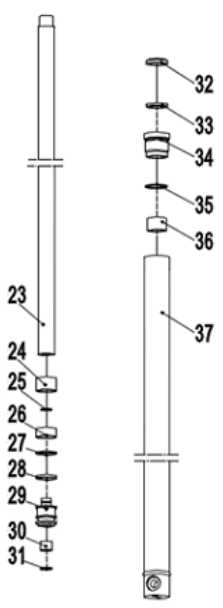
20-25N Tilting cylinder

		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 118$ (6/10)		For 3m mask
		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 88$ (6/6)		For 4-5m mask
		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 67$ (3/6)		For 5.5-6m mask
		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 45$ (3/3)		For 6.5m mask
	1	Grease mouth Z1/8	2	
	2	Earring	2	
	3	Bearing GE30ES	2	
	4	Circlip 47	2	
	5	Nut M14	2	
	6	Washer 14	2	
	7	Bolt M14x55	2	
	8	Piston body assembly	2	
	9	Yx seal ring D63x60x6	2	
	10	Support ring D63x20x2.5	2	
11	Dust cover 52x30x8/9	2		
12	Circlip52	2		
13	Circlip	2		
14	Catch 48x30x3	2		

	15	U seal ring 48x30x10	2
	16	Guide sleeve	2
	17	O seal ring 63x3.1	2
	18	Bearing 3025	2
	19	Cylinder barrel assembly	2
	20	Seal kits3040	2

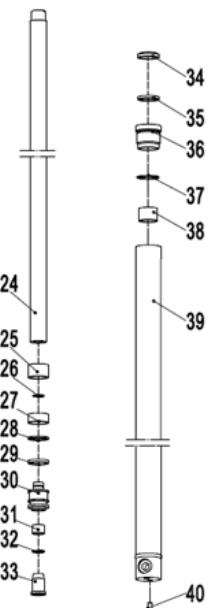
30-35N Tilting cylinder			
		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 118$ (6/10)	For 3m mask
		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 88$ (6/6)	For 4-5m mask
		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 67$ (3/6)	For 5.5-6m mask
		Tilting cylinder (TL) $\Phi 63 \times \Phi 30 \times 45$ (3/3)	For 6.5m mask
	1	Grease mouth Z1/8	2
	2	Earring	2
	3	Bearing GE30ES	2
	4	Circlip 47	2
	5	Nut M14	2
	6	Washer 14	2
	7	Bolt M14x55	2
	8	Piston body assembly	2
	9	Yx seal ring D80*70*6	2
	10	Support ring D80*75*20	2
	11	Dust cover 35*47*7	2
	12	Circlip52	2
	13	Circlip	2
	14	Catch 48x30x3	2
	15	U seal ring 35x45x10	2
	16	Guide sleeve	2
17	O seal ring 83x3.1	2	
18	Bearing 3530	2	
19	Cylinder barrel assembly	2	
20	Seal kits3038	2	

16-18N Lifting cylinder(standard mask)

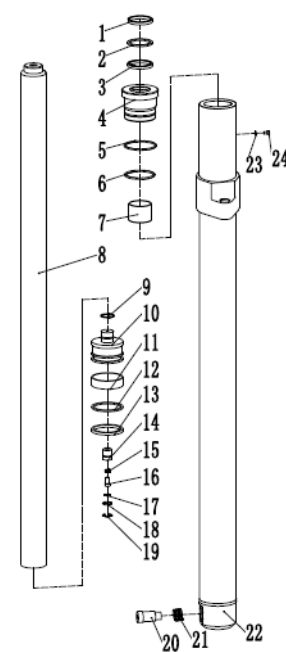
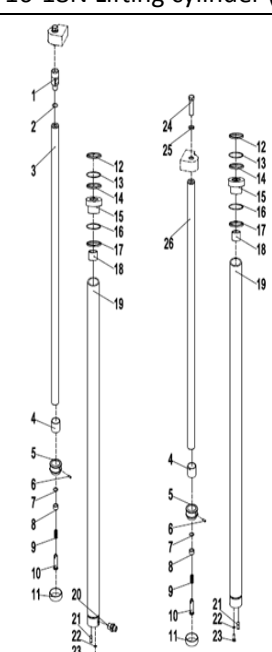


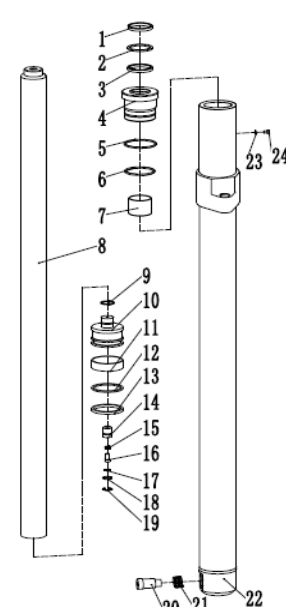
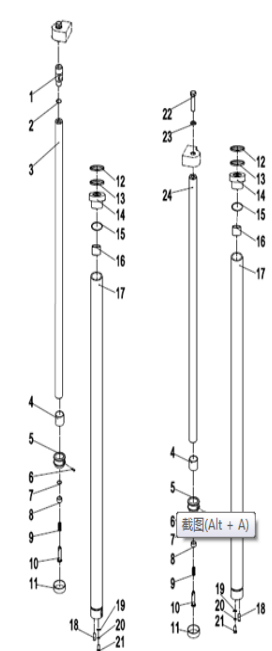
23	Piston rod
24	Adjusting bushing $\Phi$
25	Circlip
26	Support ring D45*8 (t=2.5)
27	Circlip 35*45*3
28	Seal ring 45*35*6
29	Piston
30	Copper bushing
31	Circlip
32	Dust cover 35*47*7
33	Seal ring 35*45*6
34	Guide sleeve
35	O ring 44.7*2.4
36	Bearing 3530
37	Cylinder

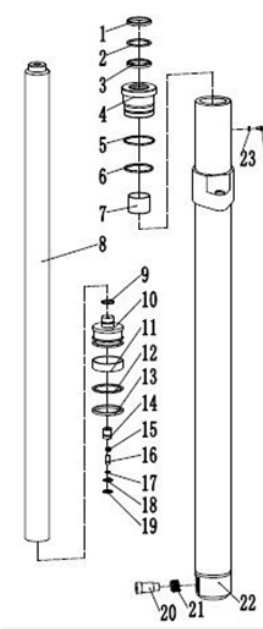
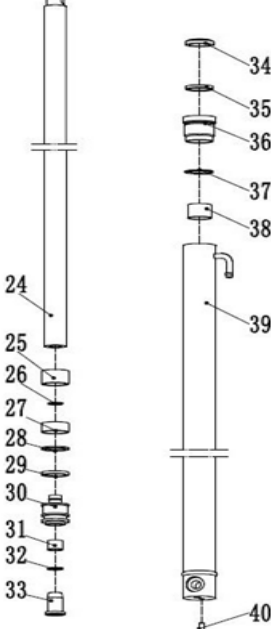
20-35 Lifting cylinder(standard mask)

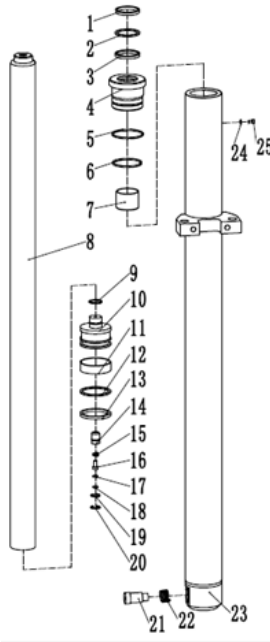
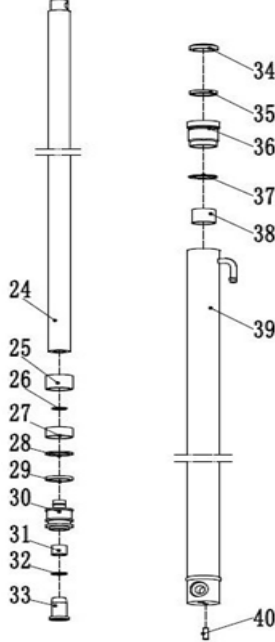


24	Piston rod
25	Adjusting bushing $\Phi$ 40.5* $\Phi$ 49*L2
26	Circlip
27	Support ring D50*20 (t=2.5)
28	Circlip 50*40*3
29	Seal ring 50*40*6
30	Piston
31	Copper bushing
32	Circlip
33	Dust cover 40*52*7/10
34	Seal ring 40*50*6
35	Guide sleeve
36	O ring 49.7*2.4
37	Bearing 4030
38	Cylinder
39	Piston rod
40	Dowel pin

16-18N Short lifting cylinder (two stage full free)		16-18N Lifting cylinder (two stage full free)				
	1	Dust cover 50*58*7/6.5		1	Left connecting rod	
	2	Catch 50*60*3		2	O ring 26*2.4	
	3	Seal ring 50*60*6		3	Left piston rod	
	4	Guide sleeve		4	Adjust bushing	
	5	O ring D75*3.1		5	Piston	
	6	O ring D70*3.1		6	Screw M4*6	
	7	Bearing 5035		7	Circlip $\Phi$ 18	
	8	Piston rod		8	Copper bushing	
	9	Circlip		9	Spring	
	10	Piston assembly		10	Buffer plunger	
	11	Support ring 70*20*3		11	Support ring 45*15*2.5	
	12	Circlip 70*60*3		12	LBH dust ring 32*40*5/6.5	
	13	Seal ring 70*60*6		13	Circlip 32*42*3	
	14	Valve bushing		14	Seal ring 40*50*6	
	15	Spring		15	Guide ring	
	16	Valve plug		16	Circlip 45*50*1.5	
	17	O ring D20*2.4		17	O ring 50*3.1	
	21	Spring		20	Explosion-proof valve PF3/8-M18*1.5	
	22	Cylinder		22	Circlip GB93-12	
	23	Spacer		23	Bolt M12*1.25*25-8.8	
	24	Nut M5*5		24	Bolt M16*1.5*40-8.8	
		18		Circlip $\Phi$ 12	25	Washer M16
		19		Circlip $\Phi$ 22	26	Right piston assembly
		20		Slide valve		

20-35N Short lifting cylinder (two stage full free)	20-35N Lifting cylinder (two stage full free)
	
<p>1 Dust cover 60*74*8/77</p> <p>2 Catch 60*70*3</p> <p>3 Seal ring 60*70*6</p> <p>4 Guide sleeve</p> <p>5 O ring D84.4*3.1</p> <p>6 O ring D77.5*3.55</p> <p>7 Bearing 6035</p> <p>8 Piston rod</p> <p>9 Circlip</p> <p>10 Piston assembly</p> <p>11 Support ring 85*20*25</p> <p>12 Circlip 85*70*3</p> <p>13 Seal ring 85*70*9</p> <p>14 Valve bushing</p> <p>15 Spring</p> <p>16 Valve plug</p> <p>17 Catch</p> <p>18 O ring D15.8*2.4</p> <p>19 Circlip Φ 12</p> <p>20 Circlip Φ 22</p> <p>21 Slid valve</p> <p>22 Spring</p> <p>23 Cylinder</p> <p>24 Spacer</p> <p>25 Nut M5*5</p>	<p>1 Left connecting rod</p> <p>2 O ring 26*2.4</p> <p>3 Left cylinder assembly</p> <p>4 Adjusting cover</p> <p>5 Piston</p> <p>6 Screw M4*6</p> <p>7 Circlip Φ 18</p> <p>8 Copper bushing</p> <p>9 Spring</p> <p>10 Buffer plunger</p> <p>11 Support rin 50*45*15</p> <p>12 Dust cover ring 40*52*7/10</p> <p>13 Seal ring 40*50*6</p> <p>14 Guide cover</p> <p>15 O ring 49.7*2.4</p> <p>16 Bearing 4030</p> <p>17 Cylinder</p> <p>18 Dowel pin 10*26</p> <p>19 Spacer12</p> <p>20 Circlip 12</p> <p>21 Bolt 12*1.25*25</p> <p>22 Bolt 16*1.5*40</p> <p>23 Circlip 16</p> <p>24 Right cylinder assembly</p>

16-18N Short lifting cylinder (three stage full free)	16-18N Lifting cylinder (three stage full free)
 <ul style="list-style-type: none"> <li>1 Dust cover 50*58*7/6.5</li> <li>2 Catch 50*60*3</li> <li>3 Seal ring 50*60*6</li> <li>4 Guide sleeve</li> <li>5 O ring D75*3.1</li> <li>6 O ring D70*3.1</li> <li>7 Bearing 5035</li> <li>8 Piston rod</li> <li>9 Circlip</li> <li>10 Piston assembly</li> <li>11 Support ring 70*20*3</li> <li>12 Circlip 70*60*3</li> <li>13 Seal ring 70*60*6</li> <li>14 Valve bushing</li> <li>15 Spring</li> <li>16 Valve plug</li> <li>17 Circlip</li> <li>18 O ring D20*2.4</li> <li>19 Circlip <math>\Phi 22</math></li> <li>20 Slide valve</li> <li>21 Spring</li> <li>22 Cylinder</li> <li>23 Spacer</li> <li>24 Nut M5*5</li> </ul>	 <ul style="list-style-type: none"> <li>24 Piston rod</li> <li>25 Adjusting bushing <math>\Phi 35.5 * \Phi 44 * L1</math></li> <li>26 Circlip</li> <li>27 Support ring D45*8 (<math>t=2.5</math>)</li> <li>28 Circlip 45*35*</li> <li>29 Seal ring 45*35*6</li> <li>30 Piston</li> <li>31 Copper bushing</li> <li>32 Circlip</li> <li>33 Dust cover 35*49*7</li> <li>34 Seal ring 35*45*6</li> <li>35 Guide sleeve</li> <li>36 O ring 44.7*2.4</li> <li>37 Bearing 3530</li> <li>38 Cylinder</li> <li>39 Piston rod</li> <li>40 Dowel pin</li> </ul>

20-35N Short lifting cylinder (three stage full free)	20-35N Lifting cylinder (three stage full free)
 <ul style="list-style-type: none"> <li>1 Dust cover 50*58*7/6.5</li> <li>2 Catch 50*60*3</li> <li>3 Seal ring 50*60*6</li> <li>4 Guide sleeve</li> <li>5 O ring D74.4*3.1</li> <li>6 O ring D69*3.1</li> <li>7 Bearing 5040</li> <li>8 Piston rod</li> <li>9 Circlip</li> <li>10 Piston assembly</li> <li>11 Support ring 75*20*3</li> <li>12 Circlip 75*65*2.5</li> <li>13 Seal ring 75*65*3</li> <li>14 Valve bushing</li> <li>15 Spring</li> <li>16 Valve plug</li> <li>17 Slid valve</li> <li>18 Spring</li> <li>19 Cylinder</li> <li>20 Spacer</li> <li>21 Nut M5*5</li> </ul>	 <ul style="list-style-type: none"> <li>24 Piston rod</li> <li>25 Adjusting bushing <math>\Phi</math> 40.5*<math>\Phi</math>49*L2</li> <li>26 Circlip 24*2</li> <li>27 Support ring D45*8 (t=2.5)</li> <li>28 Circlip 50*20*2.5</li> <li>29 Seal ring 50*40*6</li> <li>30 Piston</li> <li>31 Copper bushing</li> <li>32 Circlip 26.5*2</li> <li>33 Dust cover 40*52*7/10</li> <li>34 Seal ring 40*50*6</li> <li>35 Guide sleeve</li> <li>36 O ring 49.7*2.4</li> <li>37 Bearing 4030</li> <li>38 Cylinder</li> <li>39 Piston rod</li> <li>40 Dowel pin D10*26</li> </ul>

Troubleshooting

Trouble	Cause	Method
No oil coming out form oil pump	Oil level low	Refuel
	Suction tube or filter block.	Clean the oil circuit and fuel tank. If the hydraulic oil is dirty, replace it.
Oil pump output oil pressure is low	Bearing wear, retainer, O-ring is damaged	Replace
	Air in the oil pump	Tighten the loose joint on the suction side
		Refuel
		Check oil seal Wait until the air bubbles in the tank disappear and then use the oil pump
Noise	The hose on the suction side is twisted, and the filter screen is clogged to cause cavitation	Clear or replace filter

	The suction side of the air is loose and the air is sucked in the joint.	Re-tighten connect joints.
	Cavitation due to too high viscosity of hydraulic oil	Refuel right oil
	Air in oil	Check the reason first, than apply method.
The fork is obviously lowered when the lift lever is in the neutral position	Excessive wear clearance between valve body and stem	Replace the valve stem as required
	Stem position is not centered	Keep the stem position neutral
	Cylinder seal failure	Inspection cylinder
	Overload valve is worn or stuck by dirt	Clear or replace
Reset failure	Return spring damaged or deformed	Replace
	There is dirt between the valve stems	Clear
	Control stick mechanism stuck	Adjustment
	Reset the different axes between the parts	Re-assembly

Lifting system

Technical data

Roller	Composite roller $\Phi 78.3$ -range=45.3-49.3
Lifting chain	LH1223
Fork spacing adjustment	Manual

The lifting system consists of an inner door frame, a middle door frame, an outer door frame, a fork frame, a fork, a shelf, a lifting cylinder, a tilting cylinder, a lifting chain, etc., and is an actuator for loading and unloading operations of the forklift. The standard configuration of the forklift is a two-stage wide-view gantry with optional two-stage full free gantry (inlet gantry) and three-level full free gantry.

Lifting system adjustment

- The gantry frame is upright, and the chain is adjusted so that the distance between the fork frame and the ground of the fork frame is 74-76mm (the fork is about to leave the ground)
- The rear frame of the gantry adjusts the tension of the lifting chain to make the tension of the left and right lifting chains equal.

Troubleshooting

Trouble	Cause	Method
Door frame tilted by itself	Tilting cylinders and seals are excessively worn	Replace the piston seal or cylinder
	Multi-way valve control stem spring failure	Replace
Lifting and tilting is not flexible	The piston is stuck to the cylinder wall or the piston rod is bent	Replace damaged parts

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	Cylinder fouling	Clear
Lifting is not smooth	Improper adjustment of the fork assembly	Adjust the gap between the channel guide and the side roller
	There is not enough gap between the roller and the portal channel	Adjust roller clearance
	There is dirt between moving parts	Clear
	Insufficient lubrication	Apply grease to the contact surface of the sliding guide
	Internal door frame skew or fork frame bending	Repair or replacement
Uneven lift	Lifting chain is not adjusted well	Adjust the chain on both sides to be tight
Lifting weak or unable to lift	The oil pump gear and the pump body are excessively worn and the clearance is too large.	Replace worn parts or oil pumps
	Lifting cylinder piston seal wear, internal leakage	Replace the Y-ring
	Multi-way valve, safety valve spring failure	Replace the new spring
	Multi-way valve control rod and valve body wear excessive oil leakage	replace
	Oil leakage between multiple valve bodies	Reassemble after grinding, tighten the screws in order
	Hydraulic line leakage	Check the gasket and nut for damage
	The hydraulic oil temperature is too high, the hydraulic oil is too thin, and the flow is insufficient.	Check the cause of overheating, stop and cooling, replace the hydraulic oil,
	Overloaded	不要超载

**Standard for inspection and replacement of forks**

Fork that shows signs of cracking, deformation or wear must be outside the specified tolerance levels, and they risk the lives of operators and others.

**Crack check**

Check all fork surfaces for signs of cracks

**Back area**

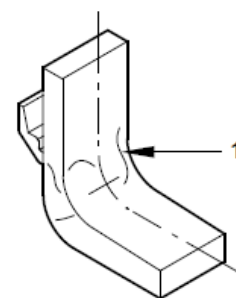
Fatigue cracking (as shown in Figure 1 of MS-3400-069) is likely to occur in the back area of the fork, carefully inspect this area, and if necessary, perform a crack-free crack test.

**Welded seam**

A fork handle attachment is included on the upper and lower forks (see Figure MS-3400-070). Check the weld for cracks. If cracks are found, remove the indicated tines safely.

**Locality test**

Use a ruler to check if the prongs are straight. If the tolerance level is exceeded, replace the tines



MS-3400-069

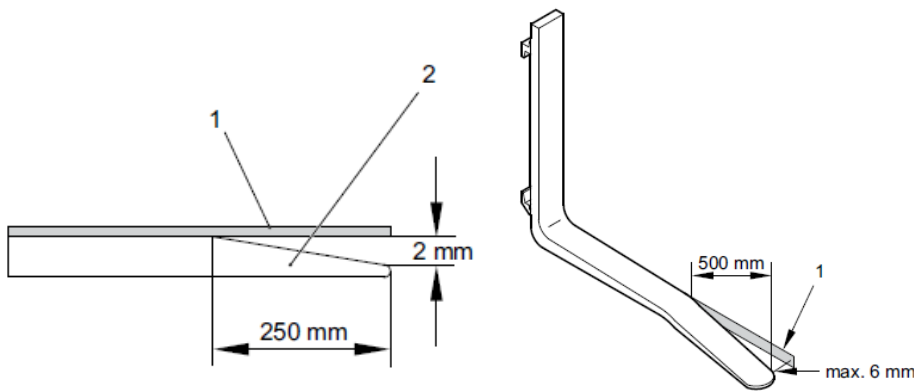
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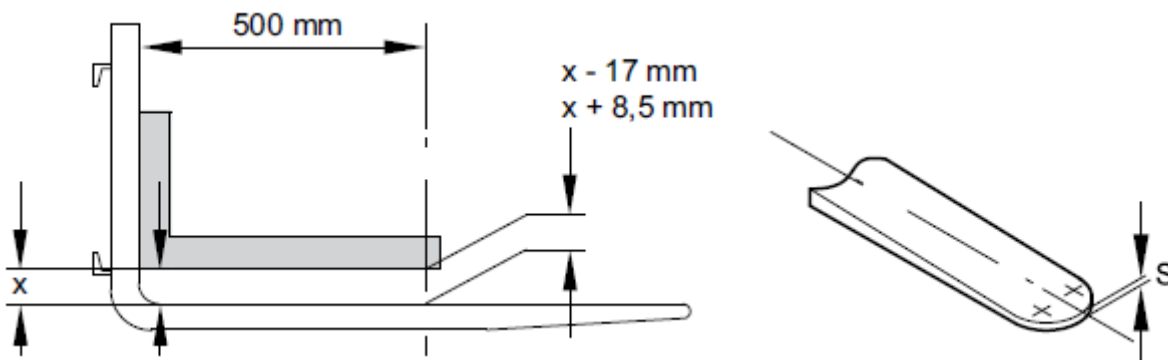
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Measure the angular deflection between the top of the fork and the fork shank. If the dimension X is outside the tolerance range, the tines must be calibrated and re-inspected by a professional.



Measure the tip thickness. If the tip thickness is less than 6mm, remove the tines for inspection.

### Fork tip height difference

Fix the tines on the fork and check that the heights of the prongs are compared with each other. If the fork tip height difference is greater than 3% of the fork length, the fork must be professionally calibrated. However, this standard still affects the use of the tines. In fact, alignment must be calibrated if the deviation is up to 10 mm.

### Fork lock block

Check the fork lock mechanism at the upper end of the two forks. This mechanism must be able to lock securely. Otherwise, the fork must be stopped for maintenance.

## Maintenance

A thorough inspection of the truck in advance will prevent the truck from malfunctioning and failing to meet its useful life. The hours listed in the maintenance program are based on the condition that the forklift operates 8 hours a day and 200 hours a month. For safe operation, the truck should be maintained in accordance with the maintenance procedures.

Daily maintenance and maintenance is carried out by the forklift driver, and other inspections and maintenance are carried out by professional maintenance personnel.

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First, the inspection before the operation

In order to operate safely and keep the forklift in good condition, it is a statutory duty to carry out a comprehensive inspection of the forklift before operation. Please contact our sales department if you find any problems.



A small fault can cause a major accident and do not operate or move the truck until the repair work is completed and the inspection is completed.

- The truck should be inspected on the platform.
- When checking the electrical system of the forklift, turn off the key switch and unplug the battery before checking.
- Improper disposal of the used waste oil (discharge into the sewer, soil, combustion, etc.) will pollute the water, soil, atmosphere, etc., which is prohibited by law.

1. Maintenance

	No.	Check point	Content
Braking system	1	Braking pedal	Foot brake pedal stroke and braking force
	2	Brake oil	Quantity and cleanliness
	3	Parking braking	The stroke and operating force of the parking brake handle
Steering system	4	Steering wheel	Elasticity, rotation and back and forth movement
	5	Hydraulic steering operation	Operation of all components
Hydraulic system, mask	6	Features	Function, whether there is crack, lubrication condition
	7	Tubing	Whether the tubing leaks
	8	Hydraulic oil	Suitable amount of oil
	9	Lifting chain	The left and right chains should be elastic.
Wheel	10	Tire	The size of the air pressure, whether there is abnormal damage
	11	Wheel nut	Firm tightening
Battery	12	Charging	Determine the battery capacity display status, specific gravity, plug should be firmly connected
Headlights, horns and switches	13	Headlights, taillights, reversing lights, turn signals, horns and emergency power off switches	Check whether it is on or off, whether the horn is ringing, and whether the emergency power-off switch is abnormal.
Detection and	14	Features	When the key switch is turned on,

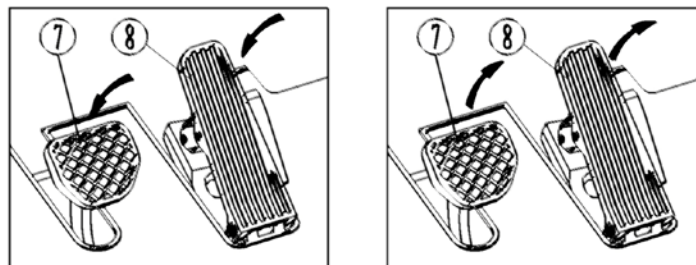
display light			“Detection status is normal” should be displayed.
Other	15	Roof guard, shelf	Whether the bolts and nuts are fastened
	16	Other parts	Integrity
	16	Other parts	Condition

2. Checking programme


(1) Check the foot brake pedal ⑦

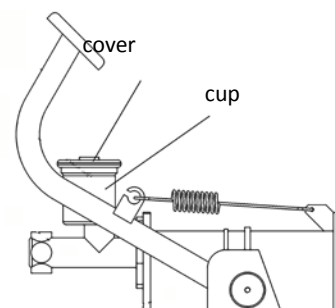
Check the brakes and make sure that the brake pedal is down from the floor level when the brake pedal is fully depressed

The stroke should be more than 50mm, and the braking distance of the forklift is about 2.5 meters at no load.



(2) Check brake oil

 • Open the brake oil cup cover and check the amount of oil and other conditions of the brake oil.



(3) Check the parking brake handle

Push the parking brake lever forward to observe the following:

- Is there a proper pull stroke?
- The amount of braking force.
- Is there any damage to the parts?

The handle handling force (standard 17-22kg) is suitable for the operator.

The operator can adjust it with a screw mounted on the top of the handle.

(4) Check the rotation of the steering wheel

Gently turn the steering wheel clockwise and counterclockwise to check for rebound. The appropriate rebound stroke is 50-100mm. The front and rear strokes of the steering wheel are about 7°. If the above conditions are met, the steering wheel will rotate normal.

(5) Check the power steering function



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Turn the steering wheel clockwise and counterclockwise to check the power steering operation.

(6) Check the function of the hydraulic system and the gantry

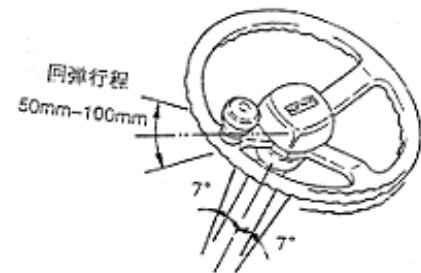
Check that the lifting and tilting operations are smooth and normal.

(7) Check the tubing

Check for oil leaks in the lift cylinder, tilt cylinder and all lines.

(8) Check hydraulic oil

Lower the fork to the ground and check the hydraulic oil level with the oil level gauge. When the oil level is in the range of H to L, the hydraulic oil quantity is in the proper range.



Model	Volume
FE4P16-35N	32 L

(9) Check the lifting chain

Lift the fork to the ground 200-300mm high to ensure that the left and right chain tension is consistent. Check that the finger stick is in the middle position and adjust it through the chain joint if the tightness is different.

**⚠️ • After adjustment, the double nut should be tightened.**

(10) Check tires (solid tires)

Check the tire and the side for damage or cracking, and whether the rim and the lock ring are deformed or damaged.

(11) Check the hub nut

**⚠️ • Loose hub nuts are very dangerous. In case of looseness, the wheels may fall off and cause the vehicle to flip. Check the hub nut for looseness. Even if it is loose, it is very dangerous. Therefore, it must be screwed to the specified torque value in advance.**

**Wheel nut tightening torque:**

**Front wheel: 18×7-8 280-320N. m**

**Rear wheel: 15×41/2-8 130-150N. m**

(12) Check the charging situation

Measure the specific gravity of the battery. When the temperature is changed to 30 ° C, the specific gravity of the battery is 1.275 to 1.285, indicating that the battery is fully charged. Check if the terminal is loose and the cable is damaged.



(13) Check headlights, turn signals and horns

Check that the lights are on properly and that the speakers are ringing normally (the horn is ringing when the horn button is pressed).

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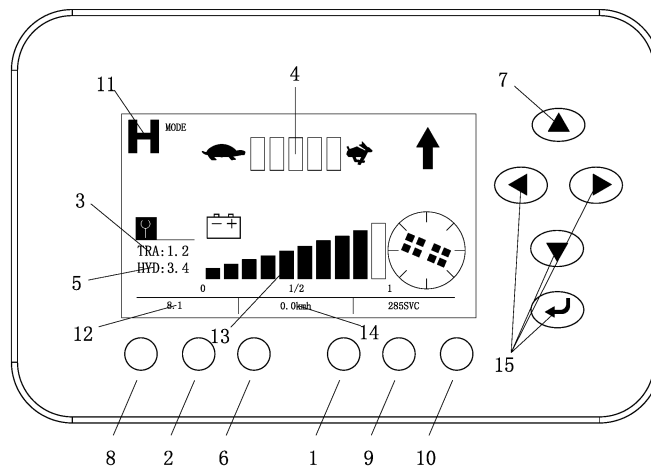
Check if the emergency stop switch is normal.



L	Left turn signal is on
N	Neutral
R	Right turn signal is on

(14) Check the dashboard function

After the key switch is turned on normally for a few seconds, the instrument panel will display as shown below.



- |                                   |                                   |   |                       |
|-----------------------------------|-----------------------------------|---|-----------------------|
| 1. Prompt for locking indication  | 2. Parking brake indication       | 3. Traction controller fault code                         | 4. speed mode         |
| 5. Oil pump controller fault code | 6. Maintenance time to indication | 7. mode selection   | 8. Low speed mode     |
| 9. Seat switch indication         | 10. Seat switch indication        | 11. neutral indication                                    | 12. Timing indication |
| 13. Power indicator               | 14. Speed indicator               | 15. Mode conversion and parameter value adjustment button |                       |

15) Check the overhead guard and the shelf  
Check for loose bolts or nuts.

(16) Check the integrity of the vehicle identification

(17) Other

Check for other abnormalities in other parts.



• In addition to checking the lamp and operating conditions, always turn off the key switch and unplug the battery before checking the electrical system.

### Post-operation check

After the work is completed, the dirt on the forklift should be removed and the forklift should be inspected as follows:

- (1) All parts are damaged or leaked.
- (2) Whether there is deformation, distortion, damage or breakage.
- (3) Add grease as appropriate.

(4) Raise the fork to the maximum height several times after work. (When the daily work does not use the fork to rise to the maximum height, this will allow the oil to flow through the entire stroke of the cylinder to prevent rust.)

- (5) Replace abnormal parts that cause malfunction during operation.



• A small mistake can cause a major accident. Do not operate or move the truck until the repair work is completed and the inspection is completed.

### 三、Cleaning forklift



• Park the truck in the designated position.

- Pull on the parking brake handle.
- Press the emergency stop switch.
- Turn off the key switch and remove the key.
- Unplug the battery.

#### 1. Cleaning forklift surface



Do not use flammable liquids to clean the truck and take safety measures to prevent short circuits.

- Clean the truck with clean water and soluble detergent.
- Carefully clean the filler port and the peripheral portion of the grease nipple.



If the forklift is cleaned frequently, please lubricate it in time.

#### 2. Clearing chain



Do not use a corrosive liquid such as a chemical detergent or an acidic liquid to clean the chain.

- Place a container under the door frame.
- Use a petrochemical derivative such as gasoline to clean the chain.
- Do not add any additives when cleaning with a steam nozzle.
- Dry the chain pin and the water stain on the surface of the chain immediately after cleaning.

#### 3. Cleaning electrical system



Do not wash the pump control and various connectors with water to avoid damage to the electrical

system.

Use a non-metallic brush or a low-power blower, follow the manufacturer's instructions to clean the electrical system, and do not move the protective cover.

4. After cleaning

- Thoroughly dry the water stains on the truck (eg. using compressed air).
- Start the truck according to the procedure.



If moisture penetrates into the motor, moisture must first be removed to prevent short circuits.



Moisture can reduce brake performance and briefly brake the truck to dry the brakes.

4、regular maintenance

- Forklifts need regular inspection and maintenance to keep them in good performance.
- Use genuine spare parts from Noblelift Machinery.
- Do not use different types of oil when replacing or refueling.
- Replaced oil and battery, can not be dumped and discarded, should be disposed of in accordance with local environmental protection laws and regulations.
- Develop a comprehensive maintenance and repair plan.
- A complete record should be made after each maintenance and repair.
- Repair of the forklift is not permitted without training.



**No smoke and fire**

- **Turn off the key switch and unplug the battery before servicing. (In addition to being part of the obstacle exclusion check).**
- **Clean the electrical parts with compressed air and do not wash with water.**
- **Do not extend your hands, feet or any part of your body between the entry frame and the instrument frame.**
- **Even if the key switch is turned off, since the capacitor is charged in the controller, it is protected from electric shock when it contacts the controller.**

1. Regular maintenance schedule    ✓—Check, correct, adjust    ×—Replace

(1) Battery

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Battery	Electrolyte level	Visual		✓	✓	✓	✓
	Electrolyte specific gravity	Hydro meter		✓	✓	✓	✓



Battery power		√	√	√	√	√
Loose terminal block		√	√	√	√	√
Loose wire connection		√	√	√	√	√
Battery surface cleaning		√	√	√	√	√
Is there any tool on the surface of the battery?		√	√	√	√	√
Is the ventilation cover tight and the ventilation opening clear?			√	√	√	√
Keep away from fire		√	√	√	√	√

(2) Control

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Control	Check the wear of the contacts					√	√
	Check if the mechanical movement of the contactor is good					√	√
	Check if the pedal micro switch is working properly.					√	√
	Check that the connection					√	√

	between the motor, battery and power unit is good						
	Check the controller to determine if the system is normal.						2 years

(3) Motor

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Motor	Cleanness motor house				√	√	√
	Cleaning or replacing bearings						√
	Whether the carbon brush and commutator are worn and the spring force is normal				√	√	√
	Is the wiring correct and reliable?				√	√	√
	Clearing the small groove on the commutator and the carbon powder on the surface of the commutator						√

(4) Drive system

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Gearbox and braking	Noise		√	√	√	√	√
	leakage		√	√	√	√	√
	Change oil						×
	Check pedal		√	√	√	√	√
	Check gear condition					√	√
	Check the bolt loosening at the joint with the frame					√	√
	Check the wheel bolt tightening torque	Torque wrench	√	√	√	√	√

(5) Wheel (front and rear)

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Wheel	Wear, crack or damage		√	√	√	√	√
	Is there a nail, stone or other object on the tire?				√	√	√
	Rim damage		√	√	√	√	√

(6) Steering system

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Steering wheel	Check gap		√	√	√	√	√
	Check axial looseness		√	√	√	√	√
	Check for radial looseness		√	√	√	√	√
	Check the		√	√	√	√	√

	operation status						
Steering gear and valve block	Check if the mounting bolts are loose				√	√	√
	Check the leakage of the contact surface between the valve block and the steering gear		√	√	√	√	√
	Check the sealing of each interface connector		√	√	√	√	√
Rear bridge	Check if the rear axle mounting bolts are loose				√	√	√
	Check for bends, deformations, cracks or damage				√	√	√
	Check or replace the lubrication of the bridge support bearing					√	√
	Check or replace the lubrication of the steering wheel bearing					√	√
	Check steering cylinder operation		√	√	√	√	√
	Check if the steering cylinder leaks		√	√	√	√	√
	Check the					√	√

	meshing of the rack and pinion						
	Sensor wiring and operation					√	√

(7) Braking system

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Brake pedal	Invalid brake stroke	刻度尺	√	√	√	√	√
	Pedal stroke		√	√	√	√	√
	Operation situation		√	√	√	√	√
	Is there any air in the brake line?		√	√	√	√	√
Parking brake control	Is the brake safe and reliable?		√	√	√	√	√
	performance		√	√	√	√	√
Rod, cable, etc.	performance				√	√	√
	Is the connection loose?				√	√	√
	Wear and joint connection with the gearbox					√	√

Pipe line	Damage, leakage, rupture				√	√	√
	Connection, clamping position, looseness				√	√	√
Brake cylinders	Leakage		√	√	√	√	√
	Check oil level, change oil		√	√	√		×
	Main pump and sub-pump operation					√	√
	Main pump, sub-pump leakage or damage situation					√	√
	Main pump, cylinder piston cup, check valve wear damage, replacemen t						×

(8) Hydraulic system

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Hydr aulic tank	Oil level check, change oil		√	√	√	√	×
	Clean up the oil filter						√
	Exclude foreign matter						√

Control valve stem	connection loose		√	√	√	√	√
	Operation situation		√	√	√	√	√
Multi-way valve	Oil spill		√	√	√	√	√
	Safety valve and tilting self-locking valve operation				√	√	√
	Measuring safety valve pressure	Oil pressure gauge					√
Pipe joint	Leakage, looseness, cracking, deformation or damage				√	√	√
	Replacement pipe						× 1~2 year
Hydraulic pump	Noise		√	√	√	√	√
	Condition of hydraulic pump drive gear wear				√	√	√

(9) Lifting system

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Chain Sprocket	Check the tension of the chain, whether it is deformed or damaged.		√	√	√	√	√
	Chain refueling				√	√	√
	Riveting pin and loosening				√	√	√
	Sprocket deformation and damage				√	√	√
	Loose bearing					√	√
Attachment	Check condition				√	√	√
Lifting	Whether the piston rod, piston rod thread and		√	√	√	√	√

cylinder and tilting cylinder	connection are loose, deformed or damaged						
	Operation situation		√	√	√	√	√
	Leakage		√	√	√	√	√
Fork	Wear and damage of pin and cylinder steel back bearings				√	√	√
	Damage, deformation and wear of the fork				√	√	√
	Damage and wear of the locating pin					√	√
Mask e fork	Cracking and wear of the welded joint of the fork root hook				√	√	√
	Whether the inner door frame, the outer door frame and the beam are welded or cracked				√	√	√
	Whether the welding of the inclined cylinder bracket and the door frame is poorly welded, cracked or damaged				√	√	√
	Whether the inner and outer mask are poorly welded, cracked or damaged				√	√	√
	Whether the fork is poorly welded, cracked or damaged				√	√	√
	Loose roller				√	√	√
	Door frame support bearing bush wear and damage						√
	Loose mask support cover bolts	Testing hammer				√	√
Mask e fork	Lifting cylinder piston rod head bolts, bent plate bolts are loose	Testing hammer				√	√
	Cracking and damage of the roller, roller shaft and welded joint					√	√

(10) Other

Name	Content	Tool	Daily(8 hours)	Weekly (50hours)	Monthly (200 hours)	3 months (600 hours)	6 months (1200hours)
Roof	Is it firm?	Testing	√	√	√	√	√



guard and shelf	hammer						
	Check for deformation, cracking, damage		✓	✓	✓	✓	✓
Turn indicator	Operation and installation		✓	✓	✓	✓	✓
horn	Operation and installation		✓	✓	✓	✓	✓
Lights and bulbs	Operation and installation		✓	✓	✓	✓	✓
Reversing buzzer	Operation and installation		✓	✓	✓	✓	✓
Meter	Instrument working situation		✓	✓	✓	✓	✓
Wires	Harness damage, fixed loose condition			✓	✓	✓	✓
	Loose circuit connection				✓	✓	✓

2. Replace critical safety parts regularly

Some parts are difficult to detect damage or damage through regular maintenance. To further improve safety, the user should periodically replace the parts given in the table below.

If the parts are not normal before the replacement time, they should be replaced immediately.

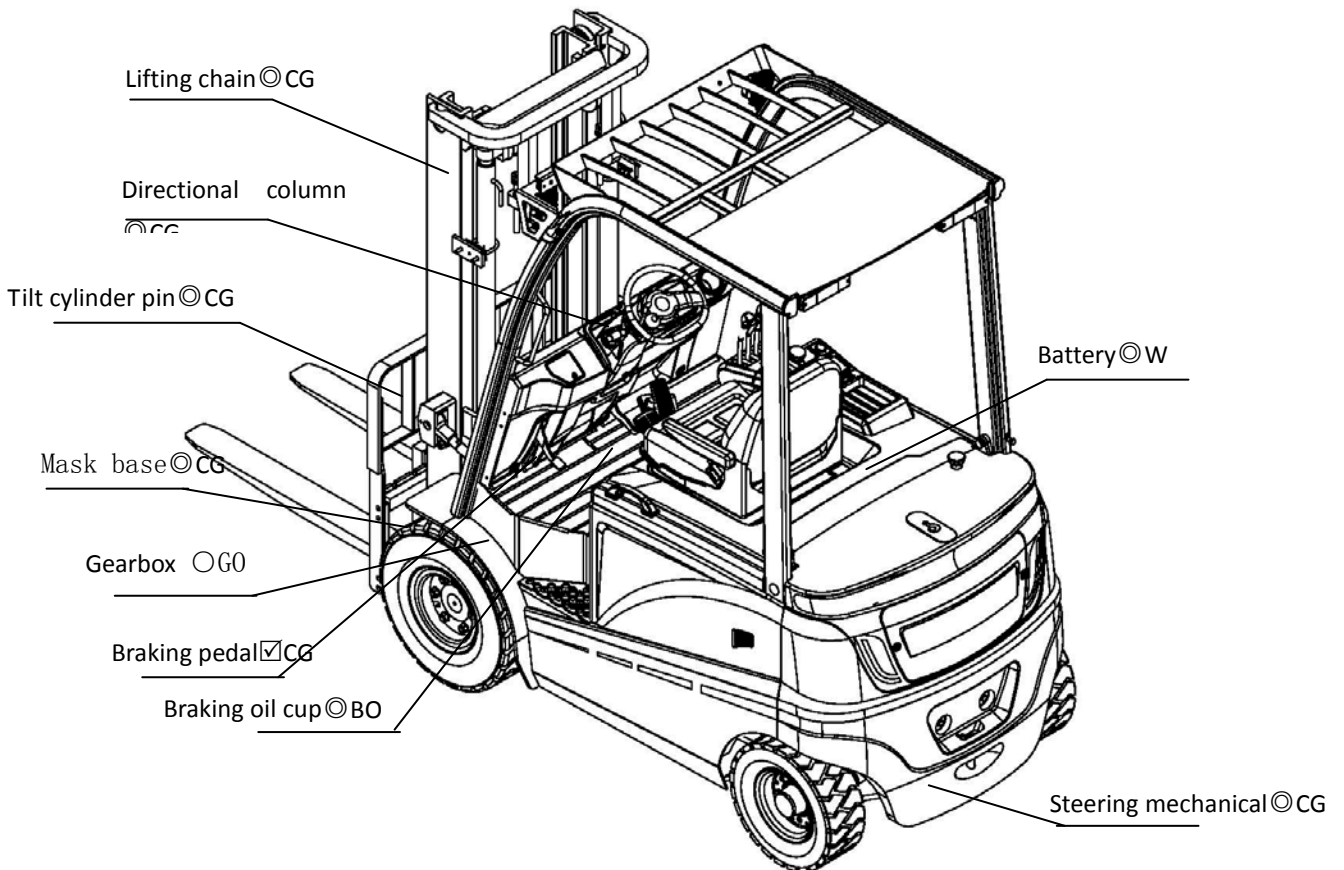
Critical safety parts	Design life (years)
-----------------------	---------------------

制动软管或硬管	1~2
起升系统用液压胶管	1~2
起升链条	2~4
液压系统用高压胶管、软管	2
制动液油杯	2~4
制动总泵缸盖和防尘套	1
液压系统内部密封件、橡胶件	2

Lubrication parts and recommended oil

1. Lubricating part

- : Replace                      F0: Hydraulic oil
- ◎: Refuel                        G0: Gear Oil
- : Check and adjust        CG: grease
- BO: Braking oil                W: Steaming water



2. Liquids list

Name	Type	Volume	
Hydraulic oil	L-HM32	30	Working

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			temperature $\geq$ -5℃
	L-HV32		Working temperature $\geq$ -20℃
Gear Oil	AFT 220	0.35×2	
Braking oil	Caltex DOT4	0.2	
Vaseline	2#	Moderate amount	Battery electrode column
Grease	3# Universal lithium grease	Moderate amount	

## Maintenance Record

No.	Date	Content	signature

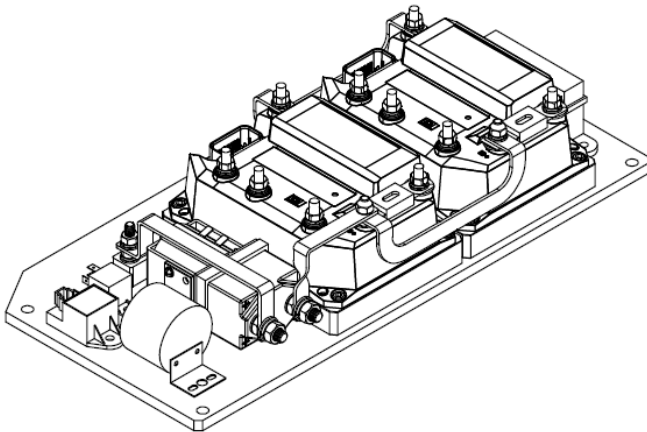

## Electrical System

### Overview

The electrical system of the FE4P series electric forklift is powered by a 48V battery pack. The traction power of the whole vehicle is provided by an AC motor. The lifting power of the cargo is driven by a DC motor driven oil pump or an AC motor to drive the oil pump, and then the hydraulic pipeline passes through the gantry. The hydraulic cylinders on both sides realize the lifting, tilting and side shifting of the fork. The lighting system is powered by a battery 48V to 24V. 4.1

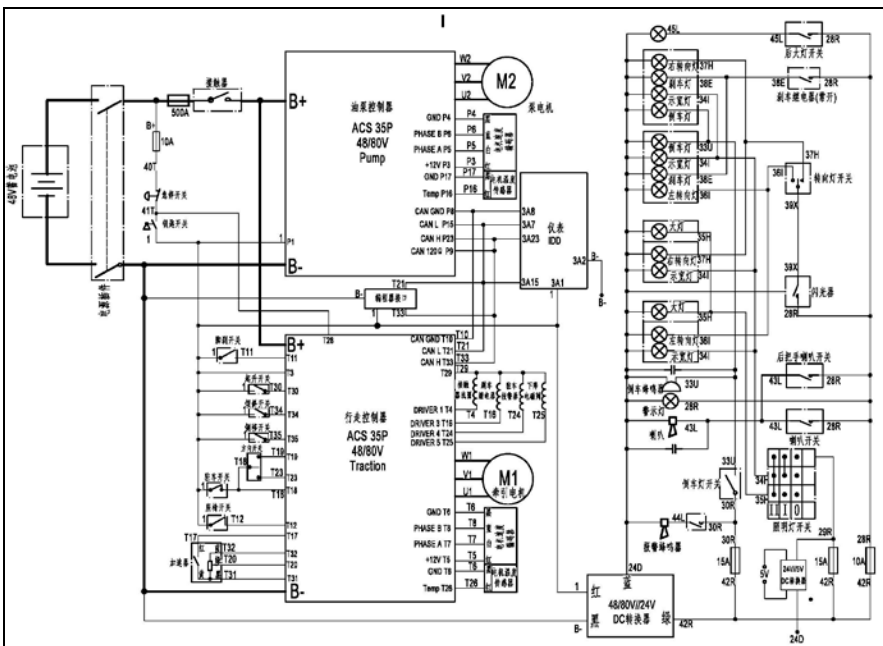
### Electronic control assembly

The Inmotion ACS AC controller is a product of the Zapi Group. This type of controller combines high safety, reliability, flexibility and ease of operation. The advanced control software ensures that the motor can be stable in different modes. Operation, including regenerative braking at full speed and high torque, zero speed and torque control, proprietary input/output ports and software, ensures the controller's economics and efficiency for electromagnetic braking and hydraulic system control.



The AC variable frequency motor for forklift traction, the AC variable frequency motor controller for steering, the instrument panel display, and the AC drive are all products of Zapi Group, the world's leading supplier of electric vehicle systems. The AC variable frequency motor is highly efficient, durable and virtually maintenance-free because it does not have a commutator for the DC motor (the commutator limits the acceleration of the vehicle, especially when the vehicle is moving at high speed), so its acceleration performance is faster. The controller is a general-purpose controller for electric vehicles that communicates using the CAN open protocol. It is ideal for managing forklift motion, I/O, operational control and information display through its analog and digital I/O and communication devices. The group's discharge monitoring with various protection functions. The dashboard display allows for a variety of data displays, factory or user settings, and the ability to enter user commands and more.

4.1.1 Schematic diagram of the electrical system



4.1.2 Main functions and settings

Correctly setting the various motor technical parameters and control technical parameters and function values of the controller can realize the safe and high-efficiency working performance and complete operation function of the electric forklift.

1. Advanced design and production process to ensure the best quality and reliability.  
2. powerful ARM core processor and operating system, while meeting functional tasks and motor control requirements.

3. Reverse braking and regenerative braking. When the vehicle is running, when the direction bar is reversed, the reverse braking signal is generated. It controls the traction motor through the motor driver to give a braking torque to achieve the purpose of vehicle deceleration. The braking force is controlled by an accelerator pedal. The regenerative braking is generated by the controller's control under the condition that the vehicle speed is relatively higher than the traction motor speed. The energy of the vehicle braking can be converted into electric energy and fed back to the battery pack. Especially when the electric forklift slides down the slope, in order to properly reduce the speed of the downhill slope of the vehicle, the accelerator pedal can be appropriately lifted and released to realize the regenerative braking, which prolongs the driving distance of the battery once.

4. The anti-slip function of the ramp. Electric forklifts with AC traction motors have excellent features that do not slip on the ramp.

5. The maximum driving speed can be set. The reasonable setting of the maximum running speed of the electric forklift can prevent the traction motor from being overloaded due to the excessive speed.

6, static recovery shut down. If the seat switch or key switch is turned off, the control unit is turned off and the direction lever must be pulled back to the neutral position to restart. If the driver leaves the vehicle and returns at any time, the steering lever needs to be pulled back to the neutral position before restarting. This feature prevents accidental unsafe operations from occurring. A time delay of a few seconds is provided at the input of the seat switch to allow the seat switch to be momentarily disconnected in the event of a bump.

7. security protection features. If the power component of the controller is damaged during operation, the controller will disconnect the main contactor in the shortest time; when the controller temperature rises too high, the controller will automatically limit the armature current of the motor; when the battery voltage is over When low, the controller will stop working for safety.

8. Traction motor controller and oil pump motor controller have self-diagnosis function. During the operation of the controller, in the event of a fault, the fault code is displayed on the display meter and the controller is automatically stopped to ensure the safety of the operating system.

9. The display meter will display the battery's power and accumulated working hours and remote vehicle management mode.

#### 4.1.6, circuit system maintenance

(1) Check the wear condition on the contacts; replace them when the contacts are worn. Contactor contacts should be inspected once every 3 months.

(2) Check the pedal or handle micro switch; measure the voltage drop across the micro switch, there should be no resistance when the micro-motion is opened and closed, and there should be a crisp sound when released.

Check every 3 months.

(3) Check the main circuit: battery-controller-motor connection cable. Make sure the cable is well insulated and the circuit connections are tight. Check every three months.

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

(5) Check the mechanical movement of the contactor; it should be freely movable and not adhered, and the mechanical action of the contactor should be checked every 3 months.

4.1.7 Combination meter

IDD is a vehicle-based instrument based on CAN and wireless communication. It can display vehicle speed, working time, battery power, Chinese and English display, password protection, fault code and other information. At the same time, it can realize remote voice alarm and dispatch, vehicle positioning and remote. Industrial Internet functions such as lock car and remote help. The vehicle parameters can also be modified according to the user to provide online real-time communication, cloud data storage and background monitoring services. IDD has the advantages of instant communication, precise positioning and high degree of visualization. It is the best terminal for the future IoT and cloud services of electric forklifts, and is widely used in various industrial electric vehicles.



No.	Instruction	Description
①	Hour meter	The number shows the cumulative working time of the current vehicle, and the 5-digit display; After the key switch is turned on, the work timer starts to work;
②	Wheel angle indication	The arrow represents the direction in which the steering wheel travels;
③	Working mode indication	Display the current working mode, there are 3 working modes of "S (turtle speed)", "P",

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		"E"
④	Travel speed display	Display current vehicle speed in KM/h or MPH
⑤	Battery level display	Show current battery level icon
⑥	Forward and backward indication	The forward gear displays “↑”, the reverse gear displays “↓”, and the neutral display has no display.

Hot key

Sign	Name	Feature
	Up button	Move the cursor up or increment the selected number by 1. Switch S mode (turtle speed mode) in the main interface
	Left shift key	Move the cursor to the left and switch the P mode on the main interface.
	Left shift key	Move the cursor to the right and switch the E mode on the main interface.
	Down button	Move the cursor up, or decrement the selected number by one, and switch the S mode (turtle speed mode) in the main interface.
	Cancel button	Cancel current content or return to previous menu
	Enter	Confirm the current operation, enter the menu mode under the main interface

Hot key

Sign	Name	Feature
	Up button	In the main interface, press “Up” and “Down” at the same time to view the meter information, including the meter number, SIM card number and software version number.
	Down button	

Fault code table

No.	Cod e	Fault analysis	Solution

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1	20	ERROR. Accelerator pedal switch activated at start-up	Release accelerator pedal, restart
2	21	ERROR. Direction switch activated at startup	Switch to neutral
3	22	ERROR. The front and rear direction switches are activated simultaneously at startup	Direction signal arrives at the controller at the same time, the direction switch is faulty
4	23	ERROR. Accelerator pedal analog value out of range	Accelerator failure/accelerator pedal failure or analog quantity needs to be recalibrated
5	24	ERROR. Accelerator pedal analog fault	
6	31	ERROR. Traction drive CAN communication failure	
7	32	ERROR. Low battery voltage	Charging
8	36	ERROR. Tilt switch activated at startup	Reset tilt switch
9	37	ERROR. Actuator switch activation when the side shift switch is activated at startup	Reset side shift switch
10	38	ERROR. Lift switch activated at startup	Reset attachment switch
11	39	ERROR. Lift switch activated at startup	Reset lifting switch
12	40	ERROR. Lifting analog value out of range	Lifting analog damage or need to be recalibrated
13	43	ERROR. Corner analog is out of range	Corner analog damage or need to be recalibrated
14	44	WARNING. Traction drive speed protection	Reset Speed alarm
15	45	WARNING. Traction drive encoder error	Encoder failure (A phase T7 of the encoder, B phase T8 line is worn or broken), check the mechanical and circuit functions of the encoder; possible alarms caused by interference caused by iron scraps attracted by the encoder. None of the above is a better controller.
16	81	WARNING. Traction drive temperature is low	Controller temperature is too low alarm
17	82	WARNING. Traction drive temperature is high	Controller temperature is too high alarm (temperature is higher than 85 ° C alarm, above 110 ° C cut)
18	83	ERROR. Traction drive temperature sensor error	The controller temperature sensor is faulty and needs to be replaced.

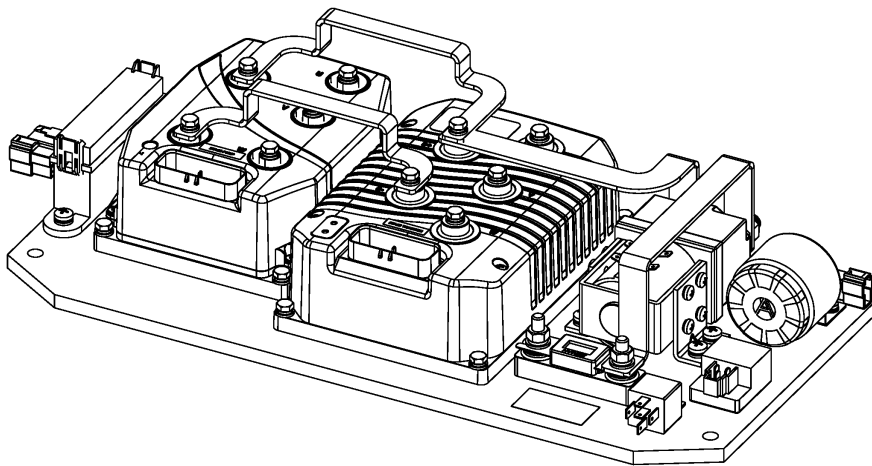
19	84	WARNING. Traction motor temperature is low	1. The traction motor temperature is too low. 2, traction motor thermistor failure
20	85	WARNING. Traction motor temperature is high	1. The traction motor temperature is too high. 2. traction motor thermistor failure
21	86	ERROR. Traction motor temperature sensor error	1. Traction motor thermistor fault (resistance value 600Ω at normal temperature). 2, wire harness failure, traction motor temperature sensor connection line broken
22	87	ERROR. Traction motor temperature sensor error	1. Traction motor speed sensor failure 2. Harness failure, traction motor speed sensor connection line break
23	88	WARNING. Traction drive DC bus voltage is high	1. The battery voltage is high. 2. The steep slope is too steep and the regenerative braking is too strong.
24	89	WARNING. Traction drive DC bus voltage is low	Need to charge or check power harness, battery line virtual connection, battery breakage
25	91	WARNING. Traction drive limited energy	Low battery and reduced vehicle speed
26	97	ERROR. Traction drive output error	Check the output harness for short circuit and open circuit (main contactor, reverse relay, etc.)
27	101	ERROR. Traction motor drive short circuit	1. Check the power harness. 2, the contact is not connected to the controller is enabled
28	102	ERROR. Traction drive temperature is high	Traction drive temperature is too high, need to be cooled.
29	103	ERROR. Traction motor temperature is high.	1. The temperature of the traction motor is too high and needs to be cooled. 2, traction motor temperature sensor failure
30	104	ERROR. Traction drive overcurrent	1. The vehicle is overloaded or mechanically stuck. 2, motor encoder failure
31	105	ERROR. Traction drive precharge timeout	Replace the pre-charge resistor (normally 50W, 100Ω)
32	112	ERROR. Traction drive DC bus voltage is high (hardware detection)	The battery voltage is high (if the voltage is not high, it is the controller failure) 48V system can not exceed 58V, 80V system can not exceed 98V
33	121	WARNING. Pump driver temperature is low	Controller temperature low alarm
34	122	WARNING. Pump driver temperature is high	Controller temperature high alarm
35	123	ERROR. Pump driver temperature sensor error	Controller temperature sensor failure
36	124	WARNING. Pump motor temperature is low	1. The oil pump motor temperature is too low. 2. The oil pump motor thermistor is faulty (the resistance at room

			temperature is 600 Ω)
37	125	WARNING. Pump motor temperature is high	1. The oil pump motor temperature is too high. 2. The oil pump motor thermistor is faulty (the resistance at room temperature is 600 Ω)
38	126	ERROR. Pump motor temperature sensor failure	1. Oil pump motor thermistor fault (resistance is 600 Ω at room temperature). 2. Harness failure, oil pump motor temperature sensor connection line is broken (P6/P26)
39	127	ERROR. Pump control speed sensor failure	Encoder failure (A phase A7 of the encoder, A phase of the B phase is worn or broken), check the mechanical and circuit functions of the encoder; possible alarms caused by interference caused by the iron scraps attracted by the encoder. None of the above is better controller.
40	128	WARNING. Pump driver DC bus voltage is high	High battery voltage.
41	129	WARNING. Pump driver DC bus voltage is low	Need to charge or check the power harness.
42	132	WARNING. Pump driver limited energy	Battery is low and needs to be charged.
43	137	ERROR. Pump driver output port failure.	Check the output harness for short circuit and open circuit.
44	138	WARNING. Pump driver overcurrent or short circuit	The pump driver temperature is too high and needs to be cooled (temperature above 85 ° C alarm, above 110 ° C cut). Use the monitor menu to compare the controller temperature with the motor temperature or ambient temperature to determine if the displayed controller temperature is correct. If not, replace the controller.
45	141	ERROR Pump driver short circuit	
46	142	ERROR Pump driver temperature is high	
47	143	ERROR Pump motor temperature is high	Pump motor temperature is too high alarm
48	145	ERROR Pump driver precharge timeout	Replace the precharge resistor
49	154	ERROR Pump driver speed control failure	
50	157	BMS Over temperature protection	Lithium battery over temperature protection
51	158	BMS Monomer over-discharge	Lithium battery low battery cell over discharge
52	159	BMS Over voltage protection	Lithium battery low voltage protection
53	163	BMS Over current	Lithium battery current is too large
54	164	Charging protection	Lithium battery charging protection
55	156	Temperature protection	Lithium battery temperature protection

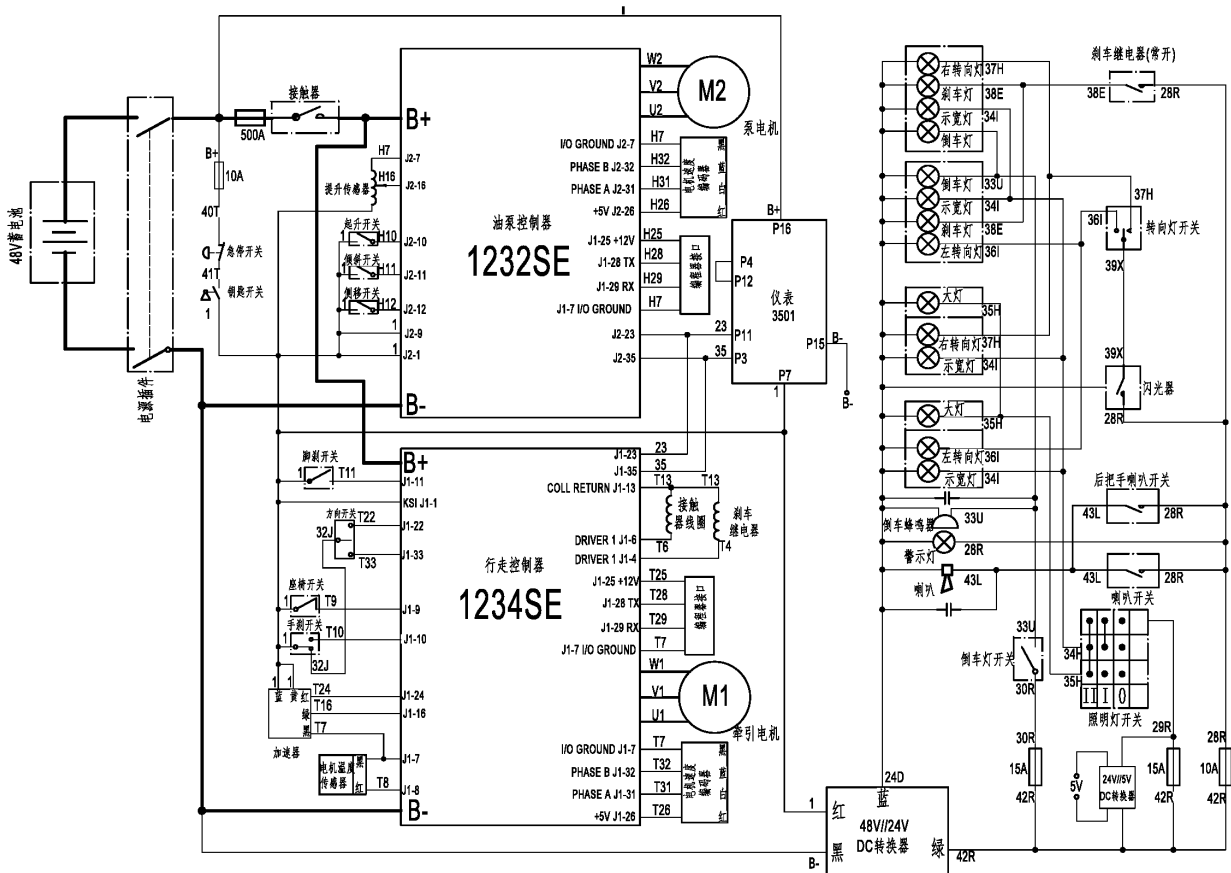
56	155	BMS CAN bus off	BMS Communication failure between CAN and controller and instrument (measuring the on/off status of communication line CAN H 33/CAN L 21 respectively)
57	165	After the seat switch is disconnected for a period of time, the direction requires a reset	Reset direction switch
58	168	BMS Current limiting protection	Lithium battery current limiting protection
59	169	BMS Current cut protection	Lithium battery cut-off protection
60	170	BMS Vehicle feedback protection	Lithium battery vehicle feedback protection
61	171	BMS CAN error	BMS CAN error
62	200	Proportional valve controller error	Special proportional valve report failure

#### 4.2 Electronic control assembly(Curtis)

The model consists of two US Curtis AC controllers 1232SE-5221 as the traction controller and 1232SE-5321 as the pump controller.



##### 4.2.1Electrical system schematic



#### 4.2.2 Main functions and settings

By correctly setting the various motor technical parameters and control technical parameters and function values of the controller, the safety and high efficiency of the electric forklift can be realized and the complete operation function can be realized.

1. The electric forklift crawling speed can be set. The electric forklift can be operated for a long time at low speeds by the controller's creep speed setting function.
2. The acceleration rate can be set. The acceleration rate is the "soft and hard" feeling of the accelerator pedal when operating the electric forklift. By setting the acceleration rate, the forklift can meet the requirements of the accelerated operation under different working conditions.
3. Reverse braking and regenerative braking. When the vehicle is running, when the direction bar is reversed, the reverse braking signal is generated. It controls the traction motor through the motor driver to give a braking torque to achieve the purpose of vehicle deceleration. The braking force is controlled by an accelerator pedal. The regenerative braking is generated by the controller's control under the condition that the vehicle speed is relatively higher than the traction motor speed. The energy of the vehicle braking can be converted into electric energy and fed back to the battery pack. Especially when the electric forklift slides down the slope, in order

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to properly reduce the speed of the downhill slope of the vehicle, the accelerator pedal can be appropriately lifted and released to realize the regenerative braking, which prolongs the driving distance of the battery once.

4. The anti-slip function of the ramp. Electric forklifts with AC traction motors have excellent features that do not slip on the ramp.

5. The maximum driving speed can be set. The reasonable setting of the maximum running speed of the electric forklift can prevent the traction motor from being overloaded due to the excessive speed.

6. static recovery shut down. If the seat switch or key switch is turned off, the control unit is turned off and the direction lever must be pulled back to the neutral position to restart. If the driver leaves the vehicle and returns at any time, the steering lever needs to be pulled back to the neutral position before restarting. This feature prevents accidental unsafe operations from occurring. A time delay of a few seconds is provided at the input of the seat switch to allow the seat switch to be momentarily disconnected in the event of a bump

7. security protection features. If the power component of the controller is damaged during operation, the controller will disconnect the main contactor in the shortest time; when the controller temperature rises too high, the controller will automatically limit the armature current of the motor; when the battery voltage is over When low, the controller will stop working for safety.

8. Traction motor controller and oil pump motor controller have self-diagnosis function. During the operation of the controller, in the event of a fault, the fault code is displayed on the display meter and the controller is automatically stopped to ensure the safety of the operating system.

9. The display battery will display the battery's power and accumulated working hours.

#### 4.1.3 Maintenance of the circuit system

(1) Check the wear condition on the contacts; replace them when the contacts are worn. Contactor contacts should be inspected once every 3 months.

(2) Check the pedal or handle micro switch; measure the voltage drop across the micro switch, there should be no resistance when the micro-motion is opened and closed, and there should be a crisp sound when released. Check every 3 months.

(3) Check the main circuit: battery-controller-motor connection cable. Make sure the cable is well insulated and the circuit connections are tight. Check every three months.

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

(5) Check the mechanical movement of the contactor; it should be freely movable and not adhered, and the mechanical action of the contactor should be checked every 3 months.

4.2.4 Integrated meter

The new Integrated meter is used to realize the auxiliary control function and provide the driver vehicle condition display interface. It consists of a control circuit, a cumulative time counter (liquid crystal display), a battery fuel gauge, a fault code display, and other display circuits. According to the current demand situation of electric vehicles, this instrument has made a new design in the control circuit and display form, which can provide drivers with intuitive vehicle status information, compact structure, elegant appearance, high automation and reliable quality.

Figure instruction:

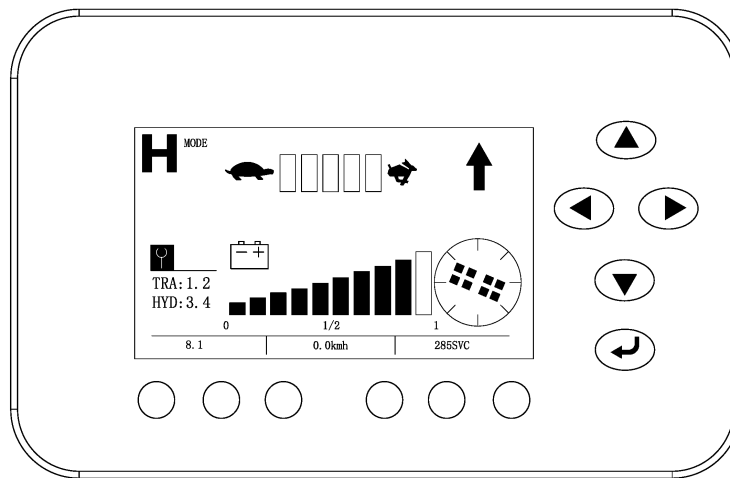


图 2-41 CURTIS meter

- 1)、“TRVAL” Indicates the state of the traction controller, the digital code indicates the controller failure, and the specific code refers to 4.4 Fault Analysis.
- 2)、“HYD” ndicates the pump controller status. The digital code indicates the controller failure, and the specific code refers to 4.4 Fault Analysis.
- 3)、The upper left letter represents the vehicle operating mode: “H” stands for high efficiency mode; “S” stands for normal mode; “E” stands for economic mode, and mode switching can be switched



by buttons

- 4)、The parameters of the instrument are adjusted. The company has completed the commissioning before leaving the factory. If it needs to be changed, contact the company’s after-sales department for modification.

4.2.5 Failure analysis

1232SE/1234SE Controller Fault Table and Diagnostic Guide

Programmer display code	Meter display code	Error	Reason
-------------------------	--------------------	-------	--------

Controller Overcurrent	1.2	Controller current overload	1, the motor external U, V or W connection short circuit 2, the motor parameters do not match 3, controller failure
Current Sensor Fault	1.3	Current sensor failure	1, the motor U, V, W on the car body circuit, resulting in leakage 2, controller failure
Precharge Failed	1.4	Precharge failed	1, the positive terminal of the capacitor is externally connected, so that the capacitor cannot be charged normally.
Controller Severe Undertemp	1.5	Controller temperature is too low	1, the controller working environment temperature is too low
Controller Severe Overtemp	1.6	Controller temperature is too high	1, the controller working environment is too harsh 2, the vehicle is overloaded 3, the controller installation error
Severe Undervoltage	1.7	Low voltage	1, the battery parameter setting is wrong 2, non-controller system power consumption 3, the battery impedance is too large 4, the battery is disconnected 5, the fuse is disconnected, or the main contactor is not connected
Severe Overvoltage	1.8	High voltage	1, the battery parameter setting is wrong 2, the battery impedance is too high 3, the battery connection is disconnected during regenerative braking
Controller Overtemp Cutback	2.2	Controller temperature is too high, resulting in performance reduction	1, the controller working environment is harsh 2, the vehicle is overloaded 3, the controller is not installed correctly
Undervoltage Cutback	2.3	Low voltage performance reduction	1, the battery is low 2, battery parameter setting error 3, non-controller system runs out of power 4, the battery impedance is too large 5, the battery is disconnected 6, the fuse is disconnected or the main contactor is disconnected



Overvoltage Cutback	2.4	Voltage over performance reduction	1, the regenerative braking current during regenerative braking causes the battery voltage to rise 2, battery parameter setting error 3, the battery impedance is too large 4, during regenerative braking
+5V Supply Failure	2.5	Controller output 5v power failure	1, the external load impedance is too low
Digital Out 6 Failure	2.6	Drive 6 output overcurrent	1, external load impedance is too low
Digital Out 7 Overcurrent	2.7	Drive 7 output overcurrent	1, external load impedance is too low
Motor Temp Hot Cutback	2.8	Motor overheating leads to performance degradation	1, the motor temperature reaches or exceeds the programmed warning temperature, resulting in lower current output 2, the motor temperature parameter setting is incorrect 3. If the motor does not use a temperature sensor, the programming parameters "Temp compensation" and "Temp Cutback" must be set to "OFF".
Motor Temp Sensor Fault2.9	2.9	Motor temperature sensor failure	1, the motor temperature sensor is connected incorrectly 2, if the motor does not use a temperature sensor, Programming parameter "MotorTemp Sensor Enable" must be set to "OFF"
Coil 1 Driver Open/Short	3.1	Drive 1 output connection coil open Or short circuit	1, the connection load is open or shorted 2, the connection pin is defaced 3, wrong wiring
Main Open/Short	3.1	Main contactor coil	1, the connection load is open or shorted 2, the connection pin is defaced 3, wrong wiring


		open/short circuit	
Coil2 Driver Open/Short3.3	3.2	Drive 2 output connection coil open Or short circuit	1. Connect the load to an open or short circuit 2. Connection pin defacement 3. Wrong wiring
EMBrake Open/Short	3.2	Electromagn etic brake coil open / short circuit	1, the connection load is open or shorted 2, the connection pin is defaced 3, wrong wiring
Coil3 Driver Open/Short	3.3	Drive 3 output connection coil open / Short circuit	1, the connection load is open or shorted 2, the connection pin is defaced 3, wrong wiring
Coil4 Driver Open/Short	3.4	Drive 4 output connection coil open / Short circuit	1, the connection load is open or shorted 2, the connection pin is defaced 3, wrong wiring
PD Open/Short	3.5	Proportiona l drive open/short circuit	1, the connection load is open or shorted 2, the connection pin is defaced 3, wrong wiring
Encoder Fault	3.6	Encoder failure	1, motor encoder failure 2, wrong wiring
Motor Open	3.7	Motor open circuit	1, motor phase loss 2, wrong wiring
Main Contactor Welded	3.8	Main contactor adhesion	1, main contactor contact welding 2, motor U or V phase disconnected or missing phase 3, there is a circuit connecting the B+ terminal to charge the capacitor

Main Contactor Did Not Close	3.9	Main contactor is not closed	1, the main contactor is not closed 2, the main contactor contacts are oxidized, melted, or Unstable connection state 3, the capacitor is charged by an external device 4, the fuse is disconnected
Throttle Wiper High	4.1	Accelerator output is high	1, the accelerator potentiometer output voltage is too high
Throttle Wiper Low	4.2	Accelerator output is low	1, the accelerator potentiometer output voltage is too low
Pot2 Wiper High	4.3	Potentiometer 2 output is too high	1, potentiometer 2 output voltage is too high
Pot2 Wiper Low	4.4	Potentiometer 2 output is too low	1, potentiometer 2 output voltage is too low
Pot Low Overcurrent	4.5	Potentiometer low current is too high	1, the potentiometer impedance is too low
EEPROM Failure	4.6	EEPROM Invalid	1. The write to the EEPROM memory failed. This may be due to a VCL write to the EEPROM memory, or a CAN BUS, or a parameter error programmed into the controller after the programmer parameters are adjusted.
HPD/Sequencing Fault	4.7	High pedal protection/operation sequence failed	1, key start, interlock, direction, and accelerator input sequence settings are incorrect. 2, wiring, switch key, interlock, square To, or accelerator input fault
Emer Rev HPD	4.7	Emergency reverse high pedal protection	1, the emergency reverse operation has ended, but the accelerator, forward and reverse input and interlock have not been reset
Parameter Change Fault	4.9	Parameter change failed/error	1, in order to ensure the safety of the vehicle, some specific parameters must be changed after the key switch is restarted.

OEM Faults	5.1-6.7	OEM failure (custom failure)	1, the user can define the fault for some phenomena, expressed by the code of VCL
VCL Run Time Error	6.8	VCL running time error	1, VCL code timeout for runtime
External Supply Out of Range	6.9	External power output is out of range	1, External load at 5V and 12V supply current is too large or too small 2, the parameter in the "Checking Menu" is wrong, such as "ExtSupply Max", "Ext Supply Min"
OS General	7.1	Operating system failure	1, Internal controller failure
PDO Timeout	7.2	PDO overtime	1, CAN PDO information accepted for longer than the PDO time limit
Stall Detected	7.3	Motor stall	1, the motor turns 2, motor encoder failure 3, wrong wiring 4, input motor encoder power failure
Motor Characterization Fault	8.7	Motor matching failed	1, code comparison occurs during motor matching: 0 = normal 1 = The controller received the encoder signal, but the amount of pulses is undefined. Please set the pulse value manually 2=Motor temperature sensor failure 3 = motor high temperature reaction failure 4=Motor overheating failure 5=Motor low temperature reaction failure 6=Low voltage response failure 7 = high pressure reaction failure 8=The controller does not detect the encoder signal, and the channel signal disappears. 9=Motor parameter setting exceeds the range
Motor Type Fault	8.9	Motor type error	1, the motor type (Motor Type) parameter value is out of range
VLC/OS Mismatch	9.1	VCL/OS Mismatch	1, The VCL program in the controller does not match the OS program

EM Brake Failed to Set	9.2	Electromagnetic brake setting is invalid	1. The vehicle still moves after the electromagnetic brake command is set. 2, electromagnetic brake braking force is too small
Encoder LOS (Limited Operating Strategy)	9.3	Encoder limited operating state	1, the restricted operating state is activated due to motor stall or encoder failure 2, wrong wiring 3, the vehicle stalls
Emer Rev Timeout	9.4	Emergency reverse reaction timeout	1, the emergency reverse timeout is activated because the EMR Timer timer expires 2, the emergency reverse switch is always in the On position
Illegal Model Number	9.5	Controller model error	1, the controller model is not recognized 2, hardware and software do not match each other 3, the controller is damaged

The programmer directly enters the inside of the controller to see the fault is more concise and convenient.

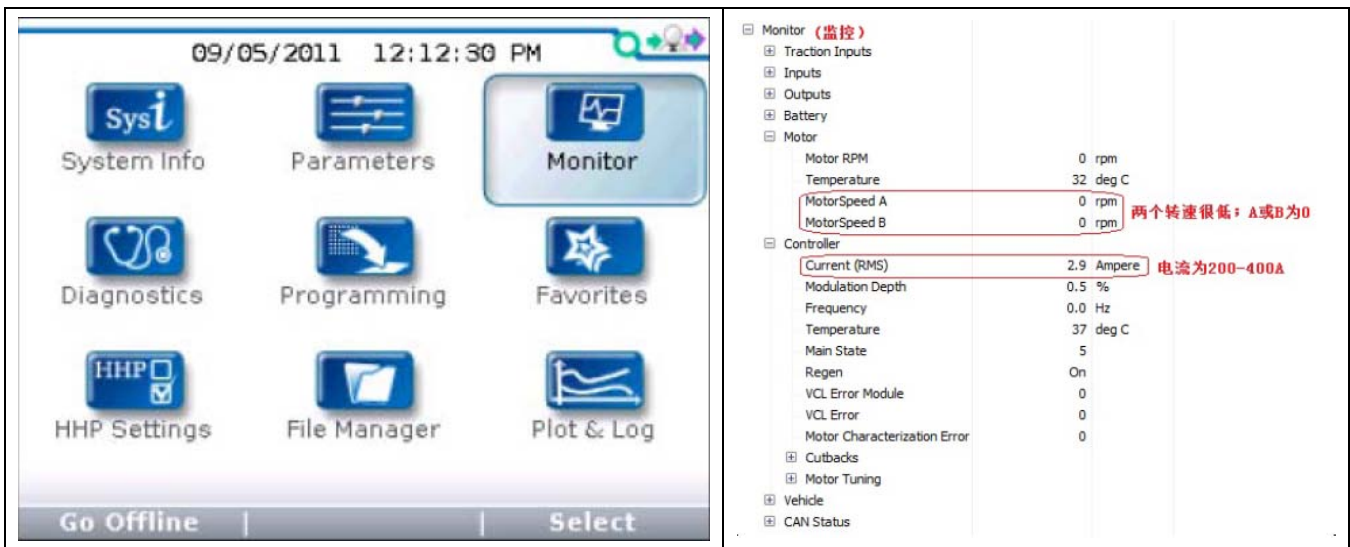
		
Hand-held connection to the controller to turn on vehicle power	Select diagnostic menu	First current fault, second historical fault.

#### 4.2.6 Fault Case Analysis and Solution

##### 1) Encoder failure, failure

Vehicle failure phenomenon: The vehicle travels very slowly and has a lot of vibration; the instrument does not display any fault codes; the pump motor does not work, but the sound of the motor is heard. A common phenomenon is that the motor generates heat after a period of operation.

Judgment method: access the monitor menu "monitor" of the handheld access controller



Solution:

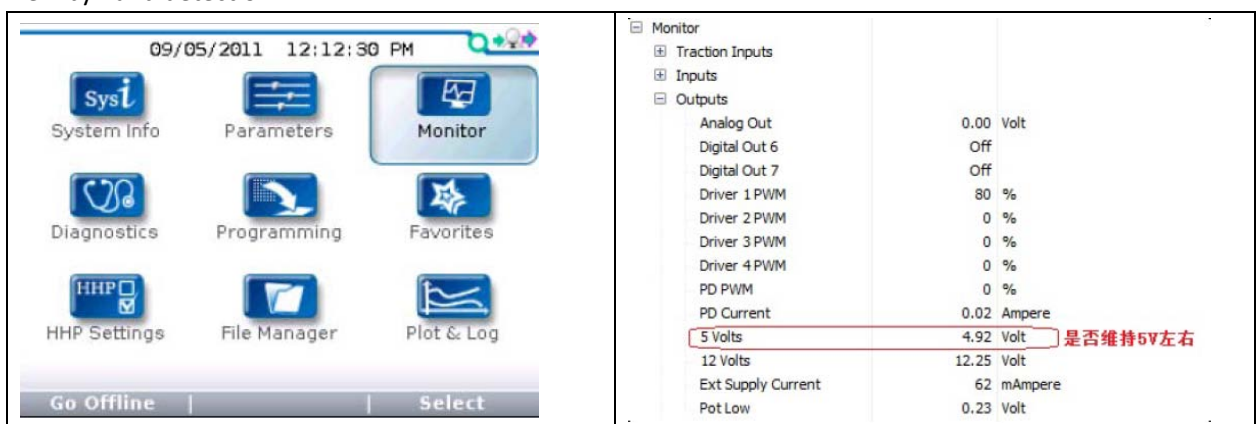
- A. Check if the motor encoder cable is loose, the plug in the plug-in is retracted, and the cable is disconnected. The above conditions are adjusted and repaired, and the encoder cannot be repaired.
- B. line, connector, wiring is completely normal, directly change the encoder.
- C. Special case: The mechanical jam causes the motor to stall. Travel motor: support the front wheel, let the drive wheel vacate, close the key switch, manually rotate the wheel; pump motor: disconnect the gear pump and the pump motor.

2) Encoder failure

Fault phenomenon: The vehicle failure phenomenon is that the vehicle travels very slowly and the jitter is severe; the instrument reports 7.3 fault code.

Judgment method:

- A. Check the electrical schematic diagram, check the encoder connection line number and the corresponding color.
- B. View by hand detection



Turn on the key switch normally, and report 7.3 fault during operation, there is a problem with the motor or

controller.

Solution:

- A. Refer to the electrical schematic to check the encoder line number and color correspondence. Most of them are wrong during the process of replacing the encoder.
- B. the internal power supply of the encoder is faulty, and the encoder is replaced.

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### 3) Instrument 7.7 failure

Fault phenomenon: open the key switch, the vehicle does not have any action, the meter reports 7.7 fault code

Judgment method: Firstly, the fault is special and not reflected in the fault code table. The fault occurs when the controller performs self-check after opening the key switch, and the voltage signal of the key switch is removed, and other switches have low voltage.

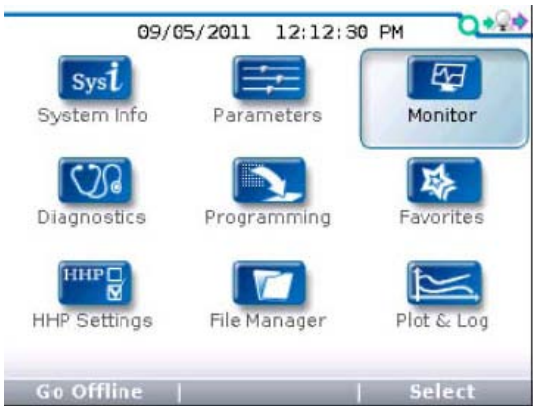
Treatment method:

- A. The vehicle is damp, drenched, and the battery leaks, causing other switches except the key switch to have low voltage to enter the controller switching signal terminal.
- B. Internal problems of the controller, replace the controller.

### 4) The vehicle meter has no fault indication, the vehicle can not operate normally

Fault phenomenon: The vehicle instrument has no fault display, but the vehicle can't walk, no lift, no steering, etc., which affects the normal operation of the vehicle

Judgment method: Most of the faults are faults caused by missing switch signals or damage to the switch electrical components. View the switch quantities through the handheld programmer.



After connecting the controller to the controller, enter the detection menu "Monitor"

Traction controller input signal change

Pump controller input signal

Monitor	
Pump Inputs	
Lift Cutout Flag	Off
Steer Flag	Off
Lift Input	Off
SS1 Input	Off
SS2 Input	Off
SS3 Input	Off
SS4 Input	Off
SS5 Input	Off

⇒ 前进、后退、刹车任意动作引起转向信号变化
⇒ 举升信号变化
⇒ 前倾、后倾信号变化
⇒ 左移、右移信号变化

Solution: Check the signal change monitored by the “Monitor” menu to confirm the existence of the corresponding switch signal, and judge the quality of the corresponding electrical device, and then replace it.

5) The main contactor is not closed

Symptom: Turn on the key switch, the contactor does not hear the sound, and the meter reports 3.9 fault code, the vehicle has no action.

Judgment method:

- A. Use a multimeter to measure the resistance of the contactor coil. The resistance should be around 200 Ω.
- B. Check if the wiring at the contactor coil is loose, and the wiring is correct (#6 line and #13 line of the controller, according to the electrical schematic)
- C, through the handheld into the controller's monitoring menu



Monitor		
Traction Inputs		
Inputs		
Outputs		
Analog Out	0.00	Volt
Digital Out 6	Off	
Digital Out 7	Off	
Driver 1 PWM	80 %	线圈处电压=电池电压X80%
Driver 2 PWM	0 %	
Driver 3 PWM	0 %	
Driver 4 PWM	0 %	
PD PWM	0 %	
PD Current	0.02	Ampere
5 Volts	4.92	Volt
12 Volts	12.25	Volt
Ext Supply Current	62	mAmpere
Pot Low	0.23	Volt
Battery		

The contactor contacts are not properly compressed due to oxidation, melting or spring deformation. The large fuse is blown.

Solution:

- A. If it is a resistance problem of the contactor coil, the main contactor needs to be replaced.
- B. If the resistance value is within the normal range, open the contactor end cover to see if the contact is in a blackened state. It can be sanded with sandpaper. If the contact is severely deformed, the main contactor needs to be replaced.

6) Accelerator output is high, the instrument reports 4.1 fault

Judgment method: check the accelerator analog output, and enter the controller's monitoring menu by hand.

Monitor		
Traction Inputs		
Inputs		
Throttle Command	0.0 %	
Mapped Throttle	0.0 %	
Throttle Pot	0.08 Volt	加速器模拟信号故障 (0-5V变化)
Brake Command	0.0 %	
Mapped Brake	0.0 %	
Pot2 Rev	6.17 Volt	
PD Throttle	0.00 %	
Steer Pot	0.00 Volt	转角电位器电压 (0-5V变化)
Steer Angle (deg)	0	
Interlock	On	
Emer Rev	Off	
Analog 1	0.02 Volt	
Analog 2	1.34 Volt	
Switch 1	Off	加速器踏板开关信号变化
Switch 2	Off	
Switch 3	On	座椅开关信号变化
Switch 4	Off	驻车制动开关信号变化
Switch 5	Off	脚踏制动开关信号变化
Switch 6	Off	
Switch 7	On	前进开关信号变化
Switch 8	Off	后退开关信号变化
Driver 1 Input	Off	
Driver 2 Input	Off	
Driver 3 Input	On	
Driver 4 Input	On	
PD Input	Off	
DigOut6 Input	Off	
DigOut7 Input	Off	
Switch 16	Off	
Outputs		

5、The key position installation torque icon

	
<p>Install the steering cylinder joint on both sides of the steering cylinder, and tighten the joint port downwards. The tightening torque is <math>64 \pm 7\text{N.m}</math>.</p>	<p>Install the two steering axle fixing plates, tighten the connecting bolts, tighten the torque <math>230 \pm 23\text{N.m}</math></p>
	
<p>Align the semi-circular frame of the frame into the drive axle, turn the left and right support plates, tighten the bolts, tighten the torque <math>400 \pm 40\text{N.m}</math></p>	<p>Flatten the drive axle, tighten the bolts and nuts. Install the split pin, tightening torque <math>400 \pm 40\text{N.m}</math></p>
	
<p>Install the fuel tank fixing bolts and tighten them to the torque. Tightening torque <math>20 \pm 2\text{N.m}</math></p>	<p>Screw in the fixing bolt and tighten it to the torque. Tightening torque <math>50 \pm 5\text{N.m}</math></p>



Install the steering unit mount into the foot brake, insert the trunnion, tighten the bolt, tighten the torque  $11 \pm 2$ N.m



The left and right brake hoses are connected to the brake pump and the joints are tightened to a tightening torque of 18 N.m



Install the multi-way valve on the bracket plate, tighten the bolts to the torque, tighten the torque  $50 \pm 5$ N.m



The multi-way valve mounting bracket is mounted on the frame, screwed into the fixing bolts, tightened according to the torque, tightening torque  $50 \pm 5$ N.m



The multi-way valve over-rod fixed seat is mounted on the frame mounting plate, and the bolt is tightened according to the torque. The tightening torque is  $20 \pm 2$ N.m.



Put a clamp on both ends of the pump oil suction hose, connect the pump suction port and the fuel tank suction port, and the rubber pipe is inserted into the depth of 35mm.

	
<p>Screw in the fixing bolt and tighten it to the torque. Tightening torque <math>450 \pm 30\text{N.m}</math></p>	<p>Flat washer on the bolt string, through the front and rear column assembly holes of the top guard, tightened according to the torque, tightening torque <math>90 \pm 9\text{N.m}</math></p>
	
<p>Apply a uniform thermal grease to the underside of the controller</p>	<p>The driving wheel is mounted on the hub and fixed firmly. The tightening torque is <math>190 \pm 19\text{N.mN.m}</math></p>
	
<p>The steering wheel is mounted on the hub and fixed firmly. The tightening torque is <math>120 \pm 12\text{N.mN.m}</math></p>	