



**1.3–2.0t 3-Wheel Battery Counterbalanced Forklift Truck**

# **Service Manual**



The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized UTILEV® distributor. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.

May 2013

# Foreword

This manual covers the components, operation, and servicing of the 1.3t-2.0t 3 wheel electric forklift truck.

To ensure safe operation of this truck, it is important to read and understand the contents of this manual.

Only qualified service personnel should perform maintenance on this truck.

Product specifications in this manual may vary from your actual truck due to periodic improvements in design.

Please contact your sales agent if you have any questions or comments regarding this manual.

This electric three-wheel forklift truck has passed the requirements for and is approved for operation in countries adhering to CE regulations.

<b>Model</b>	<b>Driven controller</b>	<b>Pump controller</b>	<b>Rated capacity(t)/ Load Center(mm)</b>
UT13PTE	CURTIS 1234×2	CURTIS 1234	1.3 / 500
UT15PTE	CURTIS 1234×2	CURTIS 1234	1.5 / 500
UT16PTE	CURTIS 1234×2	CURTIS 1234	1.6 / 500
UT18PTE	CURTIS 1234×2	CURTIS 1234	1.8 / 500
UT20PTE	CURTIS 1234×2	CURTIS 1234	2.0 / 500

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# 1 Drive System

The drive system adopts a dual-motor front wheel drive, wherein the left and right drive wheels are driven independently by different motors, the rotation speed of the left and right motors is controlled by the rear wheel steering angle, and each motor is connected to the gearbox, brakes, solid tires, rims and other components.

The reduction gearbox is a double reduction system with a compact structure, comprising a first-stage cylindrical helical gear set and a second-stage planetary final drive.

The brakes are maintenance-free, wet disc brakes.

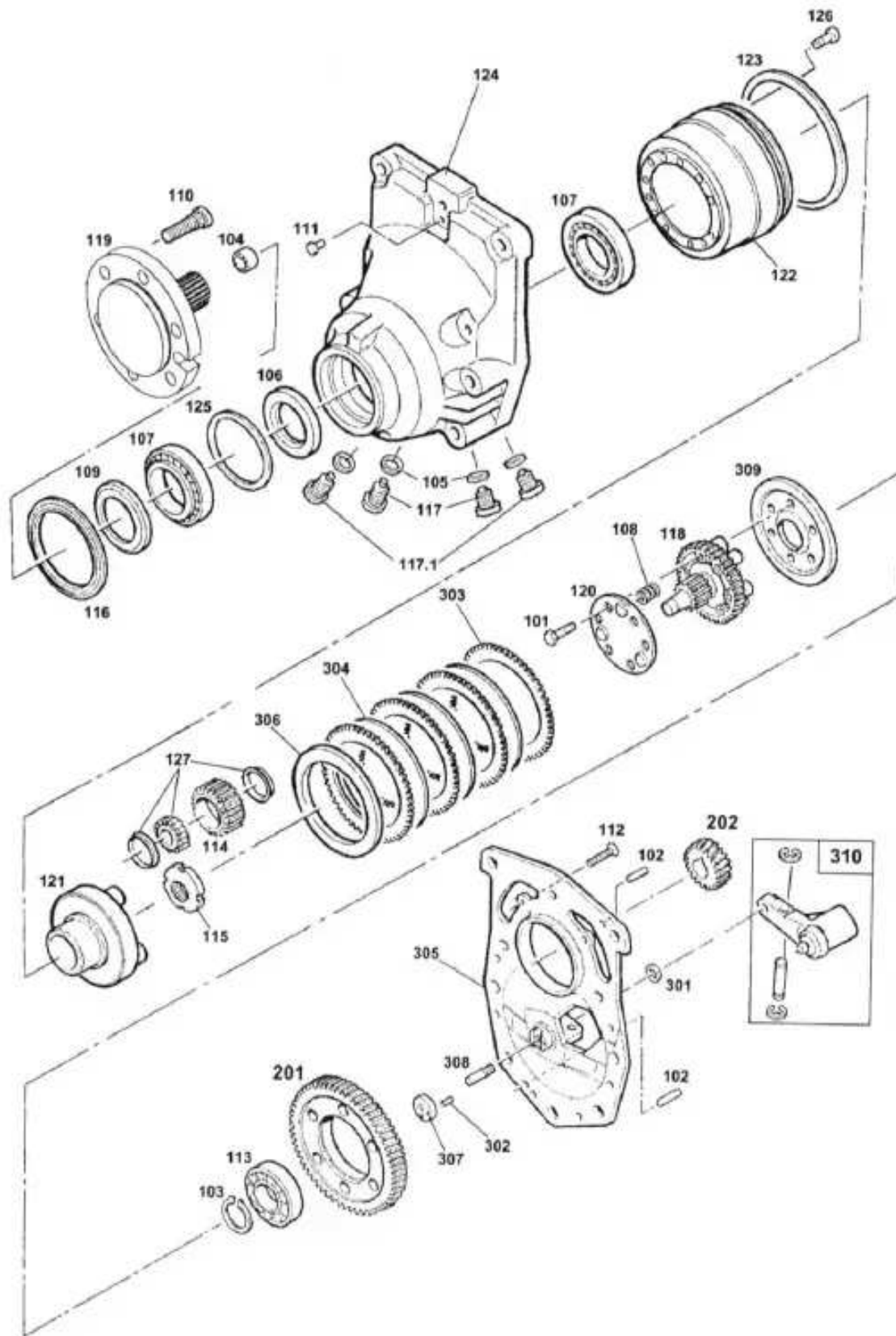
Failure	Possible Cause	Remedy
Loud impact sound when travelling and changing direction	Excessive gear backlash	Adjust
	Excessive gear wear	Replace
Gear noise when travelling	Gearbox oil level too low	Top up gear oil
	Excessive gear backlash	Adjust
	Excessive gear wear	Replace

## Gearbox

### Technical parameters

Item		Parameter
Weight (without oil)		31 kg
Oil capacity		0.35 L
Oil type		ATF DEXRON II
Foot brake	Brake fluid	
	Operating pressure	60-80 bar
	Normal pressure (maximum continuous)	80 bar
	Maximum pressure	100 bar
	Hydraulic cylinder brake fluid volume (under normal conditions)	1.71 cm <sup>3</sup>
	Hydraulic cylinder brake fluid volume (under maximum wear conditions)	3.71 cm <sup>3</sup>
Hand brake	Hand brake lever pulling force	100 N
	Stroke	6 mm
	Wear limit stroke	13 mm

# Structure





The brake rocker arm has three holes

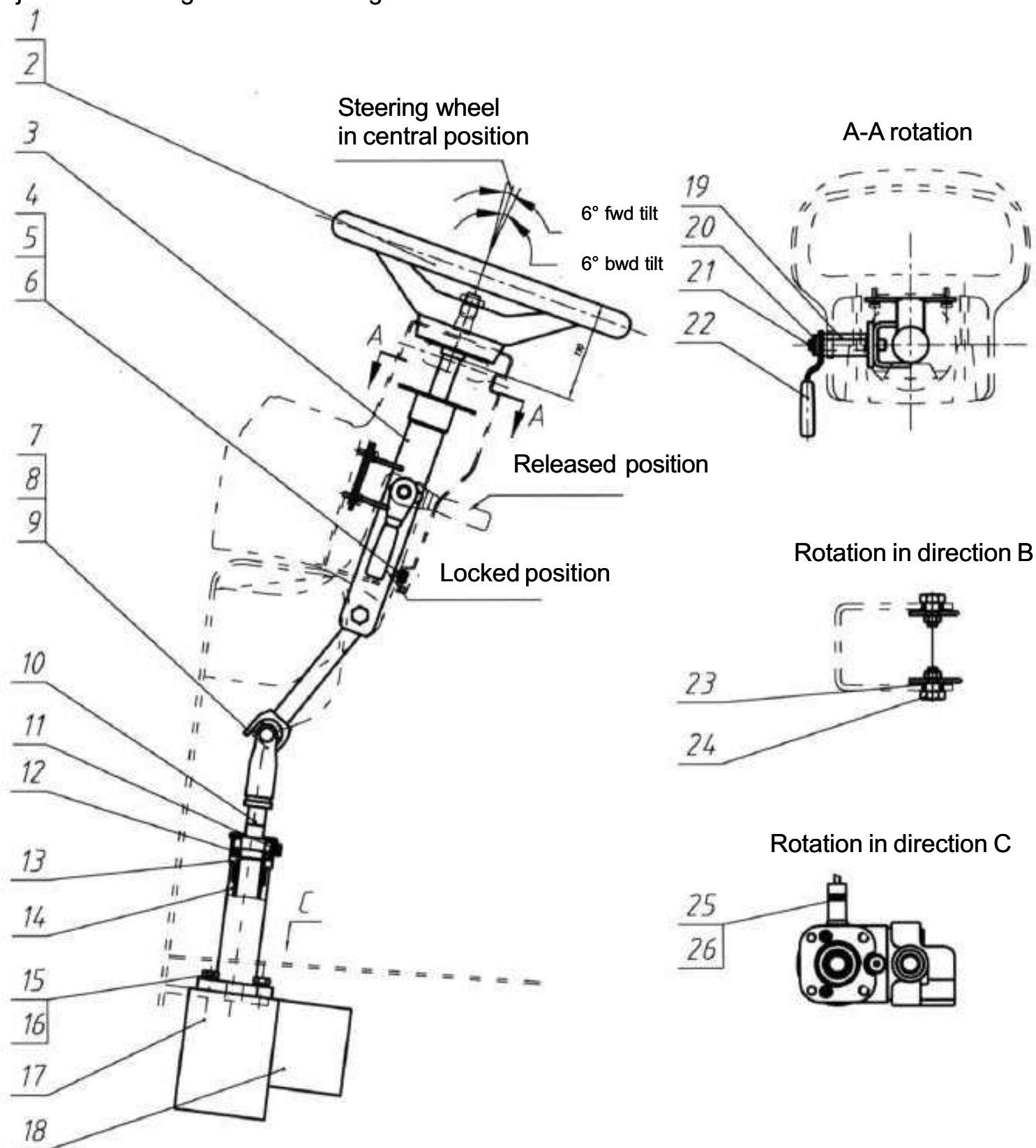
- = Air bleed plug: after adding brake fluid, loosen the bleed plug to expel any trapped air.
- = Hand brake cable connection head: connection head has a wear limit of 13 mm. Replace connection head once this limit is exceeded.
- Brake wheel cylinder inlet port: replace in the event of brake wheel cylinder leakage.

## 2 Steering System

The steering system consists of the steering device and the steering axle.

### Steering device

The steering device consists of the steering wheel, upper shaft assembly, universal joint, lower shaft assembly, bearings, snap rings, steering tube, steering gear, priority valve, clamping lever, hydraulic switch and other components. The steering wheel forward/backward tilt angle can be adjusted according to need. See Figure 2-2.



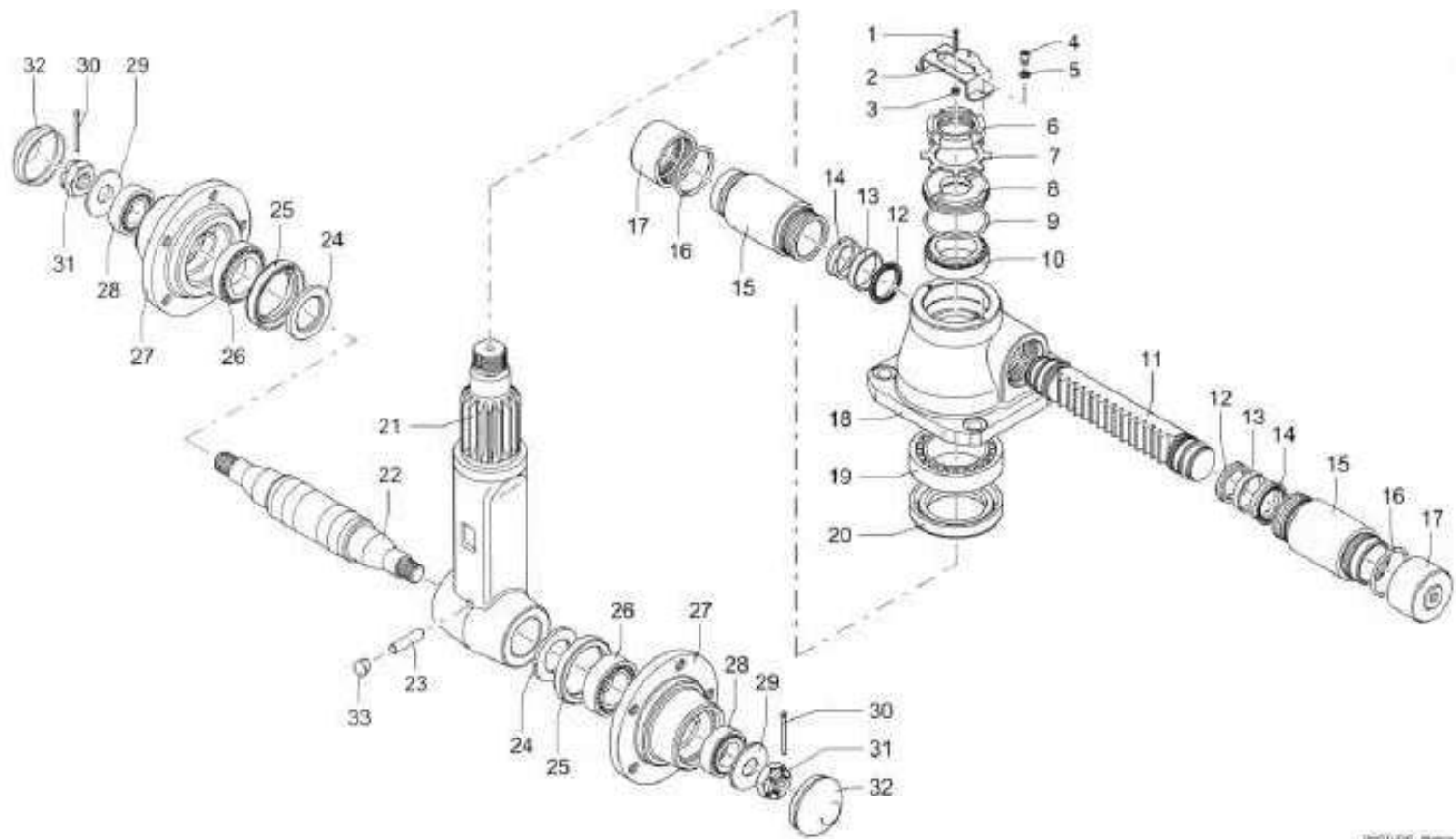
- |                    |                     |                    |                      |
|--------------------|---------------------|--------------------|----------------------|
| 1. Steering wheel  | 3. Upper shaft assy | 8. Universal joint | 10. Lower shaft assy |
| 12. Bearing        | 13. Snap ring       | 14. Steering tube  | 17. Steering gear    |
| 18. Priority valve | 19. Clamping bolt   | 22. Clamping lever | 26. Hydraulic switch |

Figure 2-2 Steering device



## Steering axle

Italian-made steering axle with a compact structure, see Figure 2-3.



- |                      |                           |                       |                 |
|----------------------|---------------------------|-----------------------|-----------------|
| 1. Fastening spindle | 2. Bracket                | 3. Nut                | 4. Screw        |
| 5. Washer            | 6. Check nut              | 7. Gasket             | 8. Adjuster nut |
| 9. Seal ring         | 10. Bearing               | 11. Rack              | 12. Seal ring   |
| 13. Guide sleeve     | 14. Seal ring             | 15. Cylinder body     | 16. Seal ring   |
| 17. Cylinder cap     | 18. Axle body             | 19. Bearing           | 20. Seal ring   |
| 21. Gear shaft       | 22. Steering axle spindle | 23. Pin               | 24. Gasket      |
| 25. Seal ring        | 26. Bearing               | 27. Steered wheel hub | 28. Bearing     |
| 29. Washer           | 30. Cotter pin            | 31. Nut               | 32. Hub cap     |
| 33. Plug             |                           |                       |                 |

Figure 2-3 Steering axle

The axle body (18) is fixed to the rear of the vehicle frame. Forces acting on it from the **ground are carried by the support bearings (10,19)**. The **adjuster nut (8) is used to adjust the preload** of the bearings (10,19). The cylinder body (15) is connected to the axle body (18). The end sections of the rack (11) acts like pistons; when hydraulic oil from the priority valve flows towards the cylinder body (15), it pushes the rack (11) to the left or to the right. The rack (11) engages with the gear shaft (21), which rotates the steered wheel left or right and turns the vehicle, with a maximum steering angle of 85° in both directions.

**Precautions for use:**

- In the event of oil leakage from the cylinder body, check and replace the seal rings (12,14, 16). Also check the guide sleeve and cylinder body for damage.
- Periodically check the bearings (10,19) and their seal rings (9,20), and replace promptly if damaged. Also change grease on a regular basis.
- Periodically check the bearings (26, 28), and their seal ring (25), and replace promptly if damaged. Also change grease on a regular basis;
- Adjusting the preload of the steered wheel hub bearings: remove the counterweight and its cover panel, then jack up the rear of the frame with an automotive jack so that the wheel is off the ground. Tighten nut (3) until the steered wheel hub cannot be moved by hand, then rotate it 1/8 to 1/4 turn in the opposite direction.
- Adjusting the preload of the support bearings (10,19): Remove counterweight and its cover panel, then jack up the rear of the frame. Tighten nut (8) until the steering spindle cannot be moved by hand, then rotate nut (8) 1/6 to 1/4 turn in the opposite direction.

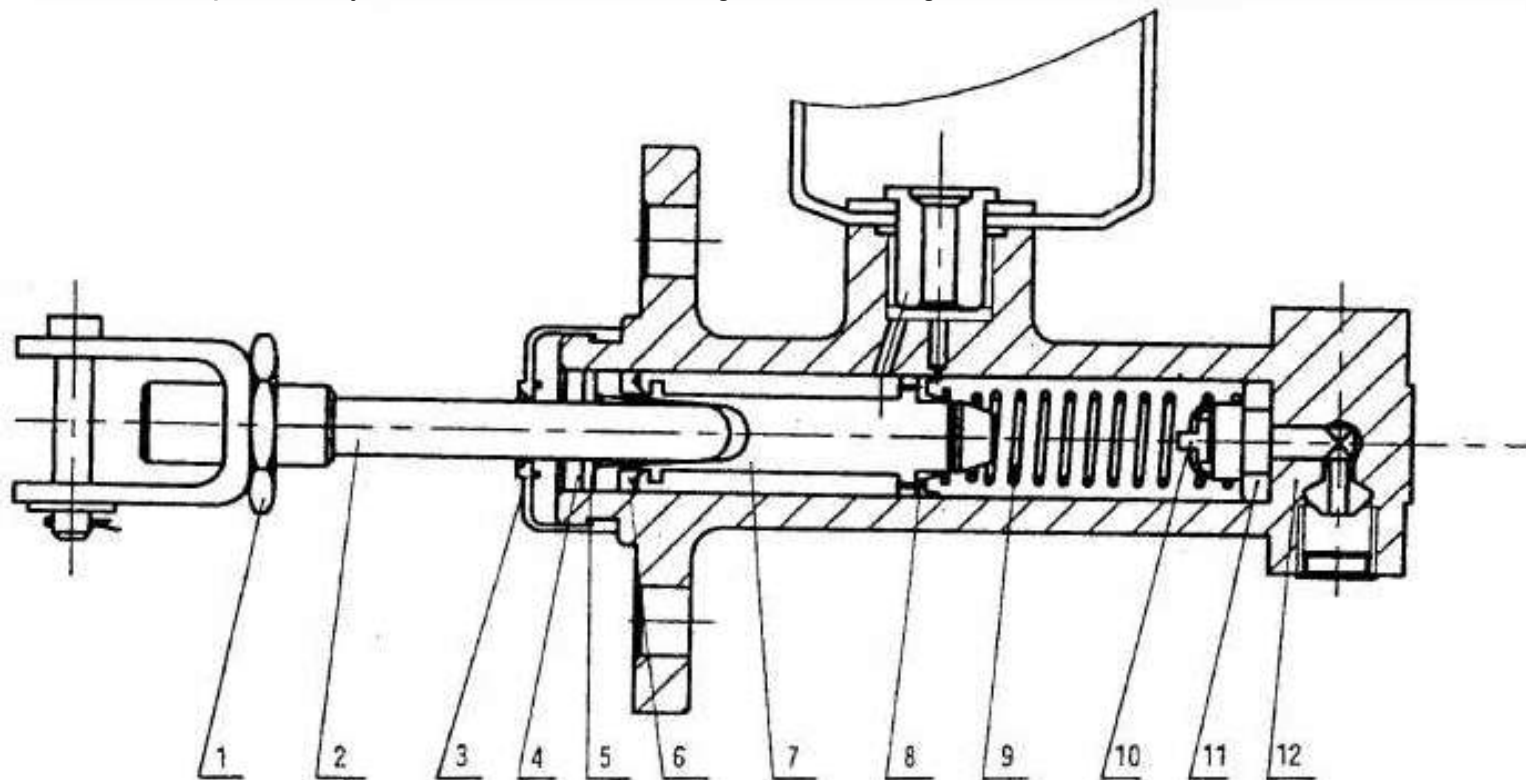
Problem	Cause Analysis	Remedy
Steering wheel will not turn	Pump damaged or faulty	Replace
	Clogged or damaged priority valve	Flush or replace
	Hose or connector damaged or pipe blocked	Replace or flush
Steering is hard	Diverter valve pressure too low	Adjust pressure
	Air in the oil line	Bleed off air
	Steering gear fails to centre, positioning spring broken or weak	Replace spring
	Excessive leakage inside steering cylinder	Check piston seal
Abnormal noise	Low oil tank level	Add oil
	Damaged steering gear shaft rack	Replace
	Damaged wheel bearing or support bearing	Replace
	Inadequate lubrication	Add grease
	Clogged suction pipe or oil filter	Flush or replace
Oil leak	Defective steering cylinder seal ring or damaged pipe or connector	Replace
	Damaged wheel hub bearing or support bearing or seal ring	Replace seal ring
Steering angles of left and right drive wheels (front wheels) do not match	Controller parameters incorrect	Adjust

### 3 Braking System

The braking system includes operation of the hand brake and foot brake. The hand brake consists of a lever and cable; the foot brake consists of a brake pedal, brake master cylinder, lines and brakes, etc. The brakes are maintenance-free wet disc brakes.

#### Brake master cylinder

The brake master cylinder consists of a valve seat, check valve and return spring, as well as a cup piston and auxiliary cup. The end part is secured using a snap washer and retaining wire, the outer part is protected by a rubber dust cover, and the master cylinder piston is actuated by the brake pedal via a pushrod. When the brake pedal is depressed, the pushrod pushes the piston forward and the brake fluid in the pump flows back to the reservoir via the return port until the main cup blocks the return port. Once the main cup pushes past the return port, the brake fluid in the front chamber of the master cylinder is compressed and opens the check valve, thereby flowing through the brake line to the wheel cylinders. This forces each wheel cylinder piston outward so that the brake shoe friction plate contacts the brake drum, thus causing the vehicle to decelerate or brake. At this point, the piston's rear chamber is replenished with brake fluid from the return and inlet ports. When the brake pedal is released, the pistons are forced back by the pressure of the return spring. At the same time, the brake shoe return spring forces the brake fluid in each brake wheel cylinder back through the check valve to the master cylinder (the front chamber of the piston). The piston returns to its original position and the brake fluid in the master cylinder flows back through the return port into the tank. The pressure of the check valve is adjusted until it reaches a certain ratio of the residual pressure in the brake line and brake wheel cylinders, so as to correctly position the wheel cylinder cups to prevent oil leakage, as well as eliminate the possibility of air resistance during hard braking.



1. Lock nut	2. Pushrod	3. Dust cover	4. Retaining wire
5. Retaining washer	6. Auxiliary cup	7. Piston	8. Main cup
9. Spring	10. Check valve	11. Valve seat	12. Pump body

Figure 3-1 Brake master cylinder

## Hand brake

The hand brake device has a pull cable mechanism. Together with the foot brake it is connected to automatically assist brakes that act on the front wheels. Only use the hand brake when parking the forklift.

Fault	Possible cause	Corrective measure
Insufficient braking force	Brake line leaks oil	Rectify and add oil
	Air in the brake line	Bleed off air
	Brake master cylinder not functioning properly	Rectify or replace
	Clogged oil line	Flush
Dragging brakes	No free play at the brake pedal	Adjust
	Damaged piston cup	Replace
	Return spring weak or broken	Replace
	Master cylinder return port clogged	Flush
	Clogged line	Flush

## 4 Hydraulic System

As high-pressure oil from the main oil pump flows through the priority valve, it is divided between two circuits. One circuit runs via the multi-way valve. High-pressure oil from this multi-way valve is routed to the lift cylinder or tilt cylinder. When the slide valves of both the lift and tilt cylinders are in the neutral position, no oil is supplied by the priority valve. When the lift slide valve is pulled, the high-pressure oil flows under the lift cylinder piston and pushes the piston rod upward. When the lift slide valve is pushed, the bottom of the lift cylinder piston is changed to the low pressure and relies on its own weight and the load weight to make the piston rod drop. At this point, oil flowing out of the lift cylinder and through the one-way speed limiting valve controls the lowering speed, and oil is not supplied by the priority valve. When the tilt slide valve is operated, high-pressure oil flows into a chamber of the tilt cylinder and the other side is changed to the low pressure, thereby causing the mast to tilt forward or backward. The other circuit runs via the steering gear, which is prioritised to ensure operation of the steering system.

### Main oil pump

Fault	Possible cause	Corrective measure
Oil pump not pumping out oil	Low oil tank level	Top up to specified oil level
	Clogged suction pipe or filter	Flush oil circuit and oil tank. Change hydraulic oil if dirty
Oil pump delivers oil at low pressure	Worn bearing; damaged ring, O-ring	Replace defective parts
	Misadjusted safety valve	Raise the pressure with a pressure gauge
	Air in the oil pump	Tighten loose connectors on the suction side
		Add hydraulic oil to the tank
		Check pump oil seals
Wait for bubbles in oil tank to disappear before using pump		
Oil pump noisy	Cavitation generated by kinked suction-side hose or clogged filter	Adjust or replace hose and clean filter
	Air entering from loosened suction-side connectors	Re-tighten every connector
	Cavitation caused by high viscosity of hydraulic oil	Replace with new hydraulic oil of viscosity suitable for the oil pump operating speed
		Only work when oil temperature is normal
	Air bubbles in hydraulic oil	Check cause of bubbles, then take appropriate steps
Oil pump leaks oil	Damaged pump oil seal, damaged O-ring or sliding surfaces of oil pump worn	Replace defective parts

## Multi-way valve

Fault	Possible cause	Corrective measure
Safety valve pressure erratic or cannot be adjusted up	Pressure adjusting screw loose	Readjust pressure and tighten screw
	Pressure adjusting spring distorted or damaged	Replace
	Safety valve spool worn or stuck	Replace or remove, clean and reassemble
	Pump malfunctioning	Overhaul pump
Lift motor is off, operating the forward/backward tilt lever tilts the mast forward	Tilt locking valve worn or damaged	Replace the spool and tilt locking valve as an assembly
	Broken tilt locking spring	Replace spring
	Tilt valve stem O-ring damaged	Replace O-ring
Mast erratic when tilted forward	Tilt relief valve malfunctioning	Replace tilt relief valve assembly
Forks drop noticeably when lift lever is in neutral position	Excessive wear clearance between valve body and valve stem	Replace stem according to required clearance
	Valve stem is not centred	Maintaining valve stem in neutral position
	Cylinder seals defective	Overhaul cylinder
	Overload valve worn or stuck with dirt	Replace or flush overload valve
Fails to reset	Damaged or warped return spring	Replace spring
	Dirt between valve body and stem	Flush
	Control mechanism catching	Adjust
	Reset parts are not coaxial	Reassemble, maintaining coaxiality
External leakage	Defective O-ring	Replace
	Poor oil port connector seal	Check fastening and sealing of corresponding parts
	Loose seal plate	Clean seal plate and retighten bolts
	Safety valve lock nut/gasket and inter-gasket connection bolts loose	Fasten
Multi-way valve cannot move back and forth	Multi-way valve lever is interfering with the valve movement	Adjust

## Pressure adjustment of main safety valve

The main safety valve pressure is preadjusted at the factory should not be readjusted by the user under normal conditions. The following example describes the adjustment method for a forklift truck with a rated load of 1600 kg:

1. Place a load rated at 125% of the forklift's lifting capacity (i.e. a load of 2000 kg) onto the forks in a stable manner.
2. Depress the accelerator pedal fully, then operate the lift lever. If the forks can be lifted within a height range of 0–300 mm, the main safety valve pressure is correct. Otherwise adjust according to step (3).
3. If the forks cannot lift the load off the ground, the pressure of the main safety valve needs to be increased. To do this, remove the front floorplate, slacken off the main safety valve lock nut, then turn the adjusting screw clockwise to increase the pressure of the main safety valve. If the forks can be lifted above 300 mm, turn the adjusting screw anticlockwise to reduce the pressure of the main safety valve.
4. Depress the accelerator pedal fully and make sure that the forks are able to lift within a height range of 0–300 mm. If this is not the case, adjust according to step (3) until the pressure meets the required lifting height range.

Warning: the load must be placed stably and securely; once the pressure has been adjusted, it should not be readjusted unnecessarily.



## Hydraulic schematic diagram

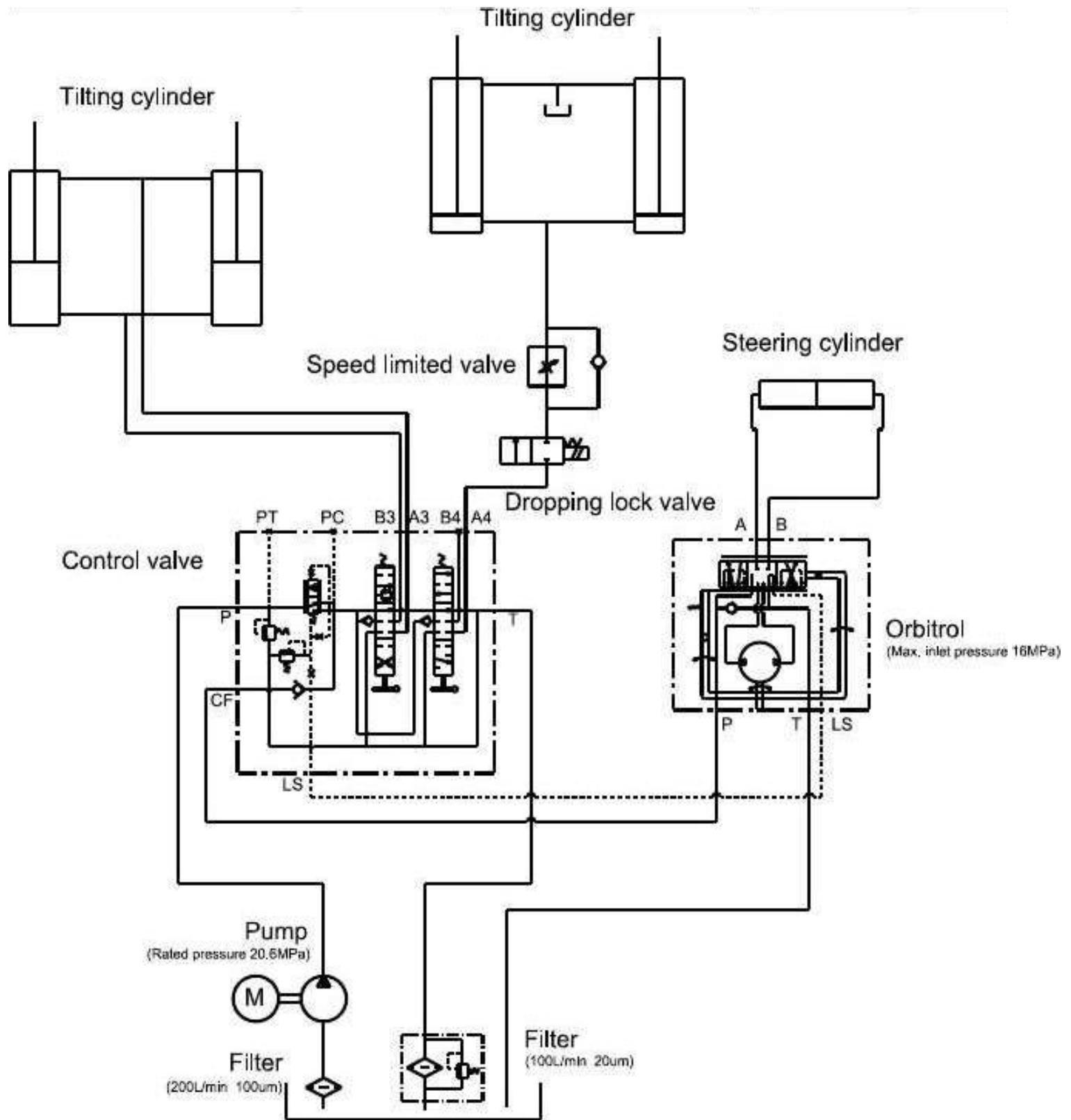


Figure 4-1 Hydraulic System Diagram

Item \ Tonnage	1.3 t	1.5 t	1.6 t	1.8 t	2.0 t
Main relief valve pressure	14 MPa	15.5 MPa	15.8 MPa	16.5 MPa	17.5 MPa

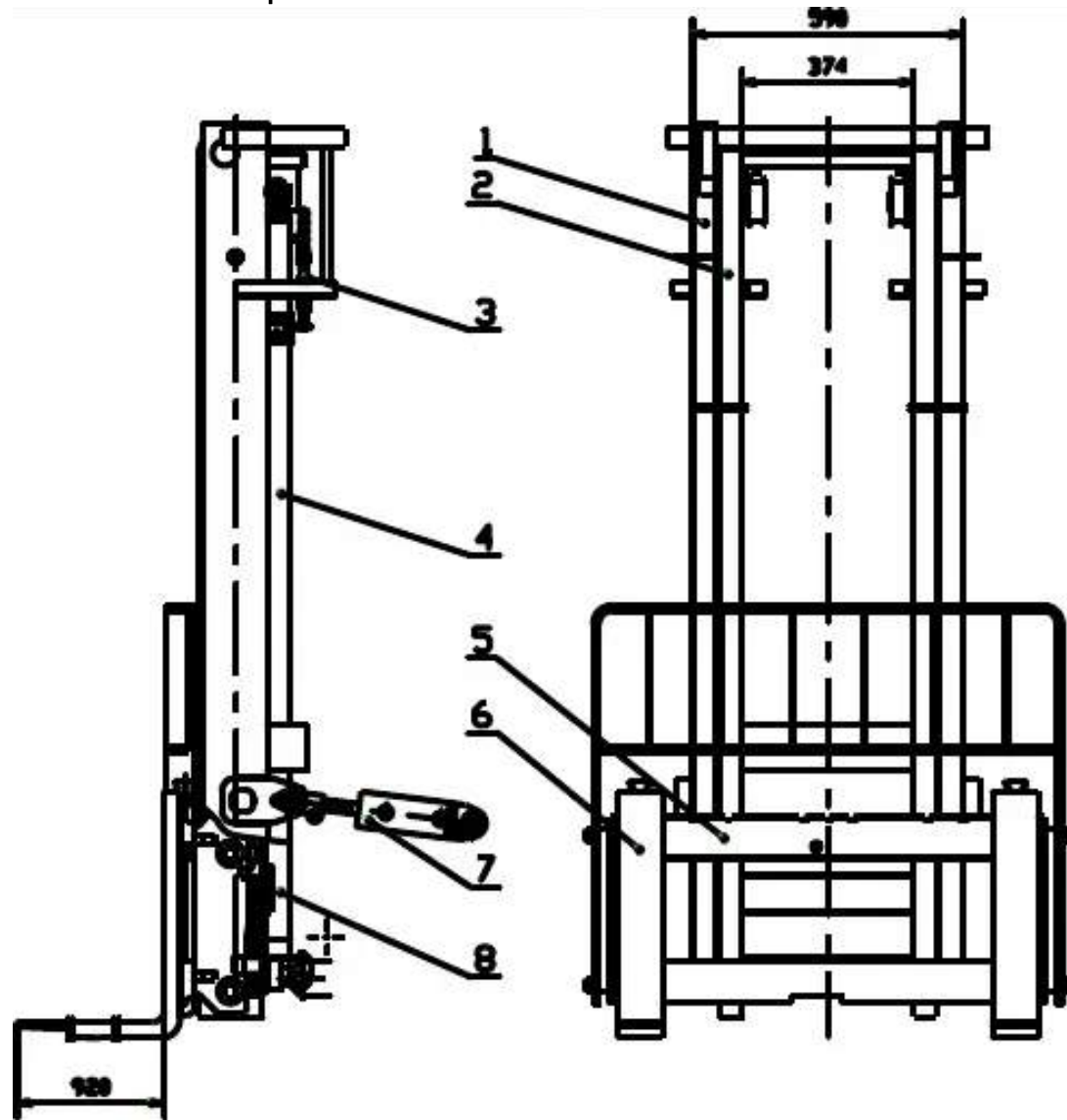


## 5 Lifting System

Fault	Possible cause	Remedy
Fork carriage and mast tilt without operator touching controls	Excessive wear on tilt cylinder seal rings.	Replace piston seal rings or cylinder
	Multi-way valve control valve spring inoperative.	Replace
Fork carriage lift and tilt action stiff	Piston seized to cylinder wall or piston rod bent.	Replace damaged parts
	Excessive cylinder fouling.	Flush
Fork lifting movement not smooth	Fork carriage assembly improperly adjusted	Adjust clearance between channel guide rail and side rollers
	Insufficient clearance between rollers and mast channel.	Adjust roller clearance
	Dirt stuck between moving parts.	Clear foreign bodies
	Insufficient lubrication.	Smear contact surfaces of guide rail with grease
	Inner mast skewed or fork bent.	Repair or replace
Forks lift unevenly	Lifting chains not adjusted.	Adjust chains to same tension
Lifting rollers do not rotate	Grease has hardened or rollers are clogged with dirt.	Clean and lubricate rollers
	Lifting rollers incorrectly adjusted.	Adjust
Excessive mast noise	Insufficient lubrication.	Lubricate
	Fork carriage side rollers unevenly adjusted. With the mast tilted, side roller strikes mast channel when descending.	Adjust rollers and side adjusting shims
	Buffer pad below outer mast does not work (container forklifts).	Adjust gaskets and rubber buffer pad so that the piston rod in the cylinder only touches the bottom of the cylinder after the inner mast contacts the buffer pad.
Lifting weak or cannot lift	Wear on oil pump gear and pump body leading to excessive clearance.	Replace worn parts or pump
	Worn seal ring on lift cylinder piston causing internal leakage.	Replace with new Y-ring
	Multi-way valve, safety valve spring defective.	Replace spring
	Worn multi-way valve lever and valve body causing excessive oil leakage.	Replace
	Multi-way valve body leaks oil.	After grinding, reassemble and sequentially tighten screws
	Hydraulic line leaks oil.	Compress coupling nut, check sealing gasket and coupling nut for damage
	Oil temperature too high, diluted hydraulic oil, insufficient flow.	Change non-compliant hydraulic oil or reduce amount of oil, check reason for high oil temperature
	Excessive load weight.	Carry out lifting in accordance with regulations

## Mast

The basic mast has a lifting height of 3 m and consists of the inner mast, outer mast, chains, fork carriage, rollers and other components.



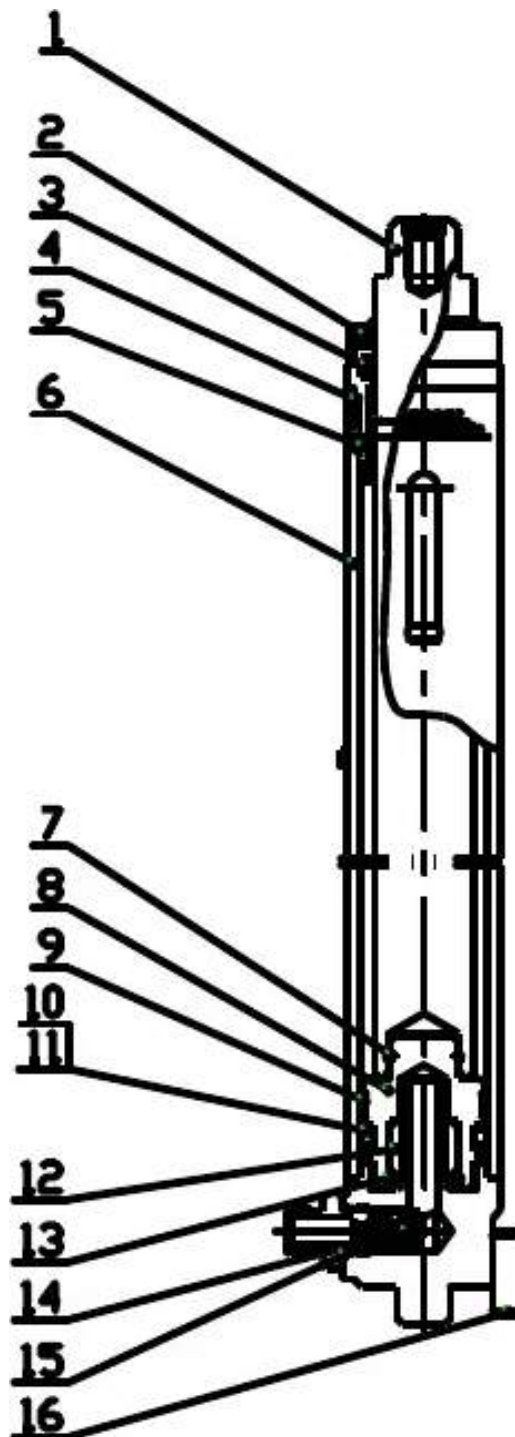
- |                           |                  |                   |                     |
|---------------------------|------------------|-------------------|---------------------|
| 1. Outer mast             | 2. Inner mast    | 3. Chain assembly | 4. LH lift cylinder |
| 5. Fork carriage assembly | 6. Fork assembly | 7. Tilt cylinder  | 8. RH lift cylinder |

Figure 5-1 Mast

Size and weight of basic mast (lifting height 3 m)

Mast dimensions	Mast weight
1895 mm×1050 mm×287 mm	428 kg

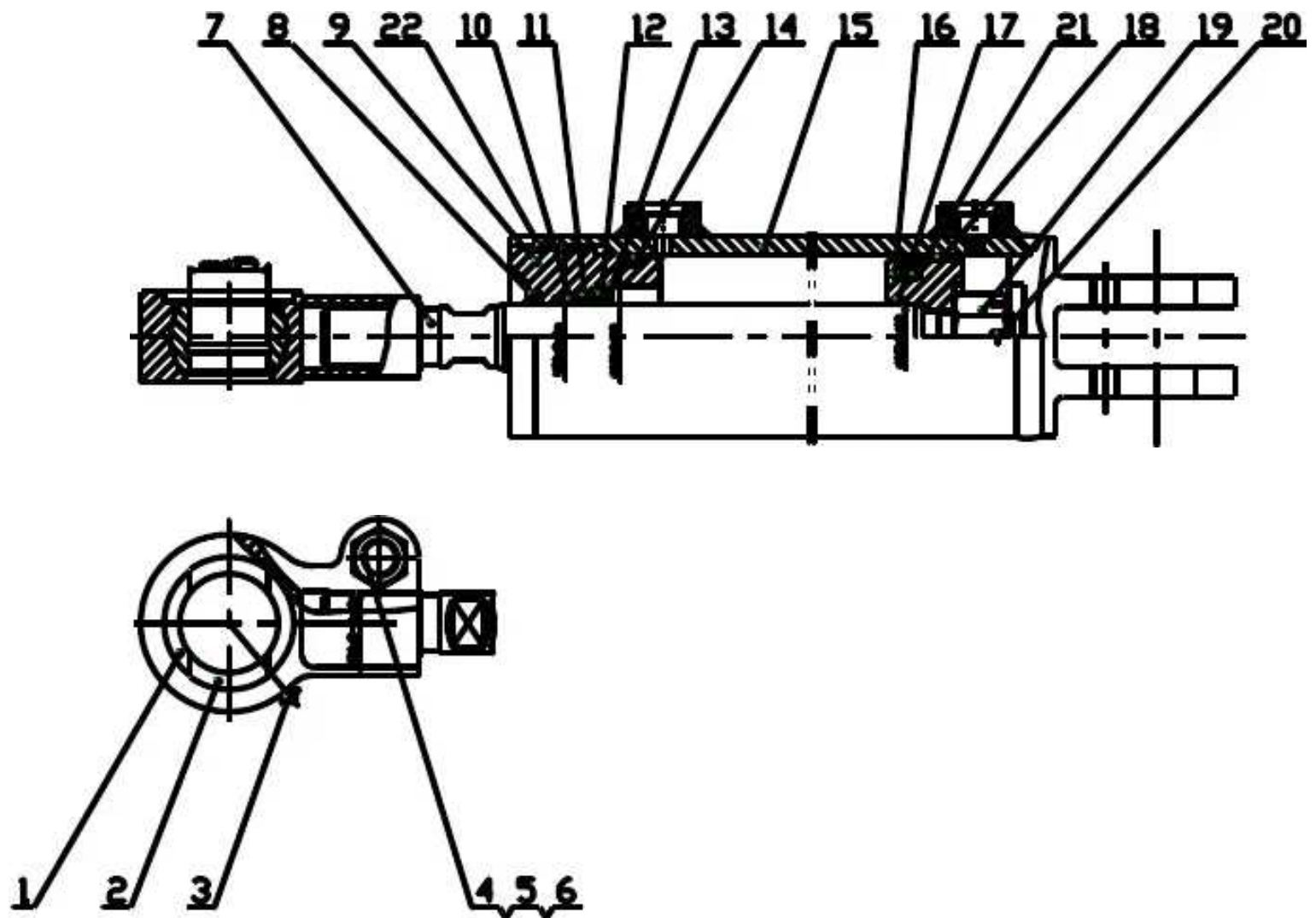
## Lift cylinder



- |                 |   |                      |                |
|-----------------|---|----------------------|----------------|
| 1. Piston rod   | 2. AF dustproof ring  | 3. B3 dustproof ring | 4. O-ring      |
| 5. Guide sleeve | 6. Cylinder body  | 7. Snap ring         | 8. Piston      |
| 9. Support ring | 10. Guard ring  | 11. B7 seal ring     | 12. Valve bush |
| 13. Snap ring   | 14. Grease nipple assembly<br>(not present on LH lift cylinder) | 15. O-ring           | 16. Pin        |

Figure 5-2 Lift cylinder

## Tilt cylinder



- |                         |                      |                   |                      |
|-------------------------|----------------------|-------------------|----------------------|
| 1. Ring                 | 2. Spherical bearing | 3. Oil cup        | 4. Washer            |
| 5. Nut                  | 6. Bolt              | 7. Piston rod     | 8. AM dustproof ring |
| 9. Guide sleeve         | 10. Guide ring       | 11. B3 seal ring  | 12. Block            |
| 13. Wire retaining ring | 14. O-ring           | 15. Cylinder body | 16. Piston           |
| 17. O-ring              | 18. Guide ring       | 19. Nut           | 20. Cotter pin       |
| 21. OK seal ring        | 22. O-ring           |                   |                      |

Figure 5-3 Tilt cylinder

## 6 Electrical System

### Controller

The MOS chopper series represents a state-of-the-art answer to the needs of the 21st century. To ensure that products remain on the market without running the risk of becoming technically obsolete, the MOS series offers the following features:

- Advanced technology
- Economical costs
- Maximum safety
- Maximum adaptability
- Open to future technical innovations
- Optimum level of protection

#### Basic design theory

- High-frequency MOS technology
- Real-time control over the internal and external components that influence the vehicle's performance, with self-diagnosis of the checking circuits themselves
- Stored Program Machine (SPC), where the hardware is completely separate from the functions to be configured. The program is parametric and can easily be modified by the end user
- Various chopper configurations can be selected, without the need for hardware modifications
- Future technology updates are made easy for the user
- The communication protocol will continue to evolve, thereby offering increasing possibilities of interaction and expansion. For this reason, the series offers a standard dialogue mode with external systems, which allows interfacing with commercially available machines. A range of individually designed control software is also offered with various prices and features.
- The controller meets IP51 requirements, providing excellent protection against spray (water, acid) and the ingress of dust or small foreign particles. Access to the control logic is very simple and allows substitution or replacement.

#### Steered wheel angle sensor

- The dual-motor drive is equipped with a steered wheel angle sensor that transmits angle signals to the electronic controller, thereby helping the motors apply differential control.
- The SET STEER MIN and SET STEER MAX functions can be used to obtain the minimum and maximum voltages of the steering potentiometer range.

#### Safety and protection features

- Battery polarity protection: the circuits must be constantly tested to avoid damage to the power unit. It is necessary to fit a main contactor controlled by the logic unit to protect against reverse battery polarity.
- Circuit connection protection: all inputs are protected against connection errors. The contactor driver can withstand a load of 2 A and has overload protection
- Thermal protection: when the controller temperature exceeds 85°C, the thermal protection function is triggered, which reduces the maximum current in proportion to the thermal increase. The temperature can never exceed 95°C.
- Battery overdischarge protection: when the battery charge is low, the maximum current is reduced in proportion to the battery's charge.
- External protection: the chopper effectively prevents ingress of dust, liquid and other foreign bodies to a degree of protection meeting IP51
- Starting sequence protection: a precise sequence of operations is necessary before the vehicle will start. Requests for drive must be made after closing the keyswitch, otherwise the vehicle will not start.

- Other protection: if any of the following situations occurs, the main contactor will not close
  - Power unit is not functioning
  - Logic unit is not functioning properly
  - The output voltage of the accelerator does not fall below the minimum voltage value stored, with 1 V added
  - Running microswitch in closed position

### **Operating characteristics**

- Speed control
- Optimal sensitivity at low travel speeds
- Speed can be reduced in both forward and reverse directions. Level can be set using handheld unit
- Regenerative Braking based on deceleration ramps
- Three different braking modes: Release Braking, Inversion Braking and Deceleration Braking
- Speed control during descent: the motor speed follows the accelerator. The chopper automatically brakes if the motor speed exceeds the accelerator set point. This provides optimum performance on a gradient
- Starts on a ramp without roll back, even without an electric brake
- Programmable anti-roll back function: when the keyswitch is closed, if the motor is rotating, the chopper detects the speed and automatically brakes, keeping the motor at a very low speed during descent on a gradient. This is a very useful safety feature and is not driver-dependent
- Indication of faults via LEDs
- Modification of parameters via instrument or handheld unit
- Internal hour meter displayed on instrument
- Memory of the last 10 electrical control alarms
- Test function for checking main parameters
- Internal contactor coil absorption circuit
- High motor and battery performance due to high-frequency switching
- Presence of an auxiliary microprocessor for safety monitoring of the CPU that controls the motor

### **Controller maintenance**

There are no user serviceable parts in the controller. No attempt should be made to open, repair or otherwise modify the controller. Doing so may damage the controller and will void the warranty. It is recommended that the controller and connections be kept clean and dry.

### **Cleaning**

Periodically cleaning the controller exterior will help protect it against corrosion and possible electrical control problems created by dirt, grime and chemicals.

Use the following cleaning procedure:

- Disconnect the power plug.
- Discharge the capacitors in the controller by connecting a load (such as a contactor coil or horn) across the controller's B+ and B- terminals.
- Remove any dirt or corrosion from the power and signal connector areas. The controller should be wiped clean with a moist rag.
- Dry it before reconnecting the battery.



## CURTIS 1234 Controller Fault Code Table

The red and yellow LEDs on the controller housing have different display modes to indicate the type of fault condition, as shown in the following table:

DISPLAY	STATUS
Neither LED illuminated	Controller is not powered on because of dead battery or line failure
Yellow LED flashing	Controller is operating normally
Yellow and red LEDs both on solid	Controller software update in progress
Yellow and red LEDs both flashing	Controller has detected a fault

### Left/right Traction Controller Fault Code Table

Instrument display Display code	Handheld display fault code	Possible cause
1 , 2	Controller Overcurrent	<ol style="list-style-type: none"> <li>External short of phase U, V or W motor connections.</li> <li>Motor parameters are mistuned.</li> <li>Controller defective.</li> </ol>
1 , 3	Current Sensor Fault	<ol style="list-style-type: none"> <li>Leakage to vehicle frame from phase U, V or W (short in motor stator)</li> <li>Controller defective.</li> </ol>
1 , 4	Precharge Failed	<ol style="list-style-type: none"> <li>External load on capacitor bank (B+ terminal) that prevents the capacitor bank from charging.</li> <li>See 1311 menu Monitor » Battery: Capacitor Voltage</li> </ol>
1 , 5	Controller Severe Undertemp	<ol style="list-style-type: none"> <li>Controller is operating in an extreme environment (below -40°C).</li> <li>See 1311 menu Monitor » Controller: Temperature.</li> </ol>
1 , 6	Controller Severe Overtemp	<ol style="list-style-type: none"> <li>Controller is operating in an extreme environment (above 99°C).</li> <li>Excessive load on vehicle.</li> <li>Improper mounting of controller.</li> <li>See 1311 menu Monitor » Controller: Temperature.</li> </ol>
1 , 7	Severe Undervoltage	<ol style="list-style-type: none"> <li>Battery Menu parameters are misadjusted.</li> <li>Vehicle seriously overloaded.</li> <li>Battery resistance too high.</li> <li>Battery disconnected while driving.</li> <li>See 1311 menu Monitor » Battery: Capacitor Voltage.</li> <li>Blown B+ fuse or main contactor did not close</li> </ol>
1 , 8	Severe Overvoltage	<ol style="list-style-type: none"> <li>Battery Menu parameters are misadjusted.</li> <li>Battery resistance too high for given regen current.</li> <li>Battery disconnected while regen braking.</li> <li>See 1311 menu Monitor » Battery: Capacitor Voltage.</li> </ol>
2 , 1	Controller Undertemp Cutback	<ol style="list-style-type: none"> <li>Controller is performance-limited at this temperature (below -25°C).</li> <li>Controller is operating in an extreme environment.</li> <li>See 1311 menu Monitor » Controller: Temperature.</li> </ol>

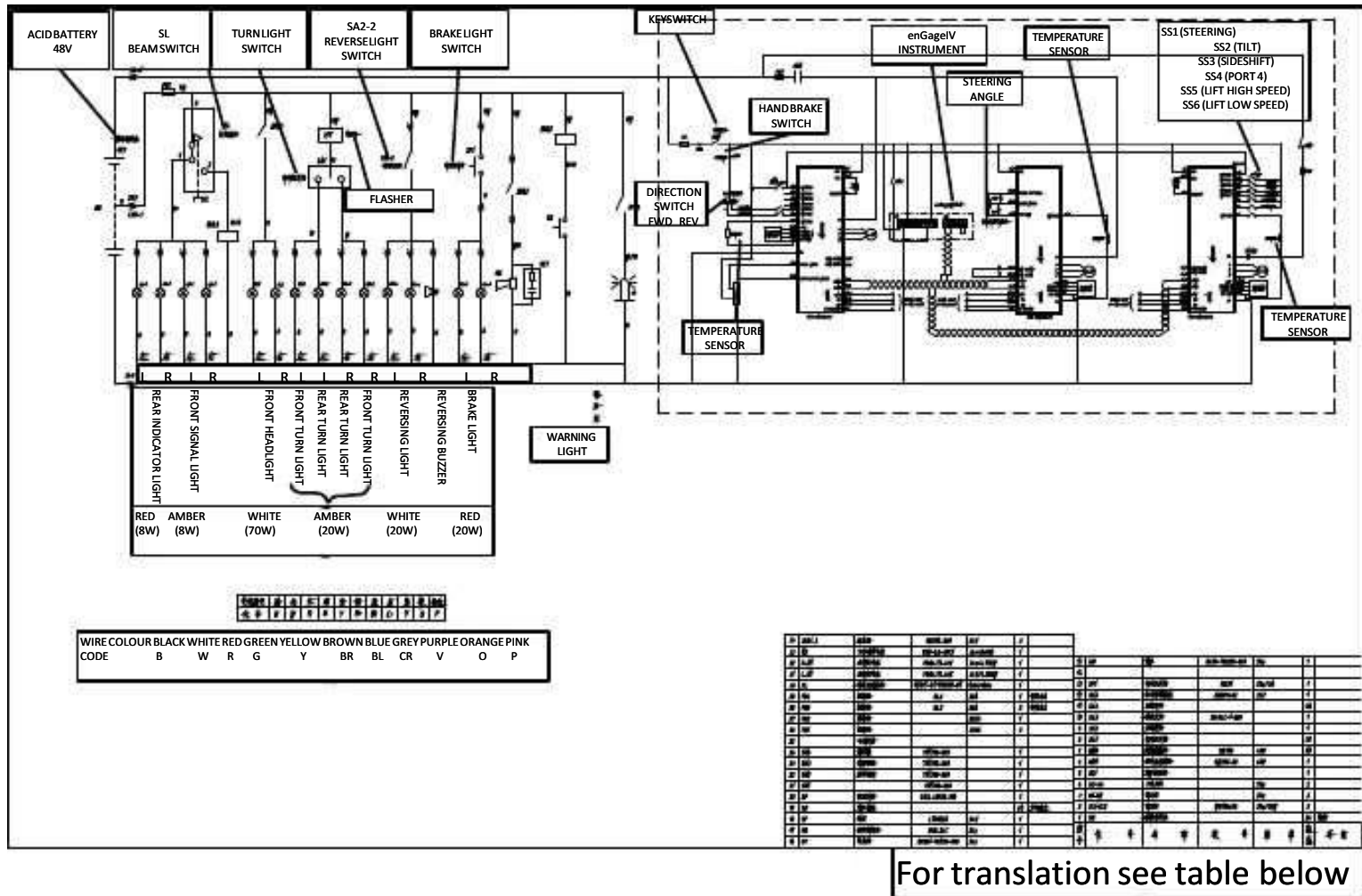
<b>Instrument display Display code</b>	<b>Handheld display fault code</b>	<b>Possible cause</b>
2 , 2	Controller Overtemp Cutback	<ol style="list-style-type: none"> <li>1. Controller is performance-limited at this temperature (above 85°C).</li> <li>2. Controller is operating in an extreme environment.</li> <li>3. Excessive load on vehicle.</li> <li>4. Improper mounting of controller.</li> <li>5. See 1311 menu Monitor » Controller: Temperature.</li> </ol>
2 , 3	Undervoltage Cutback	<ol style="list-style-type: none"> <li>1. Normal operation. Fault shows that the batteries need recharging. Controller is performance-limited at this voltage.</li> <li>2. Controller battery parameters are misadjusted.</li> <li>3. Check for non-controller system drain on battery.</li> <li>4. Battery resistance too high.</li> <li>5. Battery disconnected while driving.</li> <li>6. See 1311 menu Monitor » Battery: Capacitor Voltage.</li> <li>7. Blown B+ fuse or main contactor did not close</li> </ol>
2 , 4	Overvoltage Cutback	<ol style="list-style-type: none"> <li>1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance-limited at this voltage.</li> <li>2. Battery parameters are misadjusted.</li> <li>3. Battery resistance too high for given regen current.</li> <li>4. Battery disconnected while regen braking.</li> <li>5. See 1311 menu Monitor » Battery: Capacitor Voltage.</li> </ol>
2 , 5	+5V Supply Failure	<ol style="list-style-type: none"> <li>1. External load impedance on the +5 V supply (pin 26) is too low.</li> <li>2. See 1311 menu Monitor » Outputs: 5 Volts and Ext Supply Current.</li> </ol>
2 , 6	Digital Out 6 Overcurrent	<ol style="list-style-type: none"> <li>1. External load impedance on Digital Output 6 driver (pin 19) is too low.</li> </ol>
2 , 7	Digital Out 7 Overcurrent	<ol style="list-style-type: none"> <li>1. External load impedance on Digital Output 7 driver (pin 20) is too low.</li> </ol>
2 , 8	Motor Temp Hot Cutback	<ol style="list-style-type: none"> <li>1. Motor temperature is at or above the programmed Temperature Hot setting (above 145°C), and the requested current is being cut back.</li> <li>2. Motor Temperature Control Menu parameters are mistuned.</li> <li>3. See 1311 menus Monitor » Motor: Temperature and Monitor » Inputs: Analog2</li> <li>4. If not using a thermistor, Temp Compensation and Temp Cutback should be programmed to OFF</li> </ol>
2 , 9	Motor Temp Sensor Fault	<ol style="list-style-type: none"> <li>1. Motor thermistor is not connected properly.</li> <li>2. If not using a thermistor, Temp Compensation and Temp Cutback should be programmed to OFF</li> <li>3. See 1311 menus Monitor » Motor: Temperature and Monitor » Inputs: Analog2</li> </ol>
3 , 1	Coil 1 Driver Open/Short	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>
3 , 1	Main Open/Short	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>
3 , 2	Coil2 Driver Open/Short	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>
3 , 2	EM Brake Open/Short	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> </ol>



<b>Instrument display Display code</b>	<b>Handheld display fault code</b>	<b>Possible cause</b>
		3. Bad crimps or faulty wiring.
3 , 3	Coil3 Driver Open/Short	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring
3 , 4	Coil4 Driver Open/Short	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring
3 , 5	PD Open/Short	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring
3 , 6	Encoder Fault	1. Motor encoder failure. 2. Bad crimps or faulty wiring. 3. See 1311 menu Monitor » Motor: Motor RPM
3 , 7	Motor Open	1. Motor U, V, W line is open. 2. Bad crimps or faulty wiring.
3 , 8	Main Contactor Welded	1. Main contactor tips are welded closed. 2. Motor phase U is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ terminal).
3 , 9	Main Contactor Did Not Close	1. Main contactor did not close. 2. Main contactor tips are oxidized. 3. External load on capacitor bank (B+ terminal) that prevents capacitor bank from charging. 4. Blown B+ fuse.
4 , 1	Throttle Wiper High	1. Throttle pot wiper voltage too high. 2. See 1311 menu Monitor » Inputs: Throttle Pot
4 , 2	Throttle Wiper Low	1. Throttle pot wiper voltage too low. 2. See 1311 menu Monitor » Inputs: Throttle Pot
4 , 3	Brake Wiper High	1. Brake pot wiper voltage too high. 2. See 1311 menu Monitor » Inputs: Brake Pot
4 , 4	Brake Wiper Low	1. Brake pot wiper voltage too low. 2. See 1311 menu Monitor » Inputs: Brake Pot
4 , 5	Pot Low Overcurrent	1. Combined pot resistance connected to Pot Low is too low. 2. See 1311 menu Monitor » Outputs: Pot Low
4 , 6	EEPROM Failure	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the 1311, or by loading new software into the controller.
4 , 7	HPD/Sequencing Fault	1. Keyswitch, interlock, direction, and throttle inputs applied in incorrect sequence. 2. Faulty wiring, crimps or transfer switches at keyswitch, interlock, direction or throttle inputs. 3. See 1311 menu Monitor » Inputs.
4 , 7	Emer Rev HPD	1. Emergency Reverse operation has concluded, but the throttle, forward and reverse inputs, and interlock have not been returned to neutral.
4 , 9	Parameter Change Fault	1. This is a safety fault caused by a change in certain 1311 parameter settings so that the vehicle will not operate until keyswitch input is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling the keyswitch input before the vehicle can operate.
6 , 8	VCL Runtime Error	1. VCL code encountered a runtime error.

<b>Instrument display Display code</b>	<b>Handheld display fault code</b>	<b>Possible cause</b>
		2. See 1311 menu Monitor » Controller VCL Error Module and VCL Error. This error can then be compared with the runtime VCL module ID and error code definitions found in the specific OS system information file.
6 , 9	External Supply Out of Range	1. External load on the 5 V and 12 V supplies draws either too much or too little current. 2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mistuned. 3. See 1311 menu Monitor » Outputs: Ext Supply Current.
7 , 1	OS General	1. Internal controller fault.
7 , 2	PDO Timeout	1. Time between CAN PDO messages received exceeded the PDO Timeout Period.
7 , 3	Stall Detect	1. Stalled motor. 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder. 5. See 1311 menu Monitor » Motor: Motor RPM.
8 , 7	Motor Characterization Fault	1. Motor characterization failed during the characterization process.
8 , 8	Encoder Characterization Fault	1. Encoder characterization failed during the motor characterization process. 2. Motor encoder pulse rate is not a standard value (32, 48, 64, 80 ppr)
8 , 9	Motor Type Fault	1. The Motor_Type parameter value is out of range.
9 , 2	EM Brake Failed to Set	1. Vehicle movement sensed after the EM Brake has been commanded to set 2. EM Brake will not hold the motor from rotating.
9 , 3	Limited Operating Strategy (LOS)	1. Limited Operating Strategy (LOS) control mode has been activated as a result of either an Encoder Fault (Code 36) or a Stall Detect Fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle is stalled.
9 , 4	Emer Rev Timeout	1. Emergency Reverse was activated and concluded because the EMR timeout timer has expired; 2. The emergency reverse input is stuck On;

# Circuit diagram



For translation see table below

34	JDQ1-3	Breaker	JD201S-G00	24V	3																
33	M2	Working oil pump motor	YDB-8.6-4 HC1	34v/8.6K W	1																
32	R-M1	RH travel motor	YDQ4.75-4 HC	34v/4.75K W	1	15	HH	Horn	R450-7002 00-000	24v	1										
31	L-M1	LH travel motor	YDQ4.75-4 HC	34v/4.75K W	1	14															
30	XL	Battery connector	95011-01/9 5038-01	160A/150 v	1	13	SF1	Brake light switch		24v/3 A	1										
29	FU4	Fuse	BLX	20A	1	Core 10A	12	SA5	Red emergency stop button	JK231	24V	1									
28	FU3	Fuse	BLX	20A	2	Core 15A	11	SA4	Seat switch	XB2BT44C		-1									
27	FU2	Fuse		225A	1		10	SA3	Keyswitch			1									
26	FU1	Fuse		350A	2		9	SA2	Direction switch	JK404C-1-600		1									
25		Brake switch					8	SA1	Turn light switch			-1									
24	SM4	Port 4	TM1308-G00		1		7	KM2	Pump contactor	SW180	48V	-1									
23	SM3	Sideshift control	TM1308-G00		1		6	KM1	Traction main contactor	SW200-20	48V	1									
22	SM2	Tilt control	TM1308-G00		1		5	RC1	Horn filter			1									
21	SM1		TM1308-G00		1		4	H3-H4	Rear combination light			2									
20	SP	Hydraulic switch	0166-40502-018		1		3	H1-H2	Front signal light		24v	2									
19	SB	Horn button			-1	On steering wheel	2	EL1-EL2	Front head light		24v	2									
18	HF	Warning light	LTD152A	24V	1		1	GG	Acid battery	WD100x90	24v/70W	24								Plastic case	
17	HU	Reversing buzzer	DJB-24C	24v	1																
16	HT	Flasher	GR501-701 200-000	24v	1																
						No.		Code	Name	Model	Spec.	Qty									Remarks



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