Operator Manual

KION Baoli (Jiangsu) Forklift Co., Ltd

KB-2017-08-V1.0

Applicable For

KBET15-20

KION Baoli (Jiangsu) Forklift Co., Ltd

KB-2017-08-V1.0

Product information

Instruction and maintenance manual

This chapter gives information taken from the instruction and maintenance manual, considered as of interest for the assistance technician.

i NOTE

Consult the truck instruction and maintenance manual for detailed information on the use of the truck.

General Forklift Description

The model described in this manual is an electric forklift with seated operator and counterbalanced forks.

- side shifts
- positioners
- grippers with jaws or forks
- tipping
- load arms
- ....

i NOTE

For use of a piece of field equipment after the sale, it is necessary to apply to the authorized dealer which will verify its feasibility and, if applicable, perform the equipment installation, the updating of the residual capacity plates and the testing. The equipment will also have to be provided with identification plate and Assembly and Instructions Manual.

i NOTE

The "crane arm" attachment changes the original

intended use of the forklift, which may not move

freely oscillating suspended loads. For such application a specific approval and EC certification

of conformity is required for the forklift equipped

in this manner. In this regard, it is necessary to

contact the authorized dealer.

Definition of travel direction
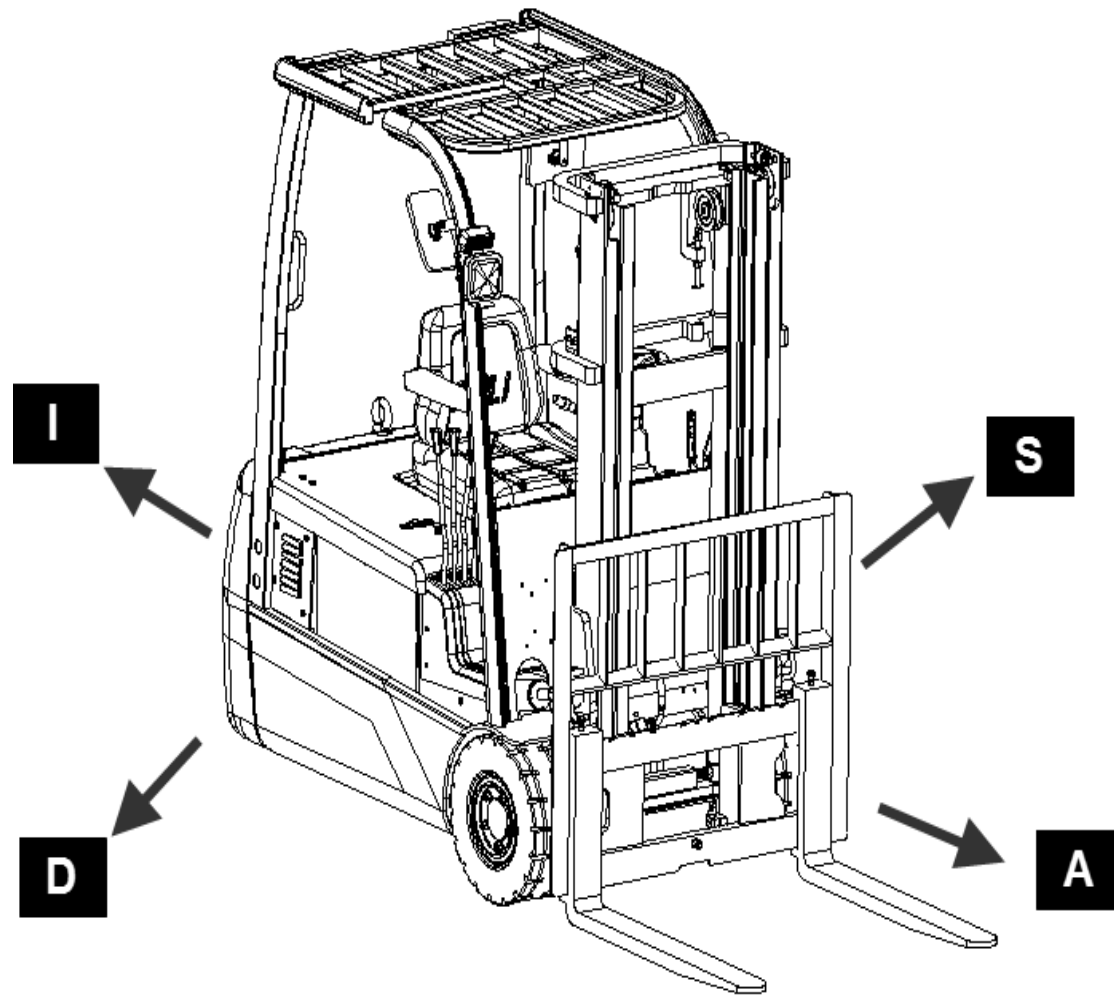
A	Forwards	I	Backwards
S	Left	D	Right

Overall dimensions for four-wheel truck

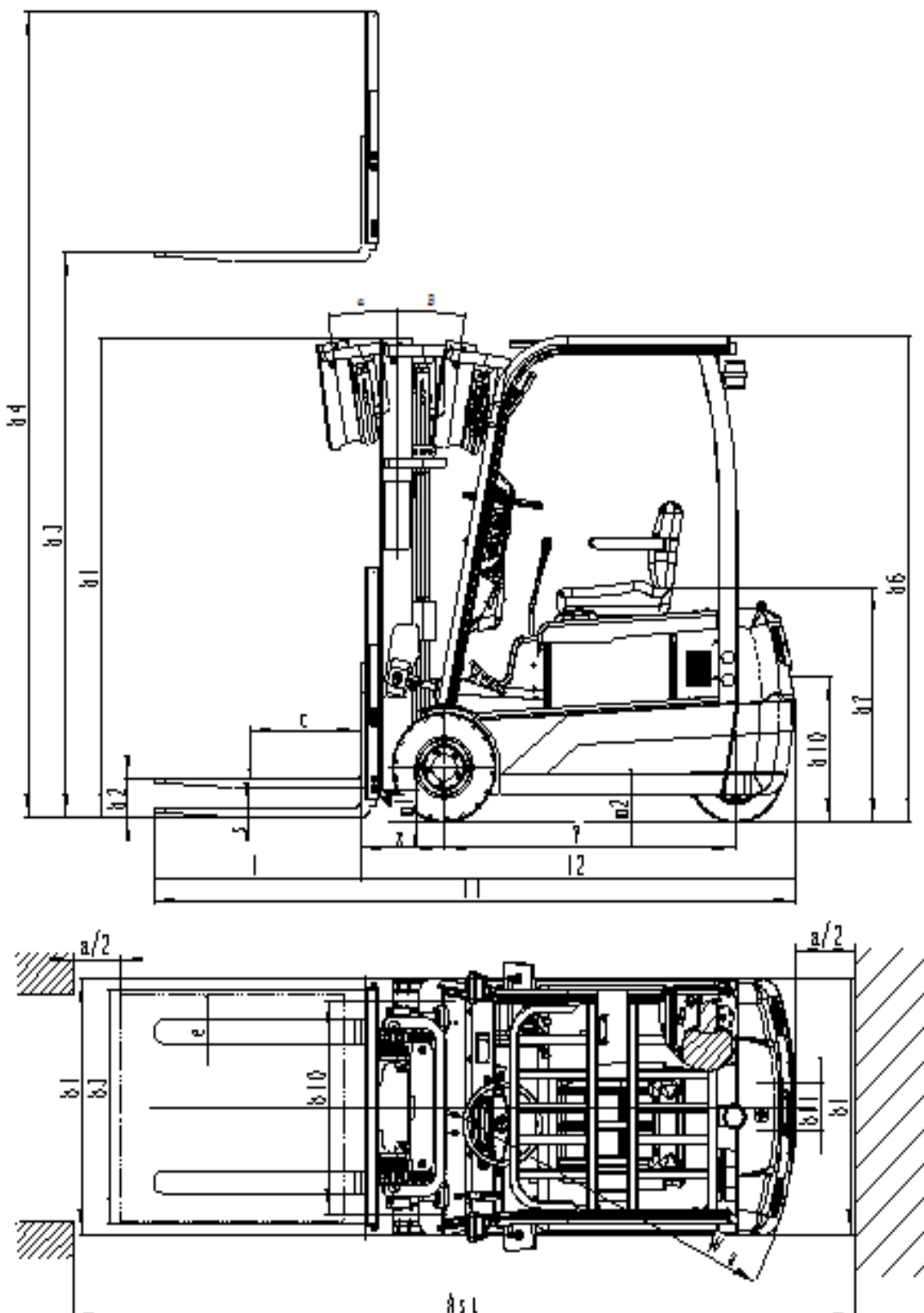| P	Manufacturer (abbreviation)			BAOLI	BAOLI	BAOLI
1.2	Manufacturer's type designition			KBET15	KBET18	KBET20
1.3	Drive: electric (battery or mains), diesel, petrol, fuel gas			Electric	Electric	Electric
1.4	Operator type: hand, pedestrian, standing, seated, order-picker			Seated	Seated	Seated
1.5	Rated capacity/rated load	Q	kg	1500	1800	2000
1.6	Load centre distance	c	mm	500	500	500
1.8	Load distance, centre of drive axle to fork	x	mm	365	365	396
1.9	Wheel base	y	mm	1295	1295	1435
2.1	Service weight		kg	3130	3260	3650
2.2	Axle loading, laden front/rear		kg	3900/730	4530/530	4970/680
2.3	Axle loading, unladen front/rear		kg	1500/1630	1500/1760	1650/2000
3.1	Tyres: solid rubber, superelastic, pneumatic, polyurethane			S/E	S/E	S/E
3.2	Tyre size, front			18x7-8	18x7-8	200/50-10
3.3	Tyre size, rear			16x6-8	16x6-8	16*6-8
3.5	Wheels, number front/rear (× = driven wheels)			2x/2	2x/2	2x/2
3.6	Tread, front	b_{10}	mm	890	890	925
3.7	Tread, rear	b_{11}	mm	205	205	205
4.1	Tilt of mast/fork carriage forward/backward	α/β	°	5/7	5/7	5/7
4.2	Height, mast lowered	h_1	mm	2005	2005	a2007
4.3	Free lift	h_2	mm	100	100	a138
4.4	Lift	h_3	mm	3000	3000	a3000
4.5	Height, mast extended	h_4	mm	3945	3945	a4040
4.7	Height of overhead guard (cabin)	h_6	mm	2015	2015	2075
4.8	Seat height relating to SIP/stand height	h_7	mm	958	958	1065
4.12	Coupling height	h_{10}	mm	600	600	637
4.19	Overall length	l_1	mm	2850	2850	3103
4.20	Length to face of forks	l_2	mm	1930	1930	2033
4.21	Overall width	b_1/b_2	mm	1066	1066	1120
4.22	Fork dimensions DIN ISO 2331	s/e/l	mm	35/120/920	35/120/920	40*122*1070
4.23	Fork carriage ISO 2328, class/type A, B			ISO II/A	ISO II/A	ISO II/A
4.24	Fork-carriage width	b_3	mm	968	968	1040a
4.31	Ground clearance, laden, below mast, laden/unladen	m_1	mm	120	120	114/124
4.32	Ground clearance, centre of wheelbase, laden/unladen	m_2	mm	110	110	105/110
4.34	Aisle width predetermined load dimensions	A_{st}	mm			
4.34.1	Working aisle width with pallet 1000 x 1200 crossways****	A_{st}	mm	3025	3025	3380
4.34.2	Working aisle width with pallet 800 x 1200 lengthways****	A_{st}	mm	3225	3225	3485
4.35	Turning radius	W_a	mm	1550	1550	1640
5.1	Travel speed, laden/unladen		km/h	14/15.5	13.5/15	13/14
5.2	Lift speed, laden/unladen		m/s	0.30/0.47	0.30/0.47	0.30/0.40
5.3	Lowering speed, lade/unladen		m/s	0.46/0.42	0.48/0.42	0.46/0.42
5.6	Max. drawbar pull, laden/unladen(5 minute)		N	/8.7	/8.8	/9.7
5.8	Max. gradeability, laden/unladen(5 minute)		%	20/20	20/20	15/18
5.10	Service brake			Electric/mechanical	Electric/mechanical	Electric/mechanical
6.1	Drive motor rating S2 60 min		kW	2x6.5	2x6.5	2x6.5
6.2	Lift motor rating at S3 15%		kW	15	15	15
6.4	Battery voltage	U	V	48	48	48
6.4.1	nominal capacity K_5	K_5	Ah	505/525/595	505/525/595	625/700
6.5	Battery weight		kg	810~920	810~920	900~990
10.1	Operating pressure for attachments		bar	160	160	125
10.7	Sound pressure level at the driver's seat		dB(A)	≤75	≤75	≤75
	Drive control			AC	AC	AC

* The specified rated lift takes into consideration the tyre deflection and the tolerances of the tyre diameter

** Without cab. Different values with cab

*** Fork overhang not included

**** For tele-, NiHo- and triplex mast

Note: E=Environmental protection solid tyre; S=solid tyre; P=Pneumatic tire

Note: E=Environmental protection solid tyre;   S=solid tyre ; P=Pneumatic tire
1) With side shift ,<mark>+17mm</mark>
2) For alternative wheels, see table.
3) battery options (capacity/weight): 505AH/595Ah-810KG/920KG
The values shown refer to standard outfits;
they are indicative only and not binding.

Three-wheel truck tyre characteristics

WHEELS			
Type	solid tyre		Environmental protection solid tyre
	front	rear	front
1.5T/1.8T	16×6-8	18×7-8	16×6-8
2.0T	16×6-8	200/50-10	16×6-8

Fork lift truck capacities - Model 1300 kg 3 wheels - with vertical masts and

forks = 1400 mm max.

mast type	max. height	Rated capacity load center 500mm		height		free-lift height	
		1.5T	1.8T	closed height	height with carriage	without carriage	with carriage
VM Standard wide-view	2500	1500	1800	1745	3542	140	140
	2700			1845	3742	140	140
	3000			2005	4042	140	140
	3250			2120	4292	140	140
	3300			2145	4342	140	140
	3500			2245	4542	140	140
	4000	1300	1600	2545	5042	140	140
VFM Full free duplex	2500	1500	1800	1745	3542	1250	743
	2700			1845	3742	1350	843
	3000			2005	4042	1500	993
	3300			2145	4342	1650	1143
	3500			2245	4542	1690	1243
	4000	1300	1600	2545	5042	1890	1543
VFHM Full free triplex	4000	1300	1500	1940	5042	1400	938
	4350	1280	1400	2065	5392	1525	1063
	4500	1250	1400	2115	5542	1575	1183
	4700	1250	1300	2185	5742	1645	1183
	4800	1200	1300	2215	5842	1745	1213
	5000	1100	1200	2315	6042	1775	1313
	5400	900	1000	2440	6442	1900	1483
	5500	750	850	2465	6542	1925	1463
	6000	500	650	2665	7042	2125	1663

Remark: This data would be changed under different working condition

❖ subtract 150kg with side shifter

mast type	max. height	Rated capacity load center 500mm		height		free-lift height	
		2.0T		closed height	height with carriage	without carriage	with carriage

VM Standard wide-view	2500	2000		1757	3540	98	98
	2700			1857	3740	98	98
	3000			2007	4040	98	98
	3300			2157	4340	98	98
	3500			2257	4540	98	98
	4000	1800		2557	5040	98	98
VFM Full free duplex	2500	2000		1757	3540	1167	757
	2700			1857	3740	1267	857
	3000			2007	4040	1417	1007
	3300			2157	4340	1567	1157
	3500			2257	4540	1667	1257
	4000	1800		2557	5040	1967	1557
VFHM Full free triplex	4000	1700		2000	5035	1370	1000
	4350	1550		2125	5385	1495	1125
	4500	1450		2175	5535	1545	1175
	4700	1350		2240	5735	1610	1240
	5000	1200		2418	6035	1788	1418
	5400	1000		2618	6435	1988	1618
	5500	950		2652	6535	2022	1652
	6000	750		2885	7035	2255	1885

Remark: This data would be changed under different working condition

❖   subtract 150kg with side shifter

Lift types:
• SX: Simplex lift
• DX GAL: Duplex lift with free lifting
• TX GAL: Triplex lift with free lifting
• WITH SLI: with side shift
• WITHOUT SLI: without side shift
SES: Single superelastic tyres
PN: Pneumatic tyres
TWIN: Twin tyres
Lift inclination: Forward (Forw.) / Backward(Back.)

Alternative lift characteristics

Abbreviations key

Lift. = Lift	Opt. = Optional
DX = Duplex lift	All lifts = All the lifts
SX = Simplex lift	S.E. = Superelastic
TX = Triplex lift	S. = Single
Sing. = Single tyre	PN. = Pneumatic
Twin. = Twin tyres	RVE = Reverse while empty

Tyre inflation pressure

Type	AXLE	SIZE	PRESSURE
1.5/1.8T	Front	18×7-8	
	Rear	16×6-8	
2.0T	Front	200/50-10	
	Rear	16×6-8	

Lamps

Front light	12V-55W
Direction indicators lights	12V-21W
Breadth indicators lights	12V-5W
Tail and stop lights	12V-21W
Reversing lights	12V-10W
Flashing beacon	12V-2W

Battery dimensions and weights

Truck type	Voltage V	Capacity Ah	Weight kg±5%
1.5T/1.8	48	505/525/595	810~920
2.0T	48	625/700	900-990

⚠ DANGER

The minimum and maximum weights of the batteries must be guaranteed.

Internal accessibility

To access the internal parts of the truck (battery), proceed as follows:

1) upward, open the battery cover, 2) remove bolts, open the electrical cover, 3) remove bolts, remove the floor, 4 remove bolts, removal of multi-way valve cover
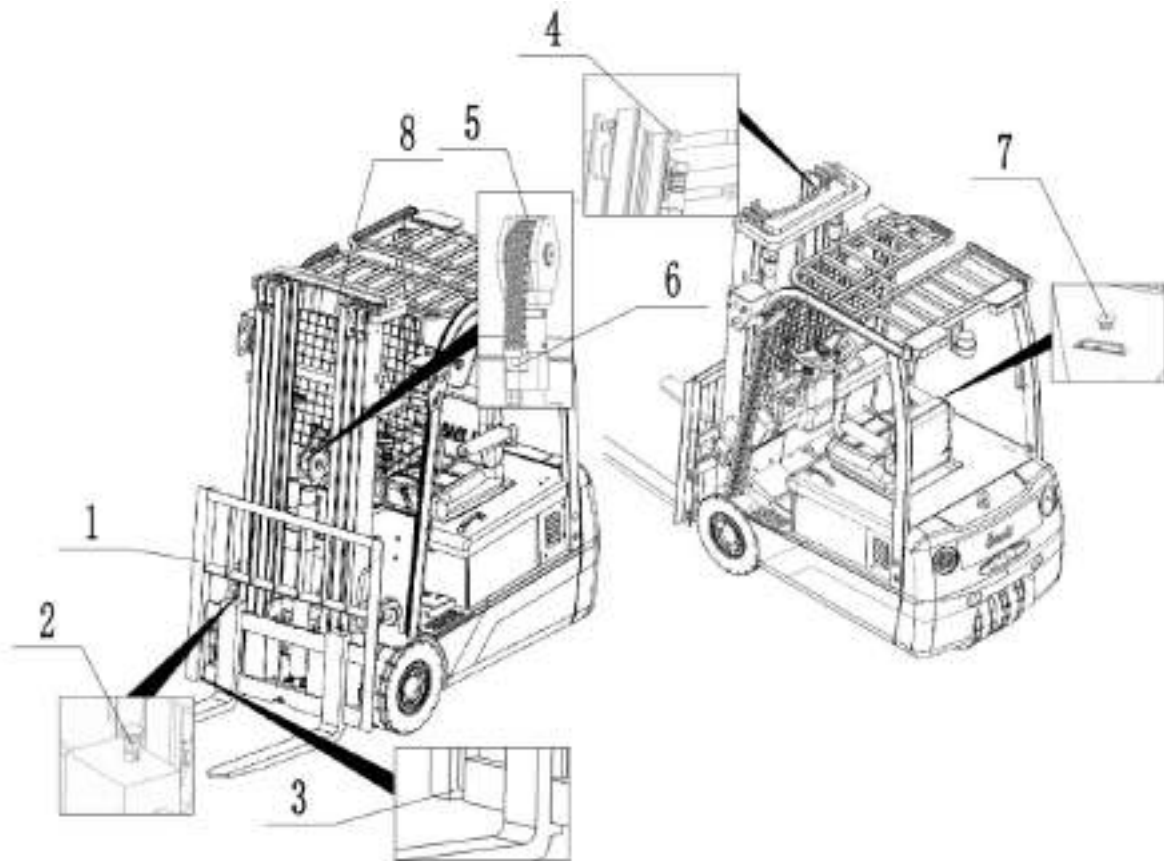
ℹ️ **NOTE**

The battery cover is held open by a gas spring .

1):To close the cover, follow the instructions above in the reverse order.

Safety features

Sollevatore:

|	
1.	Load carrying grate
2.	Fork stop latches
3.	Fork retaining device
4.	Fork carriage retaining device
5.	Chain retaining device
6.	Chain tension rod retaining device
7.	Emergency stop button
8.	Shear protection net

10. "Seat switch" microswitch that blocks operation of the truck when the operator is not seated on the driver's seat
11. Restraining belt
12. Overhead guard
13. Alarm horn
14. Reverse gear warning buzzer

12
13
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10 11 14
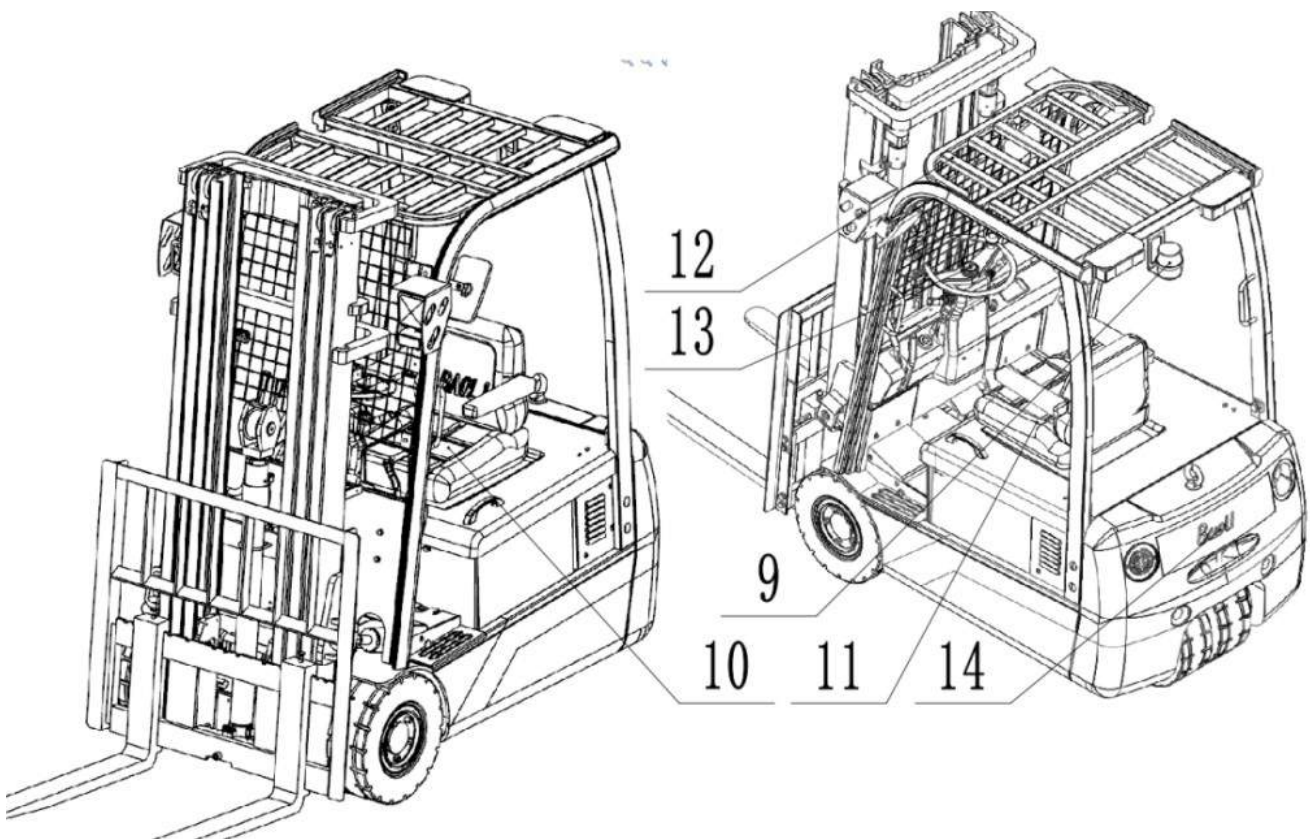
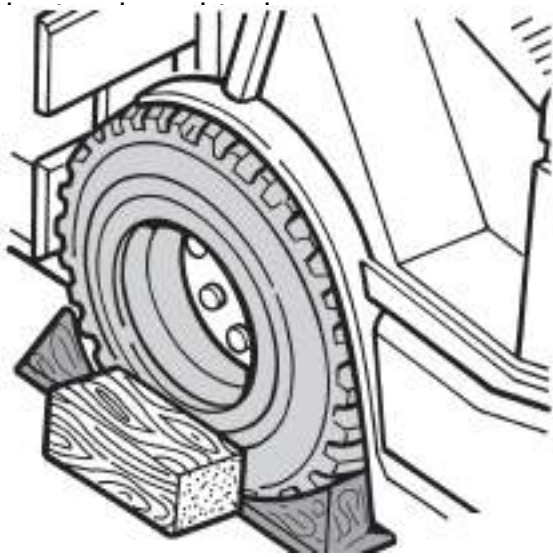| 9. flashing beacon |
| --- |

These devices most be checked daily, as described in Chapter 4.

The forklift is normally transported
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Transporting the Forklift

Forklift towing

During the towing operation, the operator must be on board the truck in order to perform the steering and braking operations.
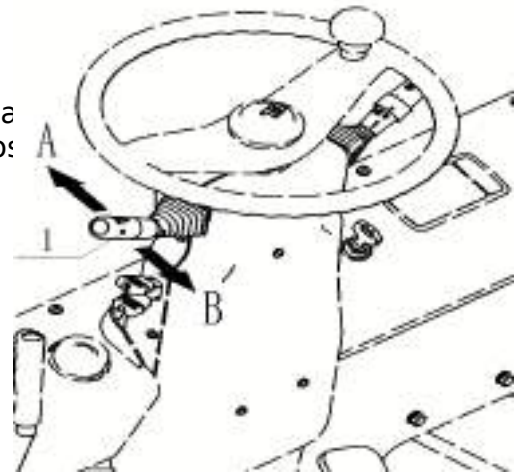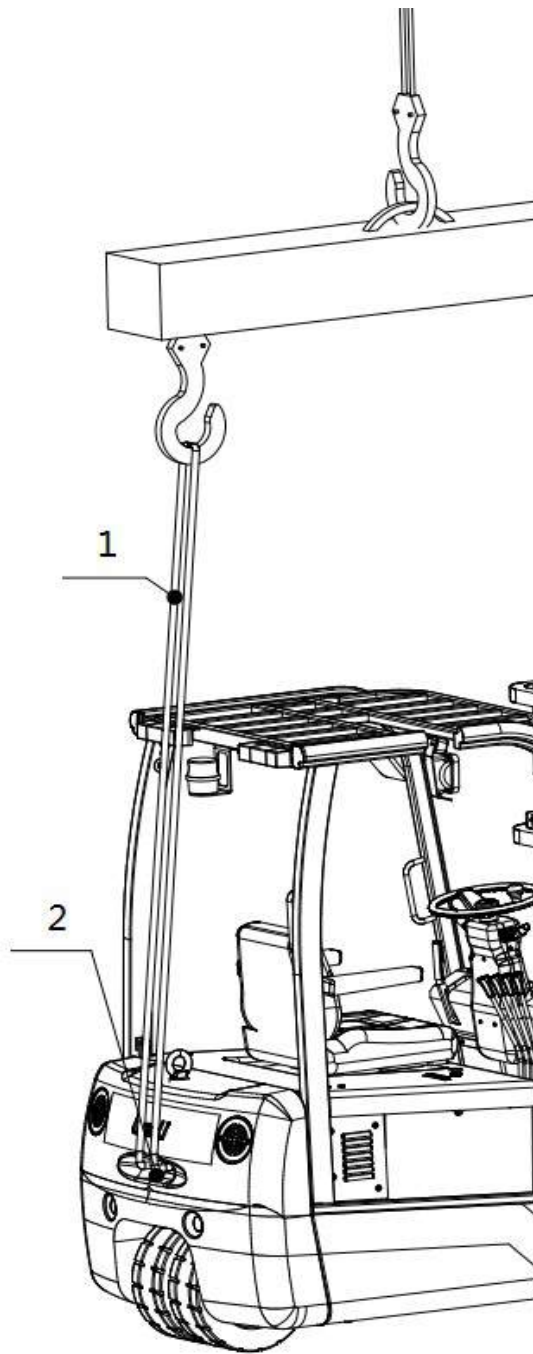
NOTE

Use non-metallic cables for towing.
Version with reversing on the steering wheel

Before towing models with reversing lever on the steering wheel, check tha̶ pos̶

Loading and unloading the truck

Use an inclined plane or movable loading ramp to load and unload the truck. If the truck is not operational or does not have the battery, lift it as described below.

Use a crane with a suitable lifting
capacity for the weight of the truck,
indicated on its designation plate.
Also take into account the weight of
the mounted battery (if applicable),
consulting the relevant designation
plate. The lifting operations must be
performed by qualified personnel. DO
NOT stand within the crane's radius
of action or near the forklift. Use non
metallic cables. Make sure that the
lifting capacity of the slings is
suitable for the weight of the truck.

**To lift the truck, proceed as
follows:**
• Insert a non-metallic sling (1) into
the rear
tow coupling (2) of the truck. Check
that the
sling adheres to the upper part of the
slot in
the counterweight.
• Pass two slings (3), one on each
side,
through the upper crossmember (4)
of the
lift's fixed mast.
• Connect the free ends of the cables
to the
hook of the crane and lift without
tearing.

The cables should have a suitable
length so as
to not graze the roof or any
additional equipment during lifting.
Use a lifting beam if necessary. The
slings must be pulled vertically.

Any other lifting and transport
method of the forklift is forbidden.

The forklift must be commissioned
exclusively by the technical support
service authorized by the
manufacturer.

Safety precautions

Description of safety symbols

This document gives the danger warnings Each of such danger warnings consists of a graphic symbol, followed by a description of the danger and its consequences, and the description of how it can be avoided. The types of warnings used are described below.

⚠ DANGER

This warning indicates serious risks for the safety of the operator and maintenance staff. It may be accompanied by additional comments.

⚠ CAUTION

This warning indicates serious risk of damaging the
truck.
It may be accompanied by additional comments.

General safety Regulations

⚠ DANGER

Failure to observe the safety provisions can cause serious harm to technical staff and to the truck.
During maintenance and repair procedures, scrupulously follow the prescriptions indicated below and the instructions given in this manual. Maintenance operations must be performed by qualified technical personnel authorized by the manufacturer. Always work within the limits of safety, according to the standards in force.

 ENVIRONMENT NOTE

Carefully follow the safety regulations pursuant to the provisions in force when handling working materials.

 NOTE

Important information regarding knowledge of the truck and its safe use along with basic information on truck maintenance are given in the **Instruction and maintenance manual.**

⚠ DANGER

Do not carry out any cleaning, lubricating or maintenance activities when the battery is connected.
If maintenance operations are carried out with the battery connected, the machine may accidentally be started, or sparks may cause harm to the technical staff
or to the machine itself. The battery must therefore be kept disconnected, unless expressly

prescribed by the maintenance or repair instructions.

- All service actions must be carried out   with maximum care and attention.

- Do not wear rings, wrist watches,   jewellery, unfastened or hanging garments such as ties, torn clothing, scarves, unbuttoned jackets or blouses, or open zips, which could be caught in the moving parts.
- Operate in separate work areas specifically intended for maintenance or specially marked off to indicate work in progress.
- During maintenance operations, engage the parking brake, turn off the truck and remove the keys from the dashboard, unless expressly required by the operation being carry out.
- Ensure that the machine cannot be moved accidentally.
- The brakes are not activated when they are manually released for maintenance or repair operations: in this case provide for control of the machine using suitable chocks or similar.
- Ensure that no one is within range of any movement of the machine or equipment.
- Do not carry out any maintenance or repair on the machine with a person sitting in the seat, unless the person is qualified and necessary for execution of the operation.
- Do not switch on the machine or activate its equipment from any position other than sitting in the driver's seat.

- To avoid improper use or use in unsafe conditions, label all controls to mark that repairs are in progress.
- Do not leave the machine unattended with parts in movement.
- Immobilise the machine and all equipment or parts that are subject to maintenance while raised, or which could accidentally move.

- When carrying out operations from beneath the truck, always use a maintenance well or a bridge crane of adequate capacity.
- The areas for maintenance must be level, and must be kept dry and clean; any puddles of water or oil stains must be removed immediately.
- Do not pile up rags soaked in grease or oil: they represent a serious fire hazard. Always place them inside a closed metal container.
- If working on a sloping surface is inevitable, immobilise the machine before starting to work, and move it to a level surface as soon as this can be done with a certain margin of safety.
- Service stepladders and platforms used in the workshop or on the worksite and other equipment must conform with the accident prevention standards in force.
- After completing maintenance operations, the truck must be returned to normal conditions of use, taking care to check the correct installation of all prescribed safety and protective devices. Take care to remove all equipment from the machine, and check accurately that all parts are firmly fixed.
- To tow the truck, comply with the instruction in this manual, using the provided connection points exclusively. Make all connections carefully/ ensure than pins and/or latches foreseen are firmly fixed before starting to tow the truck. Do not remain in the vicinity of the tow bar, ropes or chains working under tension.
- To move a machine that has broken down, use a trailer or a truck with a lowered loading platform, if available.
- When transporting the truck, follow the indications in this manual. To load and unload the machine on and off the transport means, choose a level area with a solid surface to support the wheels of the trailer or lorry. Anchor the machine firmly to the loading platform of the lorry or trailer and block the wheels.
- The chains must be firmly fixed: make sure that the anchorage is sufficiently resistant to support the foreseen load. No one must be within the vicinity of the chain or rope anchorage points under tension.
- Handle each part with extreme care. Keep hands and fingers away from interstices, rotating parts and similar.
- When lifting or transporting heavy parts, use pulleys or similar of adequate capacity, and keep all persons at a safe distance.
- Move with great care when carrying out work beneath the machine, and also when in the vicinity of the same.
- Stop the motor and make sure that there is no pressure in the hydraulic circuits before removing caps or covers.
- If any part is blocked, free the same only when the motor is off and the battery is disconnected.
- Do not check or top up the fuel tank, the hydraulic oil or the battery while smoking since

the fluids used are inflammable.

- Never pour petrol or diesel oil into open, wide or low recipients because of the risk of inflammable vapours and spills.
- Never use petrol, diesel oil or inflammable fluids for cleaning: always use non-toxic commercial solvents.
- When using compressed air for cleaning small parts, use protective goggles with side guards; use a maximum pressure of 2.1 bars according to local or national legislation in force.
- When handling easily inflammable material, do not smoke, do not use open flames, and do not cause sparks in the vicinity.
- Do not use flames as a means of illumination when proceeding with operations or when searching for leaks on the machine.
- Do not carry objects in pockets which could accidentally fall into the open parts of the machine.
- When there is any possibility of being hit by metallic parts or similar, use goggles with protective side guards, helmets, protective footwear and safety gloves.
- During welding operations, always use protective accident-prevention devices. Protective goggles must also be worn by anyone in the vicinity, even if not carrying out work. Never look at the welding arc without adequate eye protection.
- With use, metal cables become frayed: when handling them,

always use adequate protection (gloves, goggles, etc.). Do not use chains r ropes that are worn or bent for lifting or pulling.

Electrical system –

⚠ DANGER

batteries
Before performing any operation on the electrical system, disconnect the battery outlet from the relative plug.

- When using the batteries, it must be remembered that both ends of the cables must be linked to the terminals in the correct manner: (+) to (+) and (-) to (-).
- Avoid short circuiting the battery terminals.
- The gas released from the battery is highly inflammable. When recharging, leave the battery compartment open to allow for more effective ventilation and remove the caps. Ensure that ventilation is adequate in order to avoid the possibility of accidental explosions due to the accumulation of gas released during recharging.
- Never check the state of the battery by means of a "bridge" created by placing a metal object on the terminals.
- Avoid sparks and flames in the battery area.
- Do not smoke near the battery or in the maintenance area in order to avoid the risk of explosions.
- Before any operation, check that there are no electrolyte leaks: eliminate such leaks

before proceeding with the work.

- Refer to the specific Instruction and Maintenance Manual of the drive battery.
- Before any operation, check that no elements are short circuited: eliminate such short circuits before proceeding with the work.
- For electric heaters, battery chargers and similar appliances, use only effectively earthed auxiliary power sources in order to avoid the possibility of electric shocks.

Hydraulic system

⚠ DANGER

Small high pressure jets of oil can penetrate the skin.
Penetration of the skin by hydraulic oil under pressure spurting from the hydraulic system is dangerous. If this type of lesion should occur, contact a doctor immediately. Small leaks should be sought by the aid of a piece of cardboard or a piece of wood. Avoid using the hands to look for leaks.

- Use special instruments to check the pressure of the hydraulic system.

Disconnections and reconnections

⚠ DANGER

Before removal and installation of any component, disconnect the relative plug from the battery outlet.

- Lift and handle all particularly heavy parts by means of lifting gear of an adequate capacity.
- Ensure that pieces are supported by appropriate harnesses and hooks.
- Use the lifting rings specifically provided for the purposes. Pay attention to persons in the vicinity of the load to be lifted.
- Handle all pieces with great care.
- Do not place hands or fingers between one piece and another.
- Avoid twisting the chains and metal cables.

Safety Regulations Relative to Operating Materials

Rules for handling and disposing of operating materials.

ENVIRONMENT NOTE

Improper use and disposal of operating and cleaning materials can cause serious damage to the environment.

- Always use and handle the operating materials in a suitable manner and follow the manufacturer's instructions for the product's use.
- Keep the operating materials only in containers intended for this purpose and in a location that satisfies the requirements.
- The operating materials may be flammable, so avoid contact with hot objects or open flames.
- When topping up the operating materials, only clean containers should be used.
- Follow the manufacturer's safety and disposal instructions regarding the operating and cleaning materials.
- Do not disperse oils or other operating liquids! Any spilt liquid must be immediately collected and neutralised with a binding material (such as an oil binder) and then disposed of in accordance with current regulations.
- Always abide by the regulations of the anti-pollution laws!
- Before carrying out work that involves lubrication, filter replacement or hydraulic equipment interventions, the area in question must be thoroughly cleaned.
- The replaced parts must always be disposed of in accordance with the anti-pollution laws.

ENVIRONMENT NOTE

The incorrect or unlawful use of brake fluid is harmful to people's health and the environment.

Oils

- Do not allow to come into contact with the skin.
- Do not inhale oil vapors.
- Wear appropriate means of individual protection during forklift maintenance operations (gloves, goggles, etc.) to prevent the oil from coming into contact with your skin.

ENVIRONMENT NOTE

⚠ DANGER

The used oils (brake, motor, transmission, gearbox and hydraulic oil) and relative filters contain substances hazardous to the environment and must be disposed of according to current regulations. We advise you to contact the authorised service network.

The penetration in the skin of hydraulic oil that has leaked

under pressure from the forklift's hydraulic system is dangerous. If this type of lesion should occur, contact a doctor immediately.

⚠ DANGER

Small high pressure jets of oil can penetrate the skin. Look for any leaks using a piece of cardboard.

Battery Acid

- Do not inhale the vapor: it is poisonous.
- Use adequate means of individual protection to prevent contact with the skin.
- Battery acid is corrosive: if it should come into contact with your skin, rinse abundantly with water.
- Explosive gas mixtures can form when charging the battery; therefore, the rooms in which the battery is charged must be in compliance with the specific regulations on the subject (e.g. CEI-EN 50272-3,...).
- DO NOT smoke or use open flames and lights within a 2 m radius from the charged battery and in the battery charging area.

NOTE

For greater information, consult the specific battery manual that comes with the battery.

ENVIRONMENT NOTE

The batteries contain substances that are hazardous to the environment. The replacement and disposal of the life-expired battery must be carried out as required by law. We advise you to contact the authorised service network that is equipped for eco-friendly disposal in accordance with current regulations.

Maintenance
Preliminary operations before commissioning

Below are listed the operations that must be performed on the forklift before delivering it to the customer:

- General test of the forklift.
- Check and top-up, if necessary, the oil in the hydraulic system tank.
- Visually check the seal of the lift cylinder gaskets, tilt cylinders, steering control cylinder and side shift, distributor, oil pump, hydraulic system piping and fittings; eliminate any leaks. Check the oil level and top-up, if necessary, for the motor, hydraulic and differential transmission, reducers; eliminate any leaks.
- Check the brake fluid level and top-up, if necessary; visually check the seal of the brake system, service brakes and parking brake; eliminate any leaks.
- Check the motor cooling water level and top-up, if necessary; visually check the seal of the motor cooling circuit; eliminate any leaks.

- Check the inching pedal linkage, fan belt tension, handbrake tension and adjust if necessary.
- Check and restore, if necessary, the wheel nut tightening, retaining screws fastening the lift to the truck, counterweight, protective roof, lifting chains and their anchorage, clearance between movable parts, pneumatic pressure.
- Check the operation of the electrical recharging system, ignition, control instruments, and battery liquid level.
- Forklift lubrication and greasing.
- Lift greasing (mast, rolling tracks).
- Check of the safety devices

i NOTE

For the description of the operations, refer to the relative paragraphs.

Synoptic Table of Maintenance Operations

Operation	Hours	
	Everyday	100
Check wheel nut tightening		
Parking brake check		.
Chain tension check and adjustment		.
Check hydraulic tank oil level	.	
Cleaning of the electronic panel		.
Lubricating the steering axle		
Fork carriage guide lubrication		.
Service brake check		.
Trunnions greasing		.
Reduction gear oil level check		.
Rolling tracks greasing		.
Grease rear wheel bearings (4 wheels)		
Seat belt blocking system check		
Lubricate lift chain		.
Chain check and maintenance		.(1)
Change gearbox oil		
Check and adjust lift clearances		
Change hydraulic oil filter cartridge		
Protective roof tightening screws check		
Check fork wear		(1)
Check brake oil level	.	
Change hydraulic system oil		
Axial maintenance		
Change brake oil		

(1) = To be carried out absolutely every 3 months or according to current legislation.
(2) = Every 1000 hours or at least every 12 months.
(3) =First change after 1000 hours, then every 3000 hours.

Proceed as follows at each lubrication operation:
• Follow the safety precautions for the lubricant;
• Before lubricating, carefully clean the component to be lubricated;
• Use suitable binders if the lubricating product should spill;
• Keep the product in a suitable and compliant place, as per the instructions supplied with the product;
• Dispose of the lubricating product in compliance with the current laws.

ENVIRONMENT NOTE

 ENVIRONMENT NOTE

Proceed as follows at each lubrication operation:

- **Follow the safety precautions for the lubricant;**
- **Before lubricating, carefully clean the component to be lubricated;**
- **Use suitable binders if the lubricating product should spill;**
- **Keep the product in a suitable and compliant place, as per the instructions supplied with the product;**
- **Dispose of the lubricating product in compliance with the current laws.**

Supply Table

Element to be supplied		Quantity	Lubricants	International specifications
Hydraulic circuit	1.5T/1.8T	24L	L-HM46&L-HM32	ISOVG30
	2.0T	38L	L-HM46&L-HM32	ISOVG30
Bearings and grease nipples		0.1 kg	JISK2220/2#	

gearbox	1.5T/1.8T	ATF220	
	2.0T	SAE-80W		SAE-80W/API GL4/UTTO
Chains			Lubricant STRUCTOV FHD	ISO VG 150
Oil-immersed brakes	0.2 L		dot 3

Diagnostic software
Connection between the diagnostics
PC and the forklift

The diagnostics PC connects to the forklift
through the SME interface cable.

The connection can be performed on all modules.

The connection between PC and forklift must be performed with

the forklift turned off.
The diagnostics unit must be used by trained personnel only. The variation of some parameters or configurations may cause hazardous situations for the operator.

Software

The software to be used for the parameterization and diagnostics is EYEPLUS.

Instructions:

- Connect the PC to one of the electronic modules using the interface cable.
- Access the software through the relative icon.
- If EYEPLUS software installation is successful, starting the application from Windows "Programs" Menu, or using short-cut on desktop (Fig.1), you can access main menu.
- On left side, there are some notes about software release, operating mode and serial communication settings. Below lift-truck picture (picture, normally present in main menu, doesn't appear in fig.2).

There are actual active alarms (code level and description); in case of more alarms with the same priority level, the first occurred is visualized.
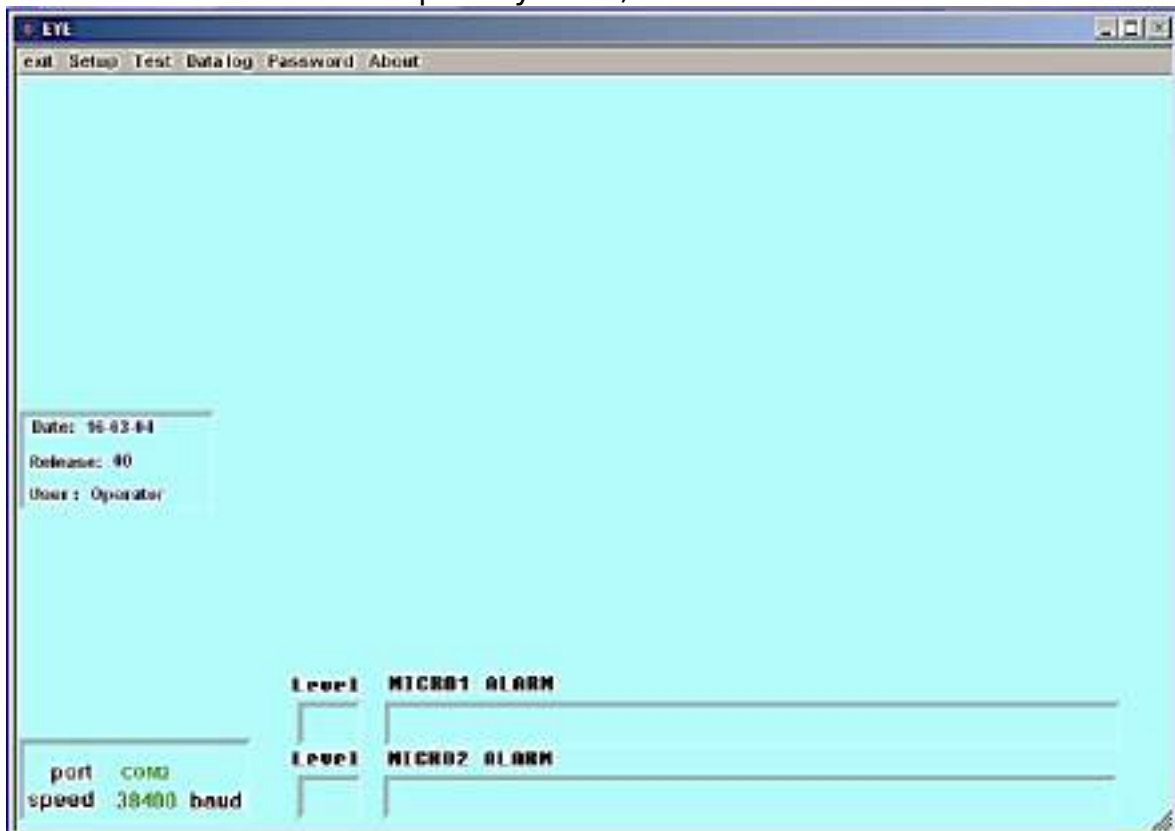
Starting EYEPLUS application, your system memory is read to in order to know truck model and to properly customize all menus, because more than one lift truck model can be available.
For example see drive motor menu in case of twin drive motors (Fig.11) and in case of single drive motor (Fig.12).

In case panel memory is blank, user himself is automatically asked to select truck model from a list defined in a configuration file named "Truckmodel.ini" (listing all truck models with their main characteristics).

Moreover, if user programs flash memory, EYEPLUS software loads source files from a directory named as lift truck model itself: this way proper source files are automatically associated to selected truck model (see FLASH PROGRAMMING section for further information).

In operator mode, from main menu you can access following menus:

<div align="center">

" **Exit** "

" **Setup** "

" **Test** "

" **Data logging** "

" **Password** "

" **About** "

</div>

"Setup", "Password" (refer to chapter 3.1.1) and "About" (Fig.3) menus are accessible even before starting of serial communication between lift truck and PC (Fig.4); in such a case some data field are missing.

To quit application or exit a submenu, press ESC key or select "Exit" menu.

In case of any problems, refer to section 4 "TROUBLESHOOTING"

Title: EYE Plus

Release: 1.1.2

Data:17-04-2007

Author: Ing. F.Sonzogno

Coauthor: Ing. A.Zannini

Company : SME Elettronica S.P.A.

Address : Via della Tecnica 40, Arzignano(VI), Italy

OK
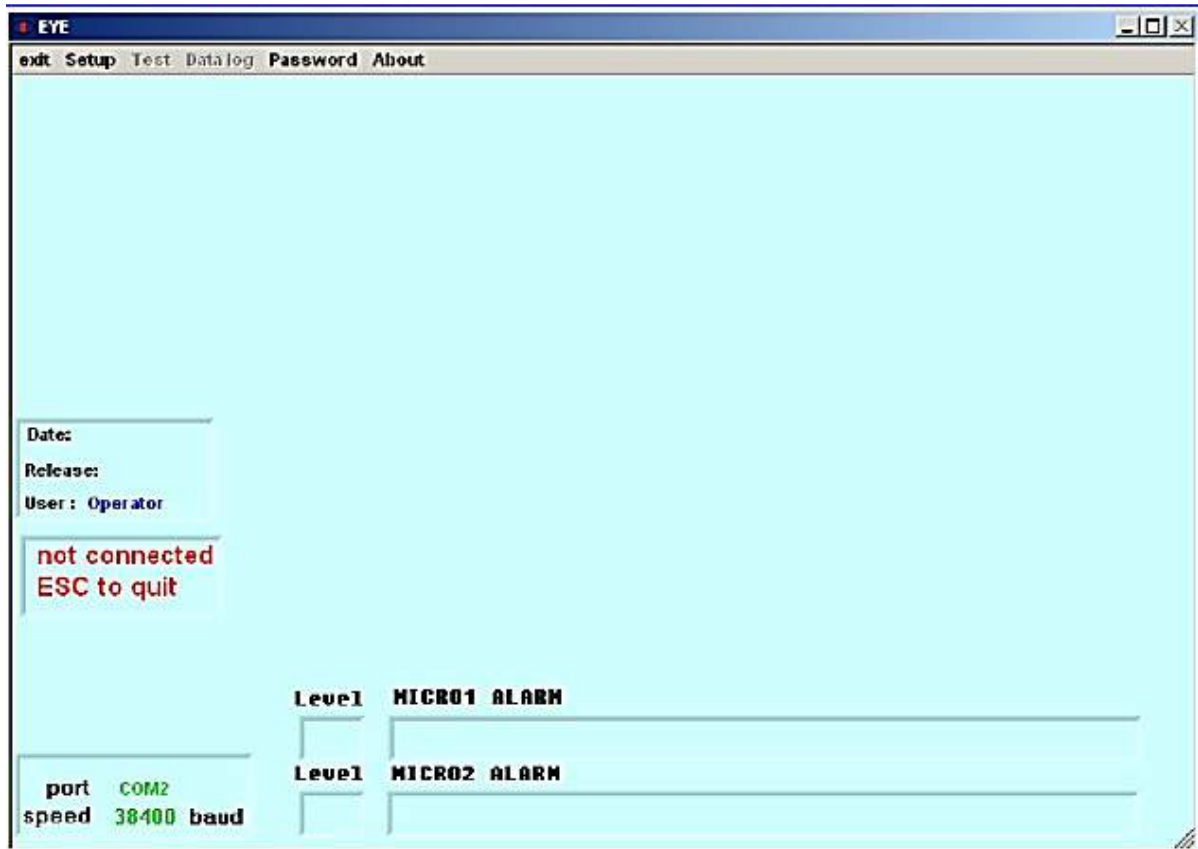
In case of faults during a serial communication data flow, any submenu is aborted and main menu front panel is reinitialized.

PASSWORD INSERTION

Selecting Password mode from menu-bar, you can
access Supervisor mode (Fig.7), inserting the right
password (Fig.5).
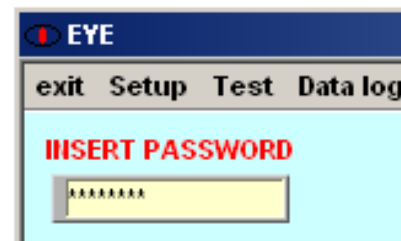
In case of wrong password insertion message Fig.6 becomes visible.
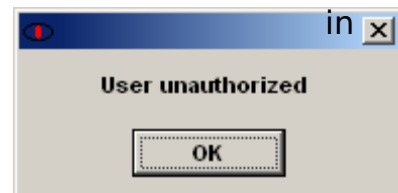
Contact EYEPLUS software developer to know correct password.
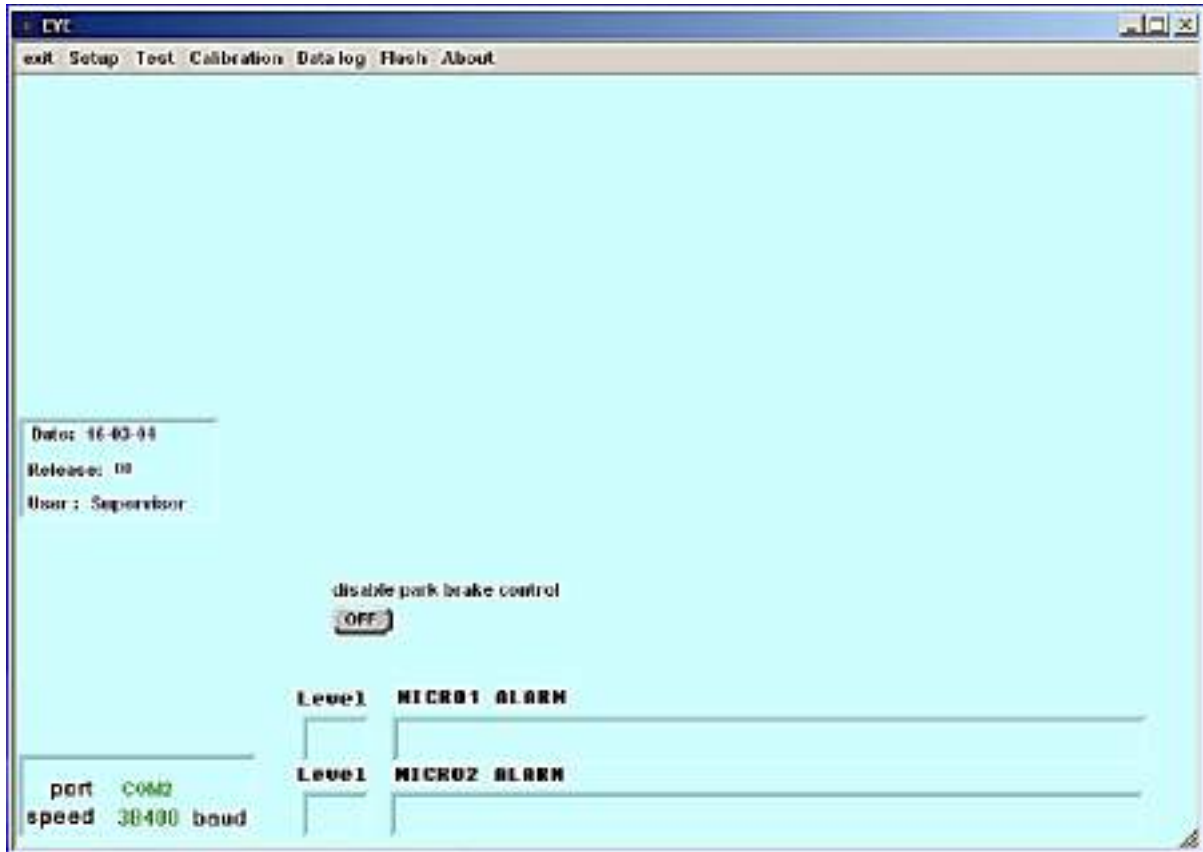
In Supervisor mode, you can access these further menus:

" Calibration "
" Flash "

" Password " menu disappears from menu-bar.
In case of faulty serial communication, main menu front panel is reinitialized as follows (Fig.8)

Notice : "PANEL BLANK" message is used to distinguish case of not programmed flash memory, so Flash menu is obviously active.

You can select active menus directly from main panel (any greyed menu is not accessible in that moment); access present sub panels with a further selection by menu (Fig.9) menu bar you can also a pop-up

NOT ACTUAL SOFTWARE / EEPROM CRC FAULT

A CRC alarm message is visualized both in case of failed EEPROM memory writing and of using a software version without the CRC control procedure.

Pressing the visualized button, you can load in EEPROM default values: if you don't execute this procedure, calibration functions are inhibited.

You have now to execute calibration procedure (see inverter manual).

A message signals also the presence of not actual software loaded on inverter panel.

In such a case you can access only basic EYEPLUS functions: some menus, for compatibility
reasons, will be inhibited.

SUBMENUS

"**Print**" function is accessible from many of listed submenus: you can send active front panel image to printer or save it on file; in that case destination directory is <**EYEPLUS PATH>\EYEPLUS\images**.

Notice: if more than one window is in use, only the one relative to the inner submenu is   active and all others work in background.
If you select a non active window, you can't communicate\ interact with inverter panel.
In such a case mouse cursor assumes the shape of an hour-glass if a non active window is
selected.

CONFIGURATION MENU (SETUP)

From setup menu (Fig.10) you can select communication serial port and image file format used by Print function .
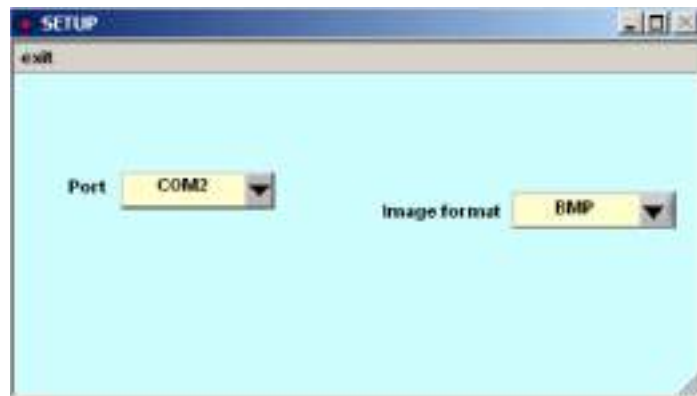
TEST MENU SECTION

This pop-up menu includes following diagnostic items :
• "Drive" menu both for twin motor applications (Fig.11)
   and for single motor applications (Fig.12)
• "Pump" menu (Fig.13)
• "Battery" menu (Fig.14)
• "Timers" menu (Fig.15)

DRIVE (TRACTION) TEST MENU
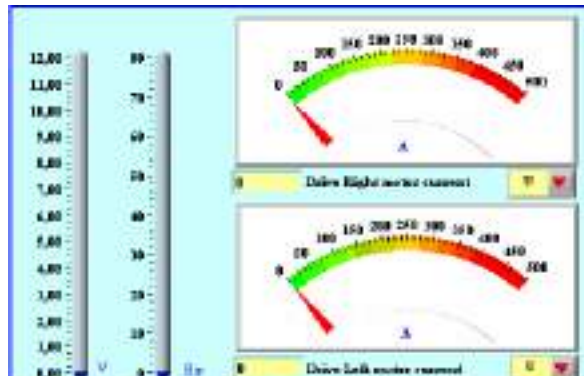
Following items appear in Drive menu front panel for twin motor applications:
- Accelerator pedal voltage
- Pedal brake pressure (in bar)
- Drive motors phase currents: you can select current phase from pop-up menu
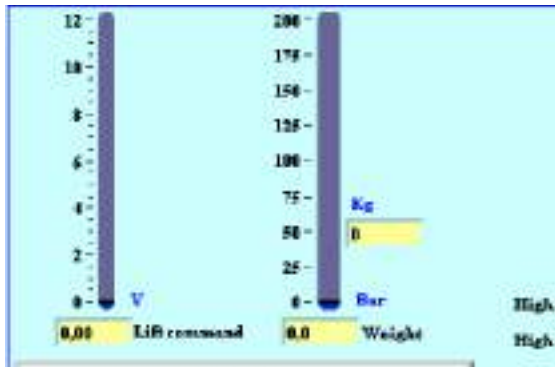- Both modules temperature: you can select measure unit between °C and °F.

Notice: temperature above 60°C is signalled by a red colour; temperature above 90°C is signalled by a flashing display.
- Steering angle in percent, using following criteria:

0%	steering completely on left
50%	straight wheels
100%	steering completely on right

- Steering sensor voltage and steering switch status
- Request RPM and motor speed for both motors, with an arrow signalling direction
- Drive motors encoder diagnostic leds, both for A and B channel
- Both motors temperature: you can select measure unit between °C and °F.

Notice: in case of an overheating alarm, the corresponding green led becomes red.
- Active output command switches
- Start, forward, reverse and seat switches status; pedal and hand brake status
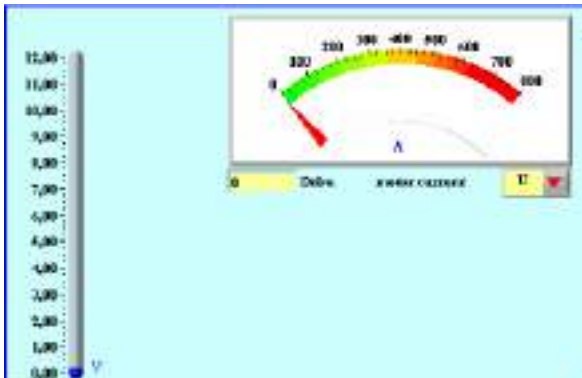
Following items appear in Drive menu front panel for single motor applications:

- Accelerator pedal voltage
- Pedal brake pressure (in bar)
- Drive motor phase current: you can select current phase from pop-up menu
- Module temperature: you can select measure unit between °C and °F.

Notice: temperature above 60°C is signalled by a red colour; temperature above 90°C is signalled by a flashing display.

- Steering angle in percent, using following criteria:

0%	steering completely on left
50%	straight wheels
100%	steering completely on right

- Steering sensor voltage and steering switch status
- Request RPM and motor speed for drive motor, with an arrow signalling direction
- Drive motor encoder diagnostic leds, both for A and B channel
- Motors temperature: you can select measure unit between °C and °F.

Notice: in case of an overheating alarm, the corresponding green led becomes red.

- Active output command switches
- Start, forward, reverse and seat switches status; pedal and hand brake status

PUMP TEST MENU

Following items appear in Pump menu front panel:

- Voltage on lift command circuit
- Hydraulic lift circuit pressure
- Pump motor current : you can select current phase from pop-up menu
- Module temperature: you can select measure unit between °C and °F.

Notice: temperature above 60°C is signalled by a red colour; temperature above 90°C is signalled by a flashing display.

- Request RPM and motor speed, with an arrow signalling direction
- Motor temperature: you can select measure unit between °C and °F.

Notice: in case of an overheating alarm, the corresponding green led becomes red.

- Weight present on the forks
- Buzzer and electro valves output status
- Customizable input switches status
- Tilt, lift and high lift digital input status
- Encoder diagnostic leds, both for A and B

BATTERY TEST MENU

Following items appear in Battery menu front panel:
- Battery and inverter voltages
- Battery charge level
- Code, description and level of active more serious alarm for both microprocessors.
    If there is more than one alarm of same level, the latest is visualized.

- There is a chronological list of latest 10 alarms, with code, description, time and temperature. First listed alarm is the first occurred.
- Temperature value is obviously referred to faulty module or faulty motor

Notice: if there are no faulty modules or motors, this is a no meaning data field.

With "**Reset alarms**" menu, you can reset alarm list.
-

TIMERS TEST MENU
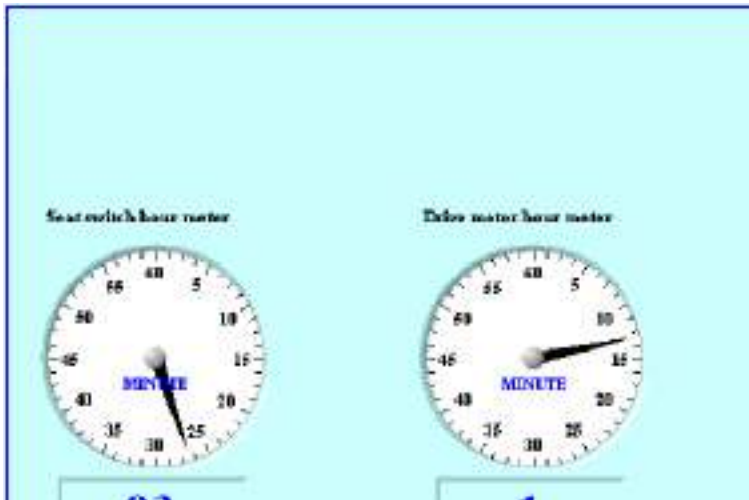
Following items appear in Timers menu front panel: total inverter working hours, drive motor and pump motor hour meter and odometer readings.

CALIBRATION

By a pop-up menu, you can access following calibration functions:

- " Battery ": Battery reset voltage calibration (Fig. 16) (**)

- " Timers ": Timers calibration (Fig. 17)

- " Steering ": Steering sensor (Fig. 18)

- " Pedal ": Pedal accelerator calibration (Fig. 19) (**)

- " Lift ": Lift calibration (Fig. 20)

- " ESH ": E/S/H parameters calibration and limits (Fig. 21, Fig. 22, Fig. 23)

- " Steering parameters ": Steering parameters calibration (Fig. 24)

- " Program service ":Program service interval setting (Fig. 25)

- " Drive motor ": Drive motors parameters calibration (Fig. 26) (**)

- " Pump motor ": Pump motors parameters calibration (Fig. 27)

- " Critical height switches ": Speed limits calibration in case of critical height (Fig. 28)

- " Weight sensor ": Weight sensor calibration (Fig. 29) (*)

- " Brake sensor ": Brake sensor calibration (Fig. 30) (*)

- " Hydro threshold ": Hydro threshold calibration (Fig. 31) (*)

- " Cab lift ": Cab lift speed calibration (Fig. 32) (*)

- " Truck setup ": Some lift truck parameters setup (Fig. 33) (*) (**)

- " Pliers calibration ": Some lift truck parameters setup (Fig. 34) (*)

- " Backing mode ": Slow mode calibration (Fig. 35) (*)

- " Timers reset ": Timers meters reset (Fig. 36)

- " Load eeprom ": EEPROM memory configuration (Fig. 37, Fig.38)

- " Parameters image" : Lift truck parameters configuration (Fig. 39, Fig. 40)

- " Hour meter calibration" : Hour meter setting (Fig. 41a, Fig. 41b) (*)

(*): Optional menu
(**): Menu present in standard or optional version

Notice : some of the parameters listed in test menus are not present in all applications

Notice: you can access all calibration menus only if in Supervisor mode and with park brake on.

Notice: a confirmation is asked to quit a calibration menu without saving changes.

Notice: you can't set a value out of fixed limits.
Such a case is signalled by the message "**OUT OF LIMIT**".

Notice: see Appendix A to find further explanation about programmable parameters
meaning. They are listed in functional groups.

BATTERY RESET VOLTAGE CALIBRATION (**)
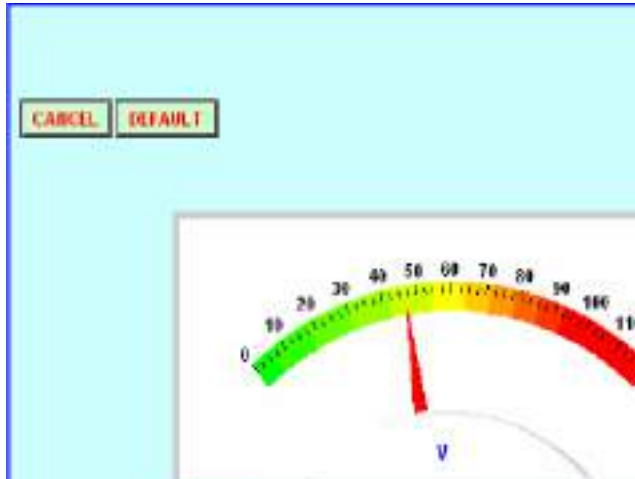
Standard version

In that menu front panel, you can find following data about battery reset voltage: description, actual value, new value you want to set, measure unit, default value, minimum and maximum settable values.

You can execute following operations:

Load default value:
1. Press DEFAULT button ; NEW data field will be automatically updated with default value
2. Press SAVE button and confirm; OLD data field too will be updated

Change actual value:
1. Insert changed value in NEW data field
2. Press SAVE button and confirm; in case of good result, OLD data field is updated. Otherwise an error is signaled and NEW data field initial value is restored.

Discard changes:
1. Press CANCEL button; initial value will be restored in NEW data field
2. Press SAVE button and confirm; OLD data field too is restored with initial value

Optional version

You can find a further parameter to be calibrated: discharged battery voltage; if battery voltage is less than this value, the corresponding alarm appears on display.

This parameter is visualized on front panel as battery reset value and also calibration procedure is the same.

TIMERS CALIBRATION

In that menu front panel, you can find following data about timer parameters: description, actual value, new value you want to set, measure unit, default value, minimum and maximum settable values.

You can execute following operations:

Load default value:

1. Press **DEFAULT** button; **NEW** data fields will be automatically updated with default value
2. Press **SAVE** button and confirm; **OLD** data fields too will be updated

Change actual value:

1. Insert changed value in **NEW** data field
2. Press **SAVE** button and confirm; in case of good result, **OLD** data field is updated. Otherwise an error is signalled and **NEW** data field initial value is restored.

Discard changes:

1. Press **CANCEL** button; initial values will be restored in **NEW** data fields
2. Press **SAVE** button and confirm; **OLD** data fields too are restored with initial values

STEERING SENSOR CALIBRATION

There are following data about steering parameters: description, actual value, measure unit, default values, minimum and maximum settable values. Pressing **SAVE** button, selected parameter **VALUE** data field is updated with steering sensor actual voltage; if this value is out of permitted range, you cannot calibrate it. In such a case check for any lift truck fault.

You can execute following operations:

Load default value:

Press **DEFAULT** button; **VALUE** data fields will be automatically updated with default values.

Change parameters value:

Discard changes:
Press **CANCEL** button; initial value will be restored in **VALUE** data fields

ACCELERATOR PEDAL CALIBRATION

Standard version

There are following data about accelerator parameters: description, actual value, measure unit,
default values, minimum and maximum settable values.
Pressing **SAVE** button, selected parameter **VALUE** data field is updated with pedal sensor actual voltage; if this value is out of permitted range, you cannot calibrate it. In such a case check for any lift truck fault.

You can execute following operations:

Load default value:
Press **DEFAULT** button; **VALUE** data field will be automatically updated with default Value.
Change parameters value:

Discard changes:
Press **CANCEL** button; initial value will be restored in **VALUE** data fields.

If selected parameter value is out of permitted voltage range, you cannot calibrate it; in such a case check for any lift truck fault.
In this window front panel there are 3 green led, expressing actual state of forward, reverse and start switches.

Optional version

There is a second pedal sensor.

Calibration procedure is like standard one, except that START led present (Fig.18) turns ON only after software verifies that the voltages on both pedal sensors are equal to Vmin + 0,5 V voltage, obtained slowly pressing accelerator pedal.

LIFT CALIBRATION

There are following data about lift parameters: description, actual value, measure unit, default values, minimum and maximum settable values. Pressing SAVE button, selected parameter VALUE data field is updated with lift sensor actual voltage; if this value is out of permitted range, you cannot calibrate it. In such a case check for any lift truck fault.

You can execute following operations:

Load default value:
Press **DEFAULT** button; **VALUE** data fields will be automatically updated with default values

Change parameters value:

Discard changes:
Press **CANCEL** button; **VALUE** data fields will be restored with initial values.

E/S/H PARAMETERS AND L1, L2 ,L3 LIMITS CALIBRATION

In that menu front panel, you can find following data about **ESH parameters**: description, actual value, new value you want to set, measure unit, default values for E, S, and H operating mode, settable per cent values for parameters in L1, L2, L3 operating mode.

You can execute following operations:

Select default value:

1. Press **DEFAULT** button ; **NEW** data field will be automatically updated with default value
2. Press **SAVE** button and confirm; **OLD** data field too will be updated

Change actual value:

1. Insert changed value in **NEW** data field
2. Press **SAVE** button and confirm; in case of good result, **OLD** data field is updated. Otherwise an error is signaled and **NEW** data field initial value is restored.

Discard changes:

1. Press **CANCEL** button; **NEW** data fields will be restored with initial values
2. Press **SAVE** button and confirm; **OLD** data fields too are restored with initial values

With **E_S_H** pop-up menu present in this window, you can select one of lift truck possible energetic operating modes (Economic, Standard and High); selected operating mode default values are so loaded on characteristic parameters.

The ESH parameters calibration procedure is optional, and you can enable/disable it with the ESH button.

In any case, you can disable limits calibration section (**L1**, **L2** and **L3** parameters) with **PROGRAMMABLE WORKING** button.

If "**programmable working**" section is disabled, and you select one of L1, L2 or L3 operating modes, a message will advise user and E operating mode will be forced .

If "**programmable working**" section is enabled, pressing **MODIFY LIMITS** button you enter Fig.22 window. You can now modify per cent values for **L1**, **L2** and **L3** limits; every single data change require to be confirmed.

In that menu front panel, there are data about L1, L2 and L3 parameters: description, measure unit, modifiable values expressed in per cent, minimum and maximum settable values.

You can execute following operation:
Change actual value:
    1.   insert new value
   2.   confirm

If actually selected operating mode percent values are now modified, exiting to ESH calibration menu, user can load new default values.
Every parameter per cent value is referred to High mode data.

Notice: You can set energetic mode also using **Compact display**. In such a case, the message in Fig. 22 appears: pressing **OK** button, parameters are updated loading new values from control board.

STEERING PARAMETERS CALIBRATION

In that menu front panel, you can find following data about steering parameters: description, actual value, new value you want to set, measure unit, default values minimum and maximum settable values.

You can execute following operations:

Select default value:
1. Press DEFAULT button ; NEW data fields will be automatically updated with default value.
2. Press SAVE button and confirm; OLD data fields too will be updated.

Change actual value:
1. Insert changed value in NEW data field
2. Press SAVE button and confirm; in case of good result, OLD data field is updated. Otherwise an error is signaled and NEW data field initial value is restored.

Discard changes:
1. Press CANCEL button; NEW data fields will be restored with initial values.
2. Press SAVE button and confirm; OLD data fields too are restored with initial values.

PROGRAM SERVICE CALIBRATION

next service at 500

To modify assistance interval, you have to enable apposite function.

You can execute following operations:

Change actual value:

1. Set button INCREASE properly to select if increase or decrease service interval
2. Change assistance interval value using HOURS INCREASE pop-up menu
3. Press SAVE AND EXIT button and confirm

DRIVE MOTOR PARAMETERS CALIBRATION (**)

Standard version

In that menu front panel, you can find following data about drive motor parameters: description, actual value, new value you want to set, measure unit, default values minimum and maximum settable values, actual value in percent.

You can execute following operations:

Select default value:
1. Press DEFAULT button ; NEW data fields will be automatically updated with default value
2. Press SAVE button and confirm; both OLD data fields and first 3 parameters will be updated

Change actual value:
Insert changed value in NEW data field (or modify one of first 3 parameters)
1. Press SAVE button and confirm; in case of good result, OLD data field is updated.
2. Otherwise an error is signaled and NEW data field (or one of first 3 par.) initial value is restored.

Discard changes:
1. Press CANCEL button; NEW data fields will be restored with initial values
2. Press SAVE button and confirm; OLD data fields and first 3 par. are restored with initial values

Notice: In that menu there are other 3 parameters (Slow speed, British unit, Display brightness) that are visualized and managed in a more user friendly way.

Notice: You can also choose if visualize on display one of the following:
- odometer indication
- time meter
- weight of the load on the forks (only after weight sensor calibration)

Optional versions

You can find further parameters to be calibrated (they obviously depend on application):
diameter of tires, starting temperature motors fan, braking ramp, speed after stop on slope, acceleration ramp limitation, inversion ramp limitation, release ramp limitation. These parameters are visualized on front panel after **partial release ramp** and also calibration procedure is the same.

PUMP MOTOR PARAMETERS CALIBRATION

In that menu front panel, you can find following data about pump motor parameters: description, actual value, new value you want to set, measure unit, default values minimum and maximum settable values, actual value in percent.

You can execute following operations:

Select default value:

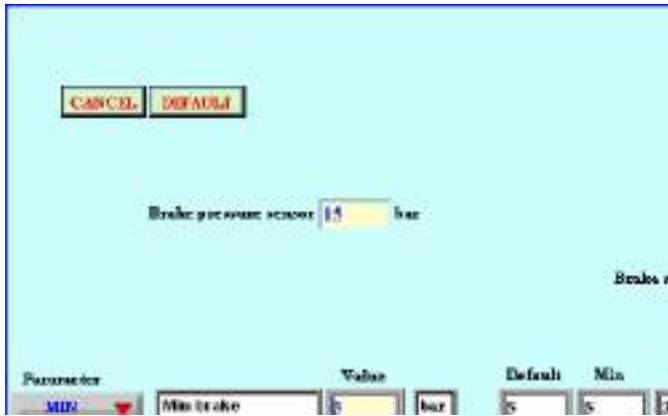1. Press **DEFAULT** button ; **NEW** data fields will be automatically updated with default value
2. Press **SAVE** button and confirm; **OLD** data fields will be updated

Change actual value:

1. Insert changed value in **NEW** data field
2. Press **SAVE** button and confirm; in case of good result, **OLD** data field is updated. Otherwise an error is signaled and **NEW** data field initial value is restored.

Discard changes:

1. Press **CANCEL** button; **NEW** data fields will be restored with initial values
2. Press **SAVE** button and confirm; **OLD** data fields are restored with initial values

CRITICAL HEIGHT: SPEED LIMITS CALIBRATION

You can set maximum speed of pump and drive motors in case of a fork height superior to critical one (that condition is signalled by two switches present on lift truck forks) In that menu front panel, you can find following data about critical maximum speeds: description, actual value, new value you want to set, measure unit, default values minimum and maximum settable values, actual value in percent.

You can execute following operations:

Select default value:
1. Press DEFAULT button ; NEW data fields will be automatically updated with default value
2. Press SAVE button and confirm; OLD data fields will be updated

Change actual value:
1. Insert changed value in NEW data field
2. Press SAVE button and confirm; in case of good result, OLD data field is updated. Otherwise an error is signaled and NEW data field initial value is restored.

Discard changes:
1. Press CANCEL button; NEW data fields will be restored with initial values
2. Press SAVE button and confirm; OLD data fields are restored with initial values
3.

WEIGHT SENSOR CALIBRATION (OPTIONAL MENU)
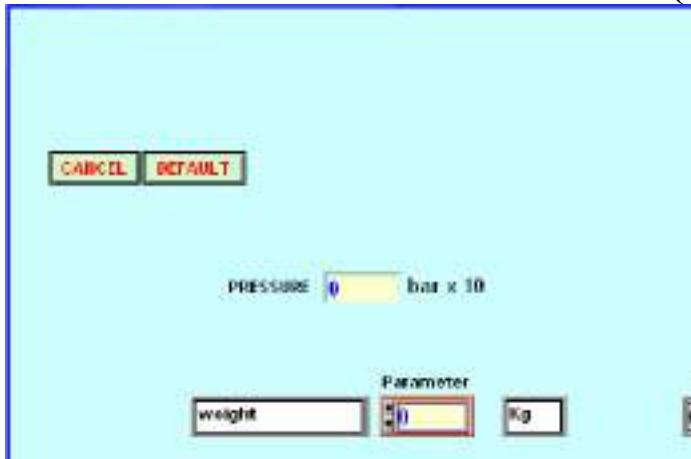
In that menu front panel, you can find following data about parameters: description, actual value, measure unit, default values, minimum and maximum settable values.

Pressing **SAVE** button, visualized pressure value is saved on actually selected parameter.

You can execute following operations:

Select default value:

Press **DEFAULT** button; **VALUE** data fields will be automatically updated with default value

Calibrate weight sensor:

Discard changes:

Press **CANCEL** button; **VALUE** data fields will be restored with initial values

BRAKE SENSOR CALIBRATION (OPTIONAL MENU)

There are following data about brake pressure sensor: description, actual value, measure unit, default values, minimum and maximum settable values.

Pressing **SAVE** button, selected parameter **VALUE** data field is updated with brake sensor actual voltage; if this value is out of permitted range, you cannot calibrate it. In such a case check for any lift truck fault.

You can execute following operations:
Load default value:

Press **DEFAULT** button; **VALUE** data fields will be automatically updated with default values

Change parameters value:

Discard changes:
Press **CANCEL** button; **VALUE** data fields will be restored with initial values.

HYDRO THRESHOLD CALIBRATION (OPTIONAL MENU)

In that menu front panel, you can find following data about hydro thresholds parameters: description, actual value, new value you want to set, measure unit, default values minimum and maximum settable values. First threshold fixes rpm value that makes truck speed pass from idle speed to steering one; second threshold does vice versa.

You can execute following operations:

Select default value:
1. Press **DEFAULT** button ; **NEW** data fields will be automatically updated with default value
2. Press **SAVE** button and confirm; **OLD** data fields too will be updated

Change actual value:
1. Insert changed value in **NEW** data field
2. Press **SAVE** button and confirm; in case of good result, **OLD** data field is updated. Otherwise an error is signaled and **NEW** data field initial value is restored.

Discard changes:
1. Press **CANCEL** button; **NEW** data fields will be restored with initial values
2. Press **SAVE** button and confirm; **OLD** data fields too are restored with initial values

CAB LIFT SPEED CALIBRATION (OPTIONAL MENU)

In that menu front panel, you can find following data about cab lift speed: description, actual value, new value you want to set, measure unit, default values minimum and maximum settable values.

You can execute following operations:

Select default value:
1. Press DEFAULT button ; NEW data field will be automatically updated with default value.
2. Press SAVE button and confirm; OLD data field will be updated.

Change actual value:
1. Insert changed value in NEW data field
2. Press SAVE button and confirm; in case of good result, OLD data field is updated. Otherwise an error is signaled and NEW data field initial value is restored.

Discard changes:
1. Press CANCEL button; NEW data field will be restored with initial values.
2. Press SAVE button and confirm; OLD data field are restored with initial values.

TRUCK SETUP (OPTIONAL MENU) (**)

Standard version

In that menu front panel, you can find following data: parameters description, actual status (ON or OFF), new status you want to set, and default status.

You can execute following operations:

Select default value:

1. Press DEFAULT button ; NEW data fields will be automatically updated with default status
2. Press SAVE button and confirm; OLD data fields will be updated

Change actual value:

1. Insert changed status in NEW data field
2. Press SAVE button and confirm; in case of good result, OLD data field is updated. Otherwise an error is signaled and NEW data field initial status is restored.

Discard changes:

1. Press CANCEL button; NEW data fields will be restored with initial status
2. Press SAVE button and confirm; OLD data fields are restored with initial status

Optional version

You can find a further parameter to be calibrated: lift priority for pump reference speed. This parameter is visualized on front panel after chat time enable and also calibration procedure is the same.

PLIERS CALIBRATION (OPTIONAL MENU) (**)

In that menu front panel, you can read actual measured value for pliers circuit pressure and know which of 1st, 2nd or 3rd setup pressure level is selected (see three green leds).

Another green led shows if your system is working in automatic or in manual mode:

Manual mode: a switch present on lift truck defines the active pressure level(1st, 2nd or 3rd).

Automatic mode: now a serial data exchange defines the active level of pressure.

If no valid code is received, it's not possible to change active pressure level.

The selected level value is not memorized, so you lose it switching lift truck off.

In front panel appear 1st, 2nd and 3rd setup pressures new and old value, measure unit, and default, minimum and maximum settable values; the same data are visualized for 4 tuneable parameters (Kp,Kd_1,Kd_2,Kd_3).

These parameters are used in software regulation:
1. Proportional coefficient Kp is the same for the 3 pressure levels.
2. There are three different derivative coefficients Kd_1,Kd_2 and Kd_3 for each pressure level.

You can execute following operations:

Select default value:
1. Press DEFAULT button ; NEW data field will be automatically updated with default value.
2. Press SAVE button and confirm; OLD data field will be updated.

Change actual value:
1. Insert changed value in NEW data field
2. Press SAVE button and confirm; in case of good result, OLD data field is updated. Otherwise an error is signaled and NEW data field initial value is restored.

Discard changes:
1. Press CANCEL button; NEW data field will be restored with initial values.
2. Press SAVE button and confirm; OLD data field are restored with initial values.

BACKING MODE PARAMETERS CALIBRATION (OPTIONAL MENU)

In that menu front panel, you can find following data about backing mode parameters: description, actual value, new value you want to set, measure unit, default values minimum and maximum settable values.

You can execute following operations:

Select default value:

1. Press DEFAULT button ; NEW data field will be automatically updated with default value
2. Press SAVE button and confirm; OLD data field will be updated

Change actual value:

1. Insert changed value in NEW data field
2. Press SAVE button and confirm; in case of good result, OLD data field is updated. Otherwise an error is signaled and NEW data field initial value is restored.

Discard changes:

1. Press CANCEL button; NEW data field will be restored with initial values
2. Press SAVE button and confirm; OLD data field are restored with initial values.

TIMERS RESET

In this menu (Fig. 36) you can reset timers signalling lift truck working hours; remember that if you press that button, a double confirmation is necessary.

EEPROM RESET MENU

This menu (Fig. 37) has two important functions:

1. In case of Eeprom alarm, you have to use **complete EEPROM reset** procedure.
2. If you have updated flash memory software, and you want to load default Eeprom configuration, you have to use complete Eeprom reset; to maintain already calibrated values you can use **partial EEPROM reset** procedure.

Pay attention: using complete reset procedure already calibrated values. Both procedures, in modify timers value and alarm history.
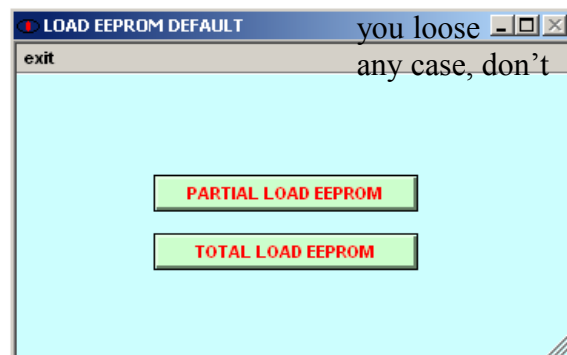
Partial EEPROM reset:
1. Press PARTIAL LOAD EEPROM button
2. Give a confirmation to load default values

Complete EEPROM reset:
1. Press TOTAL LOAD EEPROM button
2. Give a confirmation to load default values
3. Give a further confirmation (Fig. 38)
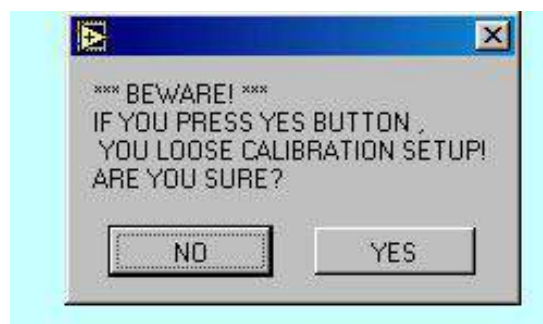
PARAMETERS IMAGE MENU
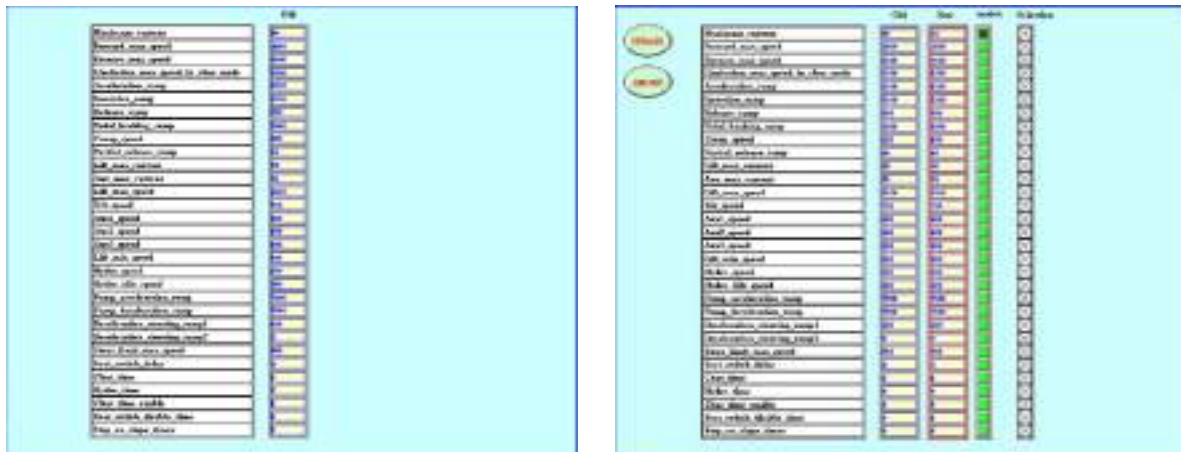
This menu (Fig. 39) is used to configure a certain number of lift trucks using the same main important parameters. In the front panel, you can find parameters description and their actual value (OLD field).

You can execute following operations:

Save actual configuration:

1. Select EXPORT menu from menu bar
2. Select destination path and configuration file name in the dialog box; then press OK button

Load saved configuration:

1. Select **IMPORT** menu from menu bar
2. Select location path and file name in the dialog box; then press **OK** button
3. You find now three new items (see fig. 40):
   - **NEW** values (the ones present in configuration file)
   - **MATCH** list, to show unvaried values (a light green led)
   - **SELECTION** list, to choose parameter to be loaded (all selected by default)
4. Press **UPDATE** button to load configuration file if selection is correct; otherwise press **ABORT** button to exit without saving

HOUR METER SETTING MENU (OPTIONAL MENU)

HOUR METER MANAGEMENT

DISABLED

HOUR METER MANAGEMENT   HOUR METER VALUE

ENABLED   0

SAVE
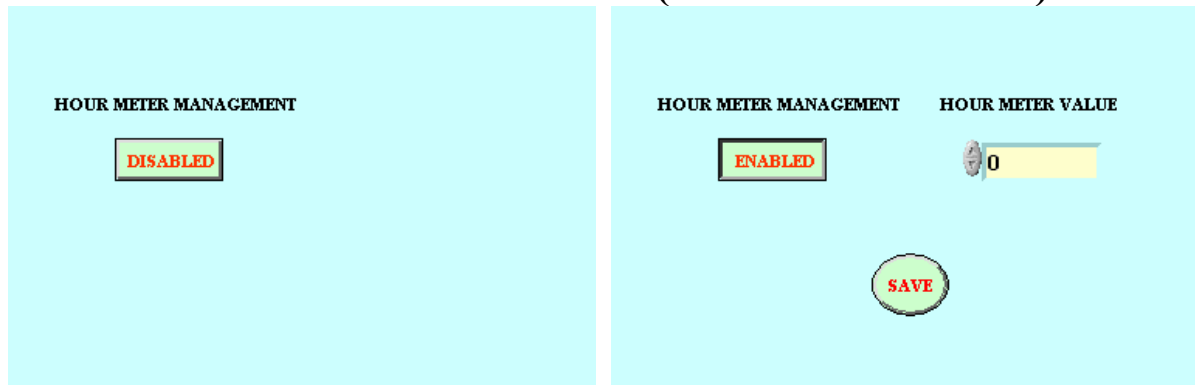
This menu (Fig. 41) is used to adjust hour meter value.

You can execute following operations

1. You have to enable hour meter management pressing **ENABLE/ DISABLE** button (Fig. 41a).
2. You can now access hour meter value field and adjust its value (Fig. 41b).
3. Then you can save new value pressing **SAVE**.

DATA LOGGING

With this menu (Fig. 42) you can save on file the values of a certain number of variables with a certain frequency.

The resulting file, **logging.out**, is saved in

<**EYEPLUS PATH**>**EYEPLUS**\out directory.

This file format is:

FIRST ROW: name of **NMAX** variables to be

saved followed by saving date and time;

SUCCESSIVE ROWS: **NMAX** recorded values separated by space.

Data acquisition procedure is following:

1. Select **Nmax** , the number of variables you want to save
2. Select the variables whose value you want to record, with apposite pop-up menu
3. You can modify sampling period, expressed in seconds.
4. Pressing **START** button, saving procedure begins; in that phase you can't modify acquisition parameters

During acquisition procedure (Fig. 43), following data are visualized:

- A led signals saving instant
- Indication of number of saved frames
- Flashing message SAVING...

To stop saving procedure you can press **START** button, or simply exiting the menu.

FLASH PROGRAMMING

OVERVIEW

As explained before (refer to chapter 3), when user programs flash memory, EYEPLUS
software loads proper files pointing a directory named as lift truck model itself, thanks to the
presence of **"Truckmodel.ini**" configuration file in EYEPLUS installation directory.

Truckmodel.ini file lists all available truck models with their main characteristics (obviously
this file has to be upgraded if new lift truck models are introduced).

To make an example, these are some lines of **Truckmodel.ini** configuration file:

> 0 C:\Source_SME\Source_TRZ_FILE\model0 model0 lift truck
>
> 1C:\Source_SME\Source_TRZ_FILE\model1 model1 lift truck
>
> 2 C:\Source_SME\Source_ONE_FILE\model1 model2 lift truck
>
> ………………………………………………………………………
>
> 6 C:\Source_SME\Source_DRV_FILE\model3 model3 lift truck
>
> ………………………………………………………………………
>
> 9 C:\Source_SME\Source_SNG_FILE\model4 model4 lift truck

Number = identifies lift truck model; the number corresponds to numeric code
present in source filename xx-xx-xx xxXX.xxx0 (this value is read also from panel
memory and used to customize automatically EYEPLUS menus)

Directory = each model has its own linked directory which contains source files

Motor system = this code defines if your truck is a single or twin motor system and
corresponds to source filename xx-xx-xx xxxx.XXX0 code (TRZ or DRV for twin
motor systems, ONE or SNG for single motor systems)

Lift Truck model = this is the name operator reads from list box when he has to
select the lift truck model (see after).

SOURCE FILES AUTOMATIC UPGRADE PROCEDURE

Moreover, SME company has developed an **utility** whose purpose is to automatically install
or upgrade source files to correct destination path.

Suppose, for example, to be connected to a model1 lift truck; the executable program is named **Source _ softwaredate_ model1.exe**, so user knows exactly which software version (**softwaredate**) he will load on panel flash memory.

Running that utility, **C:\Source_SME\Source_TRZ_FILE\model1** directory will be created (if it doesn't exist) and new **softwaredate**.TRZ0 and **softwaredate**.PMP0 files will be copied in it.

Old source files will be moved to **C:\Source_SME_old\Source_TRZ_FILE\model1** directory (automatically created) and so, in case of need, they are anyway available.

PROCEDURE FOR LIFT TRUCK MODEL SELECTION

With new source files, operator can upgrade main controller software, selecting **FLASH** item from EYEPLUS menu-bar (first of all disable active commands).

We distinguish case of flash already programmed from case of blank memory:

CASE OF FLASH MEMORY CORRECTLY PROGRAMMED

If user now tries to program model1lift truck following window (Fig. 44) will appear:
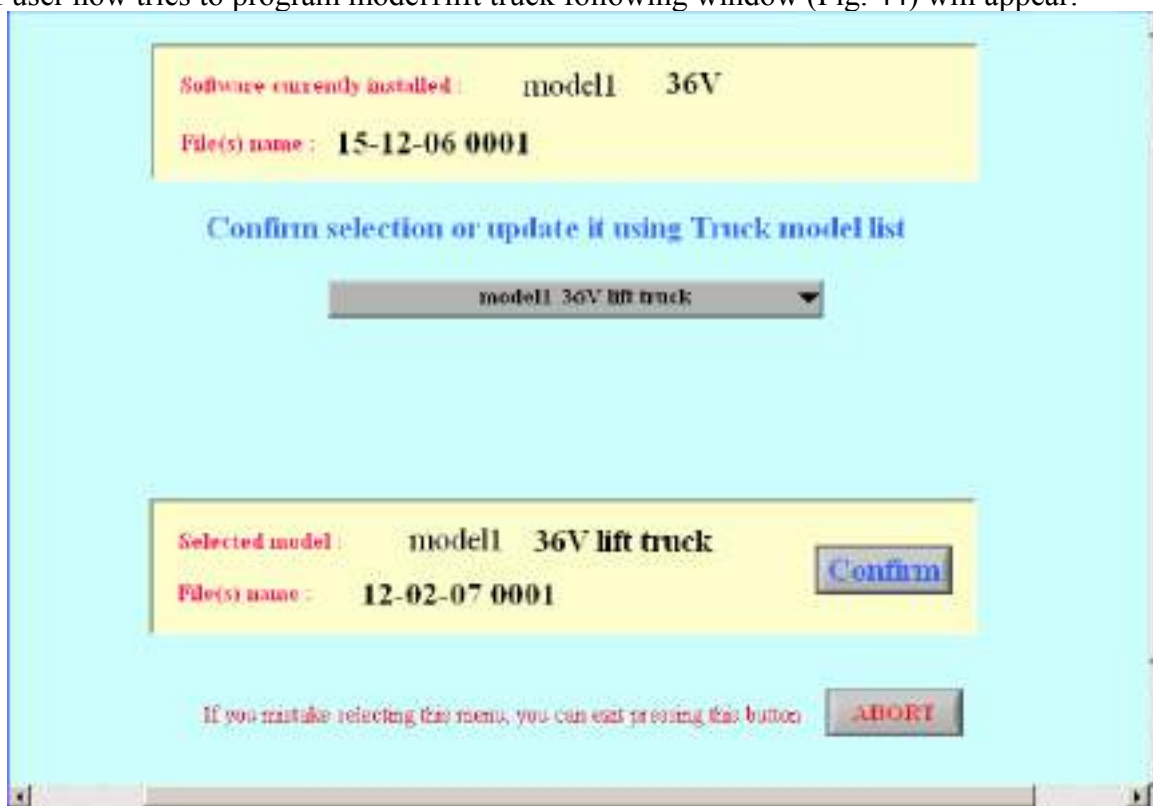
EYEPLUS software (see page before) identifies automatically truck model as model1 36V, and shows file (filename is 15-12-06-0001) currently installed in main board flash memory. Automatically selection list box points model136V lift truck model and user can see source file (filename is 12-02-07-0001) present now in C:\Source_SME\Source_TRZ_FILE\model1 Now user can confirm selection with **Confirm** button, or select another lift truck model as in the following window (Fig. 45)
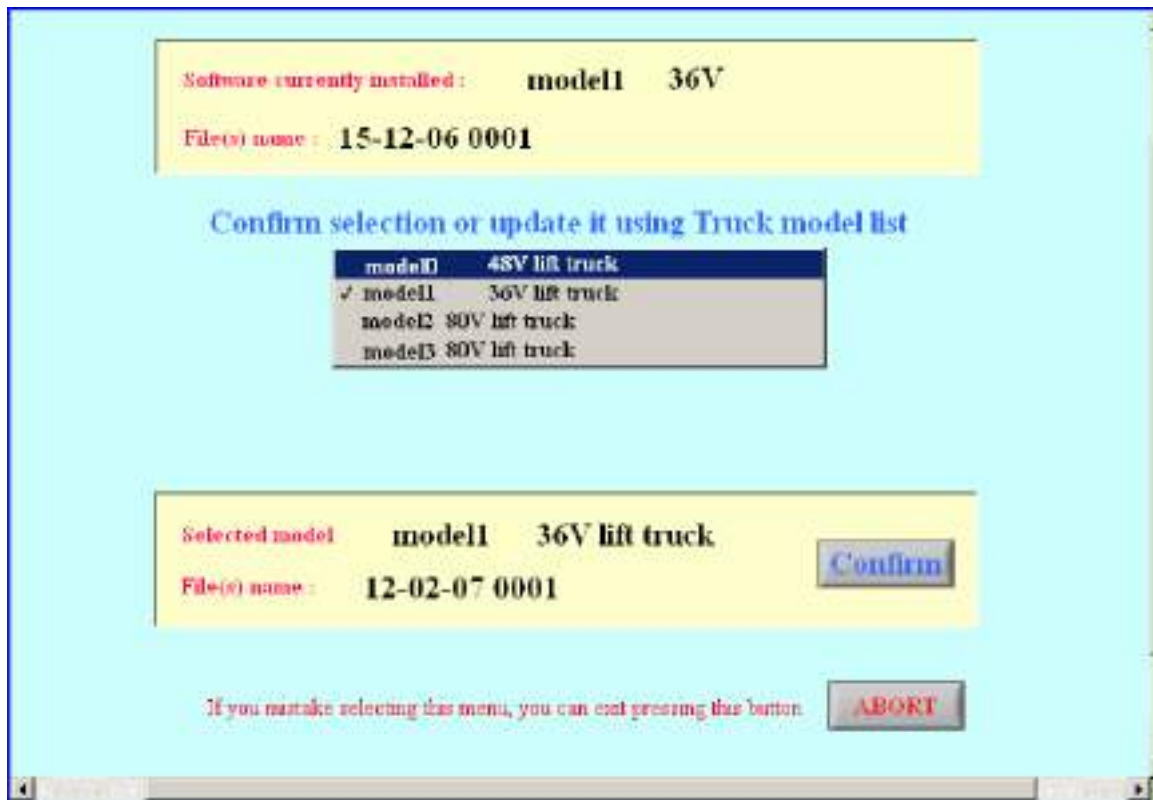
Suppose operator decides to select a model0 48V truck model instead of the current model1 36V, EYEPLUS shows in the field near confirm button, source filename (15-02-07-0000) present in directory relative to 48V lift truck model C:\Source_SME\Source_TRZ_FILE \model0 (Fig.46)

User can now confirm selection with confirm   button, or in any case of error, he can exit
without changing model pressing   abort button .

Notice: To prevent mistakes, when operator is connecting to a single drive motor system, in
selection list box are accessible only single drive models and obviously, in case of twin motor systems only twin drive models.

CASE OF PANEL BLANK

Starting **EYEPLUS** application, in case of flash memory not programmed, in main menu front panel **"PANEL BLANK"** message is visualized, and following window (Fig. 47) automatically appears :

Initially no model is selected, and no filename is visualized.

Operator can now choose lift truck model from selection list box as in the picture below (Fig. 48).
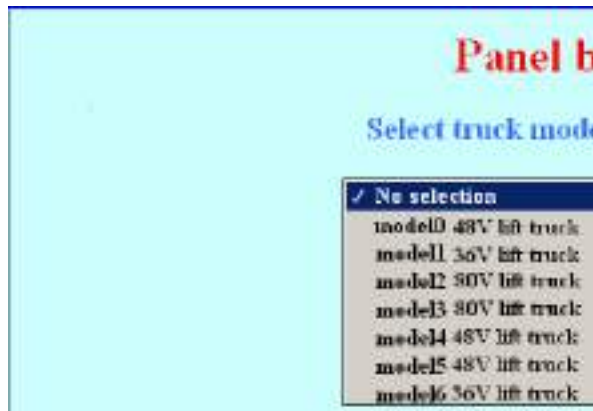
Once operator has selected a lift truck model (for example model1, see Fig,49),   confirm button appears and you can read filename present in source directory corresponding to selected model.

User can't enter main menu until a selection is made pressing Confirm button.

Notice: Remember that flash memory is blank: no information about model is present on main board, and you can't verify if your selection is correct (all single and twin drive motor systems available are listed in selection list box of Fig. 48).

In such a case a human error is possible, so take care you are doing the correct selection.

In fact, after selecting truck model and entering main menu, you could load wrong file into control board (i.e. if you've selected a twin motor system while your lift truck is a single drive motor system).

PROGRAMMING PHASE

Once selected truck model (model0, for example), EYEPLUS software points proper files in C:\Source_SME\Source_TRZ_FILE\model0 directory and flash programming phase can start (Fig,50).

User can read source directory and filename in Flash menu front panel, to be sure he selected the proper model \ source file.

1. In case of troubles with source files present in

    C:\Source_SME\Source_TRZ_FILE \model0 directory (missing files, wrong version,...) there will be an error message and flash memory will not be programmed .

2. After a synchronization phase, micro1 (drive) flash programming will start; a bar gives the percent indication of already programmed memory.

3. In case of problems with serial communication, there will be an error message and flash programming phase will be stopped..

4. After traction micro successful programming, begins micro2 (pump) programming phase.

5. A message will signal the end of programming phase, and its result.

Notice: In case of single drive motor systems step 3 and step 4 will not be executed.

Notice: Both in case of single and twin motor systems, if programming phase fails after synchronization, panel has to be programmed with correct software before being used; see troubleshooting section in case of any error

TROUBLESHOOTING

GENERALITY

Often you can solve problems reading error messages and following suggestions.

SOFTWARE INSTALLATION

In case of failed EYEPLUS software installation, follow these steps:

- Verify if your PC complies minimal requirements

- Be sure of having PC administrator rights

- Close all active applications and disable antivirus before installation

- Verify installation, step by step

In case of successful installation, if application has a runtime error:

- Verify if your PC complies minimal requirements

- Turn off PC and try again after turning it on

- Uninstall and install again EYEPLUS software

SERIAL COMMUNICATION

If application doesn't work and message "**not connected**" appears:

- Verify system ground connections

- Verify if inverter panel works correctly

- Control serial connection cable: you must use a shielded one

- Verify if serial port works correctly

- Use Setup menu to verify serial port configuration

- Verify no other applications are using serial port

FLASH PROGRAMMATION

If panel programming phase fails, when you try to load source files:

- Verify if c:\source_file or c:\source_one_file directory exists

- Verify if that directory contains the correct source files

- Be sure that source files are the ones provided by S.M.E.

If you program memory successfully, but inverter doesn't work correctly:

- Be sure that source files are the ones provided by S.M.E

In case of transmission error:

- Verify system ground connections

- Control serial connection cable: you must use a shielded one

- Verify if serial port works correctly

- Verify if there are any active commands

OTHER PROBLEMS

Application works slowly or doesn't work properly :

- Verify if your PC complies minimal requirements

Text and "objects" on main panel are not centred:

- Verify if your PC complies minimal requirements

- Don't modify window size

Monitor doesn't display correctly text and "objects"

- Verify if monitor refresh frequency is at least 75Hz

- Verify if your PC complies minimal requirements

Appendix A: programmable parameters meaning

Programmable parameters are here listed in functional groups.

The possibility of interfacing by PC with the system allows to have an exhaustive real time analysis of the system working and of the condition of its components; moreover, you can choose among a wide range of parameters in order to reach the optimum operating of the system in compliance with your needs.

DRIVE MOTOR

PARAMETER NAME	PARAMETER NAME
Drive acceleration ramp	Lift truck acceleration with accelerator pedal pressed
Drive release ramp	Lift truck deceleration with accelerator pedal released
Drive inversion ramp	Lift truck deceleration in inversion
Pedal brake ramp	Lift truck deceleration with pedal brake pressed
Drive limitation maximum speed	Maximum lift truck speed with speed limitation (turtle active)
Forward maximum speed	Maximum forward lift truck speed with no speed limitation (no alarms present and turtle not active)
Reverse maximum speed	Maximum reverse lift truck speed with no speed limitation (no alarms present and turtle not active)
Creep speed	If the truck speed is greater then this threshold, the speed reference becomes a parabolic function of the accelerator potentiometer voltage.
Steer limitation maximum speed	Maximum speed reference in the angle in which the internal wheel is mechanically still.
Drive maximum current	Drive motors maximum current (expressed in per cent of high energetic mode value)
Partial release ramp	Parameter that softens the drive inversion ramp if the traction motors are working with low rpm
E-S-H enable	If this parameter is set to 1, it is possible to change the value of the power mode with the display
Slow speed	If parameter is set to1, speed limitation is active; otherwise lift truck speed is managed as usual.
British unit	If parameter is set to 1, values are expressed in British unit, otherwise in international ones.
Time meter / odometer / weight of the load on the forks on display	If parameter value is 0, display shows the hour meter. If parameter is set to 1, odometer indication appears . If parameter value is 2, display shows weight on the forks .

DRIVE MOTOR

PARAMETER NAME	PARAMETER NAME
High lift switch 1 drive maximum speed	Max. lift truck speed when the forks are above the1st critical height
High lift switch 2 drive maximum speed	Max. lift truck speed when the forks are above the 2nd critical height
Diameter of drive tyres	This parameter gives drive tyres diameter measure (expressed in mm)
Limitation temperature	If a motor temperature is above this value, acceleration, inversion, release ramps and max torque are reduced in function of temperature value .
Starting motors fan temperature	If the motor temperature exceeds this threshold the motors fans are activated
Maintenance time inserting enable	If parameter is set to 1 program service function is enabled
Maintenance time	If the truck working hours exceed this value the display signals the maintenance request

Timers

PARAMETER NAME	PARAMETER NAME
Seat switch delay	Time interval between seat switch opening and drive and pump motors stopping
Hydro time	Time interval when pump motor works (with hydro speed) after the end of a command
Chat time	Time delay between last command given to a drive or pump motor and chat mode signalling
Stop on slope time	If operator stops on slop, after this time interval lift truck begins to slowly move

PUMP MOTOR

PARAMETER NAME	PARAMETER NAME
Minimum lift speed	Minimum lift speed
Maximum lift speed	Maximum lift speed
Tilt speed	Pump motor speed with speed function active
Lateral shift (AUX 1 function) speed	Pump motor speed with lateral shift function (1st auxiliary) active
AUX 2 function speed	Pump motor speed with 2nd auxiliary function active
AUX 3 function speed	Pump motor speed with 3rd auxiliary function active
Pump acceleration ramp	Lift acceleration
Pump deceleration ramp	Pump motor deceleration after the end of a command
Hydro speed	Pump motor speed when steering
Hydro idle speed	Pump motor speed with direction command lever not in neutral, accelerator pressed and no pump command active
Lift maximum current	Pump motor maximum current with lift function active
Auxiliary maximum current	Pump motor maximum current with lift lever released
High lift switch 1 lift maximum speed	Max. lift speed when the forks are above the1st critical height
High lift switch 2 lift maximum speed	Max. lift speed when the forks are above the 2nd critical height
High lift switch 1 tilt maximum speed	Max. tilt speed when the forks are above the1st critical height
High lift switch 2 tilt maximum speed	Max. tilt speed when the forks are above the 2nd critical height
High lift switch 1 AUX1 function max. speed	Max. side shift speed when the forks are above the1st critical height
High lift switch 2 AUX1 function max. speed	Max. side shift speed when the forks are above the 2nd critical height
High lift switch1 AUX2 function max .speed	AUX2 function speed when the forks are above the 1st critical height
High lift switch 2 AUX2 function max. speed	AUX2 function speed when the forks are above the 2nd critical height

PUMP MOTOR

PARAMETER NAME	PARAMETER NAME
High lift switch1 AUX3 function max. speed	AUX3 function speed when the forks are above the 1st critical height
High lift switch 2 AUX3 function max. speed	AUX3 function speed when the forks are above the 2nd critical height
Lift priority for speed reference	In case of simultaneous activation of lift and any other pump function if parameter is set to 1, pump motor works at auxiliary function speed; if parameter value is set to 0, pump motor works at lift speed

SENSORS AND POTENTIOMETERS

PARAMETER NAME	PARAMETER NAME
Accelerator pedal minimum value	Accelerator sensor voltage with pedal released
Accelerator pedal maximum value	Accelerator sensor voltage with pedal completely pressed
Lift sensor minimum value	Lift sensor voltage with lift lever released
Lift sensor middle value	Lift lever potentiometer voltage to which the lifting becomes proportional to the shift of the lever
Lift sensor maximum value	Lift sensor voltage with lift lever completely pressed
Steering sensor minimum value	Steering sensor voltage with wheels turned on left
Steering sensor middle value	Steering voltage with wheels straight ahead
Steering sensor maximum value	Steering sensor voltage with wheels turned on right
Weight of the load on the forks [kg]	This parameter is used to calibrate lift sensor to calculate the weight of load present on forks
No load pressure [bar · 10]	This parameter is used to calibrate lift sensor to calculate the weight of load present on forks
Load pressure [bar · 10]	This parameter is used to calibrate lift sensor to calculate the weight of load present on forks

BATTERY

PARAMETER NAME	PARAMETER NAME
Battery reset value	Minimum battery voltage necessary to reset battery discharged voltage alarm
Discharged battery voltage	If the battery voltage becomes lower than this value the battery discharged alarm is set

ALARM LIST

Maximum battery voltage

- Eye alarm code: 1
- Alarm level: 1
- Alarm cause: battery voltage, measured by a circuit inside control unit, exceeds following levels:

    63 V, in case of systems working at 36 V

    63 V, in case of systems working at 48 V

If the controller detects such a fault, refer to following troubleshooting procedure:

1. such an alarm can be caused also by the presence of regeneration currents; when lift truck is on release or reverse braking ramp, motors work as generators, and battery voltage can exceed overvoltage limit. In a case like that, the battery condition should be verified (if the battery is new it is necessary to do some charge-discharge cycles before reaching the rating declared by the constructor) or has a high internal resistance. If the case is the second and it is not possible to change the battery, the solution may be to reduce the release and reverse braking ramp.
2. incorrect wiring to battery positive or negative terminals.
3. verify if battery is still in good conditions.
4. replace the control board .

Minimum battery voltage

- Eye alarm code: 2
- Alarm level: 1
- Alarm cause: battery voltage, measured by an internal circuit, is lower than following levels :

    24 V , in case of systems working at 36 V

    24 V , in case of systems working at 48V

In case of minimum battery voltage alarm, follow these steps:

1. incorrect wiring to battery, or corroded positive or negative terminals;
2. verify battery conditions: if the electrolyte inside is partially exhausted, an under voltage alarm can sometimes be detected from the controller; even in case of low battery charge (<10%), high current rates (i.e. both pump and drive motors working in full load conditions) could cause an under voltage alarm, in particular in presence of an exhausted battery.
3. replace the control board .

Pedal trimmer fault

- Eye alarm code: 3
- Alarm level: 2
- Alarm cause: voltage measured on accelerator circuit exceeds the value calculated averaging calibration and reachable voltages; moreover, start switch seems to be open.

In case of such an alarm, follow these troubleshooting steps :

1. verify if the potentiometer initial set-up is correct; if not, repeat calibration procedure .(You can use both PC with serial communication software and COMPACT display).
2. verify if the following 68 ways connector terminals are correctly wired to their correspondent inputs in potentiometer circuit:

> K1-11 (12 V)
> K1-15 (ground)
> K1-10 (pedal input)

3. in case of correct wiring, replace the potentiometer itself.
4. replace control board

Eeprom alarm

- Eye alarm code: 5
- Alarm level: 1
- Alarm cause: eeprom does not work properly, or one of memorised values is out of correct limits.

In case of alarm follow this procedure:

1. load default values for eeprom variables, both using PC with serial communication software and COMPACT display;

2. replace the control board .

Pre-charge capacitors low voltage alarm (Capacitors not charged)

- Eye alarm code: 6
- Alarm level: 1
- Alarm cause: voltage level of pre-charge capacitors is less than 70 % of nominal battery level.It could happen, in example, if the inverter is working with main breaker open. Capacitors voltage decreases cause energy spent to keep motors in motion.

In case of alarm follow this procedure:

1. verify if main breaker coil and power terminals are in good conditions;

2. verify if supply lines power fuse is damaged;

3. verify if main breaker coils are correctly wired to their correspondent inputs :

K1-18 (positive terminal)

K1-19 (negative terminal)

4. replace main breaker;

5. replace control board.

Inverter desaturation or overcurrent alarm

- Eye alarm code: 8 for right drive motor power module

24 for pump motor power module

25 for left drive motor power module

- Alarm level: 1
- Alarm cause: actual current exceeds limits 929 A

In case of alarm follow this procedure:

1. With such an alarm present when you turn on lift truck, disconnect the power cable between the malfunctioning inverter and the corresponding motor (first, turn off the system, of course).

If turning lift truck on again, alarm is not active, then:

1. replace the cable connecting control board and inverter.
2. replace the inverter;
3. replace control board.

If turning lift truck on again, alarm is active, then :

1. replace the inverter;
2. replace the motor.

Inverter capacitors pre-charge too fast

- Eye alarm code: 9
- Alarm level: 1
- Alarm cause: pre-charge capacitors voltage increases too fast when you turn the system on.

In case of too fast pre-charge alarm, follow this procedure:

1. replace main breaker.
2. replace cable connecting the CN1 output of the control board with the corresponding inverter;
3. replace the inverter connected with the CN1output of control board
4. replace control board

Pump motor inverter overtemperature

- Eye alarm code: 10
- Alarm level: 6
- Alarm cause: the inverter temperature (measured with a temperature probe), exceeds 100 º C, or is inside [95 ºC, 100 ºC] range at least 30 s.

In case of alarm follow this procedure:

1. alarm could be caused by ineffective temperature dissipation.
2. Verify thermal coupling between inverter block and aluminium plate, and between aluminium plate and truck ballast. The presence of a correct amount of thermal grease in the coupling is essential to ensure an efficient heat exchange;
   replace cable connecting the output CN4 of the control board to the pump inverter;

3. if temperature readings seem too high in function of total time interval of lift truck using, replace pump inverter causing the alarm. You can read temperature measures using "COMPACT" display or "EYE" communication software.
4. replace main board.

Capacitors too charged on start

- Eye alarm code: 11
- Alarm level: 1
- Alarm cause: when you turn on the system, capacitors are not completely discharged by pump motor. In fact, if you turn suddenly on the lift truck, after a turning off, capacitors voltage level is too high. You have to discharge them before checking the presence of any fault (both of capacitors and of main board)

In case of alarm follow this procedure:
1. verify the correctness of wiring from pump motor and relative inverter;
2. replace cable connecting the output CN4 of the control board with the corresponding inverter;
3. replace the inverter connected to CN4 output of the control board;
4. verify if main breaker has stuck closed terminals: in such a case replace it;
5. replace the cable connecting the output CN1 of the main board to the right drive motor inverter: a defective cable could give a wrong measure for capacitors voltage;
6. replace the right drive inverter;
7. replace main board.

Low battery alarm

- Eye alarm code: 12
- Alarm level: 3
- Alarm cause: battery voltage level is lower than minimum charge value expected, referred to table 2 (for 36V system) and table 3 (for 48V system) in COMPACT display user manual.

In case of low battery alarm, follow this procedure:

1. measure battery voltage with a tester and, if different from the value reported on COMPACT display, replace main board;
2. otherwise recharge battery.

Drive motor overtemperature

- Eye alarm code: 13 for right drive motor
                            19 for left drive motor
- Alarm level: 5
- Alarm cause: The measure of drive motor temperature exceeds 155 ºC..

In case of alarm, follow this procedure:

Presence of alarm with cold motors:

1. with a handheld multimeter (in resistance operating mode) you have to measure a resistance of about 10 kohm between the two wires of the temperature probe (execute the measure at ambient temperature of 25°C).
   If the measure is not correct it is necessary to replace the temperature probe.
2. disconnect the temperature probe and check the wiring insulation between signal wire and ground wire (towards control board);
3. replace control board.

Presence of alarm with hot motors:

1. If temperature value (you can read it from display or via PC) seems correct, verify if the motor stator case are clean

Pump motor overtemperature

- Eye alarm code: 14
- Alarm level: 6
- Alarm cause: The measure of pump motor temperature exceeds 155 ºC .

In case of alarm follow this procedure:

Presence of alarm with cold motors:

1. with a handheld multimeter in resistance operating mode, you have to measure about 10kohm at ambient temperature of 25°C between the two wires of the temperature

probe. If the measure is not correct it is necessary to replace the temperature probe.

2. disconnect the temperature probe and check the wiring insulation between signal wire and ground wire (towards control board);

3. replace control board.

Presence of alarm with hot motors:

1. If temperature value (you can read it from display or via PC) seems correct, verify if the motor stator case are clean

Motor current offset alarm

- Eye alarm code: 15 for right drive motor

           16 for left drive motor

           36 for pump motor

- Alarm level: 1
- Alarm cause: non-zero phase currents when you turn lift truck on.

In case of motor current offset alarm, follow this procedure:

1. replace the cable connecting the malfunctioning inverter to control board.
2. replace inverter.
3. replace main board.

Main breaker fault

- Eye alarm code: 17
- Alarm level: 1
- Alarm cause: overcurrent on main breaker coil.

In case of alarm follow this procedure:

1. replace main breaker
2. replace control board .

Watchdog timer alarm

- Eye alarm code: 18
- Alarm level: 1

- Alarm cause: improper communication between DSPs on control board, or/and defective control board.

In case of alarm follow this procedure:

1. using EYE program interface, try to program control board flash memory;
2. replace control board .

Drive motor inverter overtemperature

- Eye alarm code: 20 for right drive motor
                         22 for left drive motor
- Alarm level: 5
- Alarm cause: inverter temperature, measured with a probe, exceed 100 ºC , or is inside [95 ºC, 100 ºC] range at least 30 s.

In case of alarm follow this procedure:

1. alarm could be caused by ineffective temperature dissipation; verify thermal coupling between inverter block and aluminium plate and between aluminium plate and truck ballast. The presence of the correct amount of thermal grease in the coupling are essential to ensure a correct heat exchange;
2. replace cable connecting the output CN1 (for right drive motor) or CN2 (for left drive motor) of the control board to the corresponding inverter;
3. if temperature readings seem too high in function of total time interval of lift truck using, replace inverter unit causing the alarm. You can read temperature measures using "COMPACT" display or "EYE" communication software.
4. replace control board.

Serial communication alarm

- Eye alarm code: 21
- Alarm level: 1
- Alarm cause: error in serial communication between the two DSP; DSP present on main board make a mutual software control, to insure fast diagnosis of such a fault.

In case of alarm follow this procedure:

1. program pump and drive DSP again; maybe software present in flash memory was corrupted.
2. replace control board.

Alarm on 5 V encoder voltage

- Eye alarm code: 37
- Alarm level: 1
- Alarm cause: Main board K1-14 terminal (5 V output) voltage is lower than 4.3 V.

In case of alarm follow this procedure:

1. verify if 5 V output is grounded, cause an incorrect encoder wiring.
2. verify if 5 V output is grounded, cause any encoder malfunction.
   In that case, replace the defective one.
3. replace control board.

Alarm on 12 V output voltage

- Eye alarm code: 38
- Alarm level: 1
- Alarm cause: Main board K1-12 terminal (12 V output) voltage is lower than 10.5 V.

In case of an alarm on 12 V output voltage, follow this procedure:

1. verify if 12 V output is grounded, cause an incorrect wiring to:
   - Accelerator potentiometer
   - Steering sensor
   - buzzer
   - display
2. replace defective device;
3. replace control board.

Pump motor commands active on start

- Eye alarm code: 50
- Alarm level: warning; while the fault condition is active, all pump motor functions (except hydro functions) are inhibited.
- Alarm cause: you find a pump motor command active when you turn your system on.

In case of alarm follow this procedure:
1. before starting to operate, turn off any active command (both levers and switches);
2. be sure that lift, tilt and auxiliary command switches, are not active;
3. replace control board.

Seat switch open on start

- Eye alarm code: 63
- Alarm level: warning; main breaker is opened and pump and drive motors are stopped.
- Alarm cause: when you start working, you find seat switch open, or, after the main breaker is closed, the seat switch remains opened for at least " seat switch delay" s.

In case of alarm follow this procedure:
1. verify if seat switch is defective;
2. replace control board.

Wrong start

- Eye alarm code: 64
- Alarm level: warning; main breaker is opened and pump and drive motors are stopped.
- Alarm cause: when you start working, you find accelerator pedal pressed or a forward/ reverse switch active.

In case of alarm follow this procedure:
1. verify if a switch was active or the pedal pressed, when you turn on the lift truck;
2. verify if start, forward or reverse switches are stuck close;
3. verify if pedal circuit voltage exceeds 1/3 its maximum range (measured in Volt);
4. replace control board.

Encoder alarm

- Eye alarm code: 74 (for right drive motor encoder)

    75 (for left drive motor encoder)

- Alarm level: 1

- Alarm cause: an encoder channel is disconnected, and motor is working.

In case of alarm follow this procedure:

1. Verify if the encoder is correctly connected to:

    - Motor itself

    - Ground : K1- 15 terminal

    - + 5 V: K1- 14 terminal

    - A channel: K1- 37 terminal (for right drive motor encoder)

        K1- 17 terminal (for left drive motor encoder)

    - B channel: K1- 36 terminal (for right drive motor encoder)

        K1- 16 terminal (for left drive motor encoder);

2. if correctly wired, replace the encoder;

3. replace control board.

Alarm of motor thermal probe

- Eye alarm code: 77 (for right drive motor thermal probe)

        78 (for left drive motor thermal probe)

        79 (for pump motor thermal probe).

- Alarm level: 7

- Alarm cause: Temperature difference between any two of the 3 motors results greater than 70 ºC

In case of alarm, follow this procedure:

1. verify if the wiring is correct;

2. replace the probe;

3. replace control unit.

Alarm of a inverter temperature probe

- Eye alarm code: 80 (for right drive motor power module probe)

                    81 (for left drive motor power module probe)

                    82 (for pump motor power module probe)

- Alarm level: 7
- Alarm cause: Temperature difference between any two of the 3 inverters is greater than 70 ºC.

In case of alarm follow this procedure:

1. check the wiring connecting control unit and inverter;
2. replace the inverter;
3. if alarm is still present, replace control unit.

CRC fault alarm

- Eye alarm code: 83
- Alarm level: 1
- Alarm cause: Faulty eeprom or mismatching software release.

In case of alarm follow this procedure:

1. restore eeprom with EYE application software, using the "RESTORE" item present in main page
2. if alarm is still present, replace control board.

Bank CRC restored

- Eye alarm code: 84
- Alarm level: warning
- Alarm cause: there was an eeprom restore, caused by a CRC alarm.

In case of alarm follow this procedure:

1. switch on the system and the turn it on again

Steering sensor alarm

- Eye alarm code: 91
- Alarm level: 5
- Alarm cause: steer circuit voltage is out of nominal range.

In case of a steering sensor alarm follow this procedure:

1. verify correctness of wiring with :
   - K1-11 (12 V),
   - K1-15 (ground)
   - K1-10 (steering sensor input);
2. if correctly wired, replace steering sensor;
3. replace control board.

Capacitors pre-charge too slow

- Eye alarm code: 98
- Alarm level: 1
- Alarm cause: pre-charge capacitor voltage grows too slowly, when you turn on the system.

In case of alarm follow this procedure:

1. replace cable connecting the CN1 output of the control board with the corresponding inverter
2. replace the inverter connected with CN1 output of the control board;
3. replace control board;

Capacitors pre-charge timeout

- Eye alarm code: 99
- Alarm level: 1
- Alarm cause: pre-charge capacitor voltage grows too slowly, when you turn on the system.

In case of alarm follow this procedure:

1. replace cable connecting the CN1 output of the control board with the corresponding inverter
2. replace the inverter connected with CN1 output of the control board;

3. replace control board;

Analogue signals

Summary of signals from the analogue transducers

i **NOTE**

The values provided in the tables are indicative only, since they depend on the mechanical tolerances of the system.

Accelerator potentiometer pins C20-21 or pins A-C on accelerator potentiometer connector	
Minimum value[V]	Maximum value[V]
0.3	9.05
NOTE: Between the reading performed with the TESTER and the reading performed with the CONSOLE, there may be a difference of ± 200mV	
Potentiometer power supply, K1-17: 12 V	

Lifting HALL sensor pins E1-E3 or pins "earth"-2 on HALL connector	
Minimum value[V]	Middle value[V]
6.2	10.05
NOTE: Between the reading performed with the TESTER and the reading performed with the CONSOLE, there may be a difference of ± 200mV	
Sensor power supply,K1-17: 12 V	

Asynchronous motors
Features of the asynchronous motors

The three-phase asynchronous motors do not require particular maintenance, since they are not subject to problems of wear due to the absence of brushes and manifold. The stator is on the internal perimeter, and housed in special slots on the ferromagnetic core are triads of windings arranged in an equidistant manner, on which the power supply is applied. The rotor is a "squirrel cage" rotor with a system of windings composed of conducting bars axial to the rotor, housed in slots along the entire external perimeter of the ferromagnetic core, in a circular form, composed of a sheet pack stacked axially to the axis and separated by thin layers of insulating paint (see drawing to the side). The ends of the bars that emerge from both faces of the rotor are short circuited and mechanically fastened with two conducting rings. With the motor axis fixed, an extremely compact and robust rotor is obtained. When the stator windings are powered with a balanced system of three-phase voltages, a

magnetic field is generated that induces currents in the rotor conductors that produce a reaction field. As long as the relative velocity between the inductive field and the rotor is non-zero, the moving field cuts through the lines of current flowing in the bars, and thus a torque is generated on the rotor, causing it to move. But its speed can never reach that of the rotating magnetic field, since this would eliminate the relative motion between the

rotating magnetic field and the induced system, and thus the current would no longer be induced which gives rise to the motion. The rotation speed of the inductive magnetic field is also called the synchronism speed. The following figure shows the mechanical characteristics obtained with constant voltage and increasing frequency. The motor works with "constant power available", while the useful torque decreases as the speed increases.
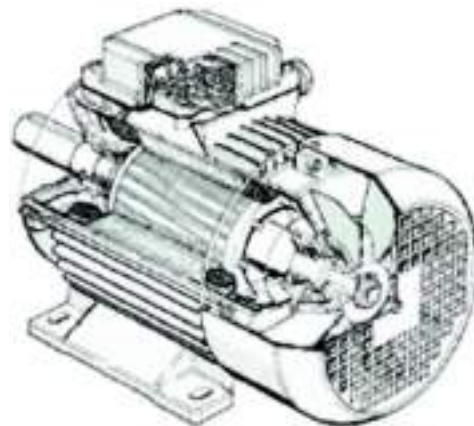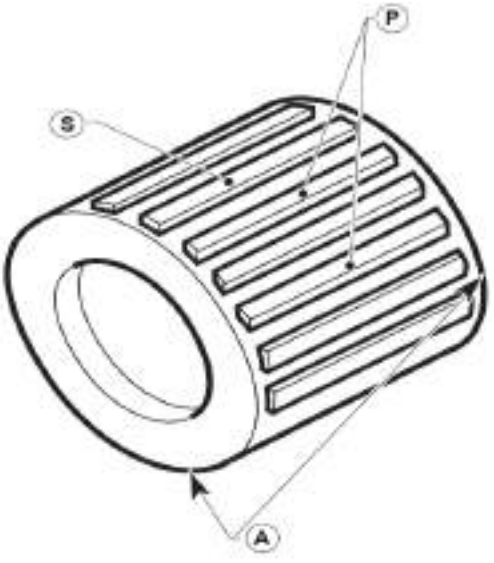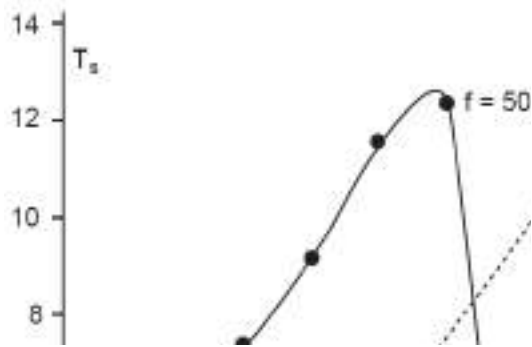
The curves show how the motor is able to start by itself by providing a certain starting torque; the torque increases with the rotation speed up to a maximum value near the synchronism speed where it reduces rapidly to zero (because when the rotor rotates at the same speed as the rotating magnetic field, their relative velocity becomes zero as does the induced electromotive force and induced currents). With the increase of the relative velocity between rotor and magnetic field, the induced electromotive force increases both in amplitude as well as frequency. Electrically the rotor windings are equipped with a given impedance that increases with the increase of the frequency and thus decreases the amplitude of the induced currents and the phase; for this reason, the torque is reduced. Changing the power supply frequency appropriately varies the synchronism speed and maximum torque, thus it is easy to change the stable working speed. During the starting phase, using a low frequency allows to obtain a smaller relative velocity, thus the rotor impedance decreases and the currents have larger amplitudes and phases, thereby obtaining a larger torque. The following figure shows the mechanical characteristics obtained with a variation of frequency proportional to the voltage, in the operating range with constant torque available.
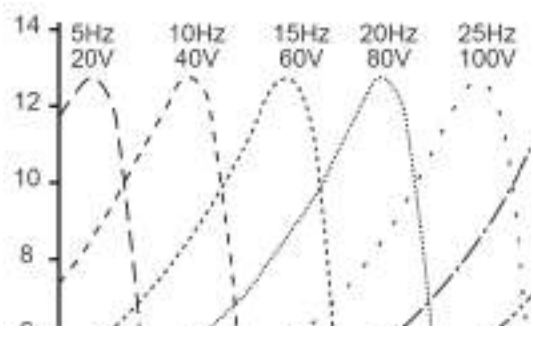
Checking the asynchronous motors

Given the frequencies in play, it is possible to vary the power supply amplitude and frequency of the motor without having problems of heat loss on the electronic power components and avoiding energy waste. This is achieved thanks to the solid-state electronic switches (MOSFET) to be used in two unique operating conditions: open or closed. These switches are connected in pairs in a bridge and powered with a continuous dual power supply. Making the switches commutate rapidly in a complementary manner, at a set frequency, causes the average output voltage Vu, obtained over a time period much longer than the commutation period, to be proportional to the duty cycle of Vu itself, which is:

$$\delta\% = \frac{T_1}{T_1 + T_2}$$

The switches working only open or in short circuit must dissipate only limited power. The power to be dissipated is mainly due to the fact that the closed switch in short circuit always has a minimum resistance over which a certain potential difference occurs while the current can be maximum. When the switch is open, there is always some current that passes through it, even if minimum, while the potential difference is maximum. The greatest cause of dissipation, however, occurs during commutation of the switches that always takes place over a short but non-negligible time. During this phase, the voltage at the ends of the switch and the current change value gradually from a maximum to zero and vice versa in a complementary manner. The following figure shows the pattern of the voltage, current and power over time for a switch during commutation.

| T | = Voltage | CR | = Current |
| CM | = Commutation | P | = Power |
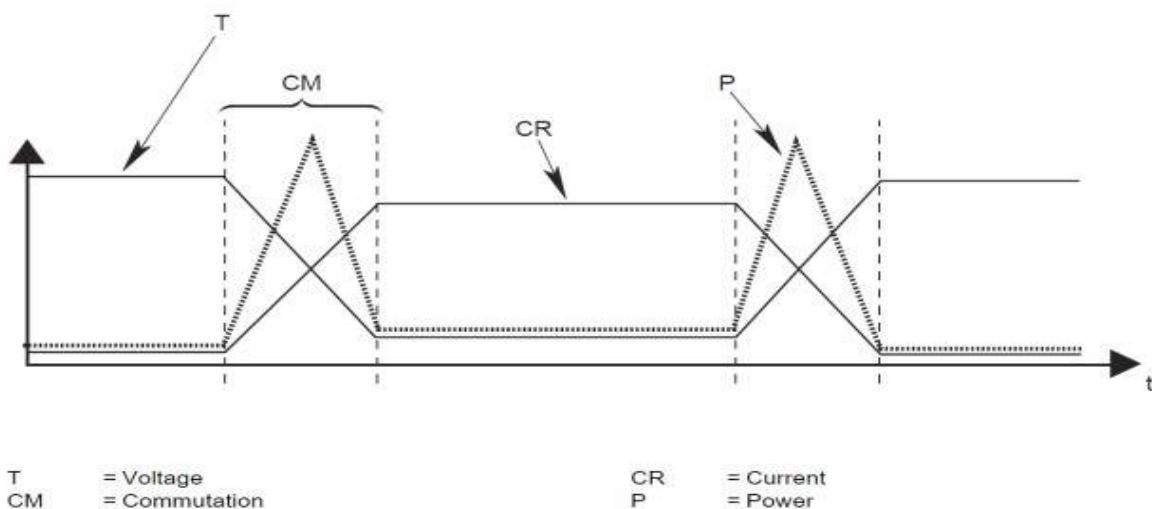
The technique to obtain a square wave with duty cycle proportional to a control voltage, called pulse width modulation (PWM), is illustrated in the diagram:
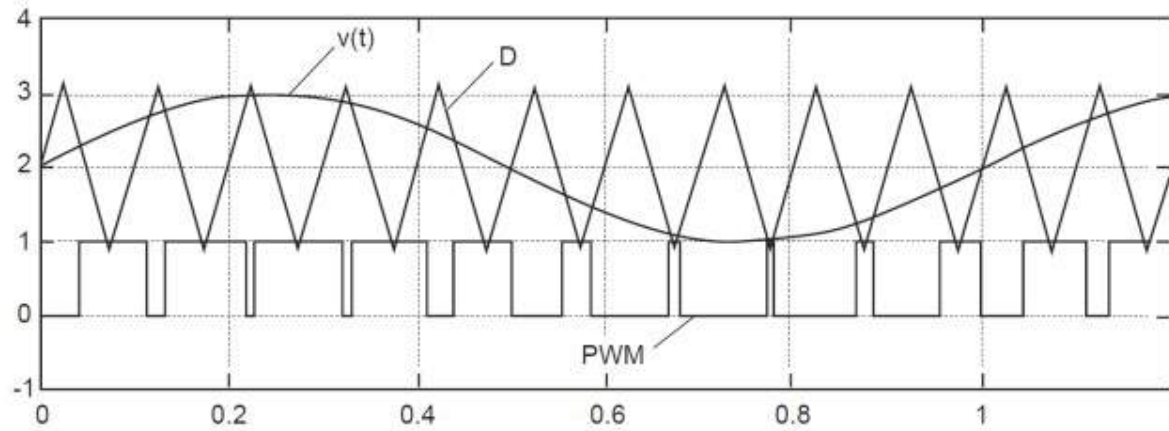
D. = Sawtooth

The control signal v(t) is compared with a saw tooth signal with a larger amplitude and a frequency much larger than v(t). When v(t), for example, exceeds the value of the saw tooth, the switches assume one of the two possible conditions.

Traction motor technical data

	KBET15/18	KBET15-S/18-S
Manufacturer	SME	SUPEREC
Designation	MT1029B	B436382GK
Operating voltage	48V	48V
Motor type	4-pole, three-phase AC motor with cage rotor	4-pole, three-phase AC motor with cage rotor
Connection	Delta	Delta
Design voltage (nominal)	34V	30V
Design current (nominal)	177A	109A
Design speed (nominal)	1500RPM	2080 RPM
Maximum speed	4500RPM	4500 RPM
Design output (nominal)	6.5KW	4.5
Operating mode (nominal)	S2 (60 min)	S2 (60 min)
Protection type	IP10	IP20
Insulation class	F	F
Weight	38.5kg	35kg
Cooling	Surface / convection	Surface / convection
Temperature sensor	E96CMT386A	
Speed sensor	ROOKMT028	

B436382GK
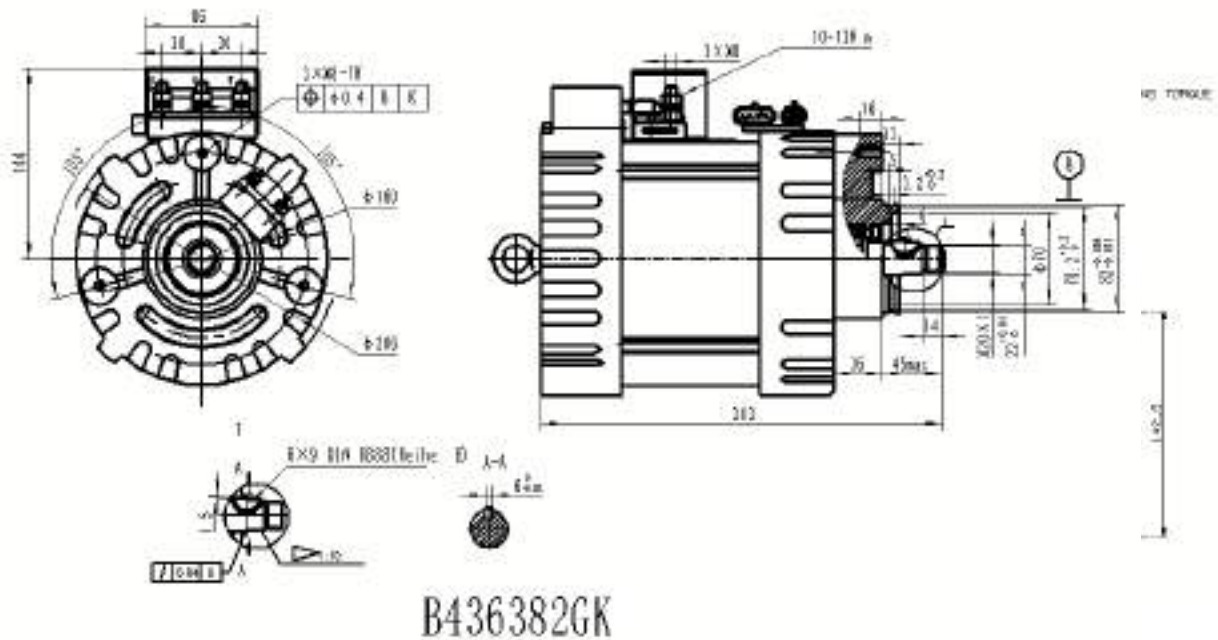
Traction motor

The motor connections U, V, W are fed to external threaded connectors on the motors.

The speed sensors are inserted in the axle from the outside, sealed with an O-ring and secured with a screw.

The temperature sensors are embedded in the stator winding. The connections are external to the motors.

The traction motors are three-phase AC asynchronous motors, which are equipped with short circuited cage rotors.

Aluminium conductors are fused into the grooving of the rotor core, which are connected at the ends with short-circuit rings. The conductors with the short-circuit rings form the cage rotors and hold the rotor core together.

The stator consists of the 4-pole stator core and the stator windings, which are incorporated as a single unit in the motor stator.

The applied voltage is induced in the rotor bars by the stator windings and causes a current to flow in the rotor. The resulting rotor current and the rotating field present on the stator generate the torque.

Method of operation

The motors are each controlled by an INVERTER. The change in speed takes place principally via a change in the frequency and voltage of the applied AC voltage.

In the motor, each of the three phases is distributed in turn to four poles in the stator, thereby generating the rotating field. The electric motors are operated in a star circuit and supplied with voltage pulses by the INVERTER.

The electric motors are controlled using pulse width modulation at a frequency of approximately 16 kHz.

Removal

![NOTE icon] **NOTE**

- **Removal of the individual units is described in detail in the corresponding chapters.**
- **Drain the gear lubricant oil and brake oil at an early stage so that the oil has time to drain off completely.**

➢ Park the vehicle safely.

➢ Apply the parking brake.

➢ Drain the gear lubricant oil.

➢ Disconnect the battery plug.

➢ Remove the floor.

➢ Release the electrical connections.

➢ Remove the lift mast; see the chapter "Lift mast: installation/removal".

➢ Jack up the front of the truck; see the chapter entitled "Safety instructions".

➢ Unscrew the huff bolts

➢ Release the parking brake.

➢ Remove the drive axle; see the chapter entitled "Removing /installing the drive axle".

➢ Retain and reuse the spring elements of the support bearings.

➢ To separate the traction motor, loosen the six M12 connecting screws.

Installation

![NOTE icon] **NOTE**

- **Installation of the individual units is described in detail in the corresponding chapters.**

- **Check the tightening torques and screw quality.**

- **Check the quality of the gear lubricant oil and brake oil.**
- **For values, see the "General technical data" in the chapter "Drive axle".**

➢ Tighten the six M12 connecting screws.

➢ Install the drive axle; see the chapter entitled "Removing /installing the drive axle".

➢ Tighten the huff bolts

➢ Install the lift mast; see the chapter "Lift mast: installation/removal".

➢ Connect the battery plug.

➢ Check the traction drive for correct operation.

- Connector of the heat sensor

Drive motor checks

If the drive motor does not accelerate after activation of the truck speed control device, it is possible that an error has occurred in the power supply section or control system or that there is a problem in the main circuit of the motor.

Visual inspection

If a defect in the motor operation is suspected, first perform the following checks.
Visually inspect the outside of the motor, looking for any signs of corrosion, dirt, interruptions, tightening of:

- U, V, W motor connections

- Connector of the rpm sensor

Also check the following:
- Correct fastening of the motor cables

- Correct fastening of the heat sensor on the right drive motor

- Correct fastening of the speed sensor

- Fastening of the support plates

- Rotatability of the rotor (bearing damage)

- Cleanliness of the motor (oil, grease, dirt)

Checks during operation
During normal operation of the drive motors, it is possible to perform the following checks:
- Temperature of the drive motors

- Noise of the bearings

Insulation check

The insulation resistance of the motor casing windings is important for proper operation of the truck. A check of the motor insulation will be valid only if it is performed using a measurement device with a suitable test voltage.

⚠ CAUTION

The test voltage of the insulation measuring instrument provided by the manufacturer is 500 V. This high test voltage makes it necessary to remove all the lines of the drive motors and the plug-in connector connecting the control cards before beginning the test.

The insulation resistance of the stator windings: U, V or W to the motor casing is greater than 5 MΩ.

Checking the rotor

After disassembly, the rotor must be thoroughly cleaned and checked, paying particular attention to any cracks or disjunction of the terminal clamps. The current will be reduced in the cracked area due to the high resistance.
It is also necessary to check that the rotor is not too hot or locally overheated which produces a discoloration of the rotor.

Terminals

Three cables are connected at the U, V, W connections. The eyelet terminals of the motor cables are fastened with hexagon nuts (tightening torque 20 Nm). The motor cables must not be interchanged. After tightening the hexagon nuts, the protective cover must be placed on the bolts.

Drive motor decomposition

KBET15/18	MT1029B	
1	Terminal plate assy	7
1a	Terminal board	8
1b	Socket screw	9
1c	Nut	10
1d	Washer	10a
1e	Spring washer	10b
1f	Hexagonal screw	10c
2	Oil seal	11
3	Socket screw	11a
4	Front cover	12
5	Spring washer	13
6	Bearing	14
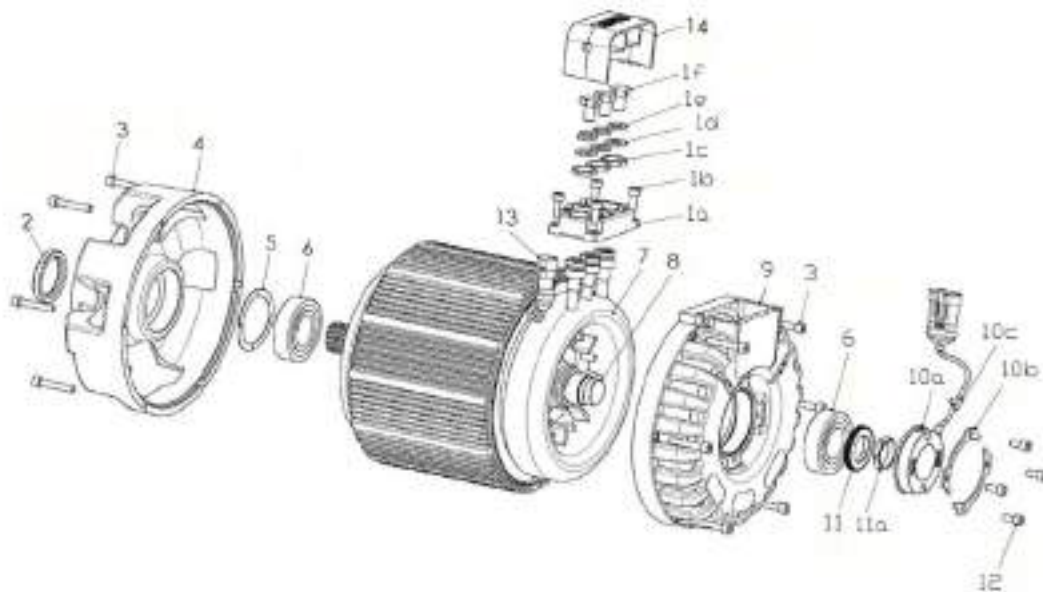
Encoder
General Information

SME manufactures two kinds of speed transducers developed for applications in AC motors: the standard\ model, whose code is E68EC050A01 and the holed model, whose code is E68EC067A01.

The encoder can detect the rotative motion of the toothed wheel fixed to the motor shaft and it generates two electrical signals (square wave and open collector type), usual for such encoders.

The two output signals, named channel A and channel B, are shifted by 90 electrical degrees. Their frequency is proportional to the rotational speed of the motor shaft. Since the toothed wheel has 64 teeth, each channel generates 64 pulses every complete turn of the shaft.

Basic principle

The basics of the encoder are a pair of hall effect sensors placed close to the rotating toothed wheel. Each sensor is biased by a fixed magnetic field generated by a permanent magnet.

When the wheel rotates, the consecutive alternance of a tooth and a cavity in front of the hall sensor causes a concentration and subsequently a dispersion of the magnetic field lines.

As a consequence of a "squared" mechanical profile, the magnetic field is sinusoidal, but the electric signal generated by the hall sensor is squared again.

The accurate positioning of the two hall sensors with respect to the toothed wheel, generates the 90 degrees of electrical shift between the two generated signals

When the rotation is clockwise (observed from the motor shaft) the signal "A" anticipates signal "B".

If the rotation is in the opposite direction (CCW) the signal "A" is delayed in comparison with "B".

This simple but significant difference allows the electronic circuits to detect the direction of rotation in addition to the instantaneous speed value.

Mechanical profile

Magnetic profile
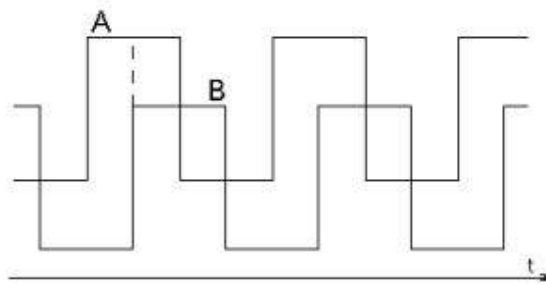
clockwise rotation
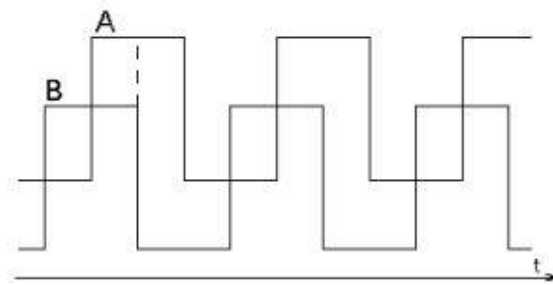
counterclockwise rotation
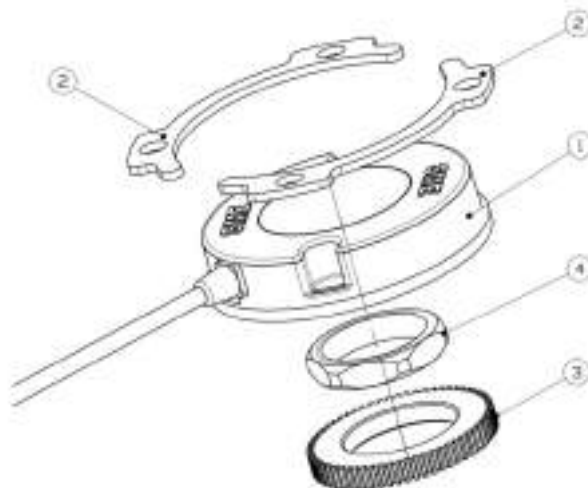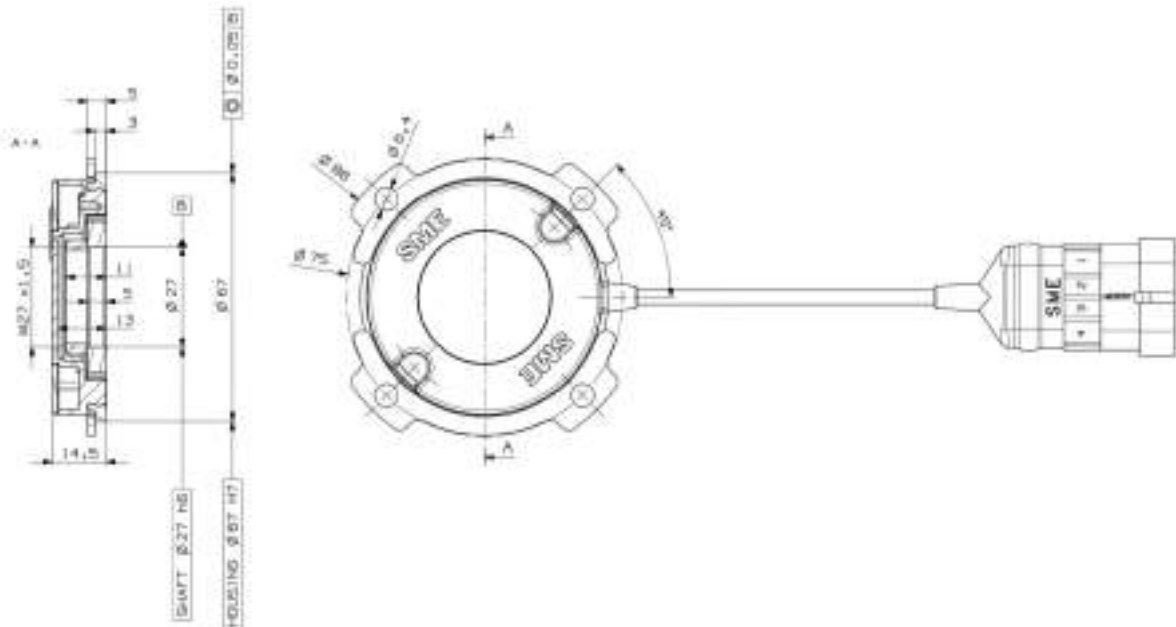
PART LIST		
N°	DESCRIPTION	SME CODE
1	SPEED SENSOR	E68EC050A01
2	LOCKING FLANGE	760EC064A
3	SPEED SENSOR GEAR	762EC069A
4	RINGNUT	762EC070A

General electric specifications	
Pulses per revolution	64
Maximum speed	6000 rpm
Output signals	2 square wave signals open collector output max output sink current 25mA (each channel)
Duty cycle	50% ± 25% each channel
Phase shift	90° ± 45° (electrical)
Connection cable	4 wires on male connector (AMP Super seal) rated length 270 mm
Supply	@Vcc =5V typ. 5mA

Temperature range	from -30°C to +120°C
Min pull-up R value	@Vcc=5V 270 @Vcc=12V 680 @Vcc=24V 1500

Electrical connections of the traction motors

Wiring diagram

The windings of the traction motors are wired in delta configuration inside the motors.

Location of the electrical connections

MT1029B
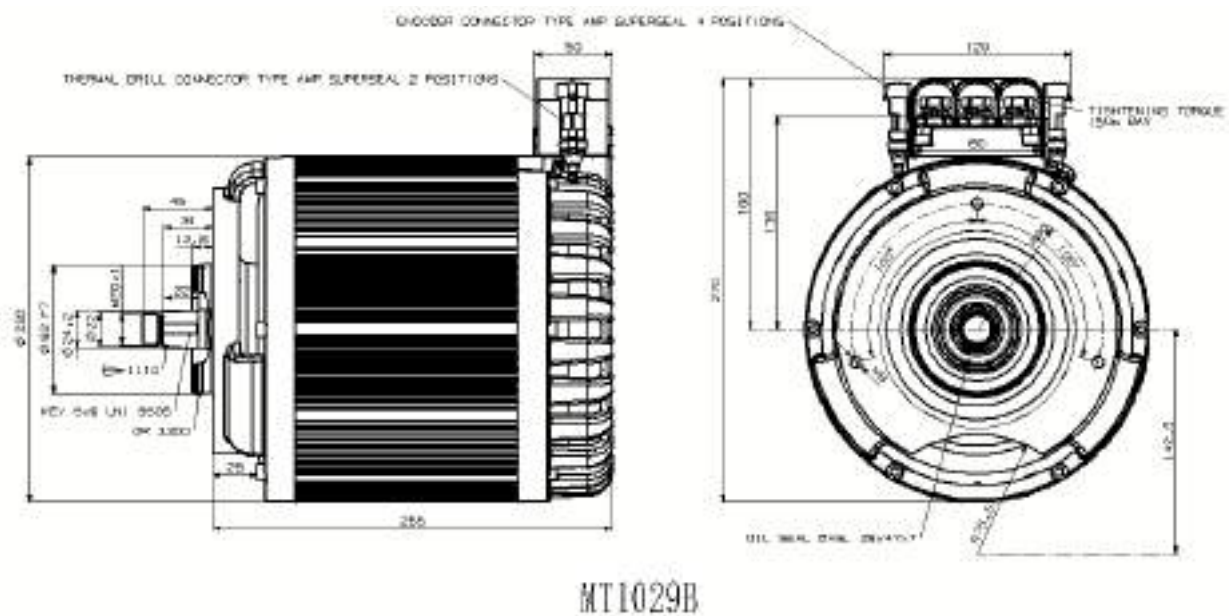
Location and type of electrical connections:

- Similar to the insulated and watertight threaded connectors, the main power connections U/V/W are located externally to the motor by means of a removable terminal board.
- Speed sensor — 4-pin "Junior Power Timer" connector.
- Temperature sensor — 3-pin connector.

Insulation testing of traction motor

General Information
Insufficient insulation values in the truck can lead to undefined errors that may not be detected through a diagnosis.

Test configuration
➢ Disconnect the battery connector.
➢ De-energise the traction motor INVERTERS by disconnecting all the power cables "U, V, W, +, -".

⚠ CAUTION

The test voltage may damage the INVERTERS.
You must disconnect the traction motor's connections (power supply cables) from the INVERTERS.

➢ Jumper the traction motor's temperature sensor at the connections.

⚠ CAUTION

The test voltage may damage the temperature sensors.
The temperature sensors must be jumpered at the connections.

Traction motor measurement

ℹ Test voltage: 100 V DC.
➢ Measurement of windings U, V, W of the traction motor in relation to the housing.

Traction motor test value

The insulation of the electrical system and the traction motor must have a minimum value of 1000 /Volt.

NOTE

If the value is less than this threshold: the insulation is insufficient.

End of test

When the test has been completed, or any necessary repairs have been carried out, all connections must be restored and the jumpers must be removed from the temperature sensors.

Front axle
Front axle technical data
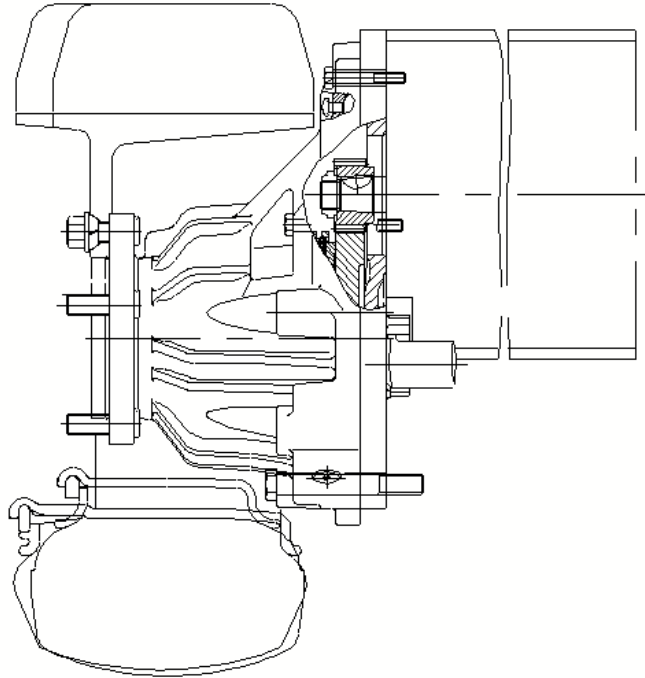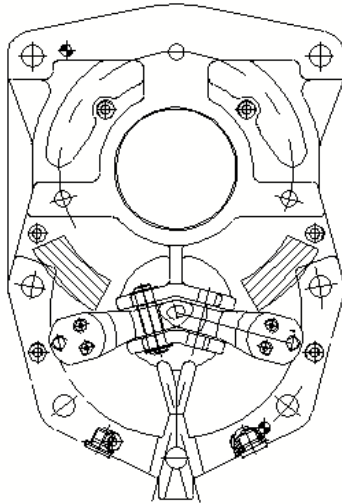
1.When adjust the wheel bearing housing, tighten back the round nut about 1/8 circle, tighten the nuts, the wheel actuation force is 50-150N.m.
2. Brake hub should be able to rotate freely, adjust the gap to make the adjusting wheel in an intermediate position.
3.Add to 3rd lithium grease accounted for 70% of the space between the two wheel bearing shell.
4. Add a small amount of grease to the inner and outer ring of bearings.
5. To prevent the wheel bolts loose, it should smear GY-340 anaerobic adhesive when in the assembly.

6.FUHONG brake.
7. Smear GY-340 anaerobic adhesive to the brake bolts when in the assembly.
8. Spraying matt gray paint on the surface.
9.The paint must not be sprayed in the transaxle case cavity.

Type	KBET15	KBET18	KBET15-S	KBET18-S
Technical specifications				
Battery Voltage	U Batt = 48 V	U Batt = 48 V	U Batt = 48 V	U Batt = 48 V
Electric motor(operating mode S2 – 60 Min.)				
Voltage	U =34V	U =34V	U =30V	U =30V
Rated current	Inom =177A	Inom =177A	Inom =109A	Inom =109A
Rated power	Pnom =6.5kw	Pnom =6.5kw	Pnom =4.5kw	Pnom =4.5kw
Rated rpm	nnom =1500rpm	nnom =1500rpm	nnom =2800rpm	nnom =2800rpm
Rated frequency	fnom =50HZ	fnom =50HZ	fnom =70HZ	fnom =70HZ
Maximum rpm	nmax =4500rpm	nmax =4500rpm	nmax =4500rpm	nmax =4500rpm
Axle				
Maximum load on the axle	24.5KN	24.5KN	24.5KN	24.5KN
Max. tractive force	8.7KN	8.7KN	8.7KN	8.7KN
Maximum truck speed	Vmax =14km/h	Vmax =14km/h	Vmax =14km/h	Vmax =14km/h
Maximum wheel speed	162rpm	162rpm	162rpm	162rpm
Tyres	18X7-8	18X7-8	18X7-8	18X7-8
Reducer gearbox i = 22				
Oil content	0.3L	0.4L	0.4L	0.4L
Type of oil	See the "Supply table"	See the "Supply table"	See the "Supply table"	See the "Supply table"
Brakes				
Braking torque on the wheel	1700Nm	1700Nm	1700Nm	1700Nm
Take-off force at the lever	300N	300N	300N	300N
With deceleration				
With the weight of the truck	3900KG	4530KG	3900KG	4530KG
Max. force on the brake lever	600N	600N	600N	600N
Oil qty.	0.35L	0.35L	0.35L	0.35L
Type of oil	See the "Supply table"	See the "Supply table"	See the "Supply table"	See the "Supply table"

Speed sensor pin-out

1   +V(red)   2   0V(black)

3   Channel A(white)   4Channel B(blue)
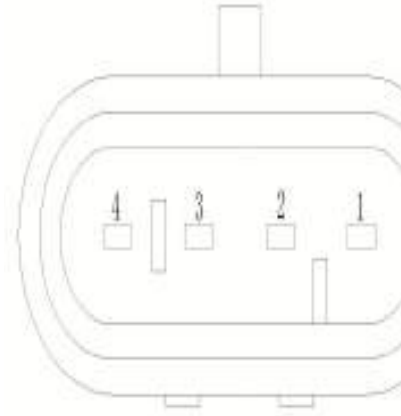
Temperature sensor pin-out
1   Sensor (+)   2   Sensor (-)
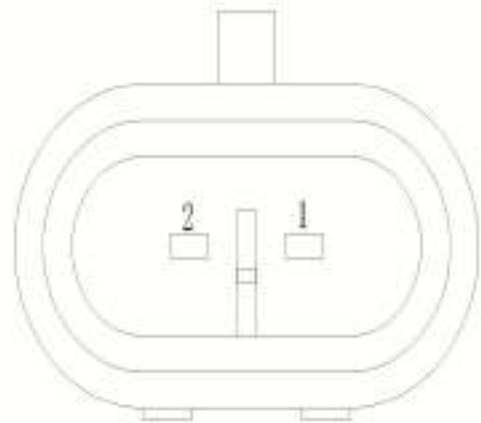
Removal of front axle with traction motors

- Disconnect the battery socket or operate the emergency stop button.
- Remove the step plate as indicated in the respective chapter.
- Remove the lift as described in the respective chapter.
- ➢ Loosen the fixing screws of the wheels.

- ➢ Position solid, stable supports underneath the chassis and then lower the jack and completely unscrew the wheel fixing screws, then remove the wheels.

- ➢ Disconnect the brake actuation cables from the axle as follows

➢ Unscrew the huff bolts

➢ Raise the caps and detach the power cables to the motors, marking them to facilitate cor-rect reassembly

➢ Extract the front axle by backing up with the truck or with the pallet truck

⚠ DANGER

Be careful not to strike or damage the components or details of the machine during this phase.

Front axle reassembly

Axle assembly diagram
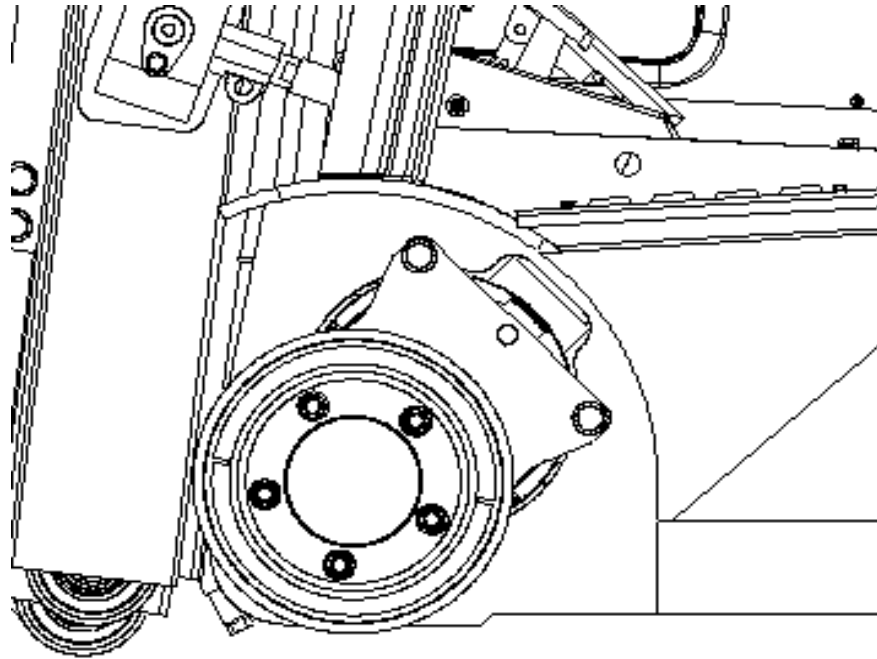
Reassemble the front axle by performing the removal operations in reverse, paying particular attention to the following operations:
• Fastening of the front axle to the chassis with tightening of the screws as per the assembly diagram.
• Reassembly of the wheels by screwing on the screws in the sequence and to the tightening torque described in the   respective chapter
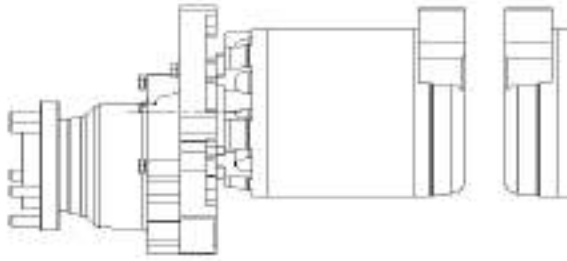
➤ Unscrew the screws fastening the overhead guard to the counterweight.

Counterweight
Counterweight removal
Three-wheel truck counterweight removal

Before carrying out the operations described below,
the lift must absolutely be completely lowered and tilted backwards. Rest the fork arms or any other equipment on the ground and position suitable, stable supports under the fixed masts or lift supports. Failure to abide by these precautions may lead to truck instability with the risk of tipping over.
Remove the battery as described in the respective paragraph.

➤ Mounted on the hook and Insert non-metallic slings with a suitable lifting capacity into the slits of the counterweight.

Compare the lifting capacity of the slings with the counterweight weights listed in the table.

Counterweight weights	
Model	Type
	15/15-S
3-Wheel	18/18-S

> Lift the counterweight and back up, removing it from the chassis. Set the counterweight on the ground.

Covers
Cover topography
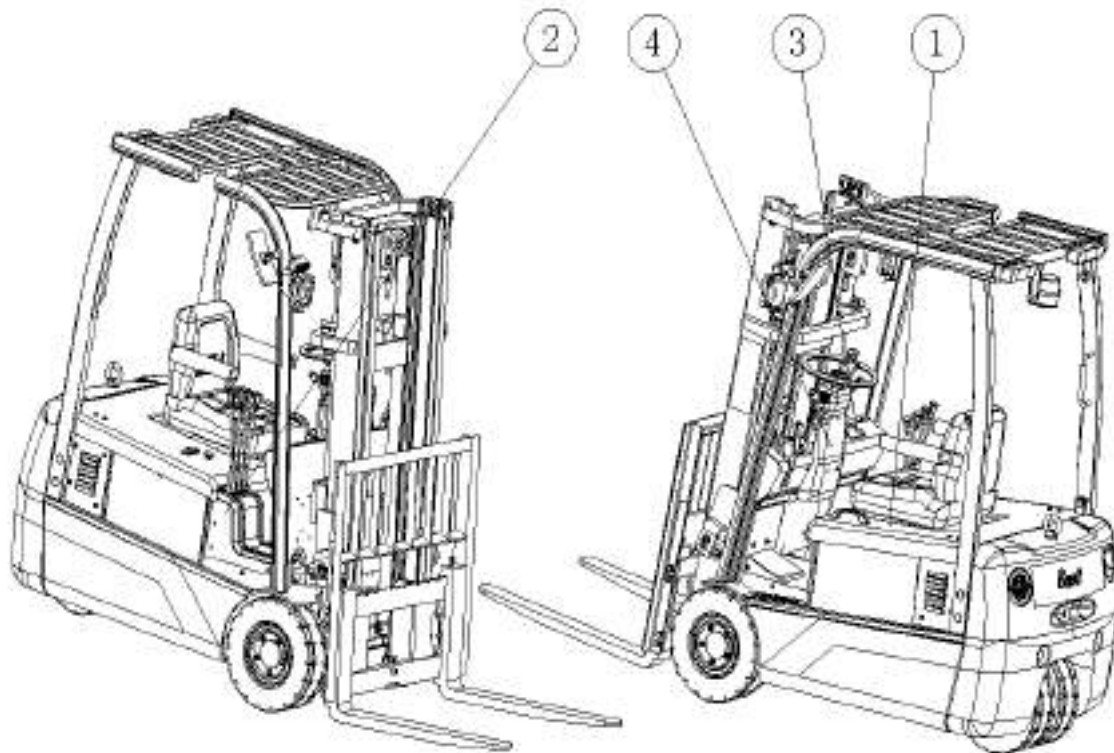
The following covers are present on the truck:
- the battery cover (1);
- the distributor cover (2);
- the control panel panelling (3) ;
- the steeringcolumn panelling (4);

NOTE
See the paragraphs in the "Truck" chapter for
the removal/reassembly operations of the covers and the "Driver's seat" chapter for the panelling.

Distributor cover removal / reassembly

Distributor cover removal

➤ Secure the truck by applying the handbrake. Disconnect the battery socket. Remove the operator's seat as described in the respective chapter. Raise the battery cover as described in the paragraph "Internal accessibility".

> **⚠ CAUTION**
>
> The removal of the battery cover must be carried out by two operators: one keeps the cover raised, while the other performs the removal operations.

➤ Disconnect the connector that connects the wiring to the seat microswitch.

➤ Disconnect the gas spring on the cover side by unscrewing the respective fixing screw.

➤ Unscrew the fixing screws of the hinge supports .

➢ Remove (with two operators working together) the battery cover complete with hinges

Battery cover reassembly
Perform the removal operations in reverse, taking care to reconnect the seat microswitch wiring correctly.

Step plate removal / reassembly
Removal
➢ Secure the truck by applying the handbrake. Disconnect the battery socket or operate the emergency stop button. Remove the rubber mat (1).

➢ Unscrew the 2 screws fixing the step plate to the chassis.

➢ Raise the step plate slightly and disconnect the accelerator pedal connector and the accelerator potentiometer connector .
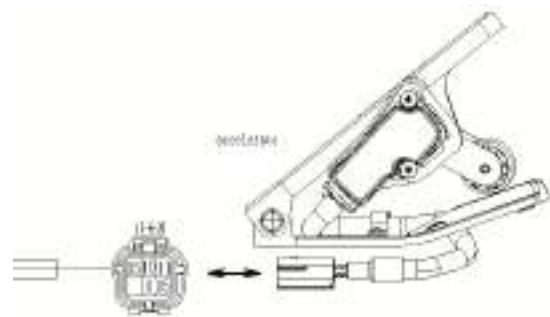
➢ Remove the step plate complete with accelerator pedal.

Reassembly
Reassemble by performing the removal operations in reverse.

Distributor cover removal / reassembly
Distributor cover removal

➢ Secure the truck by applying the handbrake. Disconnect the battery socket. Unscrew the two screws of the mask .

➢ Unscrew the six screws .
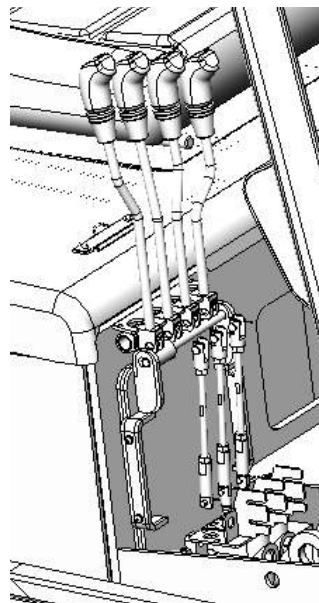
➢ Remove the mask .

Batteries
Battery removal
Battery disconnection

• Secure the truck by applying the handbrake.
• Disconnect the battery socket or operate the
  emergency stop button.
➢ Open the battery cover as described in the paragraph "Internal accessibility".and unscrew the screw.

➢ Hook a crane or a truck with a rocker or slings with a suitable lifting capacity to the battery in the two lifting points provided.

⚠ WARNING

Check the weights of the batteries in the respective paragraph.

⚠ CAUTION

Use only non metallic slings or metallic chains only if covered with insulating rubber.

Raise the battery and extract it from the compartment.

Battery reconnection
Perform the disconnection operations in reverse.

Overhead guard
Removal of the overhead guard

➢ Disconnect the connectors of the rear lights.

➢ Unscrew the screws fastening the overhead guard to the front panelling.

➢ Unscrew the screws fastening the overhead guard to the front panelling.

> Unscrew the screws fastening the overhead guard to the front panelling.

> Slowly lift the overhead guard using suitable equipment and remove it, being careful not to interfere with any parts of the truck (wiring, covers,etc.).

Reassembly of the overhead guard
Assembly diagram
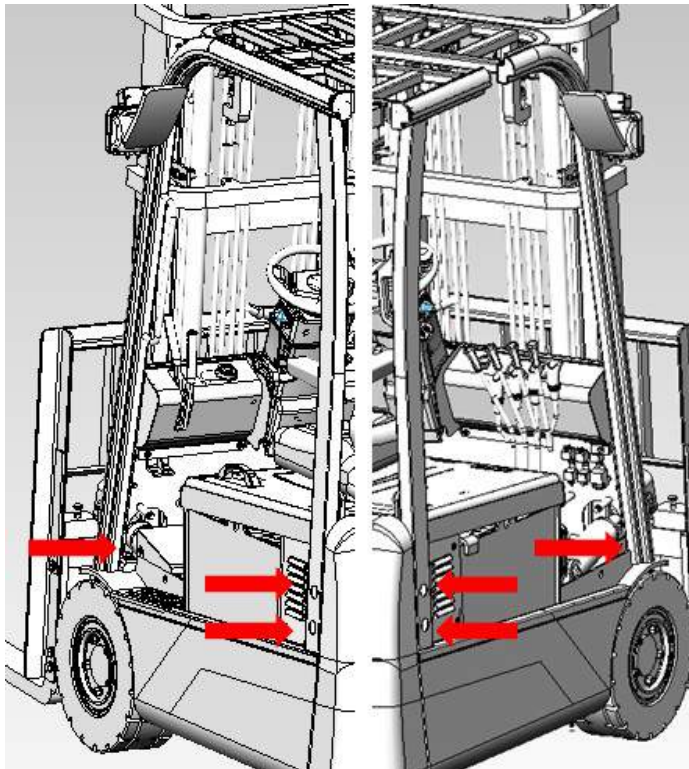
Removal / reassembly of the steering column panelling

Removal of the steering column panelling

➤ Unscrew the four screws from both sides.

➤ Unscrew the three screws from back sides.

➤ Remove the two shells from the steerin column.
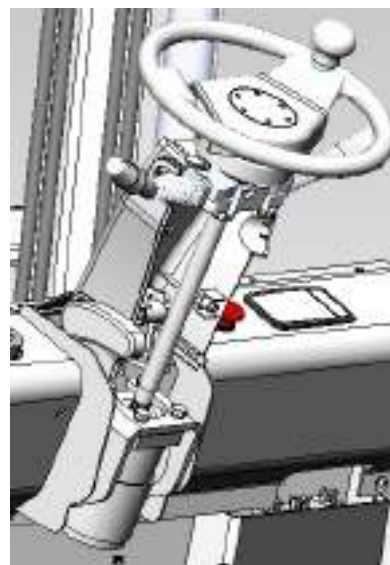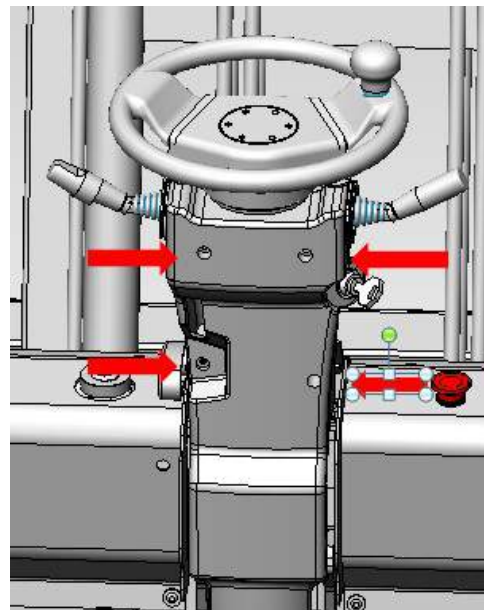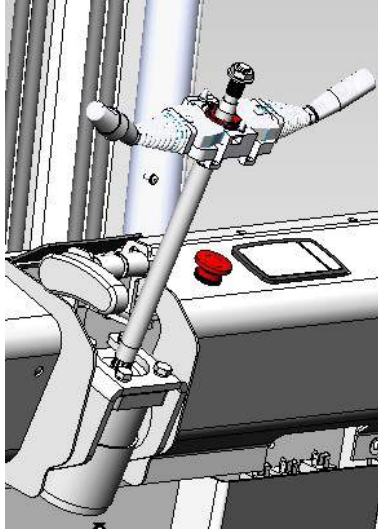
Reassembly of the steering column panelling

Reassemble the shells by performing the removal operations in reverse, taking care to correctly reassemble the locking bush before reassembling the steering wheel inclination adjustment knob, shown in the assembly diagram.
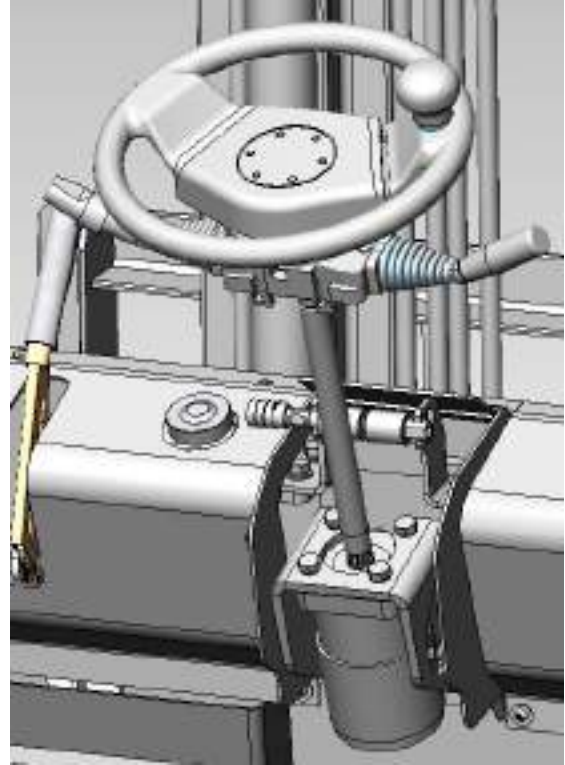
Removal / reassembly of the control panel panelling

Removal of the panelling

➢ Unscrew the five screws located on the part of the truck.

➤ Unscrew the screws

➤ Reassembly of the panelling
Reassemble the panelling by performing the removal operations in reverse, being careful to reconnect the wiring to the display.

Steering distributor
Steering distributor technical data
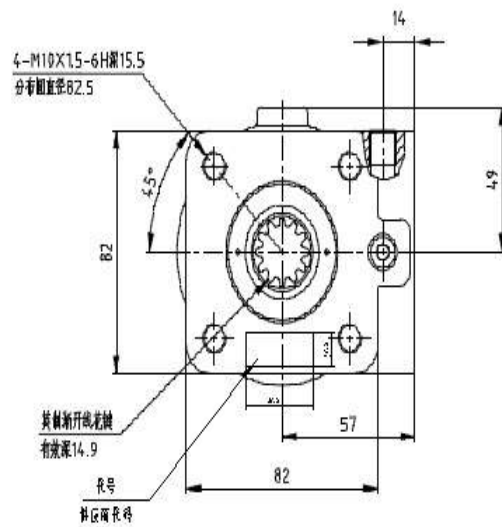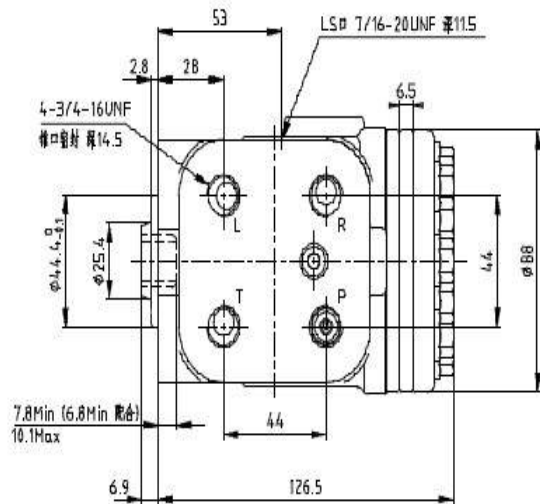
The steering unit consists of a valve and rotary
flow-rate controller. Operation of the column connects the hydraulically assisted steering with the turning wheels of the vehicle. When the steering wheel is rotated, the oil arriving from the system pump is directed through the valve and rotary

flow-rate controller to the inlet connection of the L or R cylinder, depending on the direction of rotation. The flow-rate controller measures the quantity of oil directed to the steering cylinder in proportion to the rotation angle of the steering wheel.

Hydraulic diagram
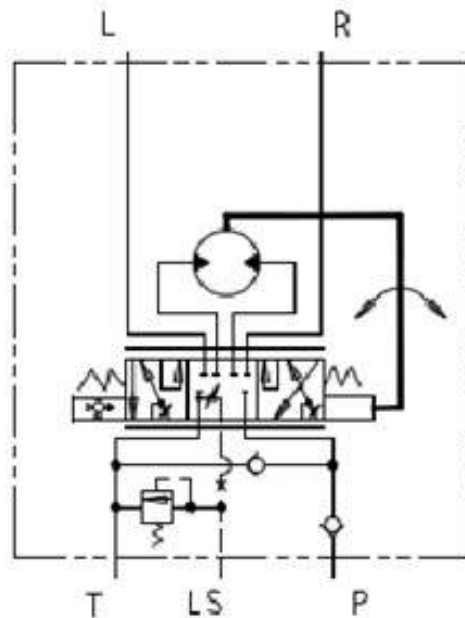
Removal / reassembly of the steering

Supplier diagram

Distributor Steering distributor removal

- Secure the truck by applying the handbrake.
- Disconnect the battery socket or operate the emergency stop button.
- Remove the step plate as indicated in the respective chapter.
➢ Remove the steering distributor feed barrels.

NOTE

Mark the respective positions on the piping in order to facilitate reassembly.

➢ Disconnect the faston connectors from the pressure switch.

➢ Unscrew the four fixing screws .

➢ Remove the steering distributor from the truck.

Steering distributor reassembly

➢ Perform the removal operations in reverse, taking care to reconnect the hydraulic piping, if not previously

marked, as shown in the figure to the side.
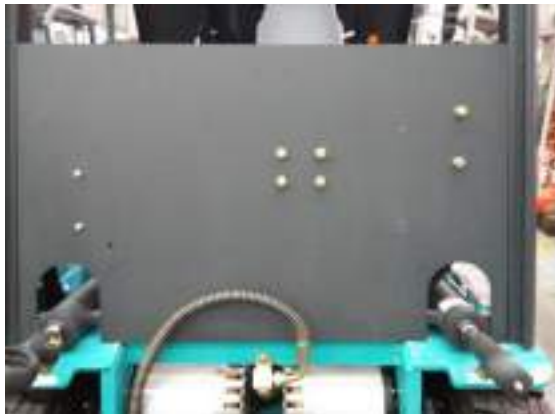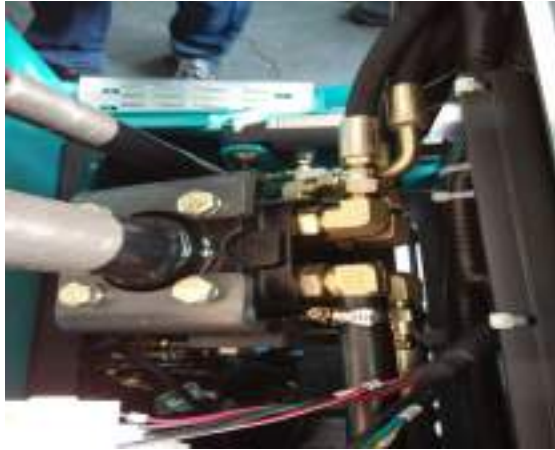
Removal / reassembly of the steering column

Removal of the steering column

- Secure the truck by applying the parking brake.
- Operate the emergency stop button or disconnect the battery.
- Remove the steering column cladding panels and the control panel panelling as described in the respective paragraphs.
- Remove, if applicable, the light switching device or manual reversing lever.

➢ Disconnect the electrical contacts , after having removed the horn button from the steering wheel

take care to avoid damaging the

⚠ WARNING

electrical contacts.

➢ Unscrew the nut and remove the steering wheel.

Steering column
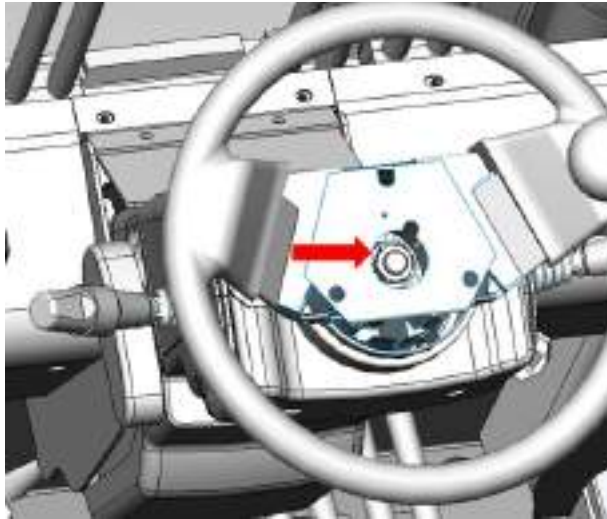
> ➢ Remove the steering column inclination adjustment pin with respective locking bush.
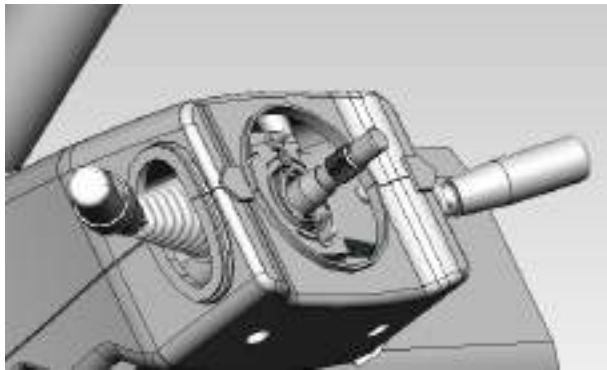
> ➢ Disconnect the horn wiring by detaching the connectors .

➢ Remove the steering column .

ⓘ NOTE

The procedure described above provides for the disassembly of the complete steering column. If necessary and/or useful, the steering column can be disassembled without disassembling the steering wheel, thus avoiding the first two operations.

Steering axle
Three-wheel truck rear axle technical data
Pivoting, fixed to the chassis.
Includes the steering cylinder which, supplied by
the steering distributor, provides for the rotation
of the axle casing through a toothed rod. A potentiometer
connected to the axle casing allows to
realize the electrical differential.
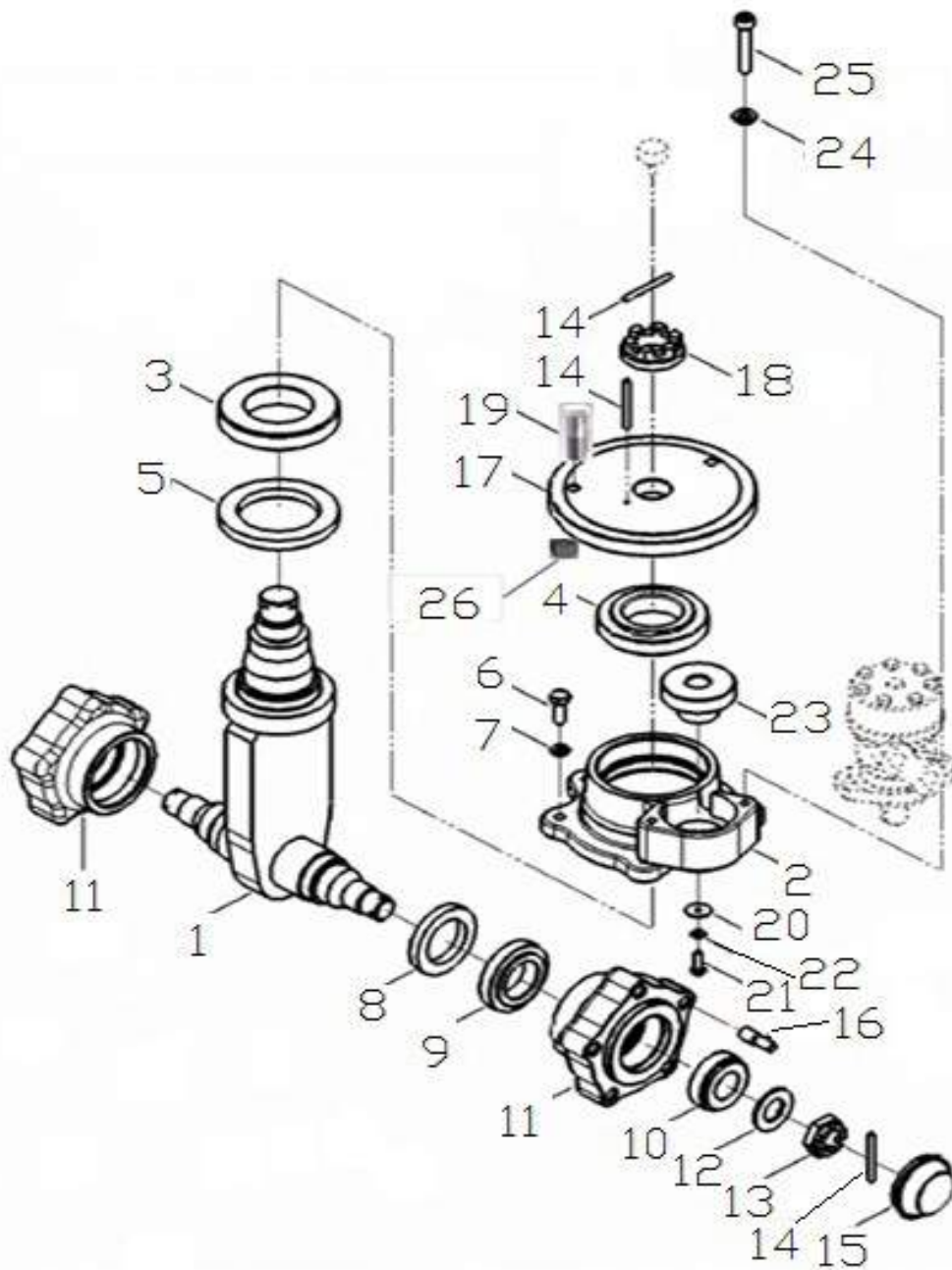
1	Axle beam assy.
2	Support
3	Bearing
4	Bearing
5	Oil seal
6	Bolt
7	Washer
8	Oil seal
9	Bearing
10	Bearing
11	Hub
12	Plain washer
13	Nut slot
14	Column pin
15	Steering hub cap
16	Stud bolt

17	Gear
18	Castle nut
19	Spring pin
20	Washer
21	Bolt
22	Washer
23	Gear
24	Washer
25	Bolt
26	Spring pin
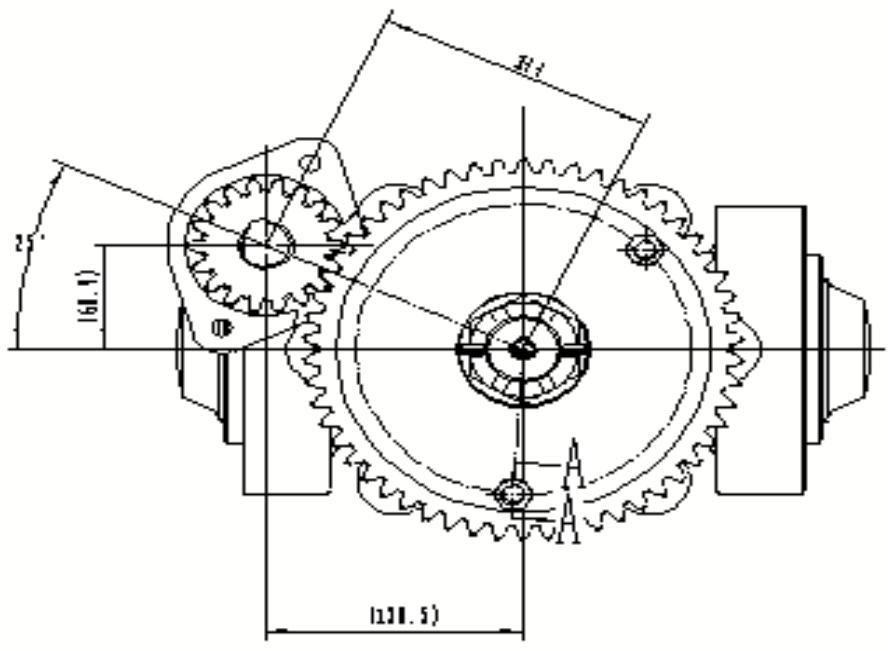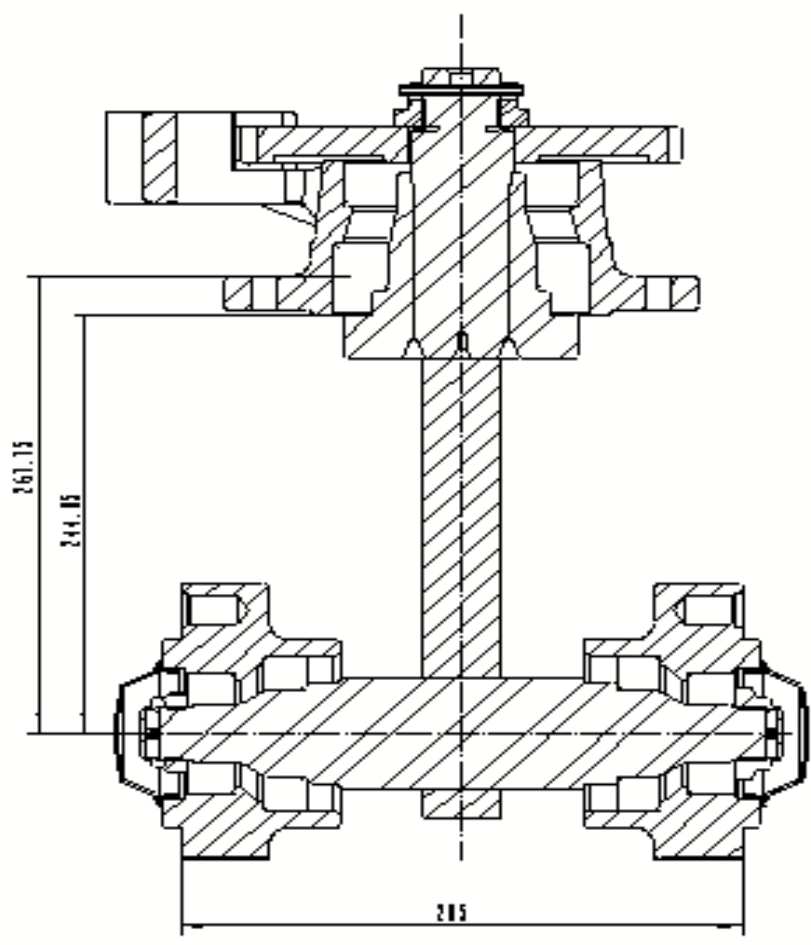
Steering axle	pivoting type
wheel angle range	90°
toe-in	/
wheel inclination	/
incidence	/
Tightening torque	
wheel hub	/
wheel locking nuts	/
axle casing fastening	/
steering cylinder stroke	/
hexagon nut on the stub axle bolt	/
Lubricant	
wheel hub support	/
stub axle support	/

Three-wheel truck axle removal

➢ Secure the truck by applying the handbrake. Disconnect the battery socket or operate the emergency stop button. Raise the rear of the truck, resting it on solid, stable supports, and block the front wheels (with handbrake and wooden blocks) to prevent the truck from moving.

Without the battery and counterweight, the equilibrium of the truck can become compromised; there is a risk that the truck will tip over!
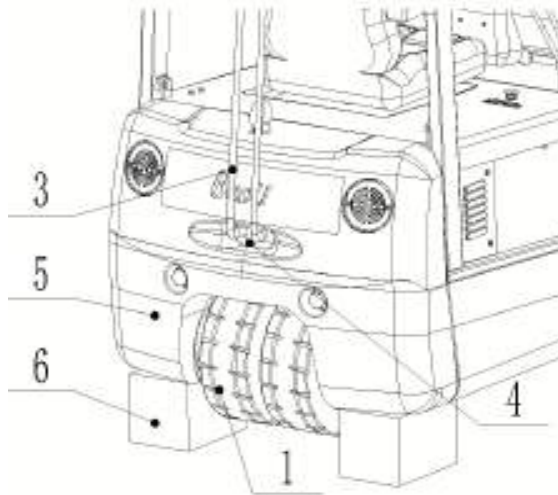
Raise the battery cover as indicated in the respective paragraph.

Use a screwdriver to open the safety catch and disconnect the potentiometer connector.
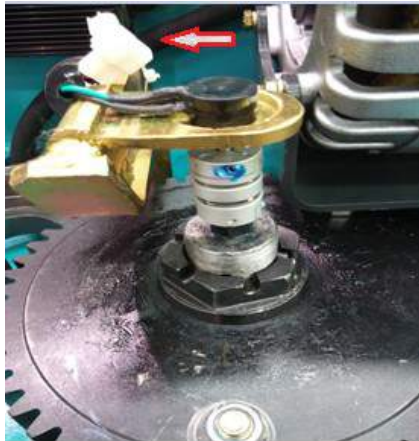
➢ Disassemble the wheels of the rear axle.

➢ Disconnect the supply piping of the Hydraulic motor from the special compartments in the chassis.
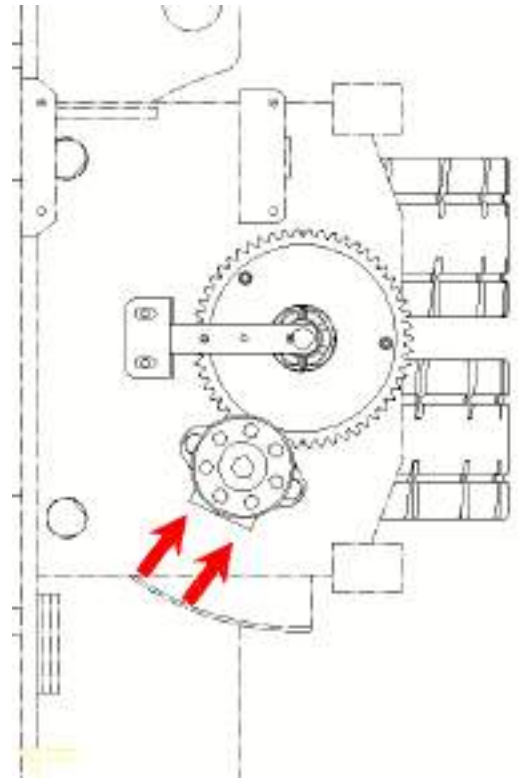
➢ Underneath the axle , place a jack or pallet truck and move it into contact with the same.
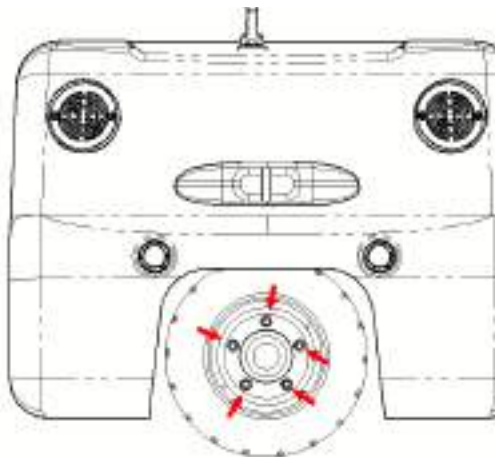
➢ Unscrew the six fixing screws of the axle.

➢ Support the axle vertically and lower the jack until freeing the cylinder from the rear reinforcements of the chassis in order to remove it. Withdraw the jack to remove the axle from the chassis.

➢ Wheel tightening torque: 200 Nm

Three-wheel truck potentiometer technical data

熱縮管
150
φ22.4
熱縮管
190
A
A

3
2
1

3
1 2
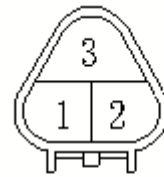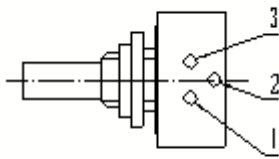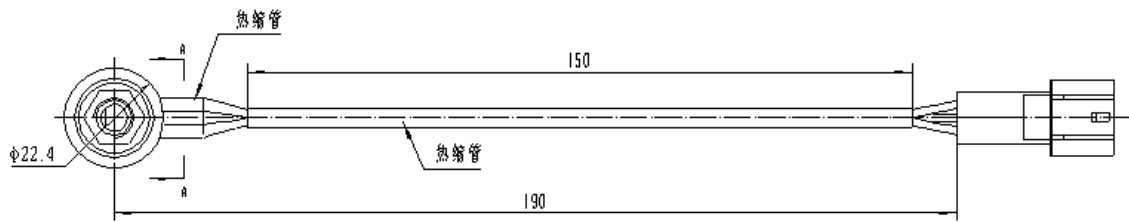
DJ7031-2.3-21

Potentiometer diagram
The wiper is shown in the base position.

Schematic Diagram

2
1
3
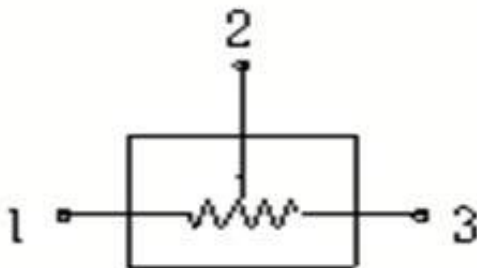
CARACTERISTIQUES ELECTRIQUES ELECTRICAL SPECIFICATIONS	Standard
Dissipation Power rating	0.3 W max at 70° C

Linearite independante Independent linearity	A±1% max
Regularite de tention de sortie Output smoothness	0.025% max
Course electrique totale(CET) Actual electrical travel(AET)	340° ± 5°
Course electrique utile(CEU) Theoretical Electical Travel(TET)	CET-3° AET-3°
Resistance totale(Rt) Total resistance	5kΩ ± 10%
Resistance disolement at 20° C insulation resistance at 20° C	≥1000MΩ,500Vcc ≥1000MΩ,500Vdc
Regidite dielectrique Dielectric strength	≥500Veff,50Hz ≥500V RMS,50Hz
Residuelles End voltage	0.5% of input voltage 0.5% de la tension totale
Resistance de charge recommande Load resistance recommended	(1000×Rt)min
Model	78Rb size 09
Mechanical travel	360°continuous
Fixation Mounting type	Bushing
Sorties Terminals	Turrets Bornes

Replacement of the three-wheel steering axle potentiometer

➤ Move the steering wheel completely to the right (turning it clockwise to the limit stop). Apply the handbrake. Open the battery cover. Disconnect the battery socket. Loosen and remove the fixing screws of the potentiometer support bracket .

> Open the safety catch and disconnect the potentiometer wiring from the panel.

> Remove the potentiometer complete with bracket , sliding it into the counterweight compartment.

Reinsert the wiring of the new potentiometer in order to later connect it to the panel.
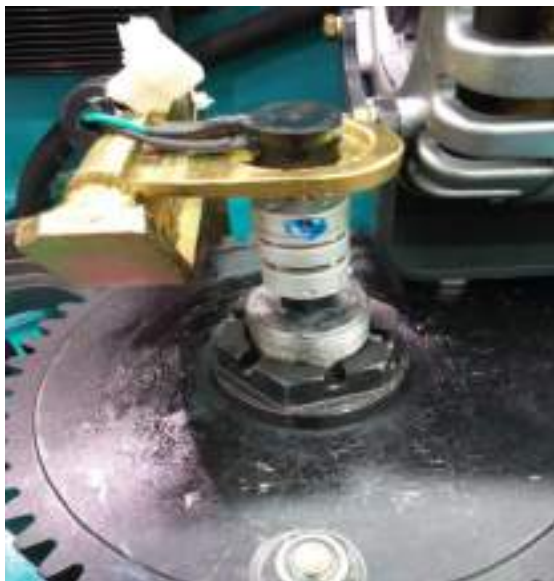
General information
Safety regulations for wheels and rims General

⚠ DANGER

Wheels and rims, important parts for vehicle safety,require correct use, periodic checks and continuous maintenance by the user. In particular, during tyre assembly and disassembly, it is necessary to follow some basic safety precautions in order to prevent possible errors and imprudence that may cause serious accidents.

- Damaged or deformed wheels must never be repaired or used in service;
- Never repair rims or disks by means of welding, for any reason whatsoever;
- The defective parts should always be replaced with parts of the same type, shape and dimensions;

- All the coupling surfaces must be cleaned well and protected against rust.

Before beginning to disassemble a wheel of the vehicle, make sure that the tyre carcass or the rim is not damaged and deflate the tyre completely in any case.

If the wheels are dismountable disk wheels, the accidental disassembly of joint nuts, with the wheel still coupled onto the hubs, is prevented with suitable devices. In the twin-tyre versions, loosen the fixing nuts by just a few turns and make sure, with the wheels lifted off the ground, that the same are "free" from any interference that would indicate structural failure. Before proceeding with any subsequent operation, completely deflate the

tyre (if not already deflated) and remove the central body of the valve for a more complete and secure discharge of the air.

Precautions for assembly

During assembly, check the integrity and conformity of the parts used. In the rims with removable rings, make sure that the rings are remounted on the same rim from which they were removed and make sure, after a first short intake of air (about 0.3-0.5 bar) with the rim in a horizontal position, that the rings are concentric and housed well in their seats. The inflation of the tyre to the final prescribed pressure - not to be exceeded - must be

performed within a sturdy cage or safety devices that can provide sufficient protection against very rare but not impossible events. For the dismountable disk wheels, the use of the cage also when disassembling the wheel tyre is certainly a good safety measure; the need for systematic and meticulous checks, particularly under harsh and abnormal working conditions, is thus well-justified: the reliability and safety margin foreseen during the design phase can in fact be compromised by severe corrosion and wear, deformations due to collisions, improper use or failure to follow the safety regulations.

For safety reasons, do not use wheels or fastening parts different than those provided originally. Do not lubricate the wheel clamping screws and nuts to facilitate disassembly and reassembly. After every assembly, periodically check the tightening of the wheel nuts as indicated in the use and maintenance manual.It is advisableto use homogenous rims and tyres on the same axle: from the same supplier and with the same design.

General information for changing
Tyres

To fully appreciate the features of stability and safety of the tyres equipping our forklifts, check the inflation pressure (for inflated tyres) respecting the values shown in your Owner's Handbook. Also check tread depth. It is advisable to change the tyres (inflated and full) if wear or damage caused by collisions appear.

For big wheels, perform this operation with the use of a wheel extraction trolley (see figure 1) or tool as shown in figure 2 with a crane or hoist.

In order to ensure a correct truck attitude, indispensable for working in complete safety, it is absolutely necessary to change both wheels on the same axle at the same time, using wheels of the same type and manufacturer.

Work in safety by inserting solid stable supports between the bottom part of the truck (chassis, fixed uprights, or ballast) and the ground, using blocks to block the wheels

which stay on the ground during replacement.

In the case of pneumatic tyres, completely deflate the tyre to change before taking off the wheel.
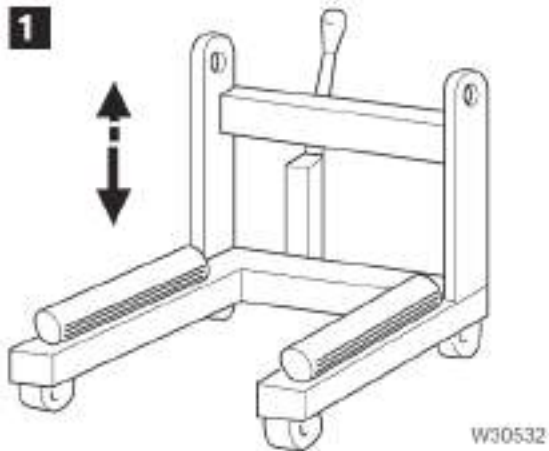
W30532
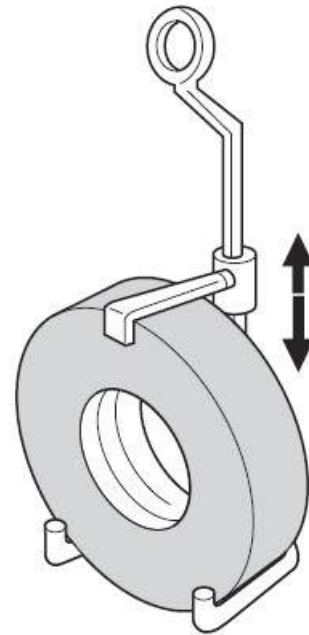
Tyrewear check
The tyre should be changed when it is clearly
worn or the tread is damaged, in particular:
PNEUMATIC tyres
Must be changed when the height of the tread is equal or less than1.6 mm.

SUPERELASTIC tyres
The superelastic tyres should be changed before reaching the maximum wear allowed, which is indicated by the tyre manufacturer on the side of the tyre by a line along the circumference.

If the forklift is used on wet or slippery surfaces, replace the

tyres before the thickness of the tread drops below 1.6 mm.
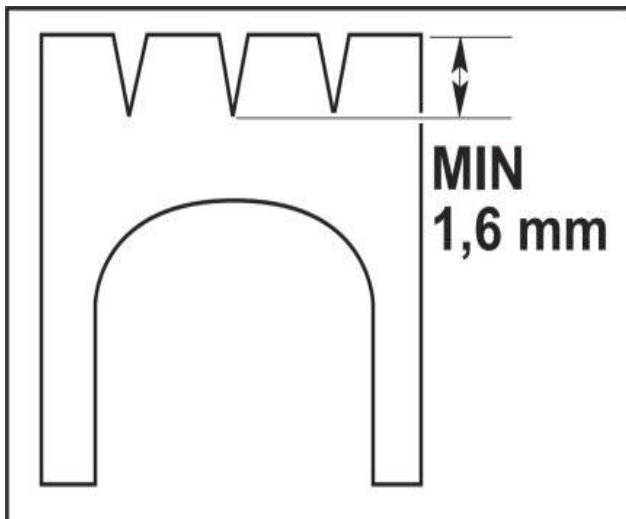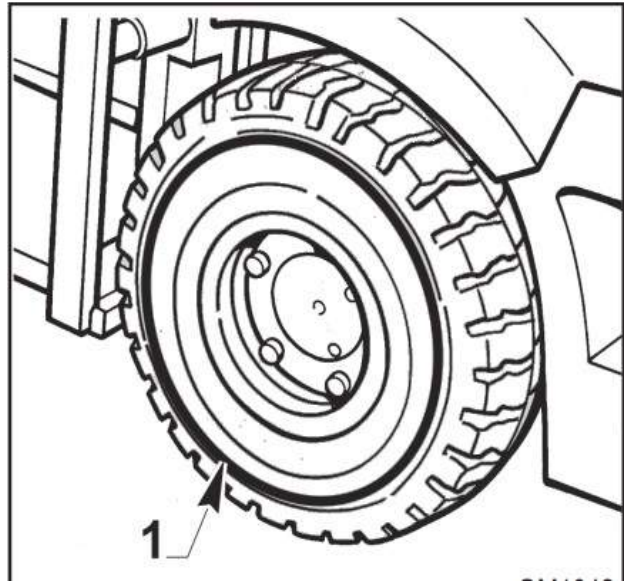
Wheel change
Wheel change
Changing a rear wheel (3-wheel version)
- Turn the rear wheel (1) so that the fixing screws are accessible.
- Turn off the forklift and perform the opera-tions preliminary to maintenance.
- Partially loosen the wheel locking nuts (2).
- Pass a sling (3) through the tow coupling (4) and hook the other end to a crane with a suitable capacity (for further information, see the chapter "Forklift transport and lifting").
- Lift the rear part of the truck and place suit-able supports (5) under the counterweight (6).
- Lower the truck so that it rests on the supports, keeping the sling tensioned.
- Completely unscrew the nuts (2) and pull off the wheel.
- Fit the new wheel.
- Tighten the fixing screws, following the sequence indicated in the paragraph regarding the next stages.
- Slightly tighten the screws so that the wheel is well seated against the hub.
- Tighten the screws to 50% of the prescribed torque.
- Raise the truck to free the supports.

- Remove the supports.
- Lower the truck to the ground.
- Tighten the fixing screws.
- Completely tighten the fastening screws (see associated paragraph).
- Repeat the operations described above to change the second wheel.
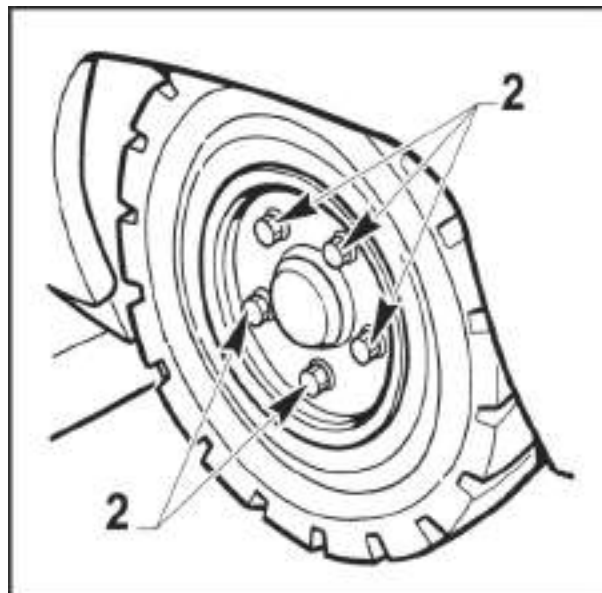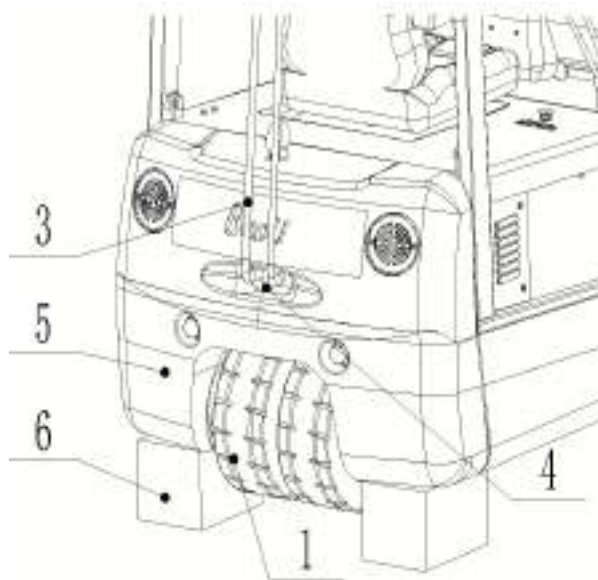
- Turn off the forklift and perform the operations preliminary to maintenance.
- Partly slacken the wheel fixing nuts (1).
- Pass a sling (2) over the crossmember (3) of the fixed mast of the lift and hook the other end to a crane with suitable capacity.
- Lift the front part of the truck and place suitable supports near the wheel to be changed.
- Lower the truck so that it rests on the supports, keeping the sling tensioned.
- Completely unscrew the screws (1) and pull of the wheel.
- Fit the new wheel, positioning it in such a way that any inflation valve is always on the outside.
- Tighten the fixing screws, following the sequence indicated in the paragraph regarding the next stages.
- Slightly tighten the screws so that the wheel is well seated against the hub.
- Tighten the screws to 50% of the prescribed torque.
- Raise the truck to free the supports.
- Remove the supports.
- Lower the truck to the ground.
- Tighten the fixing screws.
- Completely tighten the fastening screws (see associated paragraph).
- When changing wheels with tyres, inflate to the prescribed pressure.

Front wheel change.
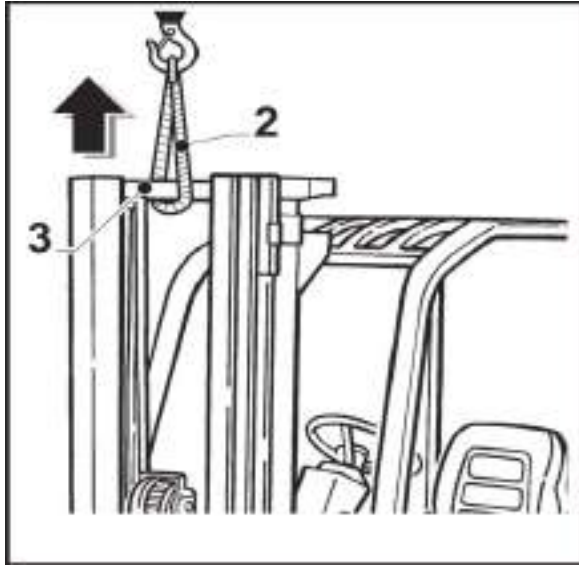
Tyre disassembly

ℹ NOTE

During disassembly, mark or identify the removable rings so that these can then be reassembled onto the same rim from which they were removed.

➤ Position the moulded support ring (A) underneath the wheel complete with tyre.

➤ With the aid of the press and the moulded ring (B), push the external ring (2) downwards until it can be freed and the clamping ring (3) can be extracted.
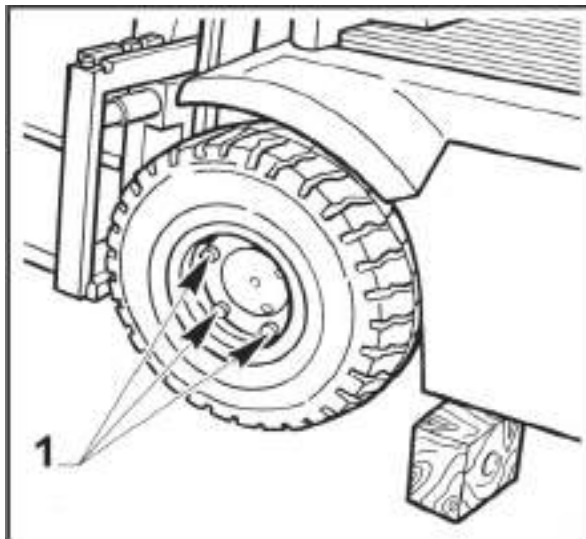
➤ Rest the rim on a support ring (F) and take the tyre off the rim using a pressure ring (G) and the press.

Wheel decomposition
Disassembly/assembly of tyres on rims with movable flange

A press is required for this operation. Check the integrity and conformity of the components.
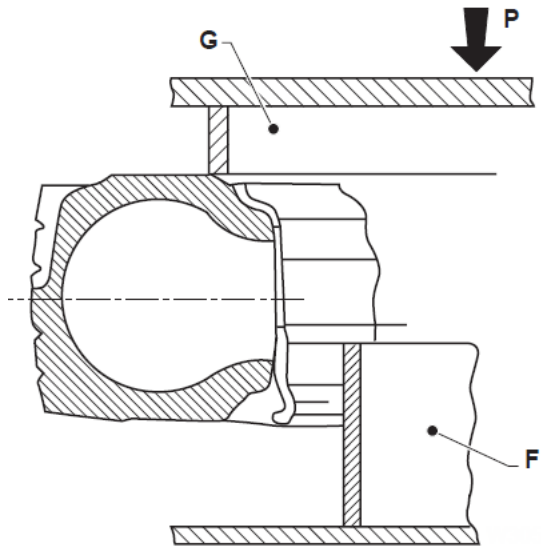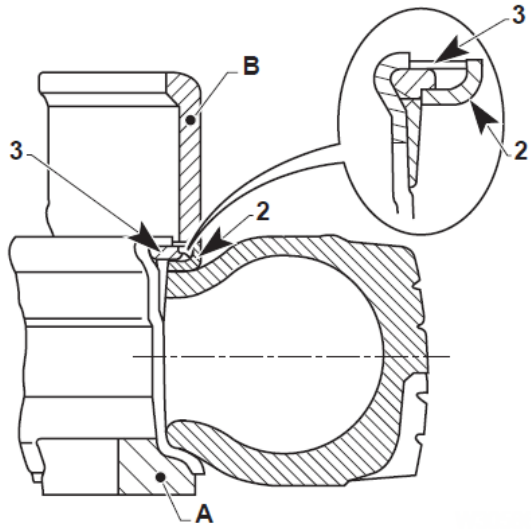
Tyre assembly

ℹ NOTE
Make sure that the removable rings are reassembled onto the same rim from which they were removed. Spread a solution of soap and water (01:20) or special tyre assembly grease on the tyre base and the throat of the rim. Never use lubricants.

➢ Fit the tyre complete with inner tube onto the rim, and position the air valve in the special opening on the rim.
➢ Press down the tyre bead.
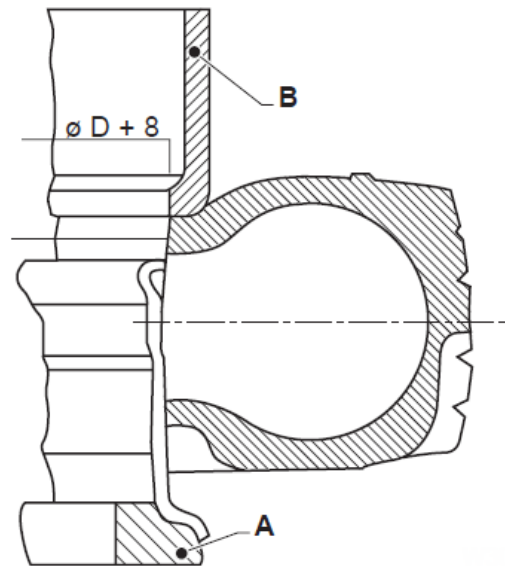
⚠ CAUTION
Do not overturn ring 1 during assembly.

➢ Rest the shoulder ring (1) around the bead of the rim and press it with the moulded ring (C) so that the space ("f") can be created to house the external ring and clamping ring.
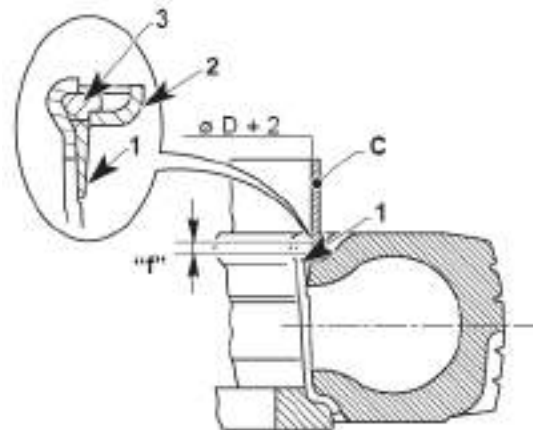
➢ Put the external ring (2) on.
➢ Apply a cone-shaped moulded ring (D) and fit the clamping ring (3) on it.
➢ Press the ring (3) with the moulded ring (B).

ℹ NOTE
For some types of rims, the shoulder rings (1) and external ring (2) are a single piece.
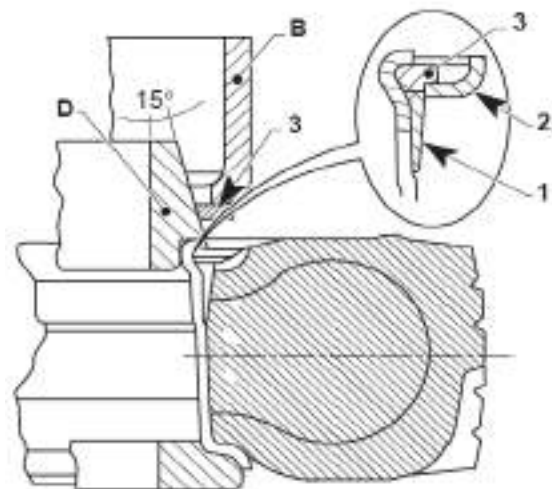
➢ With the aid of a hammer and tools (E), make the clamping ring (3) enter

into the throat of the rim so as to fix the external ring (2).

➢ Make sure, after a first short intake of air (about 0.3-0.5 bar) with the rim in a horizontal position, that the rings are concentric and housed well in their seats;

⚠ DANGER
Move away to the side of the tyre and remain there in order to correct its pressure.

➢ When the wheel is complete, inflate the tyre by first arranging the wheel inside a sturdy cage in compliance with accident prevention regulations.

➢ Do not exceed the maximum allowed pressure.

Quick tyres assembly/disassembly

Disassembly

➢ Place the flange-saving base (1) on the surface of the press and fit the wheel onto the base (1). Center and block the tapered bead (2) on the hook edge (3) of the rim.

➢ After having arranged the disassembly thrust ring (4), push to insert the Teflon ring (6) into the seat of the rim (external hook). Once the Teflon ring has been fit, before releasing it, grease the ring thoroughly. When finished, release the thrust ring (4).

➢ Place a shim pipe (7) on the press surface, turn over the tapered bead/rim/tyre group and place it on the shim pipe, then push through the same disassembly ring (4) until the complete disassembly of the tyre from the rim. Remove the Teflon ring (6) from the rim.
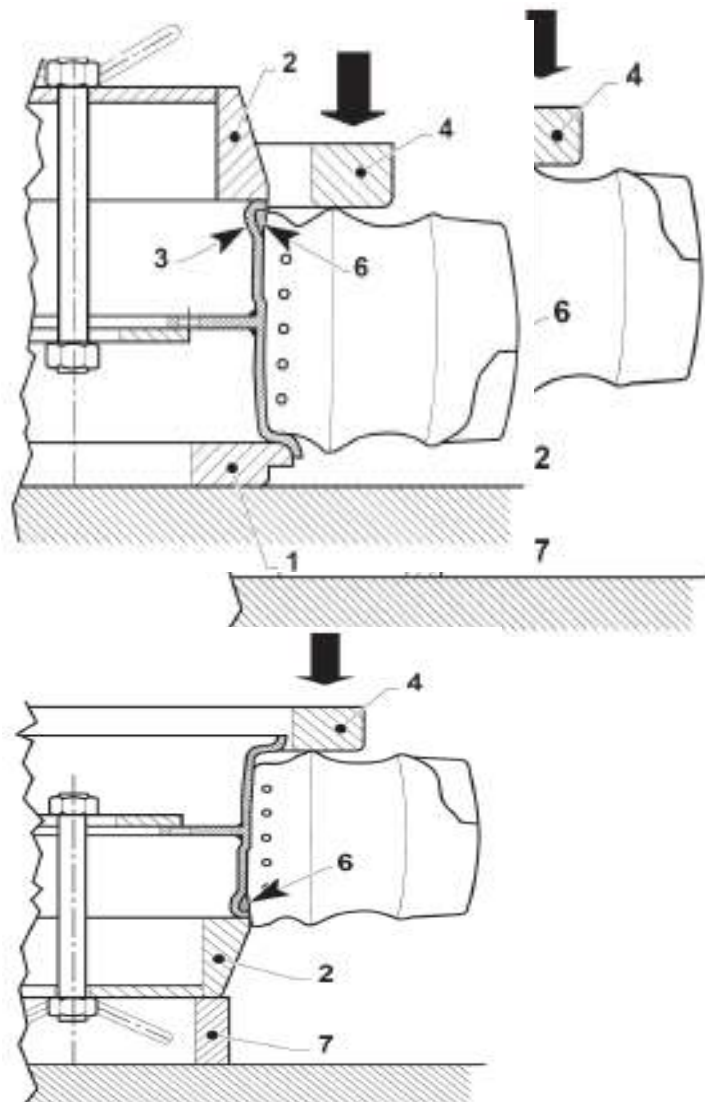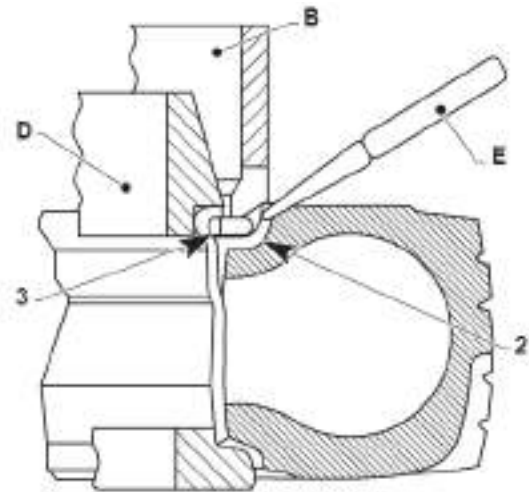
Assembly

 NOTE

A press and some rings are necessary to perform this operation. Before beginning, using only special tyre assembly grease, lubricate the entire internal surface of the tyre bead plus the exterior of the Quick edge. Grease the entire surface of the rim in contact with the tyre, paying particular attention to the area of the external hook plus the final section of the tapered bead.

➢ Place the flange-saving base (1) on the press surface and then position the rim to be mounted above the base.

➢ Arrange the tapered bead (2) on the hook edge (3) of the rim and center it if necessary.

➢ Fit the tyre to be mounted on the bead and, after having arranged the thrust ring (4), push until the tyre is completely fit along the profile of the rim and then release.
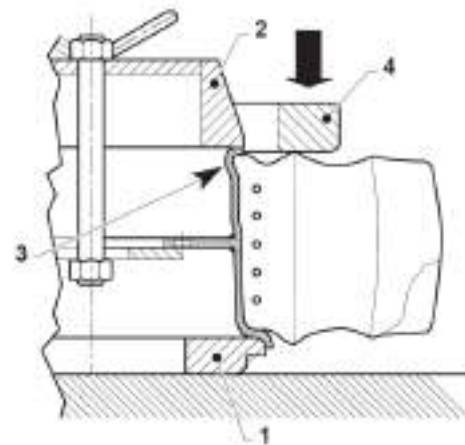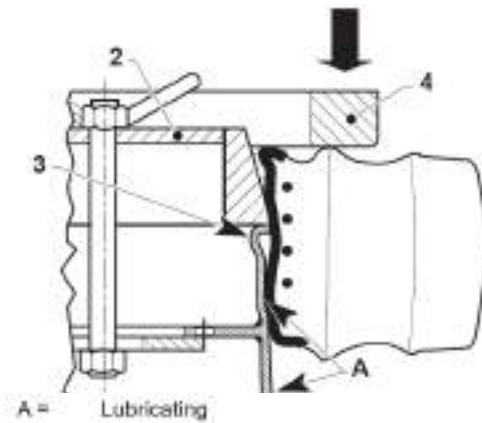
➢ In case of excessive pushing, evaluate whether or not it is necessary to perform a pressing of the tyre/rim group while pushing with the same disassembly equipment contrary to the direction of assembly in order to normalize the position of the Quick tyre on the rim.
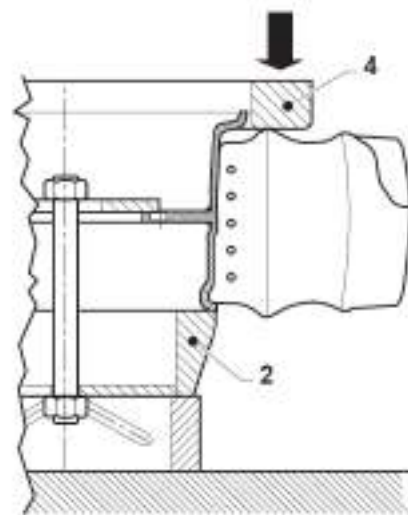
➢ In case of non-uniform or incomplete insertion along the circumference of the tyre edge, exert suitable pressure with a normalization pipe (5) on the edge until complete insertion.
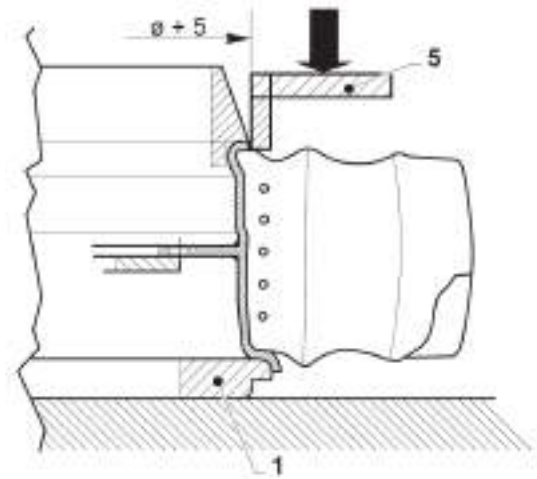
Tightening torques
Check wheel nut tightness (every
10 hours during run-in)

- Check the wheel nut tightening according to the intervals indicated in the preceding maintenance table and when a wheel is replaced.

- Follow the instructions provided in the relative chapter when replacing a wheel.
- The figure to the side indicates the tightening order of the wheel locking nuts.

The tightening torque values for the wheel nuts are indicated below:
- ➢ Front wheels = 200 Nm
- ➢ Rear wheels (Three-wheel version) = 200 Nm

ℹ NOTE
The tightening torques indicated are for clean,degreased screws without the application of lubricants.

Parking brake
Removal / reassembly of the parking brake lever
Removal
- ➢ Operate the emergency stop button or disconnect the battery. Chock the wheels to prevent accidental movements. Remove the step plate and the control panel panelling as described in the respective paragraphs. Loosen the nut and lock nut that fasten the cable to the lever support bracket.
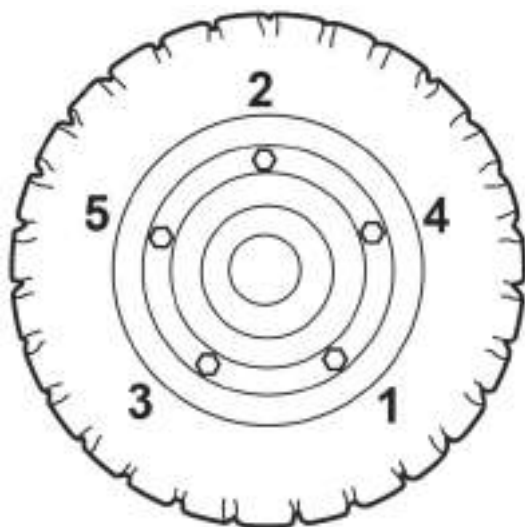
- ➢ Remove the split pin , remove the pin and free the cable.

Reassemble by performing the removal operations in reverse, taking care to tighten the fixing screws to the tightening torque indicated in the assembly diagram.

 NOTE

Once the assembly has been completed, adjust the parking brake as indicated in the respective paragraph.
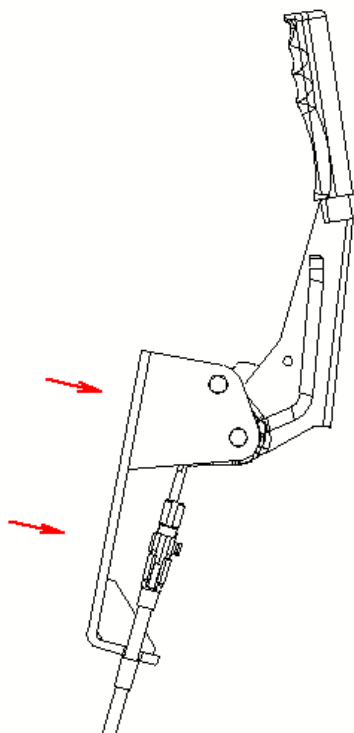
Parking brake control cable replacement

➢ Operate the emergency stop button or disconnect the battery. Chock the wheels to prevent accidental movements. Remove the step plate and the control panel panelling as described in the respective paragraphs. Loosen the nut that fasten the lever support bracket.
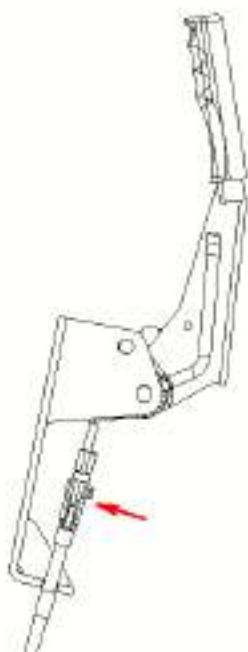
➢ Unscrew the screws and remove the brake lever .

Reassembly - Assembly diagram
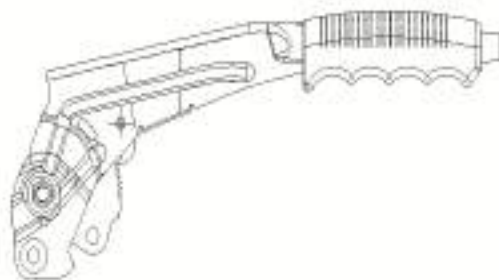
Loosen the drive wheel ball-seat nuts, but do not unscrew them completely.
Remove the lift mast; see the chapter "Lift mast: installation / removal".
Jack up the front of the truck; see the chapter entitled "Safety instructions".
Remove the drive wheels.
Remove the drive axle; see the chapter "Removing/ installing the drive axle".
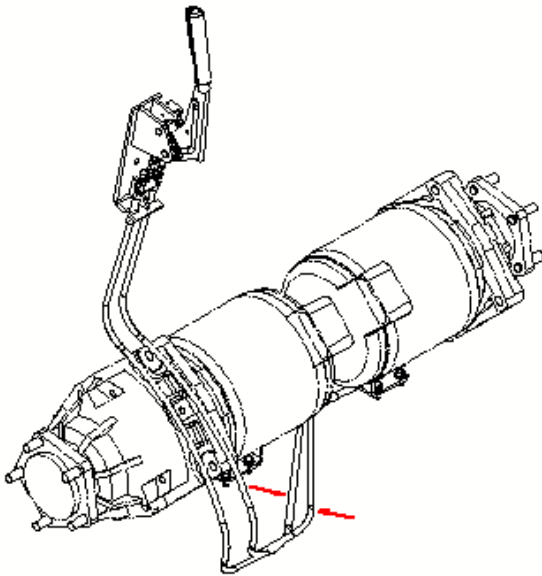
WARNING
Once the connecting screws have been removed, the drive axle splits into two parts. Chock the two axle shafts.

Braking group
Removing / installing the brake group
Removing the brake group

NOTE
- is described in detail in the respective chapters.
- Drain the hydraulic oil at an early stage so that the oil has time to drain off completely. Removal of the individual assemblies

Park the truck safely.
Apply the parking brake.
Drain the brake oil.
Disconnect the battery connector.

The brake group assembly
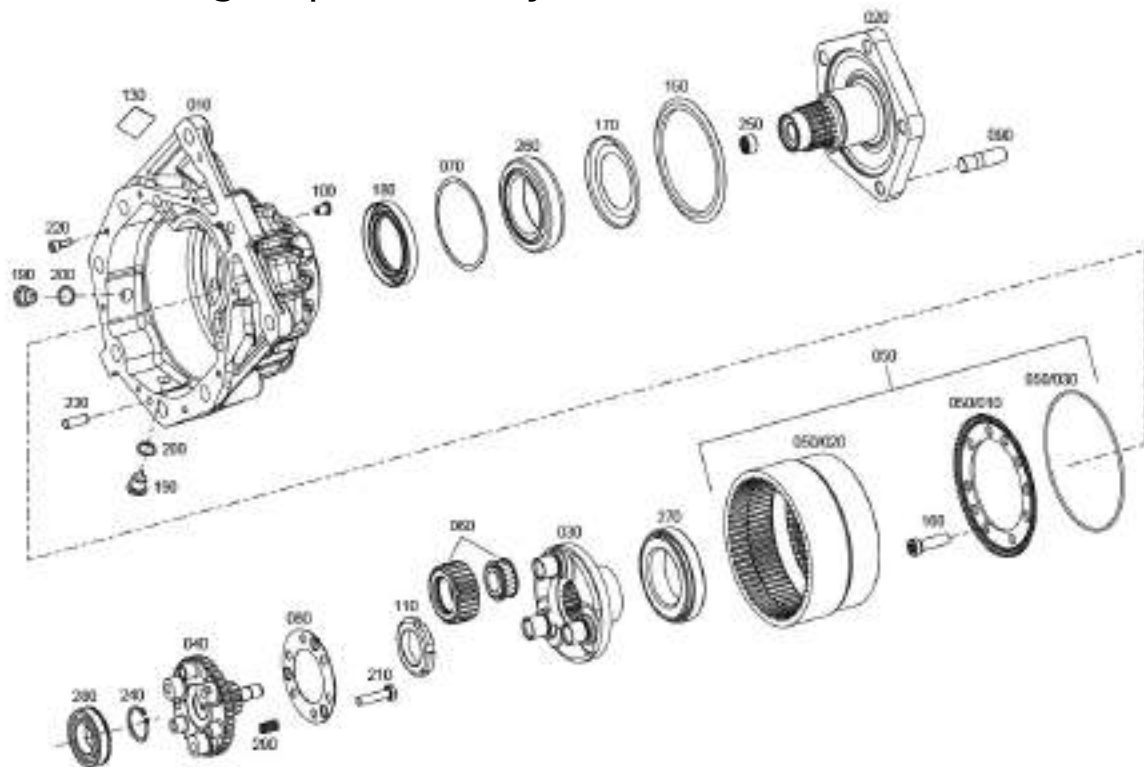
010	Housing	180	Shaft seal
020	Gear shaft	190	Screw plug
030	Planet carrier	200	Sealing ring
040	Inner disc carrier	210	Hexagon screw
050	Ring gear	220	Cap screw
060	Planetary gear	230	Cylindrical pin
070	Shim plate	240	Circlip
080	Fixing plate	250	Needle sleeve
090	Wheel bolt	260	Roller bearing
100	Breather	270	Roller bearing
110	Slotted nut	280	Ball bearing
130	Label	290	Compression spring
150	Sealing ring		
160	Torx screw		
170	Nilos ring		

Accelerator pedal
Accelerator pedal

This component has the task of transmitting the following information to the DUAL AC control:

- set speed (through the variable output of the potentiometer).

The accelerator pedal is composed of:

Rubber Grommet

Heat Shrinkage Tube

End of Corrugated Tube : 800mm
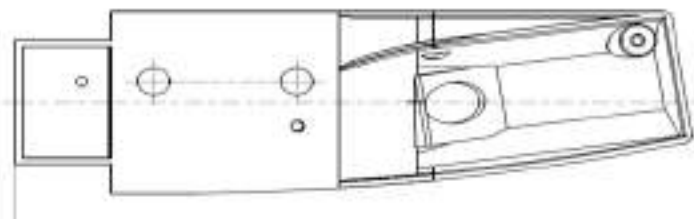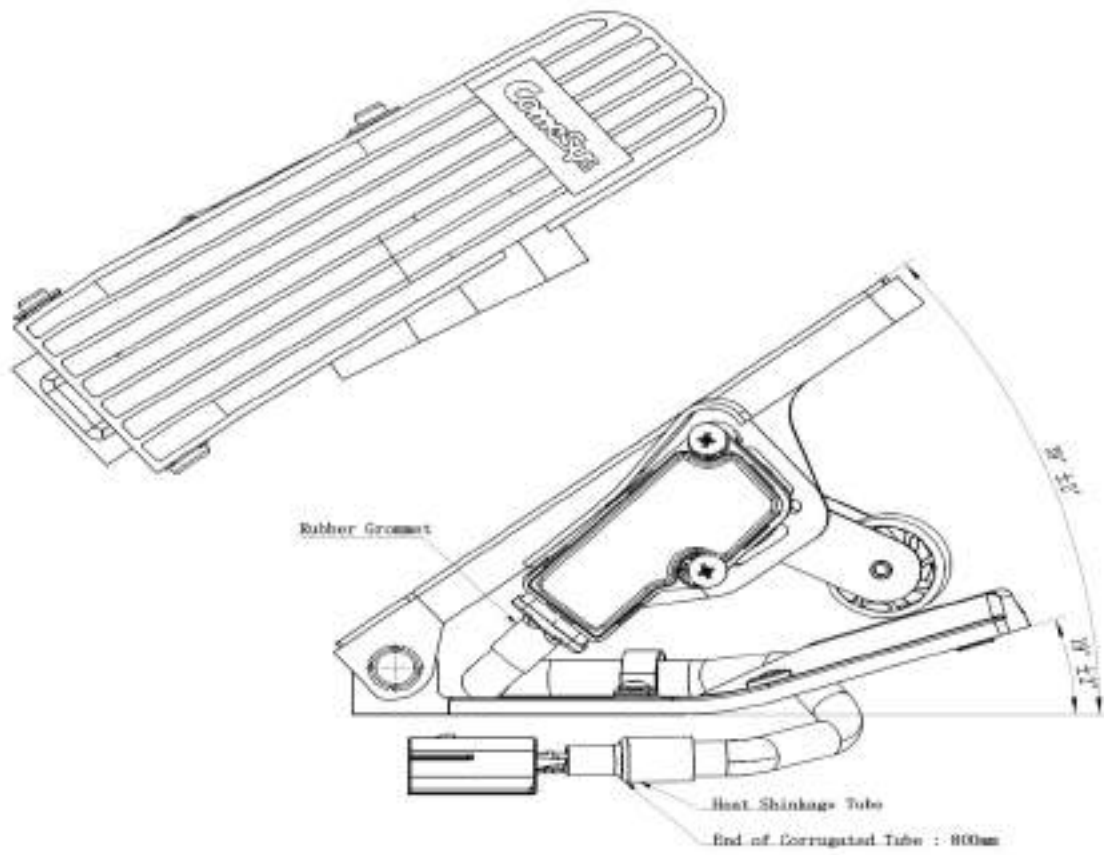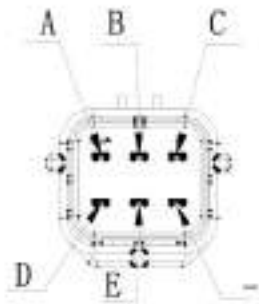
Pin Location	Description	Color
A	Power Input, Vcc	Red
B	Pedal Signal Output, Vs	Green
C	Ground (Signal)	Black
D	Switch Common	Yellow
E	FS3 (IVS3), NO	Blue
—	—	—

Accelerator potentiometer pins C20-21 or pins A-C on accelerator potentiometer connector	
Minimum value [V]	Maximum value [V]
0.3	9.055
NOTE: Between the reading performed with the TESTER and the reading performed with the CONSOLE, there may be a difference of ± 200mV	
Potentiometer power supply, K1-17: 12 V	

Item	Test Method	Decision Standard
Vibration Test	Subject to broadband random vibration between 20 and 2000Hz for 20hours in all 3 axis.	Normal Operation
Shock Test	After Exposed to Acceleration 20g (ZERO to PEAK) for 11ms	Normal Operation
Impact Test	Subject to a drop test onto a smooth concrete floor from a height of one meter a total of 6 times	Normal Operation
High voltage Test	APS Signal : After Exposed to 12Volts for 3min IVS Signal : After Exposed to 38Volts for 3min	Normal Operation
Temp. Test	After Exposed to -40° C ~ 85° C (100 cycles)	Normal Operation
Humidity Test	After Exposed to -32° C ~ 70° C (96%)	Normal Operation
	After Exposed to Salt Fog 96 Hours	Normal Operation
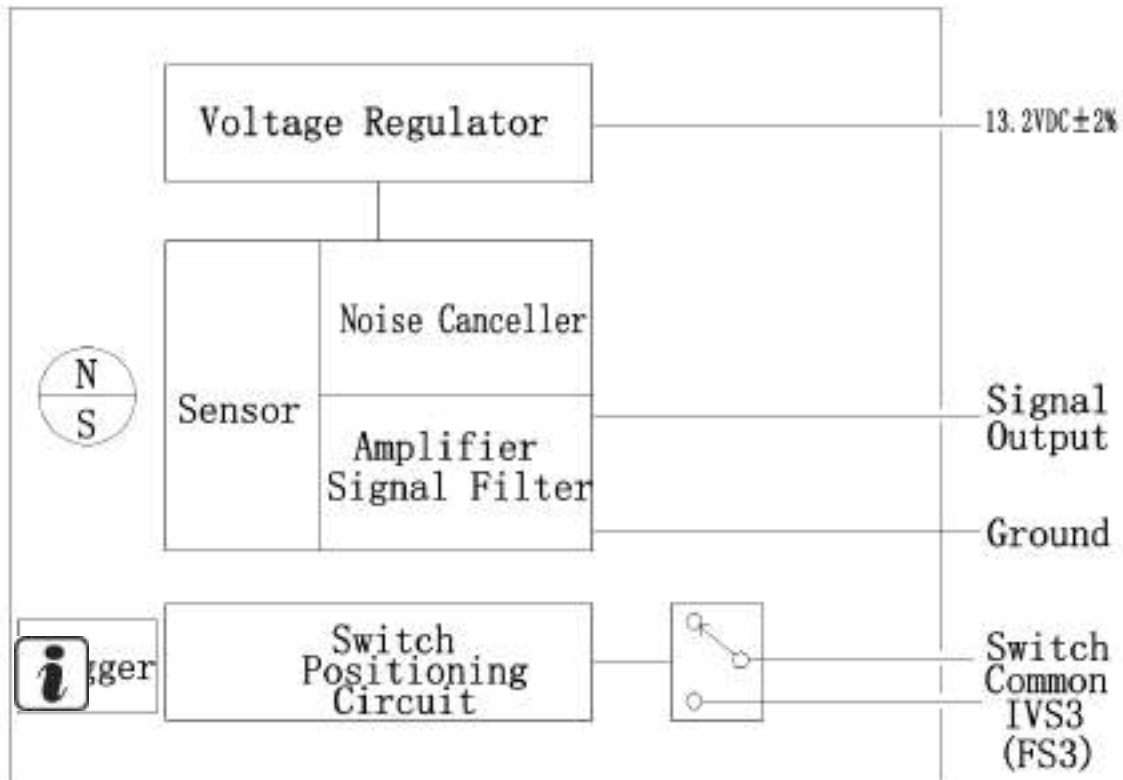
Circuit Diagram

reading performed with the tester and the reading performed with the console, there may be a difference of ±200mV.

The performance of the forklift can be adapted to the needs of the customer using the parameters THROTTLE 0 POINT and THROTTLE X POINT and THROTTLE Y POINT on the AC control. The use of these parameters is illustrated in the figure.

Spring Force

Signal Output

Actuation Force (kgf²)

C.T (0°)   Accelerator Position   W.O.T (17.5°)

High(SW, Close)
Low(SW, Open)

Voltage

Accelerator Position C.T   W.O.T

Multifunction panel

10 LED " Motor overheating alarm "
11 LED " Travelling speed" (digit)"
12 LED " operation mode "
13 LED " slow operating mode "
14 LED "Steering angle "(option)
15 LED "Time"
16 LED "Travelling speed" (forms) "
17 LED "Maintenance time "
18 LED "Operator absence"
19 LED "Parking brake applied"

At temperatures below 0°C, the display may not indicate any signal. This does not preclude normal operation of the truck, but the display of the alarms is blocked.

1 LED "Alarms"
2 LED "Light logo " (option)
3 LED "Turn signal indication" (option)
4 LED "Low brake fluid" (option)
5 Pushbutton " Operation mode "
6 Pushbutton " Slow operating "
7 Pushbutton " Diagnostic and parameter setting"
8 Pushbutton "Reduce parameter in setting "
9 LED "Battery capacity "
10 LED " Motor overheating alarm

Led "Alarms" (1)

Alarm LED is managed as follows:

- Display normally working: LED lights up briefly switching on /off your system.

- Display not communicating with control board: after 3 seconds from the moment in which the communication stops, alarm LED brightens.

- Display board microprocessor not working: alarm LED brightens.

The multifunction panel is the interface between truck and operator. It displays information on the display, and some adjustments can be made using the respective pushbuttons.

No fault code and the fault indicator lamp is off when the truck works normally.

LED "Light logo "(2)

When open the headlight ,this light shows green and the headlight turn off ,the light is off.

LED "Low brake fluid"(4)

Insufficient brake fluid LED (optional)
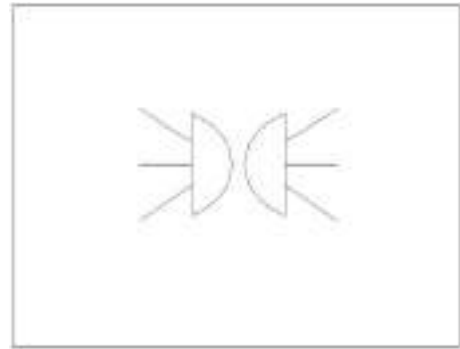
LED "Turn signal indication" (3)

Move the turning switch forward and backward, the left and right turning signal lamps flash, turn on the headlamp, lamp indicator lamp is on.
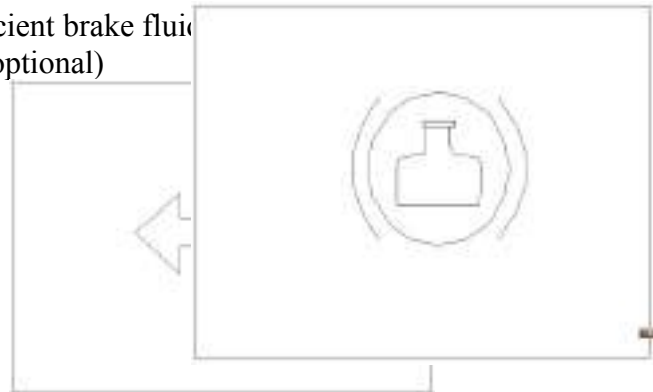
Pushbutton " Operation mode "(5) and

LED " operation mod

Press E-S-H button   (
operating mode for sys
(E-economic mode, S-
high mode)
H-High mode: High ac
decelerate rate, grade a
loading large quantity
and climbing abrupt sl
wastes electricity, only
necessary.
S-Midrange mode: The
than High mode.
E-Economic mode: The parameter has been optimized. Working on this mode in general for saving electricity.
When you choose any model ,the light (12) shows green in the specific position (E-S-H).
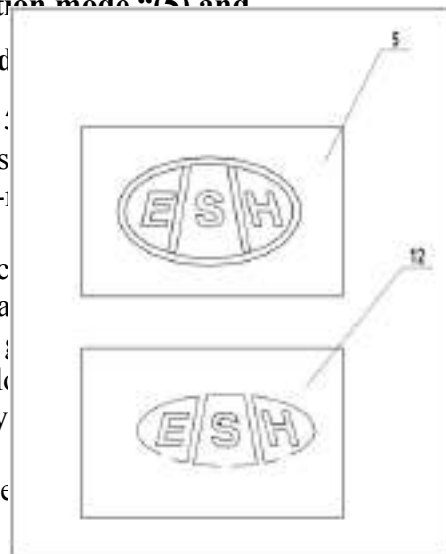
Pushbutton " Slow operating "(6) and

LED " slow operating mode " (13)

As you press the button (6), the traveling speed and lifting speed will be reduced in slow-speed mode .The light(13) is bright.

1. Star
button
diagno
2. Whe
into di
3. Quit
diagno
setting
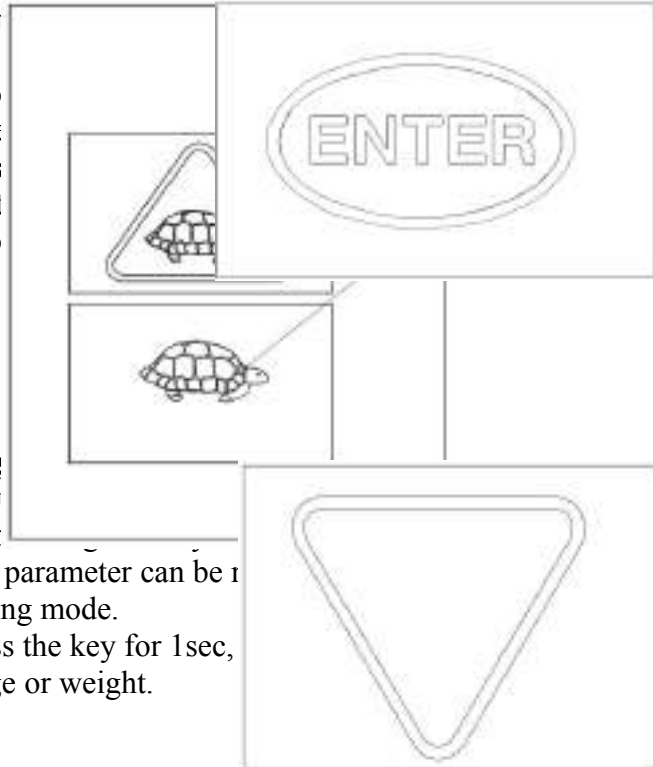
Pushb
setting
1. Red
when p
2. The parameter can be
adjusting mode.
3. Press the key for 1sec,
mileage or weight.

LED "Battery capacity "(9)

Battery level (indicated by 9 segments)
1. When the Battery capacity display 1 or 2 segments, please
2. The Battery capacit segments, the 1 se flashing must be im
3. keep using , the Ba display 0 , the fault power states , start limiting functional。
3.1 lift and auxiliary mast are disabl steering functio when requested
3.2 the output curre and pump contr about 50% of th current used by
3.3 the speed of the traction motor is reduced to 800rpm.

Pushbutton " Diagnostic and parameter

setting" (7)

LED " Motor overheating alarm "(10)

Overheated motor temperature warning
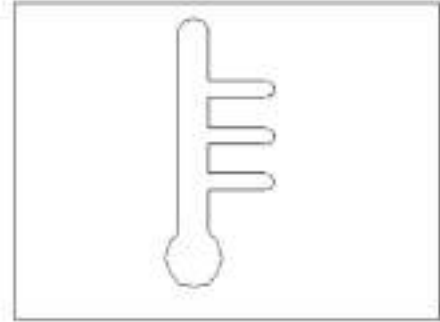
LED " Travelling speed" (digit)" (11)

and LED "LED "Travelling speed"

(forms) " (16)

The light shows the travelling speed of the truck by two kinds of forms.
Lift truck speed level, range from 0 (NO speed) to 9 (MAXIMUM speed) segment, as in symbol
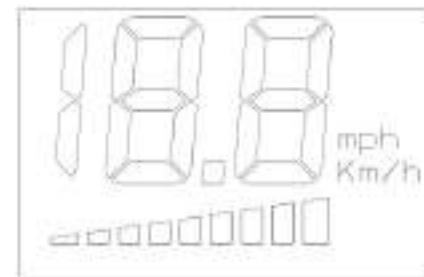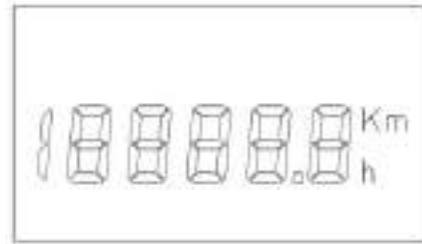
LED "Steering angle "(14)

This light indicating the position of rear wheel.
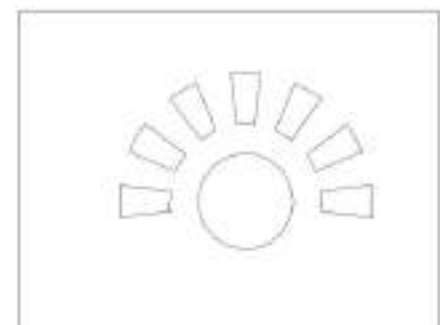
LED "Time" (15)

It shows the travelling time of the truck .

LED "Maintenance time "(17)

Remind the users to maintain and service the forklift truck.

NOTE

Alarms

Alarms may occur automatically during operation of the truck, some of which can be switched off by the operator.

Led "Seat sensor" (18)

This LED lights up when the sensor (micro switch) positioned under the seat is not activated.
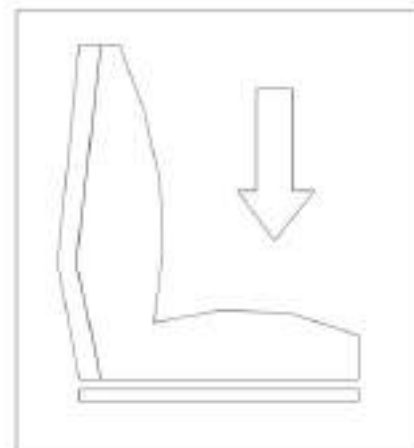
Led "Parking brake applied" (19)

This led lights up when the parking brake is applied.

Speed reductions

	Parameters involved	Description
Traction	CUTBACK SPEED SW on PARAMETER CHANGE of the DUAL AC module	Sets a percentage reduction of the maximum speed set with MAX SPEED FW/BW 100% = no limitation
Pump	CUTBACK SPEED SW on PARAMETER CHANGE of the AC2 FLASH module	Sets a percentage reduction of the maximum speed set with MAX SPEED UP 100% = no limitation
	CUTBACK SPEED 2ND on PARAMETER CHANGE of the AC2 FLASH module	Sets the pump motor speed for the tilt function.
Display	TYPE CUTBACK	This parameter is used to define the electronics on which the speed reduction must be activated. OPTION 1 = Traction OPTION 2 = Pump OPTION 3 = Traction + pump

"TORTOISE" reduction activated using the button on the display

"HARDWARE" reduction activated by means of the specific HW input

	Parameters involved	Description
Traction	CUTBACK SPEED HW on PARAMETER CHANGE of the DUAL AC module	Sets the maximum speed of the truck with the microswitch on input C10 open (or the input disconnected). Under these conditions, the speed reduction is active. The speed reduction can be deactivated by making a connection between +48V and the pin C10. The CUTBACK SPEED HW parameter is set by default to level 9 (16km/h); to set a lower speed, the parameter must be reduced.
Pump	CUTBACK SPEED HW on PARAMETER CHANGE of the AC2 FLASH module	Sets the maximum speed of the pump with the microswitch on input E13 open (or the input disconnected). Under these conditions, the speed reduction is active. The speed reduction can be deactivated by making a connection between +48V and the pin E13. The CUTBACK SPEED HW parameter is set by default to level 9 (maximum speed); to set a lower speed, the parameter must be reduced.

Multifunction panel removal / reassembly
Removal

- Disconnect the battery socket or operate the emergency stop button.
- Secure the truck by applying the handbrake.

➢ Remove the control panel panelling as indicated in the respective chapter. Disconnect the wiring connector(1) .

➢ Loosen and remove the two ring nuts and remove the bracket .

➢ Remove the multifunction panel .

Reassembly
Perform the removal operations in reverse.

*NOTE:no install

Alarms

Alarms may occur
operation of the tru
be switched off by

Some alphanumeric
3 seconds, when yc
on.
They appear where
speed indicator syn
operator to identify
Table).
Where usually is v
left side appears ba
and on right side, n
industrial truck can
quintals.

Meaning of ala

ALARM CODE	ALARM DESCRIPTION
F	Wrong eeprom + watch dog timer
F0	Maximum battery voltage
F1	Minimum battery voltage
F2	Pedal trimmer fault
F3	Drive right module desat/overcurrent
F4	Drive left module desat/overcurrent
F5	Pump module Desat/overcurrent
F6	Drive right motor current offset
F7	Drive left motor current offset
F8	Pump motor current offset
F9	Steer sensor fault
FA	5V encoders not ok
Fc	Drive right motor Encoder
Fd	Left right motor Encoder
FE	24V out not ok
FH	12V out not ok
FL	Pump inputs on at start
E1	Drive right module overtemperature
E2	Drive left module overtemperature
E3	Pump module overtemperature

ALARM CODE	ALARM DESCRIPTION
E4	Drive right motor overtemperature
E5	Drive left motor overtemperature
E6	Pump motor overtemperature
EE	Wrong start
EL	Low battery voltage
EE flashing	Seat switch opened
A	Alarm on pre-charge circuit of internal capacitors
AL	Key retention
17	Main breaker fault
40	Lift pressure sensor fault
60	Battery / inverter mismatch
77	Wrong right traction motor thermal probe
78	Wrong left traction motor thermal probe
79	Wrong pump motor thermal probe
80	Wrong right traction module thermal probe
81	Wrong left traction module thermal probe
82	Wrong pump module thermal probe
83	CRC fault
84	Bank CRC restored
91	Steering sensor fault

⚠ DANGER

Call the service department for all alarms

not indicated in the previous list.

⚠ DANGER

If, when eliminating the cause of the
alarm, the alarm persists, contact the
authorised sales and service network.

Electronic traction system

Characteristics of the electronic drive system

The drive powers two three-phase asynchronous traction motors with speed and torque control.

It supplies a three-phase AC output voltage with variable frequency between 0 and 200Hz.

The motor speed is controlled by checking information provided by two encoders that detect the number of revolutions of the traction motors.

The drive is equipped with watertight AMPSEAL connectors.

The software program resides in a FLASH EPROM and is programmable by PC.

The main functions are the following:

Regenerative electronic braking under the following conditions:

- Pression of the brake pedal (not enabled if the brake pedal and accelerator are pressed simultaneously);
- release of the accelerator pedal;
- reversal of the travel direction.

Braking: the braking intensity is proportional to
the travel of the brake pedal and determined by the analogue signal coming from the potentiometer on the brake pedal.

Accelerator pedal: the speed of the truck is regulated by the accelerator pedal using the accelerator potentiometer signal. The acceleration curve can be changed.

Buzzer: the buzzer is intermittent and can be programmed to be enabled during backward or forward travel or disabled completely.

Thermal protection: the thermal protection on the system intervenes at 75° C with linear

reduction of performance up to 100°C and then the total blocking of functions when the temperature reaches 100°C. The performance reduction occurs without abrupt speed or torque variations.

Travel direction selection: the travel direction is selected using the twin accelerator pedal or the reversing lever on the steering wheel. With the reversing lever on the steering wheel, travel is enabled only if the following sequence is observed:

- closure of the seat microswitch contact (normally open contact);
- closure of the forward or backward travel selection contact (normally open contact);
- closure of the accelerator pedal microswitch contact (normally open contact);
- accelerator potentiometer activated.

The reversing lever on the steering wheel must be in neutral position when the seat contact closes,otherwise the EARG .INC START alarm appears (this function can be changed using software: parameter SRO on SET OPTION of the drive MASTER).

Handbrake: when the handbrake is applied, the respective contact opens the circuit on pin C9 of the DUAL AC module. If the handbrake is not applied and the dead man's switch contact is open (no operator present), the reversing buzzer sounds intermittently.

In this situation:

- travel is inhibited;
- if the accelerator pedal is pressed, the traction motors are powered for two seconds in order to facilitate departing on a slope.

Slow travel (tortoise) : a slow (tortoise) speed
can be set, with reduction percentage modifiable through software (CUTBACK SPEED SW), that can be turned on and off using a button on the display. It is also possible to reduce the speed by opening a contact on pin C10; the relative maximum
speed will be set using the software parameter
CUTBACK SPEED HW. The slow speed (tortoise) function is also possible for the pump motor. When the accelerator pedal and brake are pressed simultaneously, the speed of the truck is reduced by a percentage value defined by the parameter PB BRK CTB.

Slow cornering: The traction motors are controlled as a function of the steering angle, measured by a potentiometer installed on the steering

axle. The 3-wheel truck allows counter-rotation of the motors so that the truck can turn itself around.
The steering angles are the following:
• 3 wheels: +90° / -90°

The speed, acceleration and deceleration of the truck vary as a function of the steering angle, with the objective of increasing the active safety of the truck (programming parameters X CURVE CUTBACK and CURVE CUTBACK).

Seat microswitch: As soon as the seat microswitch opens (micro-openings, due to potholes for example, are not considered), two
independent timers are activated, a 1.8-second software timer and a 3-second hardware timer, that cut off power to the two contactors. During the software delay the electronic controller attempts to brake the machine; at the end of the delay, it opens the contactors and resets the current in order to avoid damaging the contacts.
Potentiometer calibrations: The calibration of the accelerator, steering and brake potentiometers is carried using software so as to remedy any tolerances in the components.
Indication of the battery charge state: The percentage indicating the

battery charge may increase only if the battery is effectively recharged; it does not increase by stopping the truck or by turning the key off and then on again.

Plate data: traction

BATTERY VOLTAGE	24-60 V
MAXIMUM IMPULSIVE DRIVE INVERTER CURRENT	450 A
MAXIMUM IMPULSIVE PUMP INVERTER CURRENT	450 A
SWITCHING FREQUENCY	3-6-9 KHz
EFFICIENCY	0.95
PROTECTION LEVEL	IP54
MECHANICAL SIZE	580 mm x 248 mm x187 mm
WEIGHT	24 Kg
VIBRATION	5g 10-500Hz in X,Y,Z axis
TEMPERATURE RANGE	30 °C ¸ + 40 °C
MAXIMUM MODULE TEMPERATURE	95°C
CONTROLLER	Complies with EN 1175-1 EN 12895-1

Connectors

Pin number
Use
Name
Function

K1 – 1
IN

Battery
Negative supply voltage of control board

K1 – 2
OUT

24 V supply

K1 – 3
IN
A

Lift pressure (optional)
Proportional voltage signal (0-5V); you can connect a pressure
linear sensor, made by SME cod B00ID160 working correctly in 0¸250 bar pressure range

K1 – 4
IN
D

start switch for accelerator
pedal
START signal
N.O. with internal pull-up and Vmax(in)=24V

K1 – 5
IN
A

accelerator pedal 2°
potentiometer
Proportional voltage signal (0-5V) or (0-12V) managed as
accelerator pedal input

K1 – 6
IN
D

park brake switch
Park brake signal
N.C., with internal pull-up and Vmax(in)=24V

K1 – 7
IN
D

seat switch
Seat switch signal
N.O., with internal pull-up and Vmax(in)=24V

K1 – 8
IN
D

reverse drive direction switch
reverse drive direction di selezione signal
N.O., with internal pull-up and Vmax(in)=24V

K1 – 9

IN
D

forward drive direction switch
forward drive direction signal
N.O., with internal pull-up and Vmax(in)=24V

K1 – 10
IN
A

accelerator pedal 1°
potentiometer
Proportional voltage signal (0-5V) or (0-12V) managed as
accelerator pedal input

K1 – 11
OUT

12 V supply
12V supply voltage (self-protected electronic component)
with: Idc (nominal) =500mA; Imax = 1Adc

K1 – 12
IN/OUT
D

LIN data line (Display I/0)
Data line of LIN interface for COMPACT display

K1 – 13
IN
A/D

not used
Digital input, for an optional encoder, Vmax(in) =5V
Analogue input (0-12V)

K1 – 14
OUT

5 V encoder supply
5V supply voltage (self-protected electronic component)
with: Idc (nominal) =500mA; Imax = 1Adc

K1 – 15
OUT

GND
Negative supply voltage for data type signals, with selfprotection
against noises coming from DC power line; Imax=500mA

K1 – 16
IN
D

PHASE B of left drive motor
encoder
PHASE B signal of the sensor bearing mounted into the left
drive motor; internal pull-up; Vin:(0 – 5V)

K1 – 17
IN
D

PHASE A of left drive motor
encoder
PHASE A signal of the sensor bearing mounted into the left
drive motor; internal pull-up; Vin:(0 – 5V)

K1 – 18
OUT

+ coil main breaker
Positive command of contactor coil; Inom=1A; Imax = 5A

K1 – 19
OUT

coil main breaker

Main breaker coil reference signal; Inom=1A; Imax = 5A

K1 – 20
OUT
A

not used
Self-protected open collector power output, you can apply it
to an ON/OFF or proportional electrovalve coil; Vmax =Vali;
Inom=2A; Imax=6A

K1 – 21
OUT
D

not used
Self-protected open collector power output, you can apply it
to an ON/OFF or proportional electrovalve coil; Vmax =Vali;
Inom=2A; Imax=6A

K1 – 22
IN

+ battery
Control board supply voltage; V = Vsupply

K1 – 23
IN

+ battery key input
Supply voltage of key and coils ; Vkey=Vsupply

K1 – 24
IN
A/D

not used
Digital input , N.O., internal pull-up, Vmax(in)=24V;
Analogue input (0-12V)

K1 – 25
IN
D

not used
Digital input , N.O., internal pull-up, Vmax(in)=24V;

K1 – 26
IN
A

not used
Analogue input (0-12V)

K1 – 27
IN
A

not used
Analogue input (0-5V)

K1 – 28
IN
D

PHASE B of pump motor
encoder
PHASE B signal of the sensor bearing mounted into the pump
motor; internal pull-up; Vin:(0 – 5V)

K1 – 29
IN
D

PHASE A of pump motor
encoder
PHASE A signal of the sensor bearing mounted into the pump
motor; internal pull-up; Vin:(0 – 5V)

K1 – 30

| | IN |
| | D |

Not used;
PHASE A of an optional
encoder
Digital input for an optional encoder, motor; internal pull-up;
Vmax(in)=5V;

	K1 – 31
	IN/OUT
	A/D

Not used;
PHASE B of an optional
encoder
Digital input for an optional encoder, Vmax(in)=5v;
Open Collector power output, to command an ON/OFF
electrovalve coil; Vmax =Vsupply; Inom=2A; Imax=6A

	K1 – 32
	IN
	D

Asynchronous RS232 serial
RX input
RX input for asynchronous RS232 serial communication standard

	K1 – 33
	OUT
	D

Asynchronous RS232 serial TX
output
TX output for asynchronous RS232 serial communication
standard

	K1 – 34
	IN/OUT
	D

CAN – H (not used)
H line input for CAN (Controller Area Network) component;
presence of internal termination resistance

	K1 – 35
	IN/OUT
	D

CAN – L (not used)
L line input for CAN component; presence of internal termination
resistance

	K1 – 36
	IN
	D

PHASE B of right drive motor
encoder
PHASE B signal of the sensor bearing mounted into the
right drive motor; internal pull-up; Vin:(0 – 5V)

	K1 – 37
	IN
	D

PHASE A of right drive motor
encoder
PHASE A signal of the sensor bearing mounted into the
right drive motor; internal pull-up; Vin:(0 – 5V)

	K1 – 38
	IN
	D

AUX3

Digital input to activate pump motor auxiliary function AUX3; N.O., internal pull-up, Vmax(in)=24V

K1 – 39
OUT
A

fans command (optional)
Open Collector power output, to command fans (or other devices) Inom = 1A, Imax=3A; Vmax=60V;

K1 – 40
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF electrovalve coil; Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 41
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF electrovalve coil; Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 42
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF electrovalve coil; Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 43
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF electrovalve coil; Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 44
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF electrovalve coil; Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 45
OUT

Not used;
Electrovalves supply voltage
PWM supply voltage for electrovalve coils (or similar devices)

K1 – 46
IN
D

lift high switch
Voltage signal of lift critical high switch, N.O., internal pull-up, Vmax(in)=24V

K1 – 47
IN
A/D

Not used
Digital input , N.O., internal pull-up, Vmax(in)=24V;
Analogue input (0-12V)

K1 – 48
IN
D

pedal brake switch
Activation signal for park brake, N.O., internal pull-up,
Vmax(in)=24V

K1 – 49
IN
A/D

Not used
Digital input , N.O., internal pull-up, Vmax(in)=24V;
Analogue input (0-12V)

K1 – 50
IN
A

lift lever potentiometer voltage
Proportional voltage signal (0-12V), input of lift lever potentiometer

K1 – 51
IN
A

Not used
Proportional voltage signal (0-12V)

K1 – 52
IN
A

Not used
Proportional voltage signal (0-12V)

K1 – 53
OUT
D

buzzer command
Open Collector power output, to command buzzer activation;
Vmax =24V; Inom=30mA; Imax=100mA.

K1 – 54
IN
D

tilt switch
Request of tilting, N.O., internal pull-up, Vmax(in)=24V

K1 – 55
IN
D

Not used;
PHASE B of an optional encoder
Digital input
PHASE B signal for an optional encoder; internal pullup;
Vin:(0 – 5V)

K1 – 57
IN
D

digital input for 3 / 4 wheels
choice;
PHASE A of an optional encoder
Digital input to select a lift truck with 3 wheels
(Closed) or 4 wheels (Open);
PHASE A signal for an optional encoder; internal pullup;
Vin:(0 – 5V)

K1 – 58
IN
A/D

right drive motor thermal sensor/switch

Analogue input (or digital as optional) used for right drive
motor thermal sensor (0-5V); internal pull-up;

K1 – 59
IN
A/D

left drive motor thermal sensor/
switch
Analogue input (or digital as optional) used for left drive
motor thermal sensor (0-5V); internal pull-up;

K1 – 60
IN
A/D

pump motor thermal sensor/
switch
Analogue input (or digital as optional) used for pump motor
thermal sensor (0-5V)

K1 – 61
IN
A/D

Not in use
Digital input , N.O., internal pull-up, Vmax(in)=5V;
Analogue input (0-5V)

K1 – 62
IN
A

steering angle sensor voltage
Proportional voltage signal (0-12V) or (0-5V), used as
input to steering sensor circuit

K1 – 63
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF
electrovalve coil;Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 64
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF
electrovalve coil;Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 65
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF
electrovalve coil;Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 66
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF
electrovalve coil;Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 67
OUT
A

Not used

Power output, to command a proportional electrovalve
coil; Vmax =Vsupply; Inom=2A; Imax=6A

K1 – 68
OUT
D

Not used;
Electrovalve (or alike) command
Open Collector power output, to command an ON/OFF
electrovalve coil;Vmax =Vsupply; Inom=2A; Imax=6A

Hydraulic functions electronic system
Functions of the AC2 module

The AC2 drive controls a three-phase asynchronous pump motor.

The motor speed is controlled through the encoder assembled on the motor.

The drive enables the pump motor (hydraulically assisted steering function) when a travel direction is selected or the steering wheel is turned (pressure switch). The hydraulically assisted steering is always active when the truck is in motion.

The rpm of the pump motor, in hydraulically assisted steering, is inversely proportional to the truck speed (the higher the truck speed, the lower the rpm of the pump motor) through the HYDRO SPEED REDUCTION parameter.

The thermal protection intervenes at 75°C, with linear reduction of performance up to 100°C and then total blocking of functions above 100°C.

If the temperature of the drive reaches 90°C, the traction drive is inhibited; this is to prevent the sudden failure of hydraulically assisted steering while the truck is in motion.

A thermal protection is provided on the pump motor so that, when reaching the limit temperature, the rpm of the pump motor in the lifting function is limited to a value equal to the frequency set with MIN SPEED UP plus 60Hz. If the temperature rises another 10°C with respect to the set threshold, an alarm occurs which blocks the functions, except for the hydraulically assisted steering which will have just enough speed to safely manoeuvre the truck.

The motor speed during fork arm lifting is proportional to the inclination of the relative lever, through a voltage signal coming from the HALL sensor. During the tilt manoeuvre with hydraulically assisted steering active, a speed can be set through the TILT + HYDRO SPEED parameter using the single signal coming from the pressure switch.

Using the tortoise button located on the display, the speed of the lift and tilt function can be reduced by an amount adjustable through software.

It is also possible to reduce the maximum speed attainable by opening the contact (pin E13); the maximum speed will be set through a parameter.

When the operator is absent all hydraulic functions are inhibited, including the lowering of the load, using a N.C. solenoid valve (normally closed).

The software program resides in a FLASH EPROM and is programmable through diagnostics software.

Types of hours counters
Types of hour counters:

There are five different types of hour counters:

- Machine: the hours increase when the pump motor is powered. These hour counters can be viewed on the display or through a PC.

- Electronics: counts the hours of operation of each electronic component (DUAL AC, AC2 FLASH, ECO DISPLAY); the hours increase when the components are powered (KEY ON). These hour counters can be viewed only through a PC.
- Traction motor: counts the hours of operation of the traction drive motor. These hour counters can be viewed on the display or through a PC.
- Seat: counts the hours of operator presence on board (seat contact closed).
- Hours worked in the day: displays the hours worked during the day, corresponding to the hours of pump motor operation; using the PC, the hours worked in the previous thirty days can also be viewed.

Hours counter management in
case of electronic system replacement

In order to be able to recover the accumulated
hours, in case of replacement of one or more
electronic components, these hours are stored
on both the DUAL AC and the ECO DISPLAY.
The hours counter for the daily hours worked resides on the ECO DISPLAY only, however, since losing the daily hours is acceptable if the display must be replaced. To avoid any "drift", if at any time the two counts of the same hours counter differ by 5 hours, the two hours counters are synchronized to the higher value.
In case of replacement, the hours counters stored on the two electronics will not be synchronized with one another and the non-blocking alarm 365 WRONG HOUR COUNTER will appear on the display when the truck is switched on.
In order to clear the alarm, the hours counters
must be synchronised through the SINC HOUR COUNTER parameter.
At synchronisation, the hours counter showing
fewer hours with respect to the other will synchronise with the counter having the larger number of hours.

The synchronisation of the hours should never be performed for the "electronics" hours of the components.

NOTE
In order for the system to work properly, it is essential that the spare electronic component has the hours counter at zero or at least with a number of hours less than that on the hours counter of the original component.

Resetting the machine hours
If the machine hours are less than 100, the following hour counters can be reset through the RESET HOUR parameter in the SET OPTIONS menu of the ECO DISPLAY: machine, traction, seat, daily hours.

Electronics panel removal / reassembly
Electronics panel removal
- Disconnect the battery socket or operate the emergency stop button.
- Secure the truck by applying the handbrake.
- Raise the battery cover as indicated in the chapter "Internal accessibility".

➢ Disconnect the positive cable from the contactors (+B).

➢ Unscrew the Eight top fixing screws of the electronics panel.

➢ Unscrew the two bottom fixing screws .
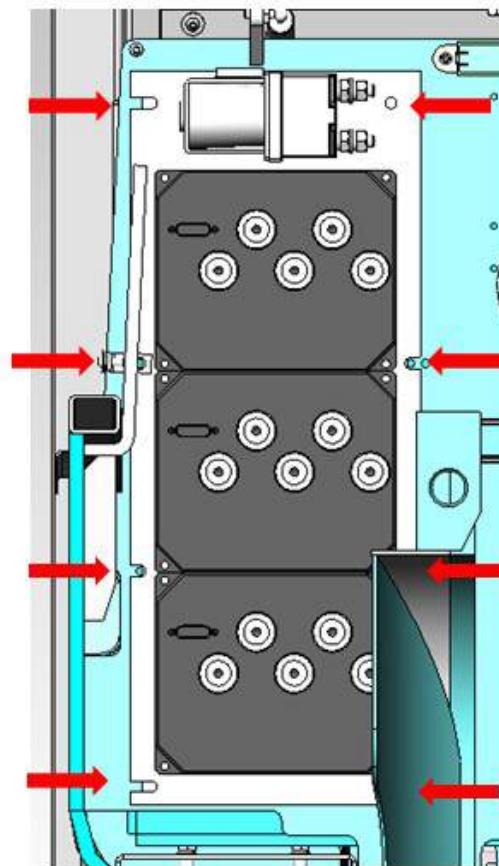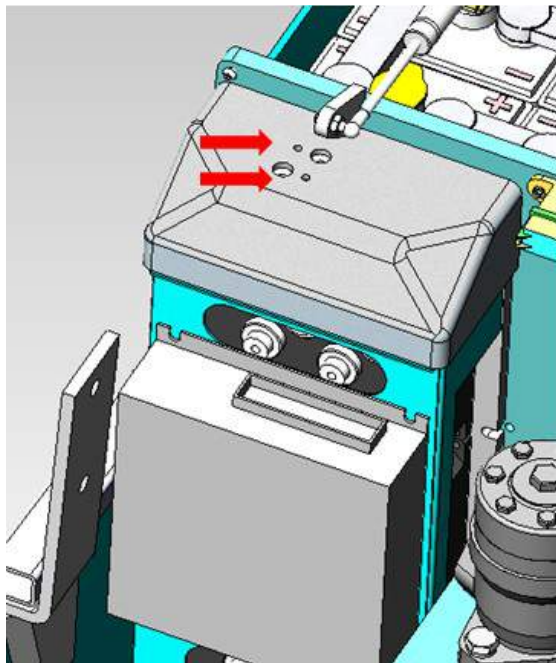
➢ Disconnect all the wiring connections from the top part of the electronics panel.

 NOTE

Mark the respective positions on the cables in order to facilitate reassem

➢ Raise the electronics panel sideways and disconnect the power supply cables from the modules.

 NOTE

Mark the respective positions on the cables in order to facilitate reassembly.

➤ Slip the power cables off the contactors
bracket in order to free the electronic panel.
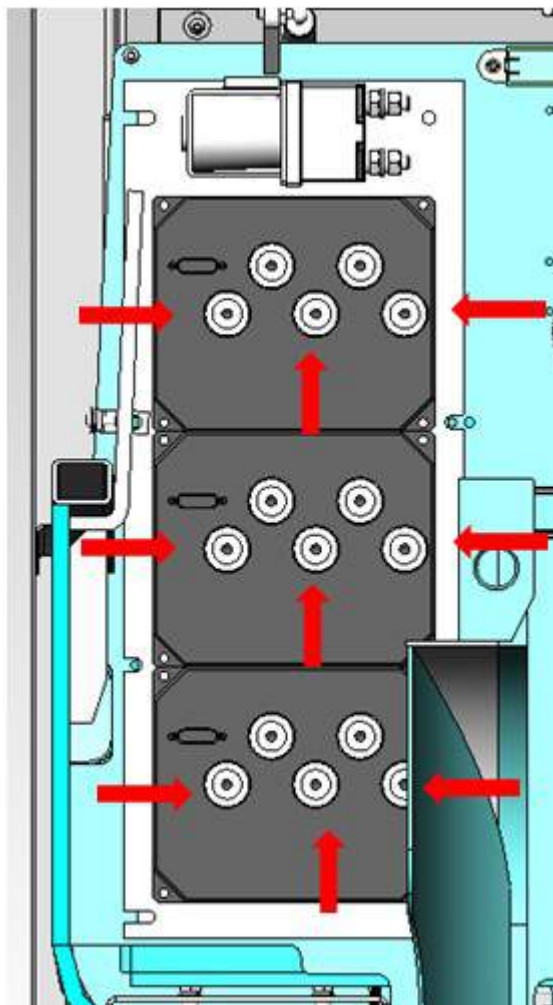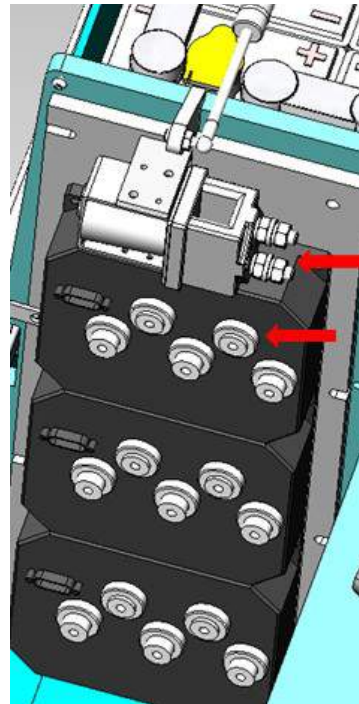
➤ Remove the electronics panel .

Electronics panel reassembly

Reassemble by performing the removal operations in reverse.

Protection of the electrical system

The following protections are provided (in addition to all the other protections intrinsic to the controls or those described previously):

- The safety circuits of the controls must be diagnosed by the microcontroller. The correct operation of the microcontroller must be checked by a watchdog circuit. In addition, the microcontrollers of the drive and pump controls must check one another using the serial can-bus connection, through implementation of a specific protocol (based on stuffing bit or other similar techniques). The Dual AC has two microcontrollers that share the inputs and that check one another; for example, if a micro enables the gear because it "sees" the relative input change state, but the other micro does not see any change of state on the same input, the control must go into alarm.
- If the accelerator is pressed, before putting the key in the ON position,

the contactor closes but the forklift does not move. It is necessary to completely release the pedal in order to restore forklift operation.

- If the distributor lever (or the joystick) is operated before putting the key in the ON position, the relative hydraulic function must not be enabled, and the lever must be released to restore forklift operation.

- If the negative wire of the accelerator, brake, steering or lifting potentiometer power supply should break, the control must go into alarm; this check is carried out through an out-of-range diagnosis of the output signal of the potentiometers; thus the potentiometers, during normal operation, must have a working stroke that guarantees the presence of voltage intervals outside the allowed range, so as to permit the aforesaid diagnosis; a different alarm code must be coded for each potentiometer.

- Without an operator on board, the hydraulic functions are disabled, including descent.
.

Emergency pushbutton

➢ The emergency pushbutton is a contact which is normally closed, and it allows to interrupt the passage of current on the electronic system so as to immobilize the forklift in case of emergency. It can be used in all situations of danger; the pushbutton must be used only and exclusively in case of sudden loss of control of the machine. To reset the button, just rotate it clockwise by 1/4 of a turn. The control, as soon as it "hears" the pressing of the emergency pushbutton, zeros the current; the de-energizing is independent from the control and occurs through the emergency pushbutton wiring/coil.

Replacing the emergency stop button

- Secure the truck by applying the parking brake.
- Disconnect the battery.
- Remove the panelling of the hydraulic distributor as indicated in the respective paragraph.
- Disconnect the wiring from the emergency stop button.

➢ Remove the body by pressing the "Open" key .

➢ Use an appropriate crescent wrench to unscrewthe ring nut .

Replace the pushbutton with a new one, and reassemble the same by performing the disassembly operations in reverse.

Assembly / disassembly of the
lights switch (option)
Disassembly of the lights switch
- Secure the truck by applying the parking brake.
- Operate the emergency stop button or disconnect the battery.
- Remove the panelling of the steering column as indicated in the respective paragraph.

➢ Unscrew the screws (1) of the shell (2).
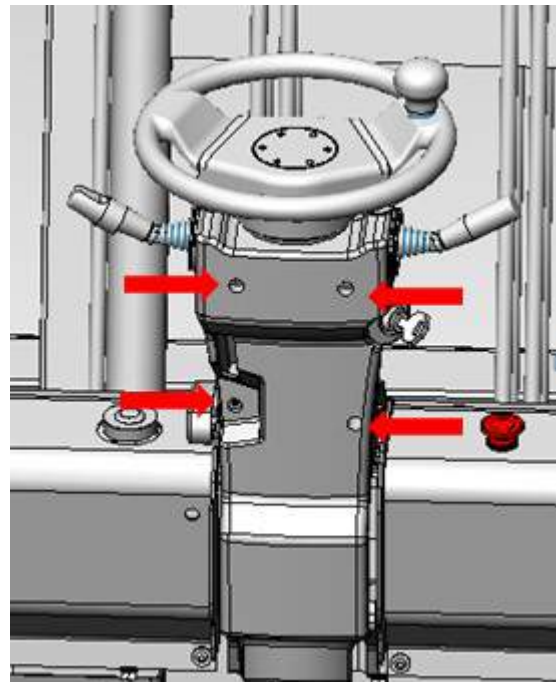
➢ Remove the shell .

> Unscrew the screws and remove the locking ring .
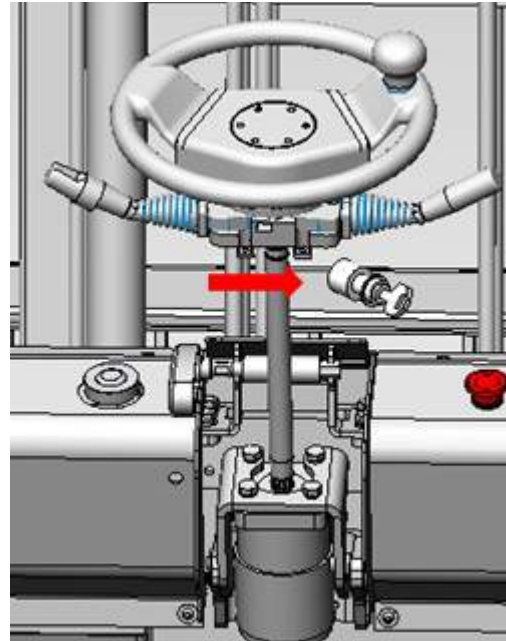
> Disconnect the wiring and remove the lights switch device .
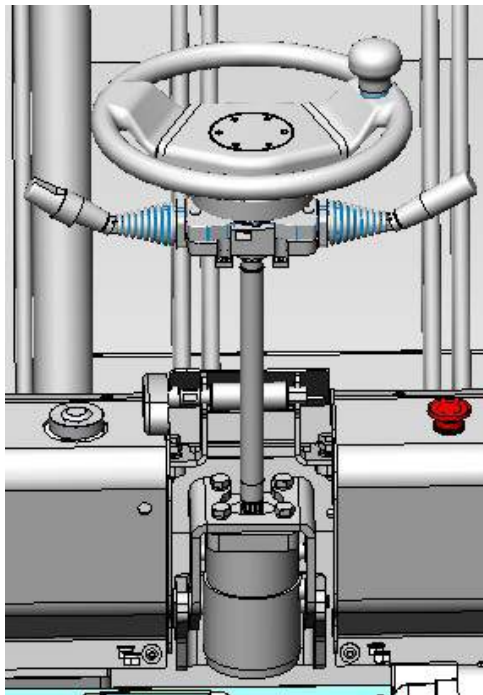
Assembly of the lights switch

> For the assembly, perform the disassembly operations in reverse.

NOTE

Be careful that the plug is correctly inserted into the seat of the steering column.

having the same characteristics (see the technical data chapter).

Rear lights unit lamps

Follow the instructions in the points below in order to change a lamp in the rear lights unit.

- Remove the transparent cover (1) by unscrewing the two screws (2).
- Lightly press and turn the burnt-out lamp to remove it from the bayonet fitting, and then replace it with a new one. The lamp positions are as follows:
  Reversing lights lamp (3)
  Stop lights lamp (4)
- Put the transparent cover (1) back on.
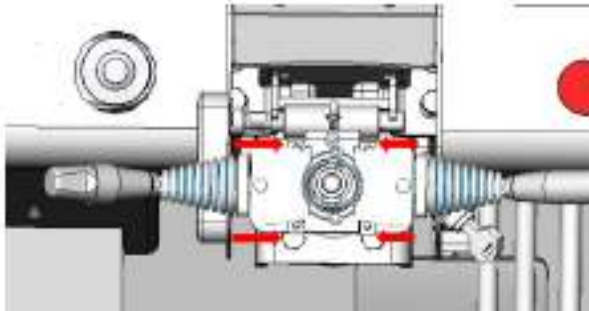
ℹ **NOTE**
The indications refer to the left rear lights unit.

Work light replacement procedure (optional)

➢ To replace a working lamp bulb, loosen the screws (1) and remove the light cluster (2).
➢ Release the bulb (3) by releasing the spring pins (4), then disconnect the plug (5) and change the bulb.
➢ Refitting is the reverse of removal.

Lamp replacement (if applicable)

Before replacing a lamp, check that the respective fuse is intact (see the paragraph ""Fuse replacement""). Replace the lamp with another one

Con...
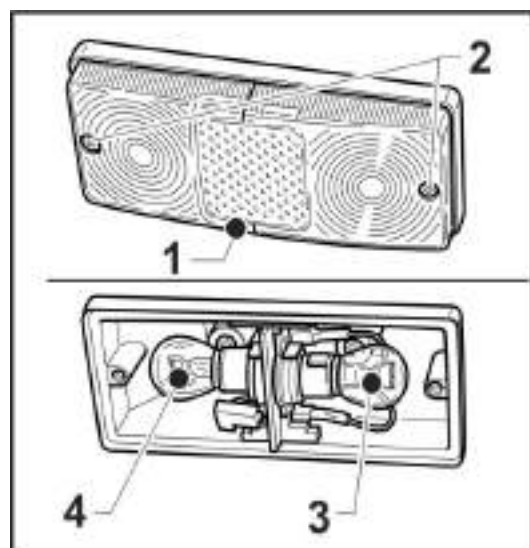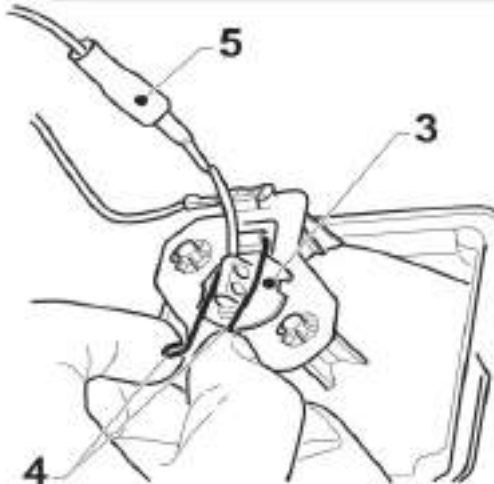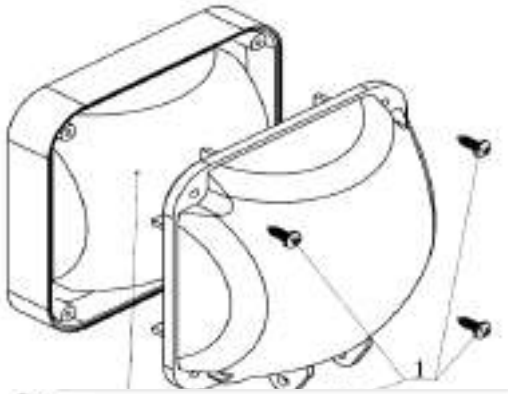
➢ T
A
T
s
require redundancy to ensure safety. The line contactors have contacts in series but with the coils controlled independently; these open every time a failure is detected in any circuit that can lead to full-power running movements, as dictated by the reference standards.

➢ Upon ignition, the contacts of the contactors (LC1 and LC2) are checked according to the following sequence:

• 1) The system closes LC1, and tries to pass current; if the voltage Vcond drops, everything is fine, otherwise LC2 is stuck.

• 2) LC1 is opened.

• 3) The system closes LC2, and tries to pass current; if the voltage Vcond drops, everything is fine, otherwise LC1 is stuck.

• 4) The system closes LC1, and tries to pass current; if Vcond drops, a contactor is open; if it does not drop, everything is fine.

The contactors protect against battery polarity
reversals and uncontrolled movements; in fact,

they must not close if the following occurs:

• the power unit doesn't work
• the logic is not working properly
• the operator present contact is not closed (including the safety belt contact as well)

Moreover, once closed, the contactors must open when there is any type of failure in any circuit that would lead to the loss of control of the forklift and/or uncontrolled movements of the forklift. The maximum operate time must be 200msec.

NOTE

The line contactors always open and close in the absence of current except during failure.

1

2

3

4

5

6

7

8

10A

10A

10A

10A

10A

7.5A
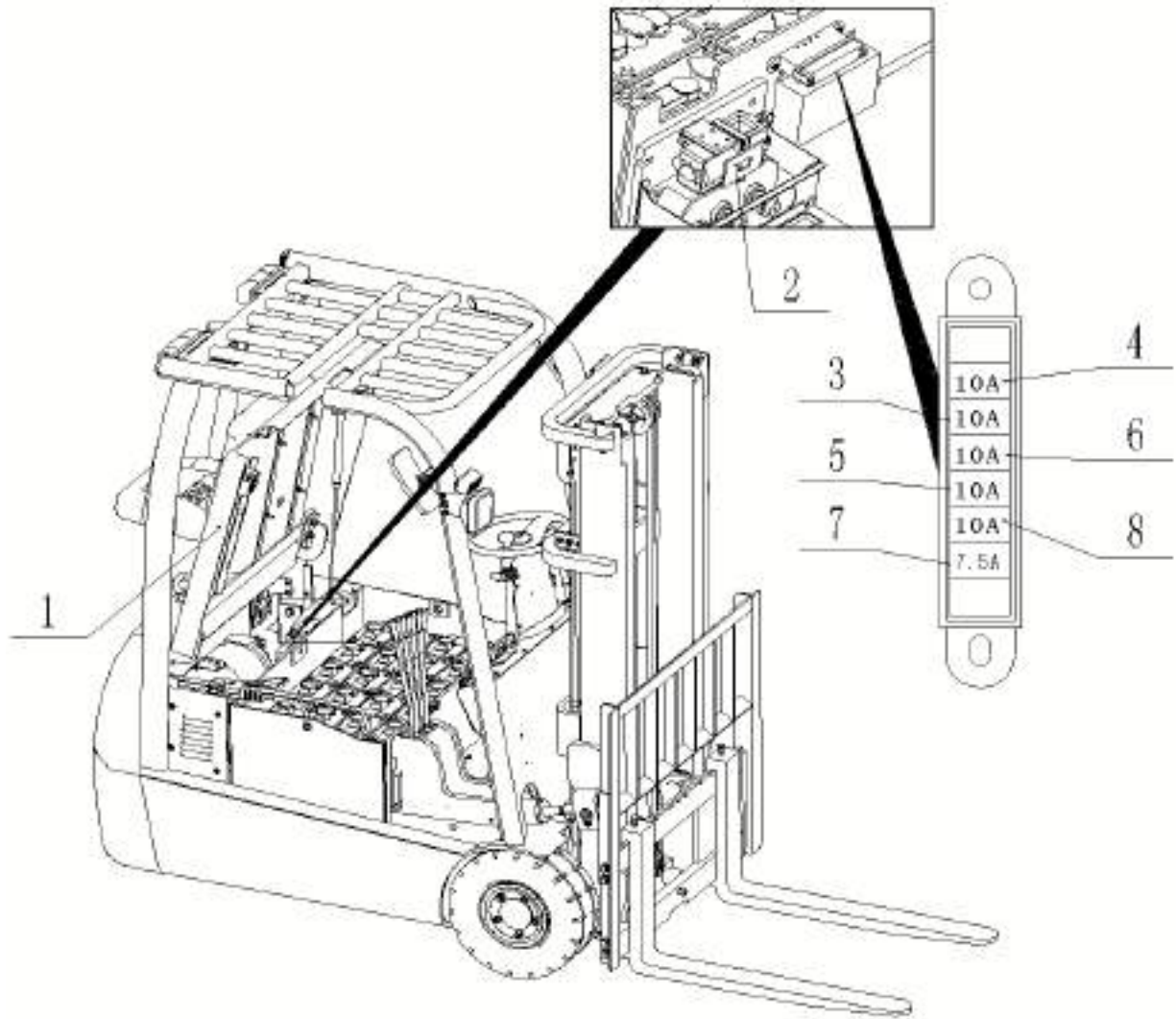
Location of Fuses

To access the fuses, the battery cover (1)
must be raised as indicated in the
relative paragraph.
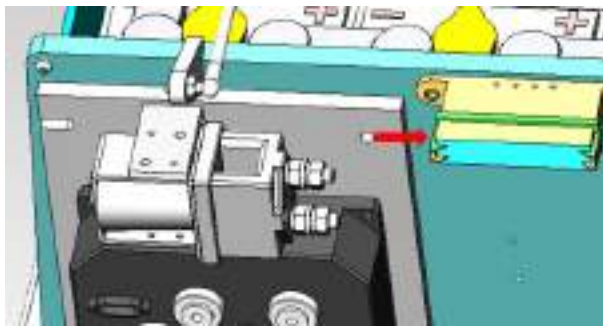
Changing a fuse

Turn off the forklift and perform the operations
preliminary to maintenance.

- Raise the battery cover (1) as indicated in the relative paragraph.
- The power fuses (2) is positioned on the electronic units, while the service fuses (3, 4, 5, 6, 7, 8) are positioned in the relative fuse box . Power Fuses (2).
- Loosen the screws and replace the fuse, then retighten the screws . Service and Auxiliary Fuses (3, 4, 5, 6, 7, 8).
- Change the blown fuse in the fuse box. Fuse Values.

Before changing a fuse, eliminate the cause that led to its blowing. The blown-out fuse must be replaced with a fuse of the same amperage only. Do not tamper with the forklift's electrical system.
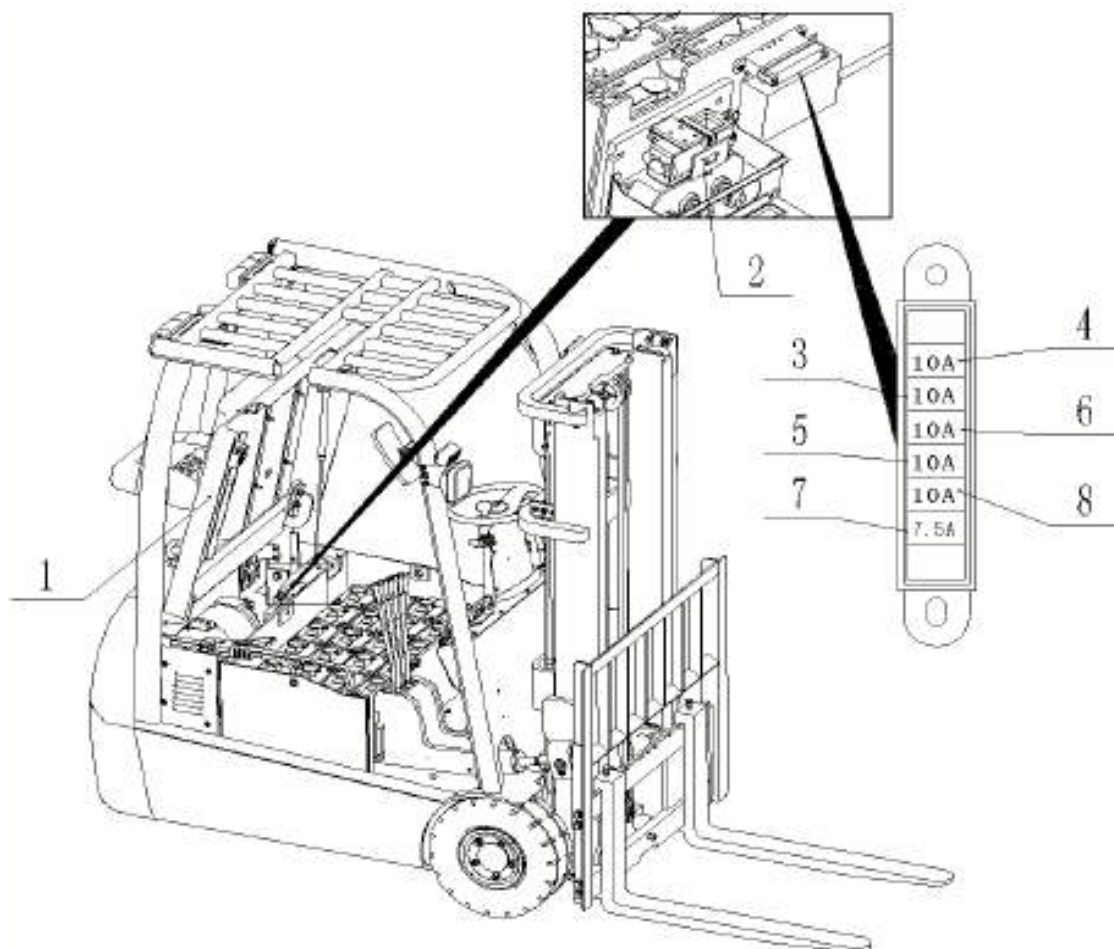
- "2" = Traction and Pump power fuse
- 700A
- "3" = DC-DC start signal fuse 10A
- "4" = Blade fuse for starting switch 10A
- "5" = Blade fuse for lights converter 10A
- "6" = Reserve fuse
- "7" = Reversing lights fuse 10A
- "8" = Blade fuse for horn 10A

DC/DC Converter

➢ The series converter has the task of taking the battery voltage and reducing it to 24V, supplying a power of 100W. When the converter works properly, the green LED (1) is lit.

The converter powers:
- the stop and reversing lights
- the electronics panel cooling fan
- the buzzer

With the use of this component, a smoothed discharge is obtained for all the elements making up the battery, thus improving its performance and lifetime.

A maximum of two 300W converters are provided for the optional equipment.

➢ The connector used is a watertight 5-pin Amp connector. This component is powered through pins 1 (+battery) and 4 (-battery), while its activation occurs on pin 5 with the battery positive, after key contact. The identification of the pins considering the converter-side (2) wiring is described in the table:

NOTE

The ENABLE input must be connected to the positive pole of the battery after key contact.
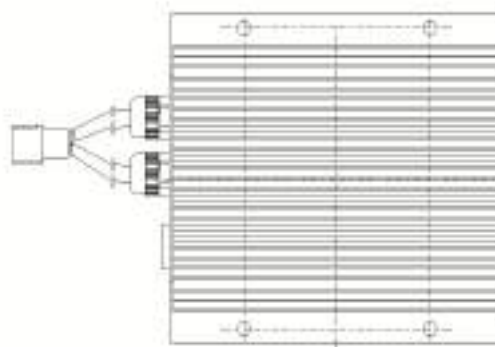
DJ7061-6.3-11

KBET		
Position	Function	Wire diameter
1	+ 48V	1.5mm²
2	Control terminal	1.5mm²
3	− 48V	1.5mm²
4	+ 12V	4mm²
5		
6	− 12V	4mm²
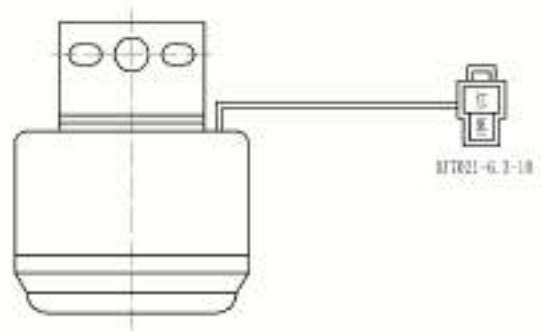
Buzzer

➤ This acoustic signal is powered at 24V by the DC/DC converter and receives the negative from pin 31 of the C connector of the DUAL AC module. It can be parameterized via software in the "Display Parameters" menu through the BUZZER parameter.
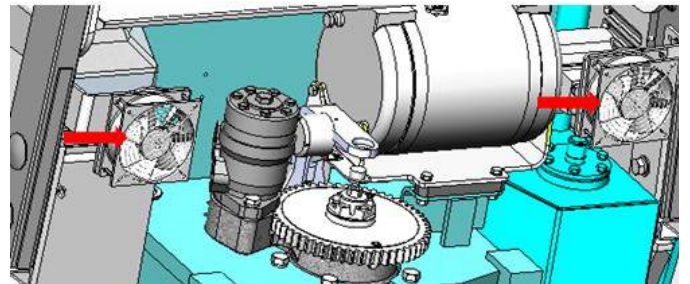
Fans

Panel fans

➤ The two fans protect both the drives (from overheating; they are powered directly by the 12V DC/DC.

clockwise rotation

Encoder des

Three encoders
truck
to measure the
one
for each motor (two traction motors and one
pump motor); the encoders are composed of a
sprocket and an inductive sensor that "counts"
the teeth. The encoders are pick-up encoders
with apparently identical structures but
with different numbers of teeth on the
sprocket.

➢ The connector used is shown in the figure, and the four terminals are described in the table.

Terminal	Function	Color
1	Positive	Red
2	Ground	Black
3	Channel A	White
4	Channel B	Brown

Mechanical profile

Magnetic profile

Sensor electrical output profile

In addition to the supply terminals, there are two channels on which two signals are transmitted, signal A and signal B. These two signals are necessary because the logic acquires both forward and reverse gear information. The signals consist in a sequence of phase-shifted square waves; when the signal A - B is greater than zero, the truck is in forward gear, otherwise if A - B is less than zero, it's in reverse gear. Clearly there is only a single direction for the encoder on the pump motor.
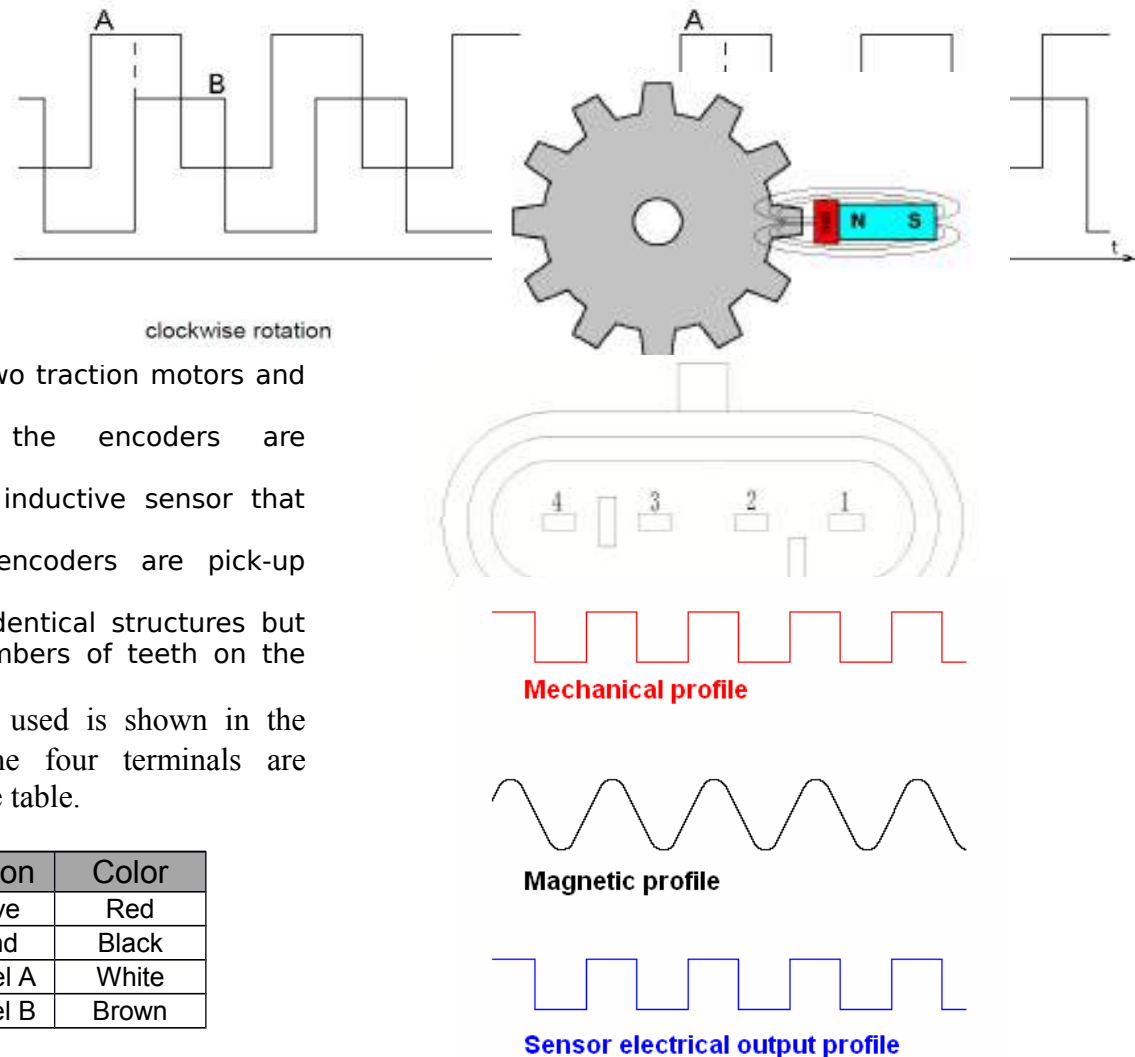
Traction motor encoders

The inductive sensors have an 11V regulated power supply; they are powered by the DUAL AC. Traction motors have 64 teeth on the encoder wheel. The connector used is shown in the figure.

Pump motor encoder

The inductive sensors have an 11.3 V regulated power supply, and they are powered by the AC2 (pin C1). There are 96 teeth on the phonic wheel. The connector used is shown in the figure.

Hydraulic circuit
Layout of hydraulic parts
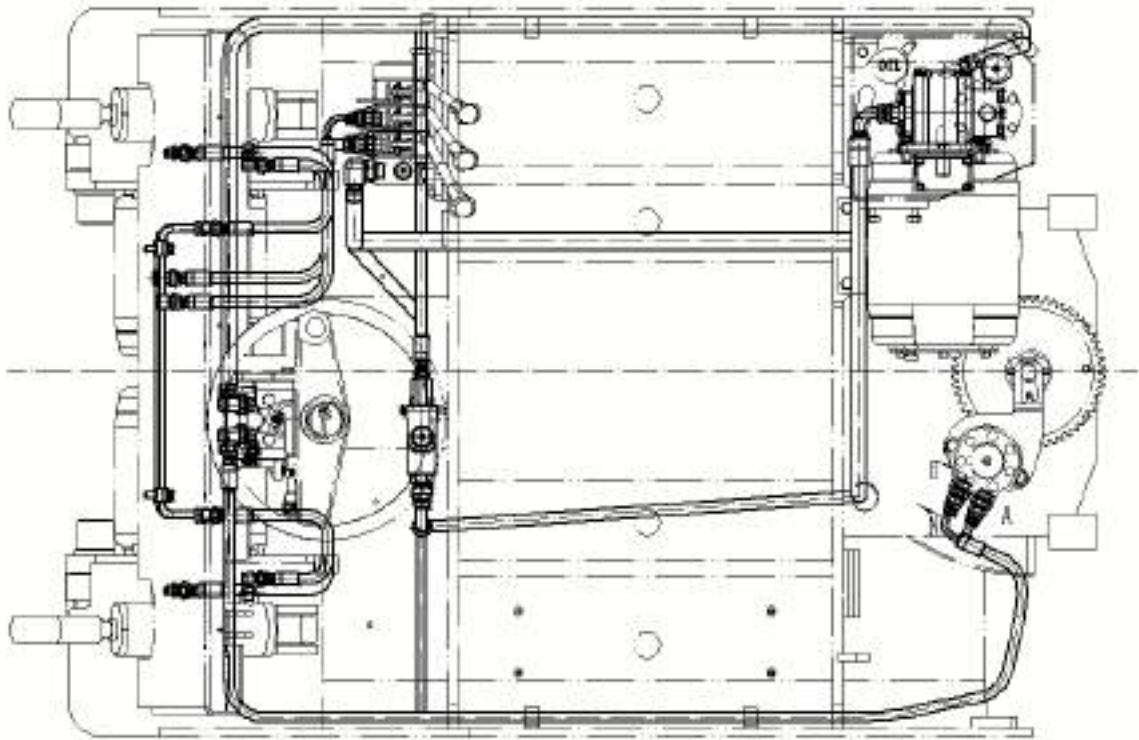
Hydraulic system assembly diagram

ℹ NOTE

The assembly diagrams of the entire hydraulic part of the truck are provided below; for the diagram with ISO symbols, see the appendix chapter located at the end of this manual.

Pump motor
Pump motor technical data
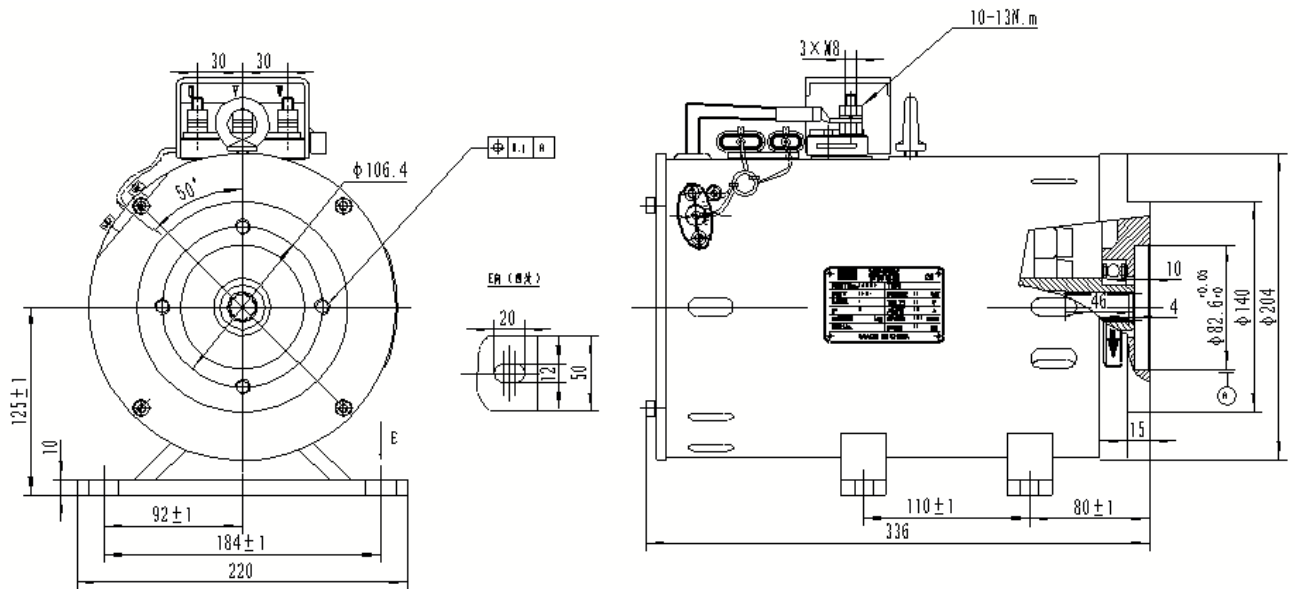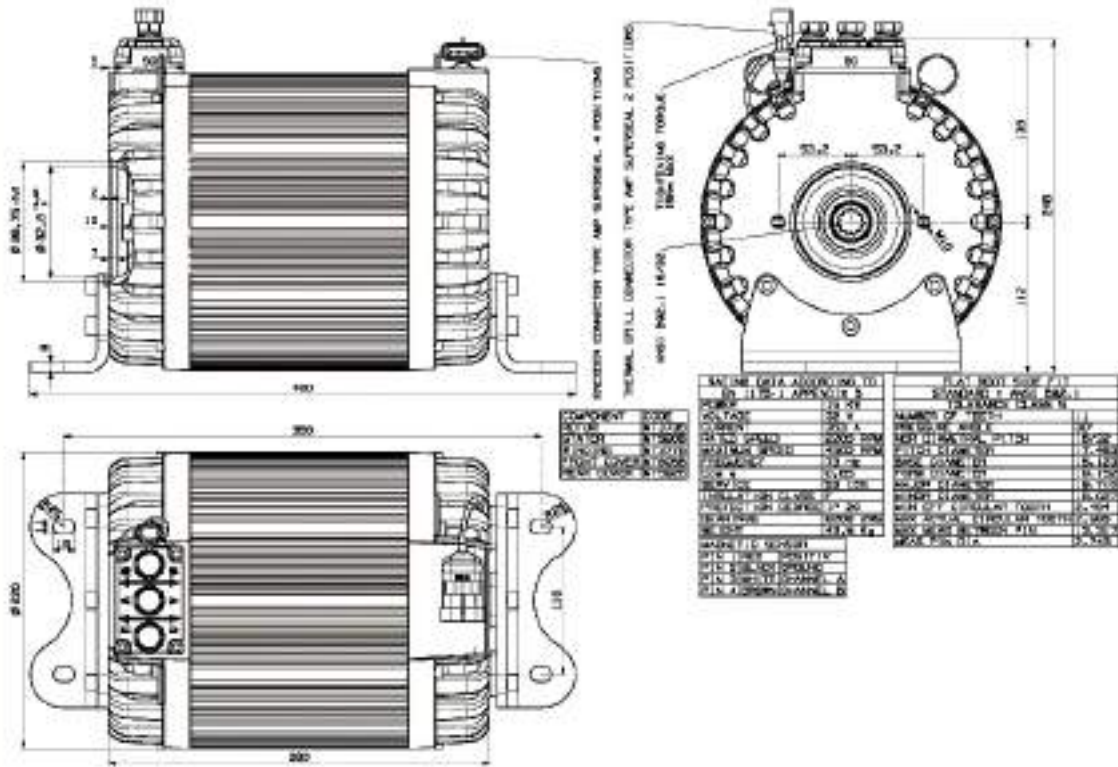
S431181GK

Motor specifications
Three-phase asynchronous squirrel-cage motor

Marking of the terminals and direction of rotation in conformity with the standard IEC 60034-8

Temperature sensor specifications

Temperature sensor KTY 84 - 130		
AMP 2-965421-1	Connector configuration	
	1	red
	2	blue

Specifications of the speed sensor output signal
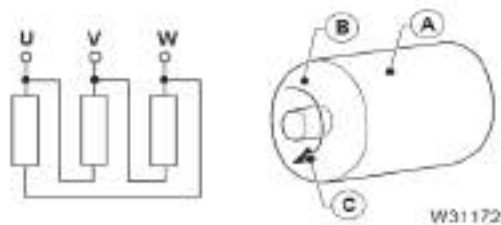
A	Motor
B	Pump side
C	Direction of rotation - right

W31172

W31173
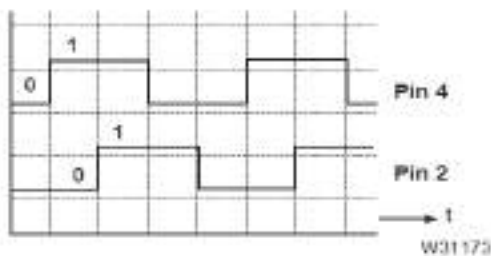
Pump motor removal

- Disconnect the battery socket or operate the emergency stop button.
- Secure the truck by applying the handbrake.
- Remove the operator step plate as indicated in the respective chapter.

➢ Drain the oil tank of the hydraulic system completely by removing the appropriate drain plug or empty it using an aspirator.

➢ Loosen and remove the fixing screws . And disconnect the wiring from the connector of the temperature sensor .

➢ Disconnect the wiring from the connector of the pump motor encoder .

(5).

➤ Loosen the four screws fastening the motor support to the chassis.

Lift the pump motor and upgrade, removing it from the chassis . The KBE15/18 forklift truck need to use non-metallic slings with a suitable lifting capacity tied the pump motor.

⚠ CAUTION

In this photo the pump motor fan has been removed, however this is not necessary. If present during this operation, be careful not to strike the fan!

➤ Disconnect the motor power supply cables
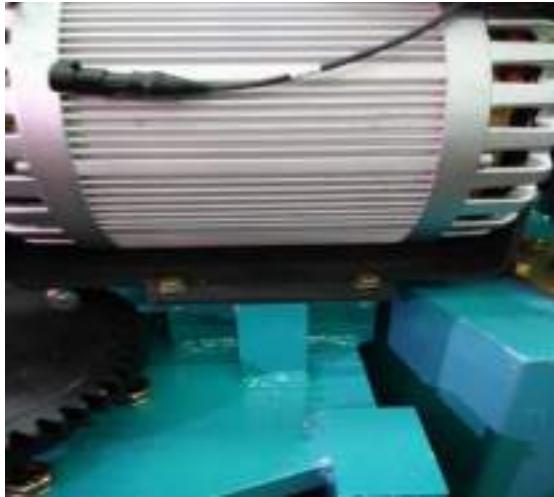
Assembly of the pump onto the motor

Reassemble by performing the disassembly operations in reverse, being careful to position the driving disc correctly.
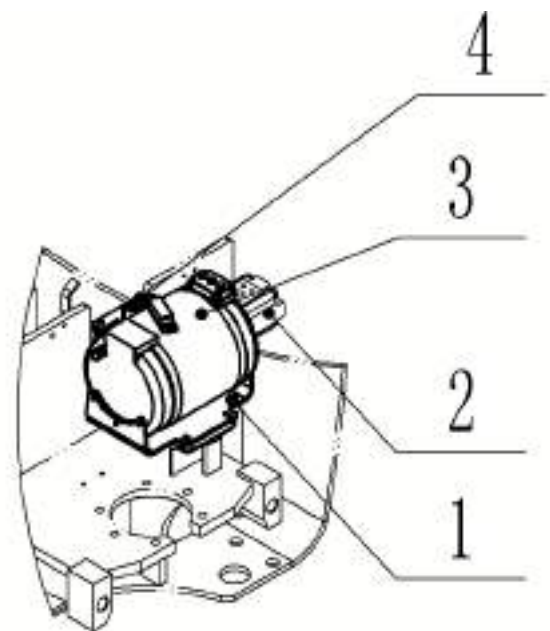
1	Motor support
2	Oilpump
3	Pump motor
4	Screw M8x16

Pump motor reassembly

Perform the removal operations in reverse, taking care to tighten the various components to the tightening torques indicated in the assembly diagrams.

Assembly of the pump motor to the chassis

Replacing the pump

- Remove the pump motor with the pump connected, as indicated in the respective chapter.
- Position the motor on the work bench.

➢ Remove the pump from the motor by unscrewing the two screws.

Replacing the pump motor encoder

- Disconnect the battery socket or operate the emergency stop button.
- Secure the truck by applying the handbrake.
- Remove the operator step plate as indicated in the respective chapter.

➢ Disconnect the wiring from the connector of the pump motor encoder.

➢ Loosen and remove the fixing screw of the encoder bracket. Remove the encoderand replace it with a new one.

Oil tank
Hydraulic oil tank

➢ The oil tank complete with filter has a 23-litre capacity. For the disassembly of the tank, follow the instructions provided in the respective chapter.

1= Oil inlet
2= Oil filter
3= Oil dipstick
4= Filter cartridge
5= Drain plug
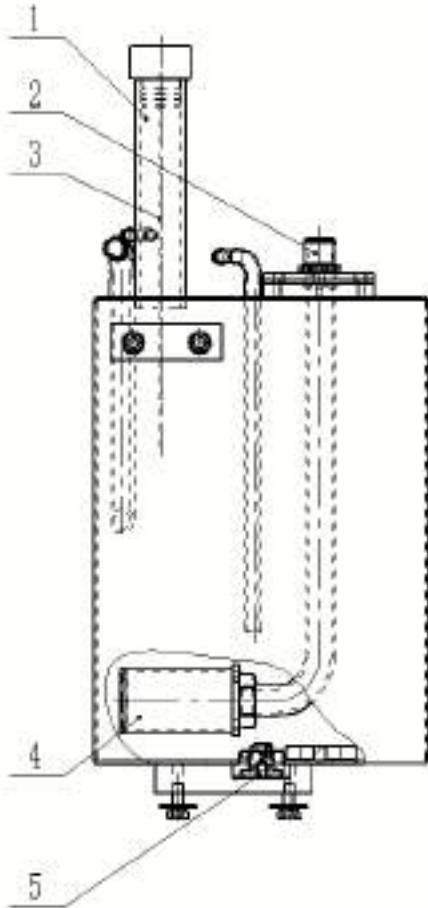
- Secure the truck by applying the handbrake.
- Remove the operator step plate as indicated in the respective chapter.

➢ Disconnect the pump motor that goes from the tank .

➢ sconnect the piping that goes from the tank to the hydraulic distributor.

Oil tank removal / reassembly

Removal

- Position the truck over a work pit.
- Disconnect the battery socket or operate the emergency stop button.

If a work pit is unavailable, the tank can be disassembled from above by removing the pump motor unit and the hydraulic distributor cover.

Reassembly
Perform the disassembly operations in reverse,
reassembling the plate with the help of another
operator who will support the tank from above.

➢ Unscrew the screws of the brackets fixing the tank (bottom and side brackets).

➢ Remove the tank (8) by extracting it out from below the truck.

ℹ NOTE

Check hydraulic tank oil level

Turn off the forklift and perform the operations preliminary to maintenance.

⚠ CAUTION

The hydraulic oil level must be checked by positioning the truck on a flat surface with the fork arms at the maximum elevation and the lift tilted forward.

The KBET15/18 lift truck need to remove the step plate firstly as indicated in the respective chapter.

Hydraulic distributor
Hydraulic distributor technical data
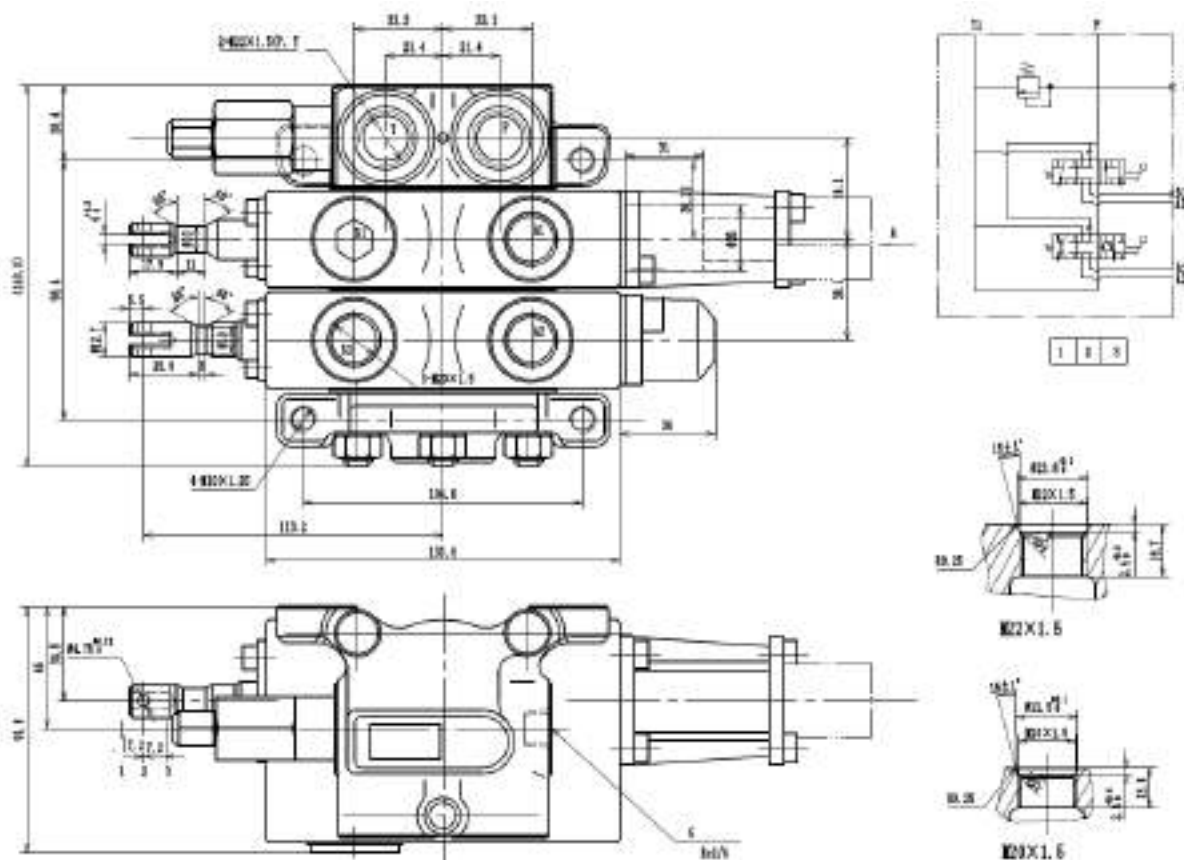
NOTE

When the operations have been completed,
bleed the air from the hydraulic system as described in the respective paragraph.

⚠ CAUTION

After this replacement, you will probably need to recalibrate the Hall sensor concerning the lifting element. In this case, follow the instructions in the respective paragraph.

Valves
Safety valve (load lowering block) (VBDC)

➢ This device provides protection against barrel breakage, as it prevents the uncontrolled and accelerated movement of loaded hydraulic equipment in the event the hydraulic counterpressure fails due to broken delivery piping. The device is screwed directly into the oil inlet of the equipment to be protected, and it consists of a disc that is lifted from its seat in rest position, by means of a spring, thus allowing the passage

of oil through the predetermined section. When the flow-rate increases, the hydraulic forces exceed the force exerted by the spring and the valve closes immediately. There is a hole on the disc of the valve that, regardless of force due to the size of the load, allows a constant outflow of oil which is suitable to lower the load slowly until it rests on the bottom.

- F-->B= Flow during supply
- F<--B= Flow during draining
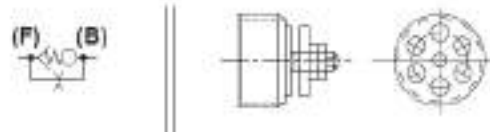
Safety valve layout
Safety valve positioning on the Simplex lift
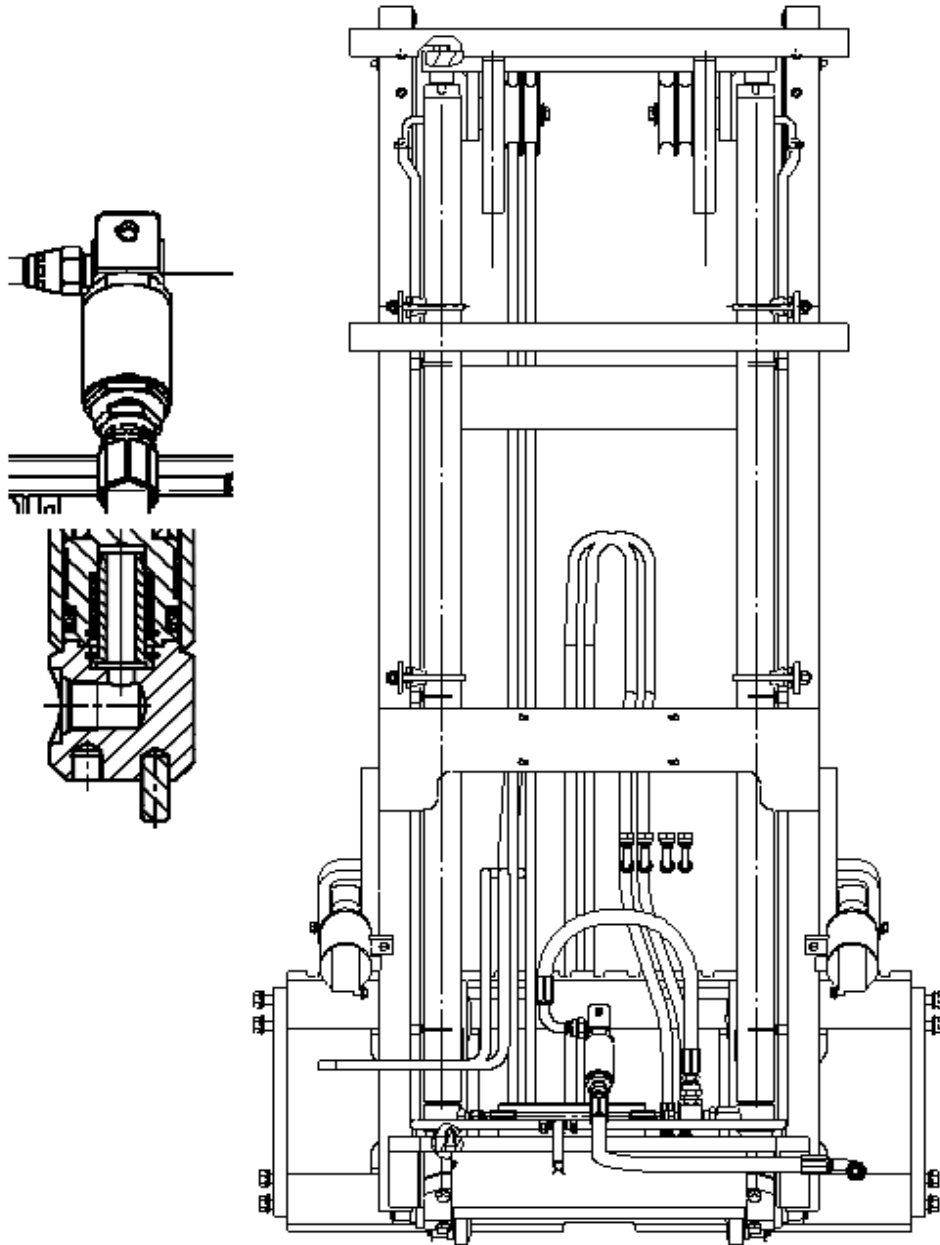
A   Safety valve
B   Throttle valve

for the type of valve to be used, refer to the
Spare Parts Catalogue only.

Safety valve positioning on the Duplex lift
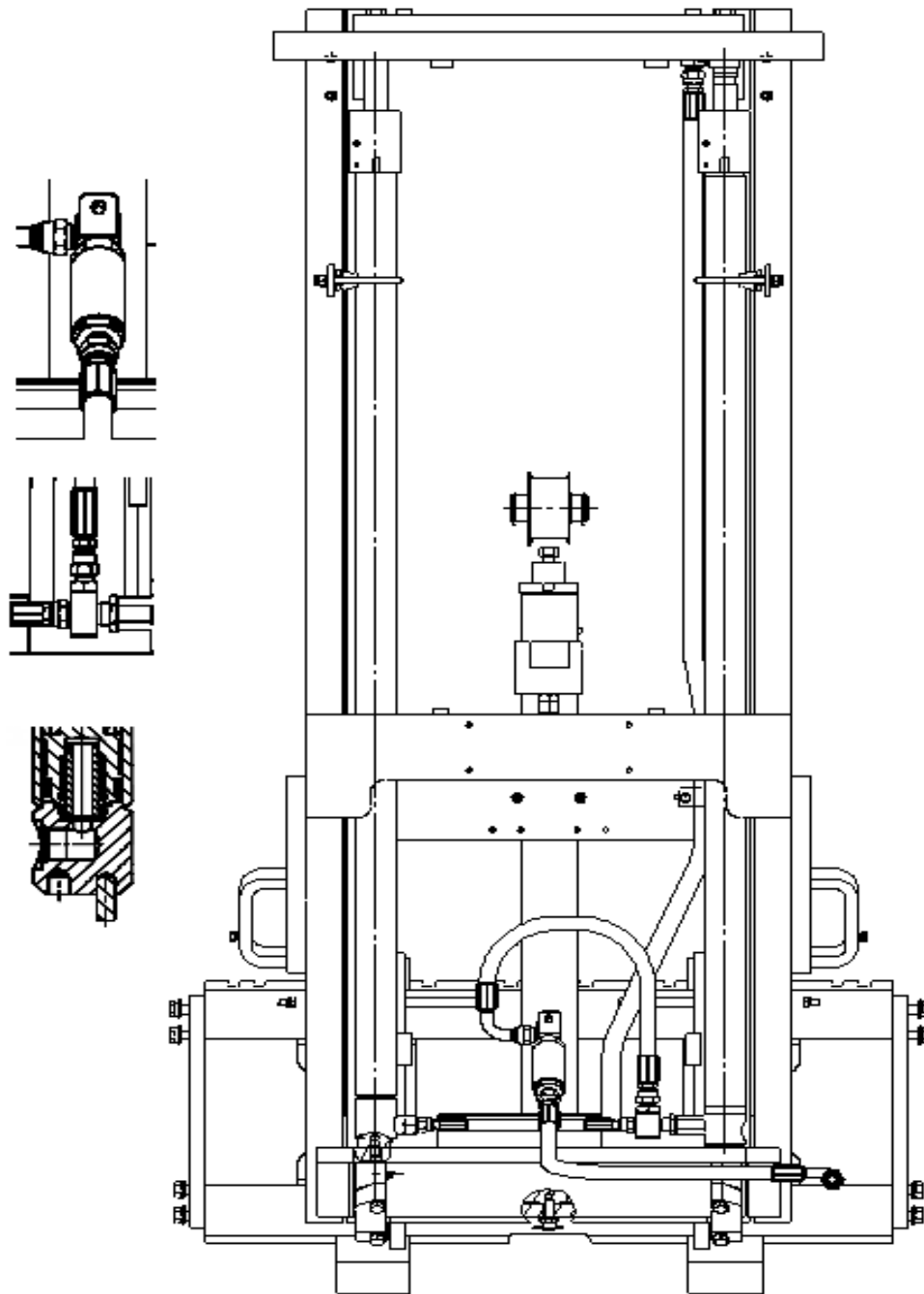
A   Safety valve
B、C   Throttle valve

⚠ CAUTION

For the type of valve to be used, refer to the Spare Parts Catalogue only.

Safety valve positioning on the Triplex lift

A   Safety valve
B   Throttle valve

For the type of valve to be used, refer to
the Spare Parts Catalogue only.

Tilt cylinders
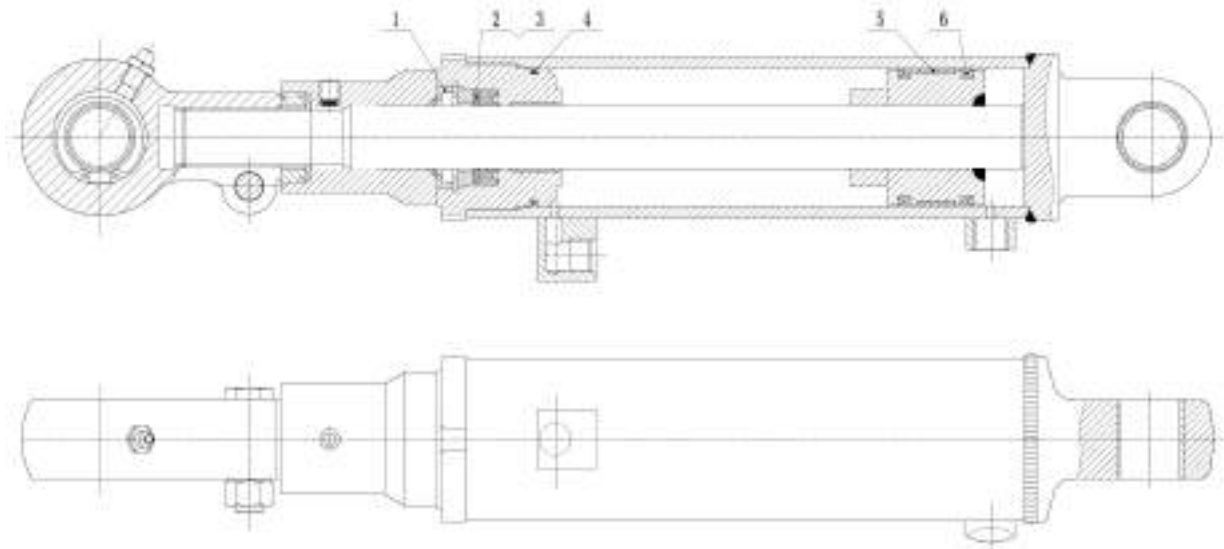
1	Seal'52X32X8/11
2	Stop
3	Seal'48X32X10
4	Seal '70X3.1
5	Set of seals 'D70X20X2.5
6	Seal 'D70X60X6

Tilt cylinder removal / reassembly

Removal

⚠ DANGER

It is prohibited to remove both tilt cylinders from the truck as this may cause the lift to move; remove one cylinder at a time.

- Place the lift in the vertical position.
- Move the fork carriage down to the lower limit stop.
- Disconnect the battery socket or operate the emergency stop button.
- Release the pressure from the cylinders (lift and tilt cylinders as well as those of the SLI or any other equipment) by moving the respective levers of the hydraulic system distributor in both directions several times.

Reassembly

Perform the removal operations in reverse, being careful to grease the joints before reassembly with the type of lubricant described in the "Supply table". When

reassembly has been completed, bleed the
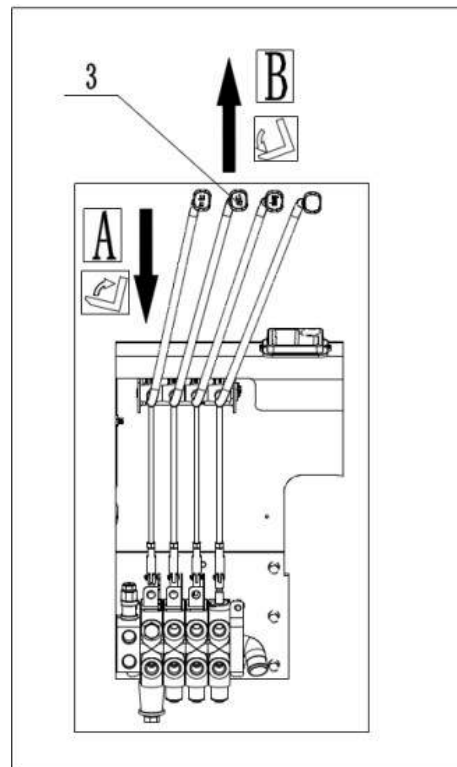cylinders as described in the relative
paragraph.

Air bleeding of the tilt cylinders

➢ Tilt the lift completely to the limit
   stop （ 3 ）   forwards and backwards
   several times. The bleeding occurs
   automatically. At the end of the
   operations, check the oil level.

ENVIRONMENT NOTE

For disposal of the waste oil, abide by

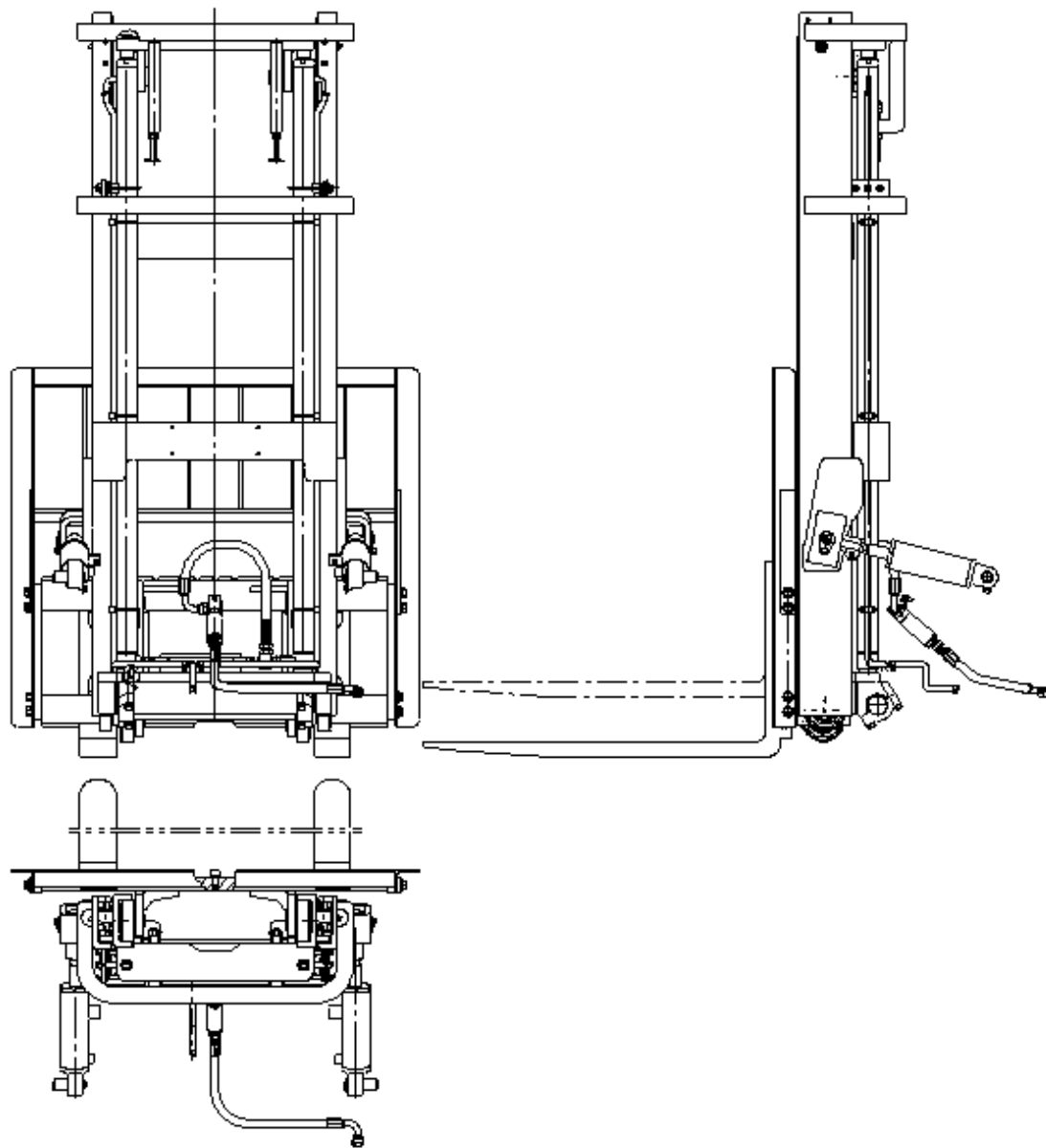current regulations on the subject.

Lifts

Technical data for service

Lift support screws	Tight

Roller screws		Load chains	Maximum elon
		Lowering speed	Maximum a

Lift typologies

Simplex Lift

During lifting, the dimensions of the lift are always higher than the load. Composed of two lift cylinders and two masts (fixed and moving).

Duplex Lift

Composed of three lift cylinders (two side cylinders and one central cylinder), and two masts (fixed and moving). During lifting, the extended mast is never higher than the load being lifted
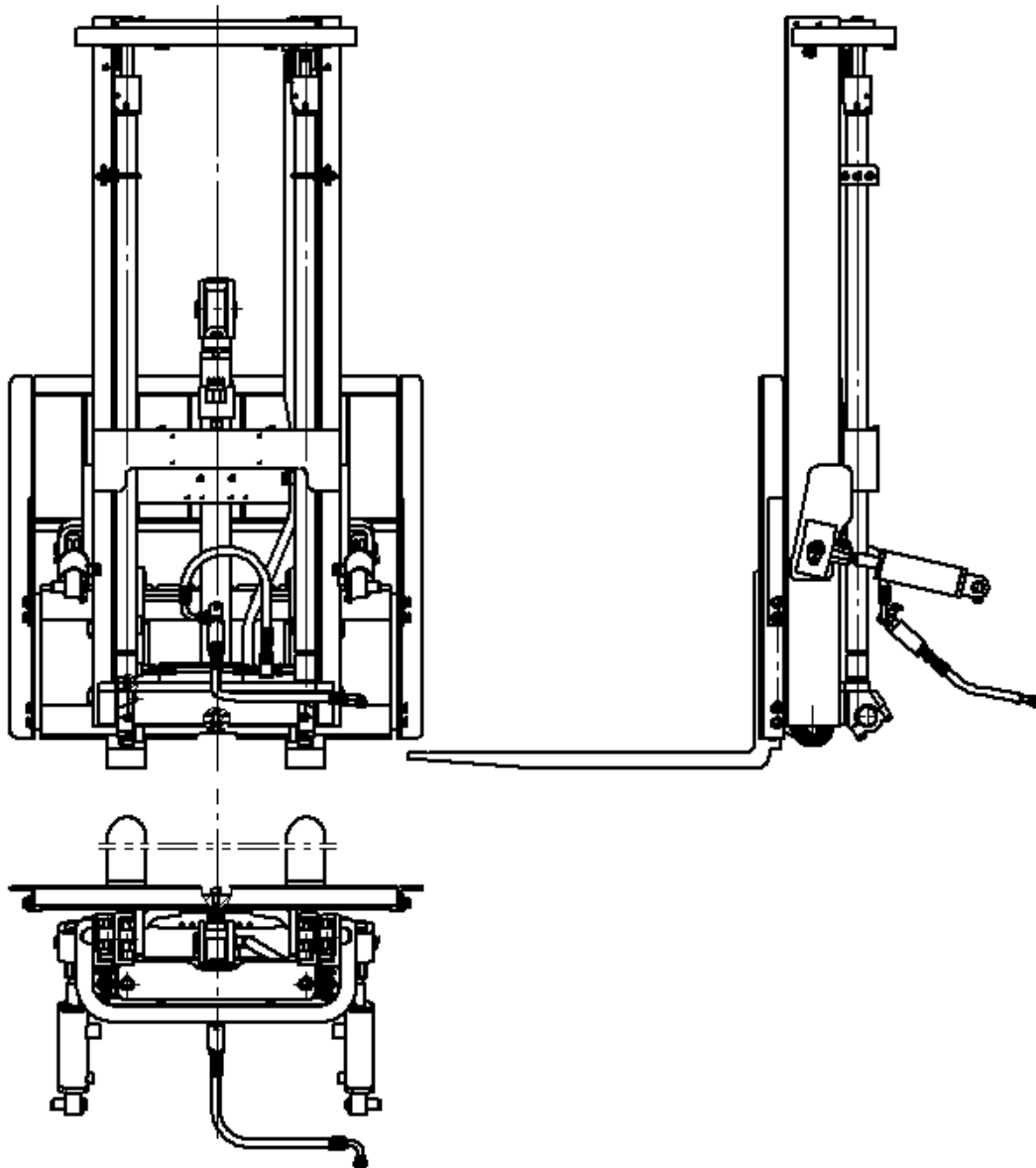
Triplex Lift

Composed of three lift cylinders (two side cylinders and one central cylinder), and three masts (fixed, inner and moving). Similar to the duplex lift, during lifting, the extended mast is never higher than the load being lifted.

All the lift typologies provide excellent visibility. The section of the mast is an H-section. The fork carriage and the sections

of the masts are guided by support rollers that also absorb transverse stress.

For the assembly and disassembly of the lift, refer to the respective paragraph.

i **NOTE**

To limit wear, the sliding tracks of the rollers should be greased as needed with high-pressure adhesive lubricant.
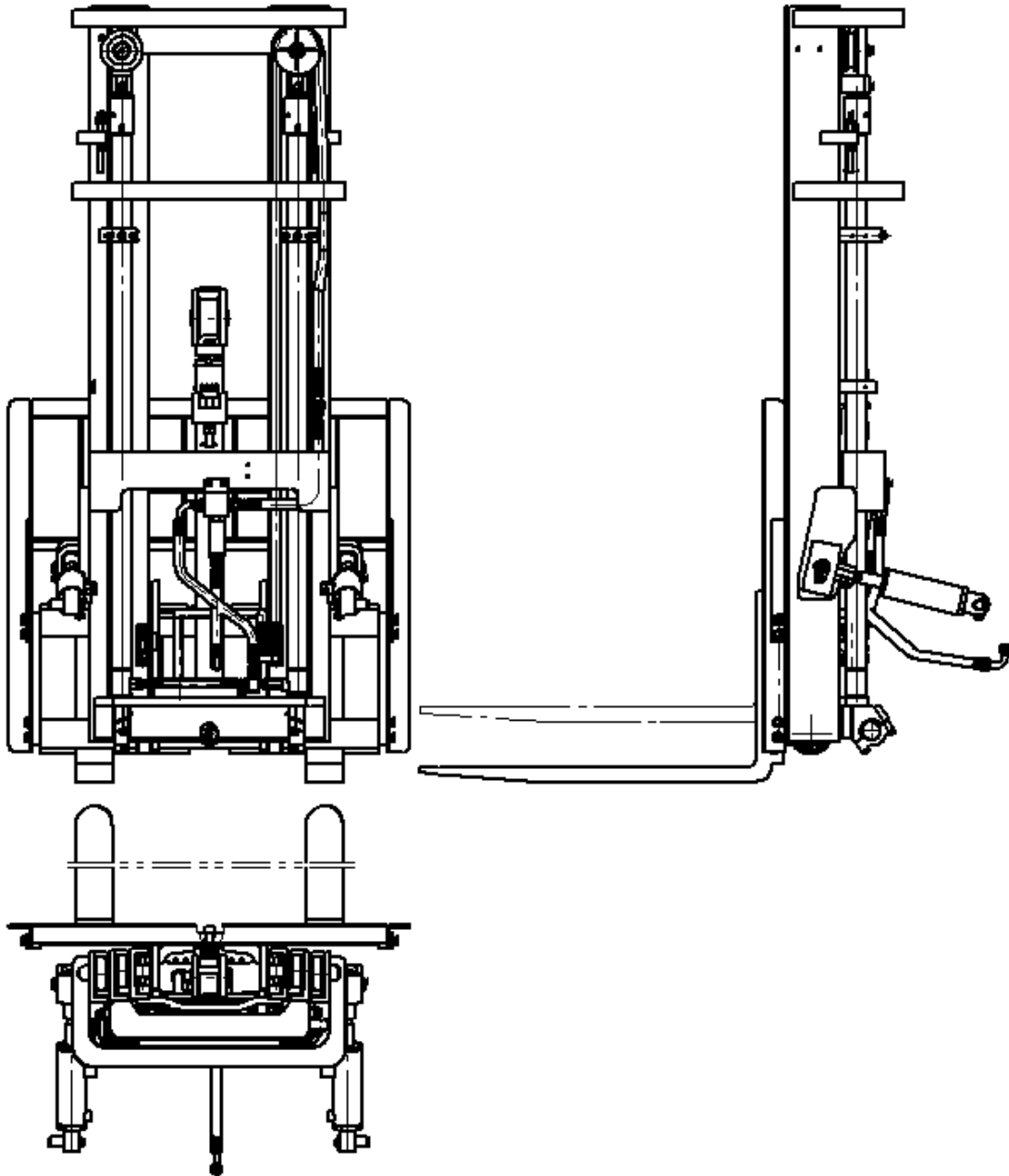
Simplex Lift

Simplex lift functional description

The two cylinders are housed in the section of the outer mast and are supplied by piping that branches off from the metering valve.

The two pistons are connected on top with the cross traverse of the inner mast (or moving mast).

When the cylinders are powered, the two pistons emerge and raise the inner mast.

The limit stop inside the cylinder.

The load chains are fixed to the outer

(fixed) mast and passed around the inner

In this manner the lift is extracted with respect to the fork carriage in the proportion of 1 : 2.

A lowering brake (metering valve) incorporated in the rigid piping limits the maximum lowering speed to 0.55 / 0.50 m/sec.

The retaining device prevents the

accidental overrun of the fork carriage

from the moving mast (see the respective

paragraph).

mast through chain rollers, while at the other end they are connected to the fork carriage.

Hydraulic circuit for powering the

Simplex lift cylinders

1	Clip	10	O-ring

2	Band	11	O-ring
3	Clamping piece	12	Pipe union
4	Connection piece	13	Pressure line assy.
5	Throttle valve	14	Pressure line assy.
6	Pipe union	15	Bolt
7	Screw joint	16	Washer
8	Valve 'safety valve	17	Washer
9	Pressure line assy.	18	Screw joint
		19	Hose

The oil inlet is located at the throttle valve . From that point the oil reaches the two cylinders by passing through the piping. The safety valves, fitted inside the cylinders, prevent a rapid and uncontrolled lowering of the load in case the piping breaks.

ⓘ NOTE

Adjustments or repairs are not permitted on these valves. In case of malfunctioning or anomalies replace the valves. For the type of valve, refer to the Spare Parts Catalogue only.
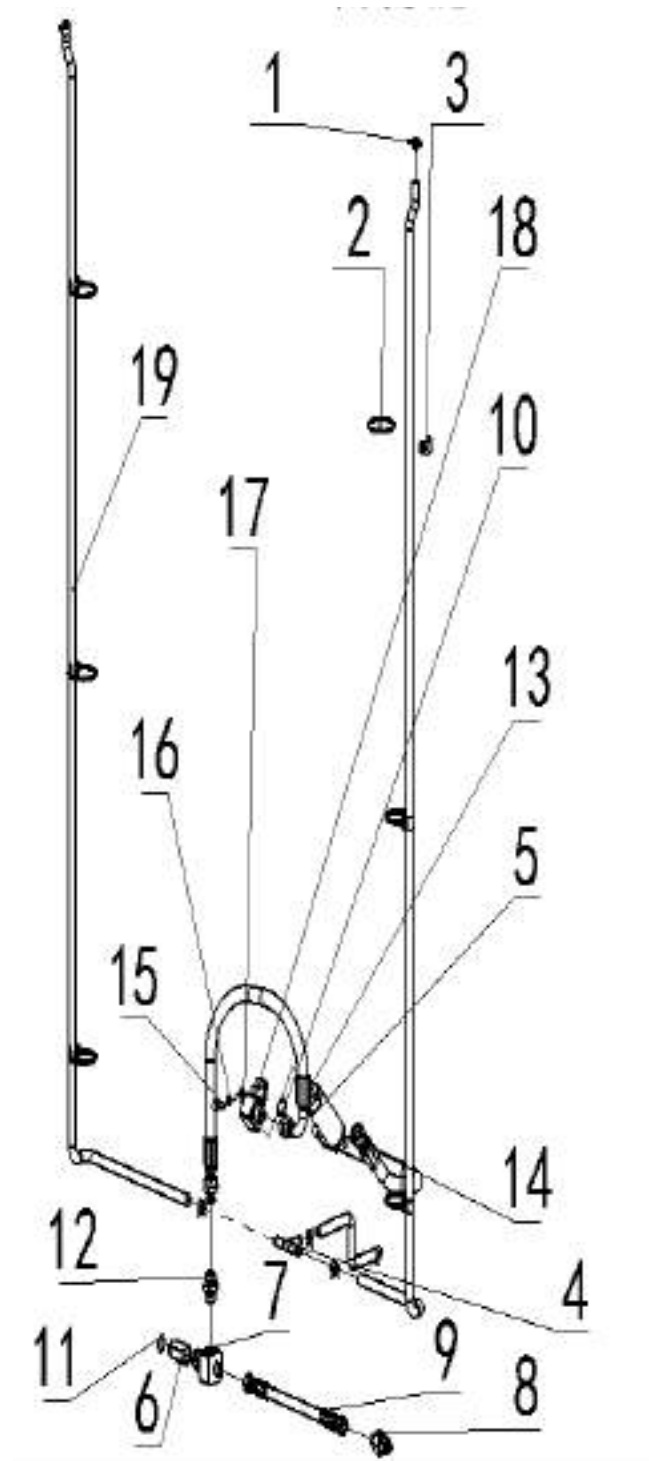
Adjusting the Simplex lift load chain

The load chains must be adjusted uniformly using the tensioning attachments.
The centre of the upper rollers of the fork carriage (four-roller carriage) or, depending on the case, the centre of the middle rollers of the carriage (six roller carriage), must remain inside the section of the inner mast for a dimension at least greater than "X" (see respective diagram) when the pistons of the lift cylinders are completely extended (up to the limit stop inside the cylinder).
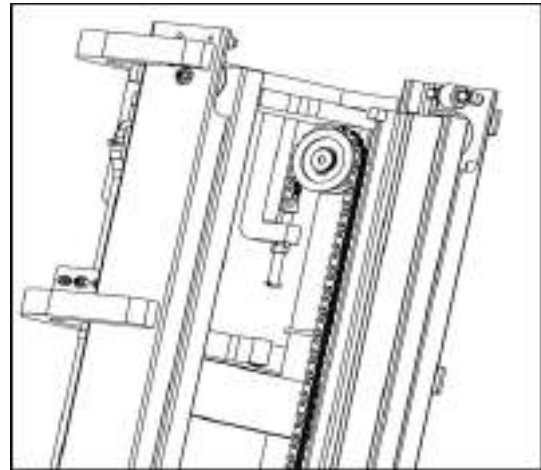
Never compensate tyre wear by adjusting the load chain tension.

When adjusting the load chains, a minimum distance of 2 mm must be kept from the fork carriage retaining device (see adjustment in the respective paragraph).
➢ For the load chain locking device according to the sketch shown on the side, see the respective paragraph.

ℹ NOTE

The wear, possible damage and elongation of the load chains should be checked according to the accident prevention rules and as described in the User and Maintenance Manual.

Duplex Lift

Duplex lift functional description

The lift is fitted with three cylinders.

The intermediate cylinder allows the large free lift height simply by means of a telescopic effect inside the moving mast.

The chain is fixed to the moving mast and is passed around the central cylinder by means of a chain roller while the other end is fixed to the fork carriage.

In this manner the fork carriage rises without increasing the dimensions of the lift.

The two outer cylinders are located in the H-section of the outer (fixed) mast.

The pistons of the outer cylinders are connected to the inner (moving) mast.

If the cylinders are filled with oil, the first piston to be extended is that of the intermediate cylinder, since it has the largest surface area.

Then the two pistons of the outer cylinders

emerge and raise the inner mast.

A lowering metering valve limits the maximum lowering speed to 0.55 / 0.50 m/s.

The retaining device prevents the accidental overrun of the fork carriage from the moving mast (for its adjustment, see the respective paragraph).

Hydraulic circuit for powering the Duplex lift cylinders

1	Screw joint	10	Screw joint
2	Pressure line assy.	11	Screw joint
3	Washer	12	Pressure line assy
4	Connection piece	13	Valve 'safety valve
5	Bolt	14	Pressure line assy.
6	Bolt	15	Pressure line assy.
7	Pipe union	16	Throttle valve
8	O-ring	17	O-ring
9	Pipe union	18	Screw joint
		19	Washer

The oil enters at the metering valve(1). From this point it passes through the side piping to the outer cylinders. On the Duplex lift the oil powers the central cylinder through the left outer cylinder and the vertical piping. Due to the difference in the surface area of the two pistons, the first piston to be extended is that of the central cylinder.

Stroke1= operates the fork carriage only.

Stroke2= extends the inner (moving) mast.

(refer to the respective diagrams).

The safety valves are fitted in the cylinders and prevent the rapid and uncontrolled lowering of the load in case the piping breaks.
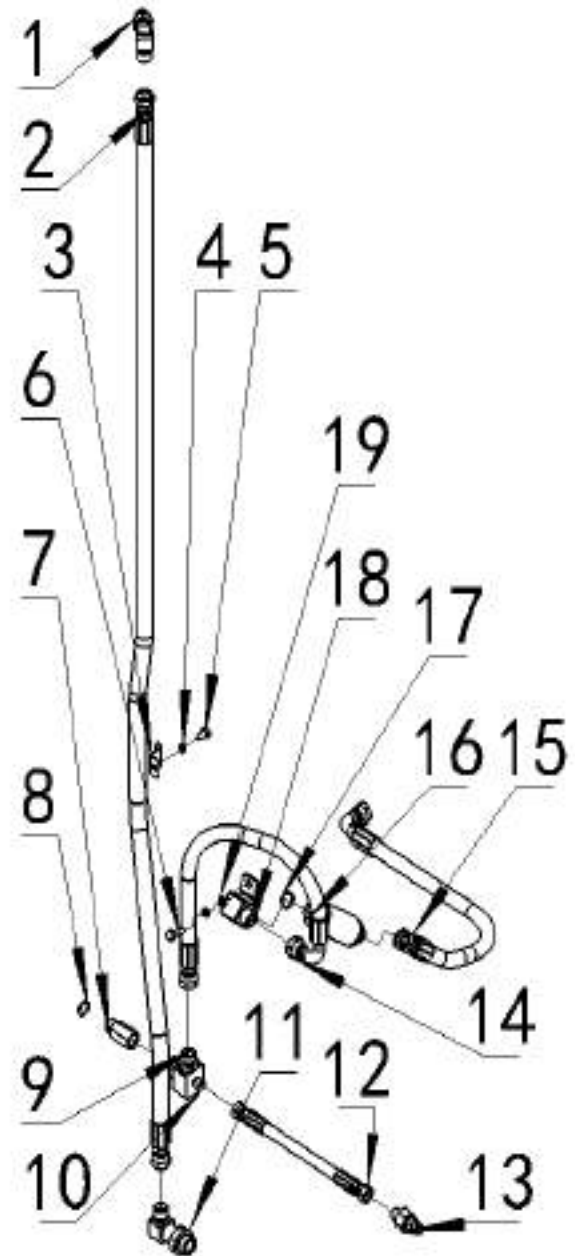
NOTE

Adjustments or repairs are not permitted on these valves. In case of malfunctioning or anomalies, replace the valves. For the type of valve, refer to the Spare Parts Catalogue only.

Adjusting the load chains of the Duplex lift

➢ The load chains must be adjusted uniformly using the tensioning attachments .

The centre of the upper rollers of the four-roller fork carriage or, depending on the case, the centre of the middle rollers of the six-roller carriage, must remain inside the section of the inner mast for a dimension at least greater than "X" (see respective diagram) when the piston of the lift cylinder is completely extended (up to the limit stop inside the cylinder).

Never compensate tyre wear by adjusting the load chain tension.

When adjusting the load chains, a minimum distance of 2 mm must be kept from the fork carriage retaining device (see adjustment in the respective paragraph).

➢ For the load chain locking device according to the sketch shown on the side, see the respective paragraph.

🛈 **NOTE**

The wear, possible damage and elongation of the load chains should be checked according to the accident prevention rules and as described in the User and Maintenance Manual.

Triplex Lift

Triplex lift functional description

The lift is fitted with three cylinders. The central cylinder allows the large free lift height, yet without exceeding the external dimensions, simply by means of a telescopic effect inside the inner mast.

The two outer cylinders are located in the H-section of the outer or fixed mast.

The pistons of the side cylinders are connected to the intermediate mast.

The load chains for stroke 2 (see the lifting diagram) are fixed to the outer (fixed) mast at the top and the inner (moving) mast at the bottom.

If the cylinders are filled with oil, the first piston to be extended is that of the central cylinder, since it has the largest surface area.

Then the pistons of the two outer cylinders

emerge to raise the intermediate mast. The

intermediate mast raises the inner mast through the chain connection in the proportion of 1 : 2.

A lowering metering valve limits the maximum lowering speed to 0.55 / 0.50 m/s.

The fork carriage retaining device prevents the accidental overrun of the fork carriage from the inner mast (for its adjustment, see the respective paragraph).

Hydraulic circuit for powering the

Triplex lift cylinders

1	Washer	15	Screw joint
2	Bolt	16	Bolt
3	Pressure line assy.	17	Junction assy.
4	Junction assy.	18	Pressure line assy.
5	Throttle valve	19	Pressure line assy.
6	Bolt	20	Nut
7	Pressure line assy.	21	Pipe
8	O-ring	22	Washer
9	Pressure line assy.	23	Bolt
10	Pipe union	24	Clamping piece
11	O-ring	25	Hose pulley
12	Screw joint	26	Bush
13	Pressure line assy.	27	Valve 'safety valve
14	Pipe union	28	
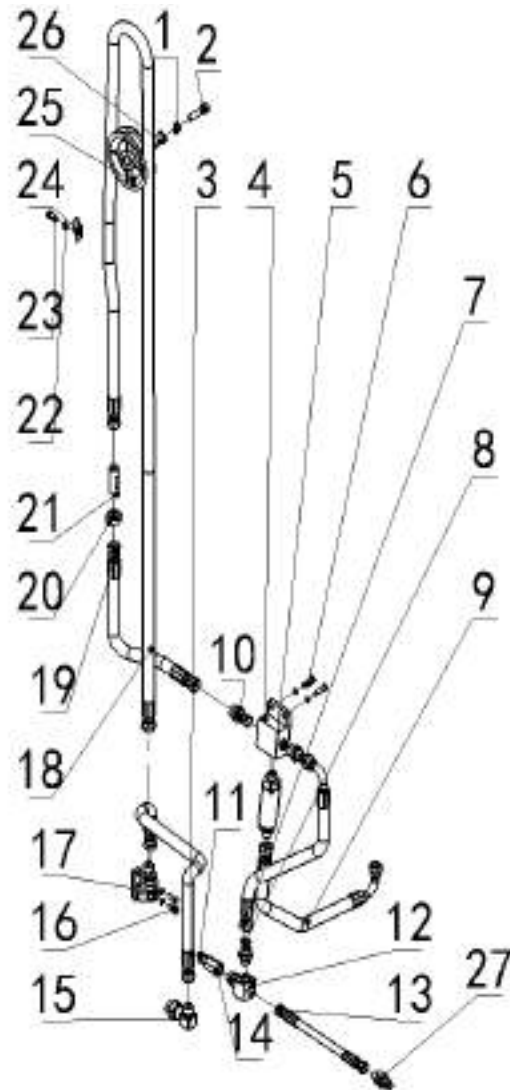
The oil from the lowering metering valve supplies the outer cylinders through the side piping. The central cylinder is

supplied through the left outer cylinder and piping. Due to the difference in the surface area of the two pistons, the first piston to be extended is that of the central cylinder.

Once the latter has reached the limit stop, the pistons of the outer cylinders emerge.

Stroke 1: operates the fork carriage only.

Stroke 2: extends the intermediate and inner mast (refer to the respective diagrams).

The safety valves are fitted in the cylinders and prevent the rapid and uncontrolled lowering of the load in case the piping breaks.

🛈 NOTE

Adjustments or repairs are not permitted on these valves. In case of malfunctioning or anomalies, replace the valves. For the type of valve, refer to the Spare Parts Catalogue only.

Adjusting the lifting chains on the

Triplex lift

➢ **Outer chains**: the outer lifting chains should be adjusted uniformly using the tensioning attachments.
➢ **Intermediate chain**: the load chain is adjusted using the tensioning attachment.

The centre of the upper rollers of the four-roller fork carriage or, depending on the case, the centre of the middle rollers of the

six-roller carriage, must remain inside the section of the inner mast for a dimension at least greater than "X" (see respective diagram), when the piston of the intermediate cylinder is completely extended (up to the limit stop inside the cylinder).

Never compensate tyre wear by adjusting the load chain tension.

When adjusting the load chains, a minimum distance of 2 mm must be kept from the fork carriage retaining device (see adjustment in the respective paragraph).

i **NOTE**

The wear, possible damage and elongation of the load chains should be checked according to the accident prevention rules and as described in the User and Maintenance Manual.

Load chain locking device

➢ The intermediate chain of the Duplex and Triplex lifts and the outer chains of the Simplex and Triplex lifts are secured on the lifts as illustrated in the sketch to the side.
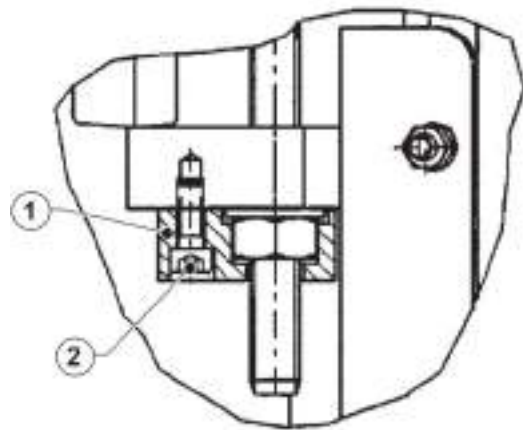
Fork carriage retaining device

➢ When the load chains are adjusted, it is necessary to ensure that when the lift is completely extended, the limit stop is not beyond the stroke of the lift cylinder, i.e., that the block (1) and the fork carriage retaining device (2) must not touch one another. You must absolutely ensure that between the block (1) and the fork carriage retaining device (2) there is an opening of at least 2 mm.

ⓘ NOTE

On the lifts with a considerable elevation, it is simple to determine the size of the opening by sticking a little plasticine on the block (1), raising the fork carriage up to the limit stop and then measuring the thickness of the plasticine with a gauge.

Check

Determine the side clearance and the dimension "X" using a feeler gauge

The indication of the dimension "X" = 0.6 mm represents an indicative value for the insertion of the next-largest support roller during the running-in, i.e., with the new profile (dimension "A" = 75.4 + 0.8), at the beginning, the material of the profile will be compacted at the sliding points of the support rollers.

After a certain running-in period, which varies depending on the application, the dimension "X" will almost completely stop varying: it will stabilize.

To minimize wear, it is important that adhesive lubricant be applied on the sliding tracks of the rollers after having cleaned the tracks.

The figures on the right show how to determine the dimension "X" of the fork carriage support rollers.

- Raise the fork carriage.

- Insert wooden wedges under the fork arms.

- Lower the fork carriage.

The support rollers will stop on the side opposite the sliding track.
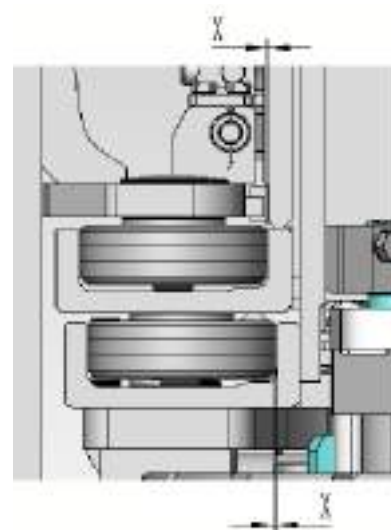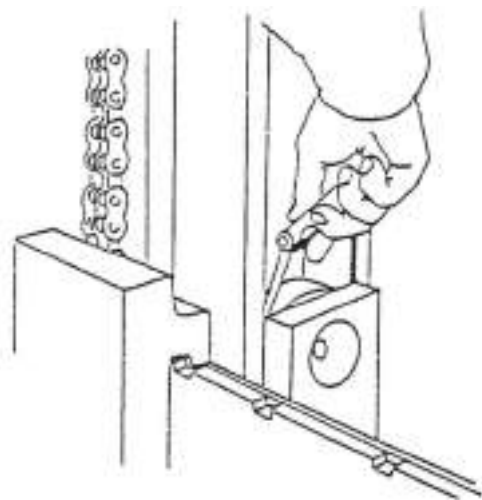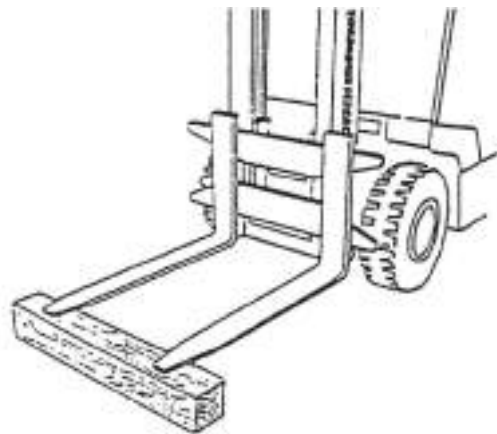
At this point it is possible to determine the dimension "X". **Disassembly of the Simplex lift Cylinder**

- Position the lift vertically.
- Extend the lift piston (approx. 20 cm) until the top fastening becomes easily accessible in order to remove the lock ring.
- Remove the lock ring from the upper piston fastening.
- Use slings to hook the top cross traverse of the inner mast to a crane and keep the mast in this position.
- Lower the lift completely (the pistons will lower and come off the cross traverse). Operate the emergency stop button and then move the distributor levers in both directions to release all the pressure from the hydraulic system.
- Loosen the bottom feed line connection.
- Loosen the cylinder bracket and remove the cylinder from the lift.

Replacing the set of gaskets:

- Clamp the cylinder in a vice.
- Unscrew the cylinder head using a hook spanner for ring nuts. If the cylinder head is difficult to unscrew, heat it with a flame. The cylinder head is fixed with Loctite 243 in three points on the perimeter.

Reassembly the side cylinders of the Simplex lift

Reassemble by performing the disassembly operations in reverse.

ℹ️ NOTE

During reassembly, the cylinder head should be tightened completely after having applied Loctite 243 in three points on the perimeter of the thread. When finished reassembling, bleed the hydraulic system as described in the respective paragraph.
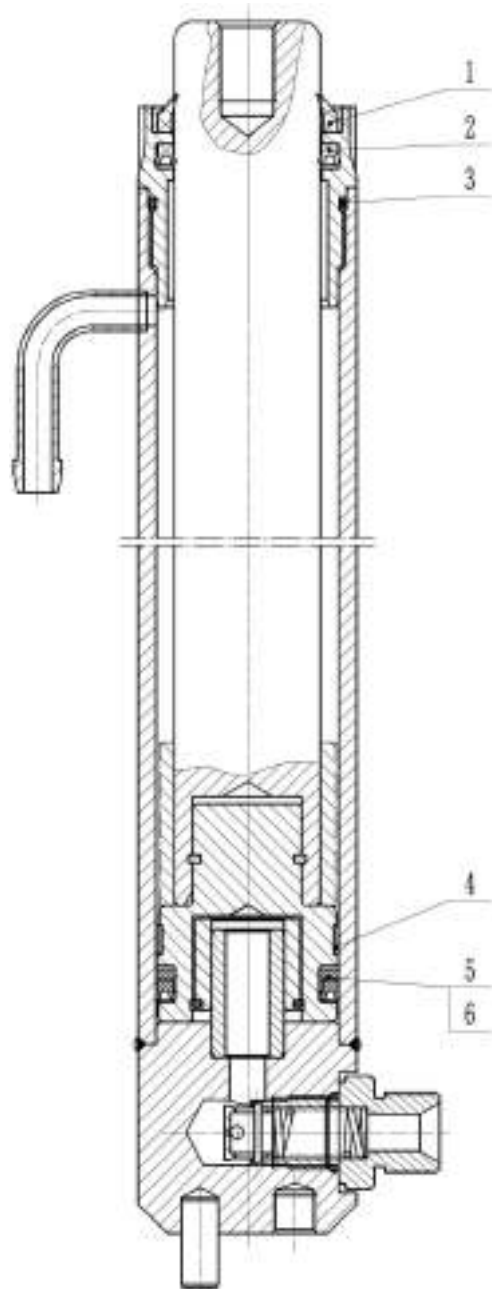
Disassembly of the side cylinders of the Duplex lift

- Use slings to hook the top cross traverse of the moving mast to a crane.

- Move the distributor levers in both directions to release the pressure from the circuit.

- Disconnect the supply piping of the central cylinder and the bottom connections of the side cylinders.

- Remove the snap rings fastening the pistons to the cross traverse.

- Use a crane to raise the moving mast until extending the pistons from the cross traverse (use a screwdriver to help, if necessary).

- Loosen and remove the cylinder brackets.

- Retrieve the cylinders.

Assembly

Reassemble by performing the disassembly operations in reverse.

![i] **NOTE**

When reassembling the adapter, the cylinder head and the piston, proceed as follows:

Adapter: Tighten completely, after having applied Loctite 275 on the thread and Loctite 243 on the support surface.

Cylinder head: Tighten completely, after having applied Loctite 243 in three points on the perimeter of the thread.

Piston: Tighten with a tightening torque of 30 + 10 Nm, after having applied Loctite 275 on the thread.

When finished reassembling, bleed the hydraulic system as described in the respective paragraph.
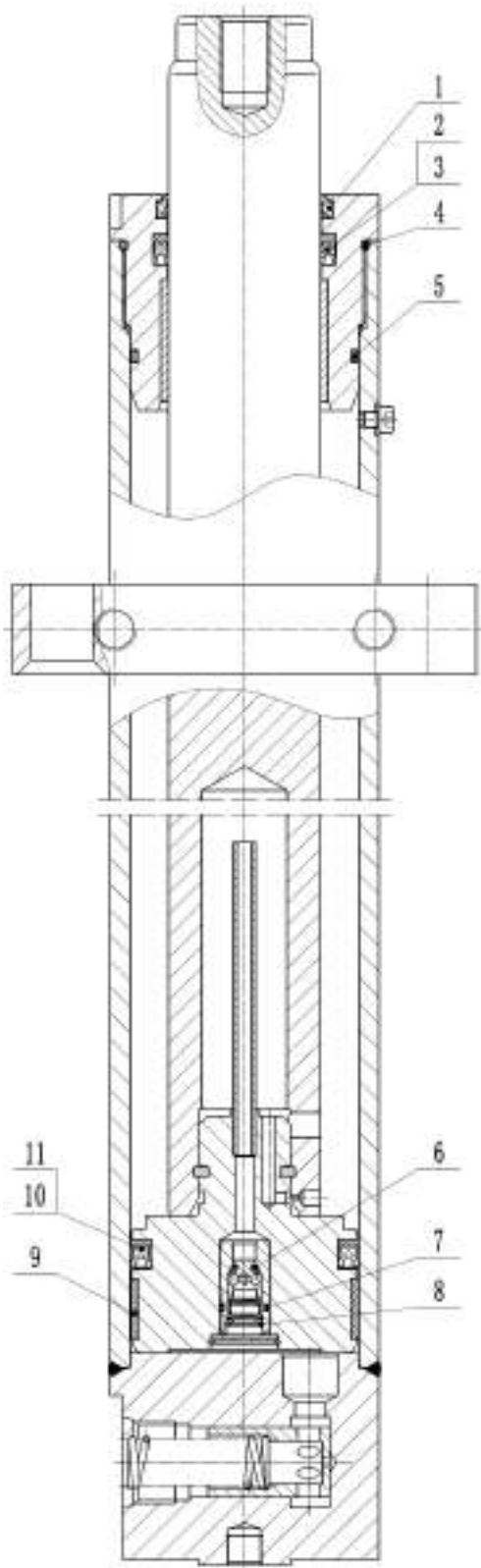

Reassemble by performing the disassembly operations in reverse.

![i] **NOTE**
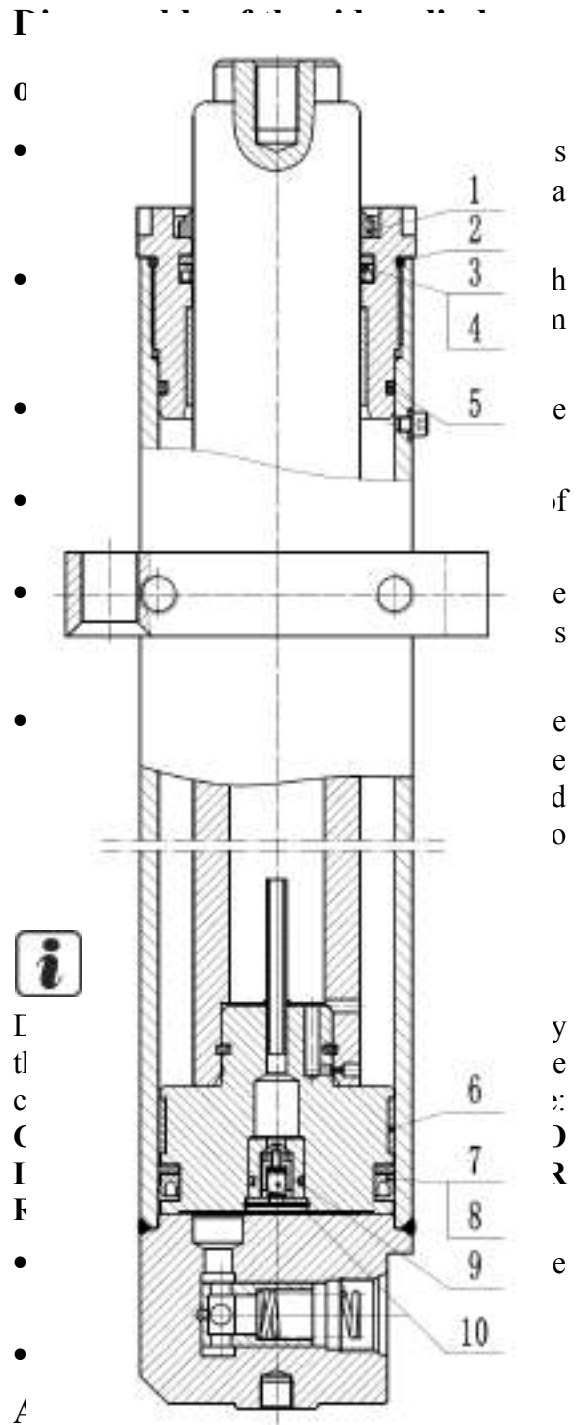
When reassembling the adapter, the cylinder head and the piston, proceed as follows:

Adapter: Tighten completely, after having applied Loctite 275 on the thread.

Cylinder head: Tighten completely, after having applied Loctite 243 in three points on the perimeter of the thread.

Piston: Tighten with a tightening torque of 150 + 50 Nm, after having applied Loctite 275 on the thread and on the contact surface of the piston.

When finished reassembling, bleed the hydraulic system as described in the respective paragraph. Workshop

Duplex / Triplex central cylinder

The cylinder is a single-action cylinder (plunger cylinder). The cylinder liner and the cylinder base are welded. The cylinder head is screwed onto the cylinder liner and secured with Loctite 243. The seal between the cylinder liner and the cylinder head is guaranteed by an O-ring. The seal between the cylinder head and the plunger is provided by the gasket 2. The limit stop is realized by the piston screwed onto the plunger and fixed with Loctite 275. A safety valve is screwed onto the cylinder base and prevents the rapid and uncontrolled lowering of the load in case the piping breaks.

The intermediate cylinder is fitted with end damping .

Disassembly of the intermediate cylinder:

- Raise the fork carriage. Hook up the fork carriage using slings and a crane or hoist. Position a solid, stable support underneath the fork carriage and lower it to rest on the support. Release the chain.

- Operate the emergency stop button and move the distributor levers in both directions to release the pressure from the circuit.

- Disassemble the hydraulic connection from the cylinder base.

- Disassemble the cylinder bracket.

- Extract the lift cylinder.

- Clamp the cylinder pipe in a vice positioned near the cylinder base (so that the vice does not deform the cylinder barrel).

- Unscrew the cylinder head using a hook spanner. If the cylinder head cannot be unscrewed, heat it with a flame.

- Extract the plunger from the cylinder barrel.

- Clamp the plunger in a vice using the protective jaws and unscrew the pulley support fork. The support fork is secured with Loctite 243.
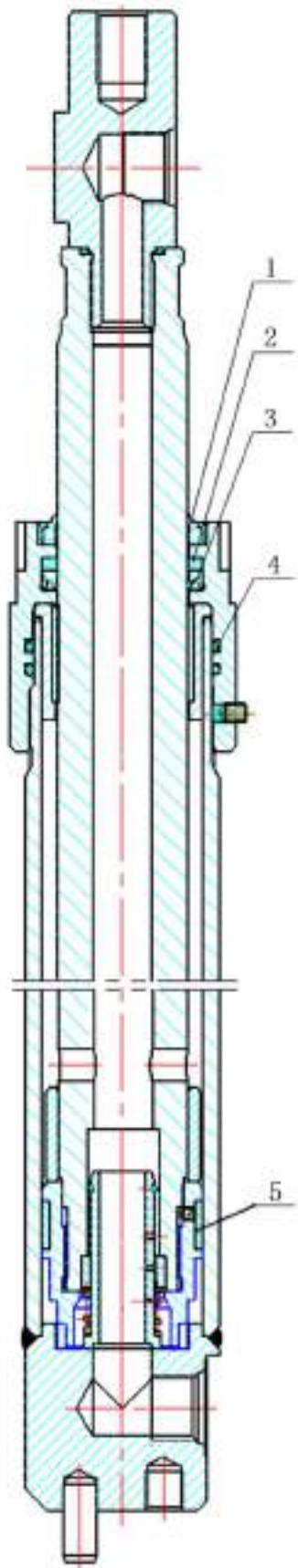
- Extract the cyli[...]
plunger.

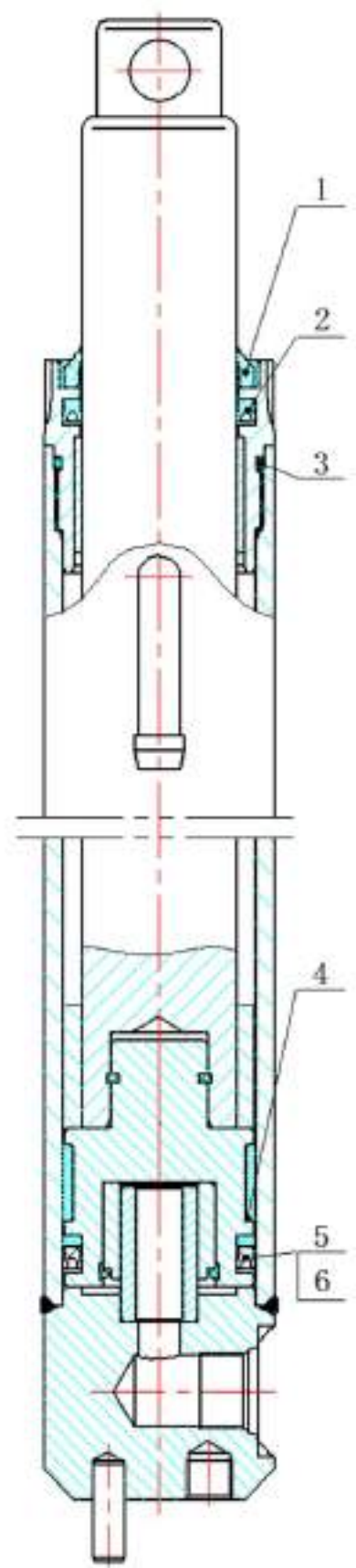**Assembly**

Reassemble by reversin[...]
sequence.

 NOTE

To reassemble the cylin[...]
piston , proceed as follo[...]

Cylinder head: Tighten[...]
having applied Loctite 2[...]
on the perimeter of the t[...]

Piston: Tighten with a t[...]
350 + 50 Nm, after havi[...]
275 on the entire surface[...]

**When finished reassen[...]
hydraulic system as de[...]
respective paragraph.**

 NOTE

When replacing the set of gaskets, do not disassemble the plunger piston.

Disassembly of the fork carriage

- Position the lift vertically.

- Disassemble the fork arms and any other equipment, if applicable.

- Raise the fork carriage slightly. Rest it on a solid, stable support.

- Completely lower the inner mast using the hydraulic system.

- Unhook the load chains from the fork carriage.

- Remove the screw of the fork carriage retaining device from the inner mast.

- Pull the fork carriage up and off the inner mast.

Adjustment of the support rollers: See functional unit in the respective paragraph.

Adjustment of the fork carriage retaining device: See functional unit in the respective paragraph.
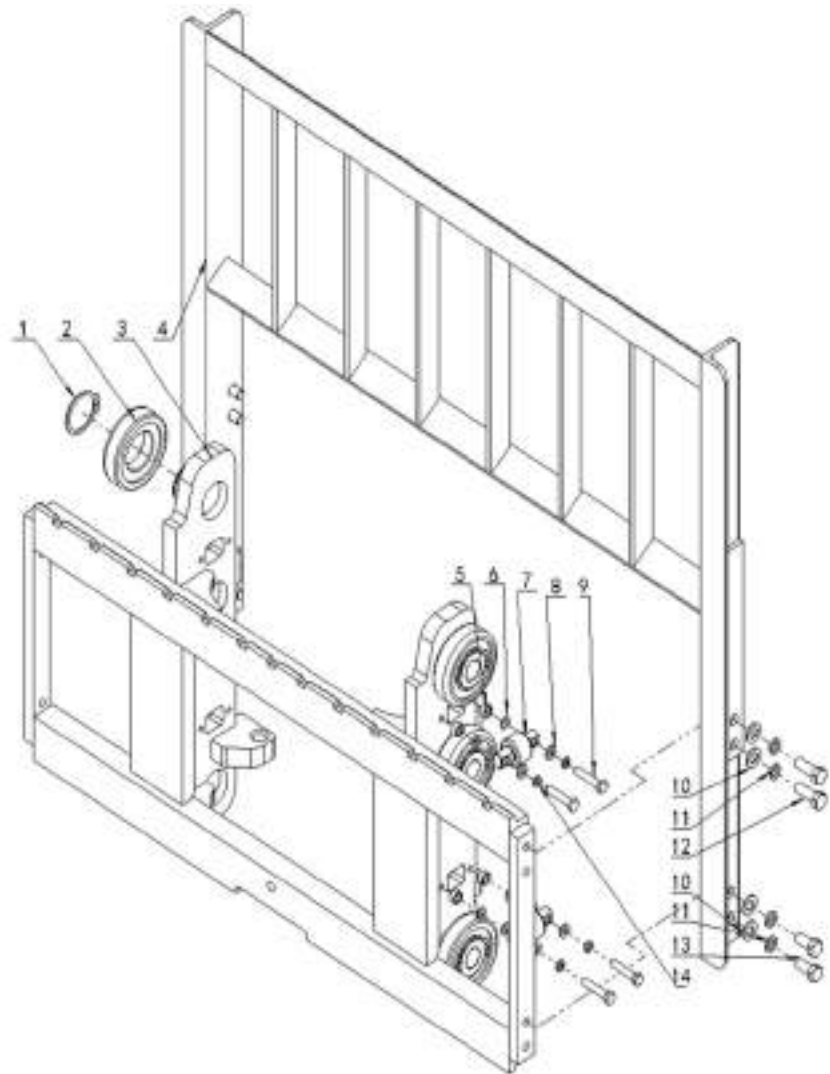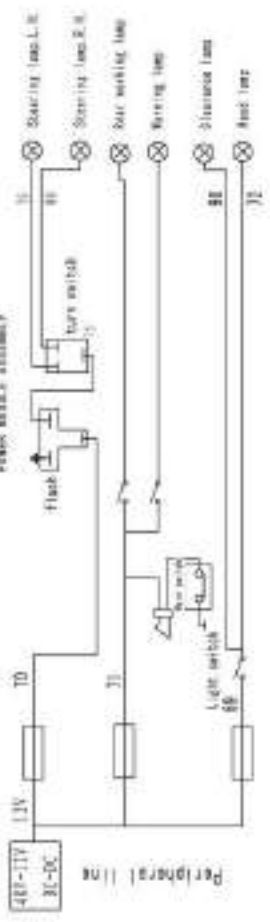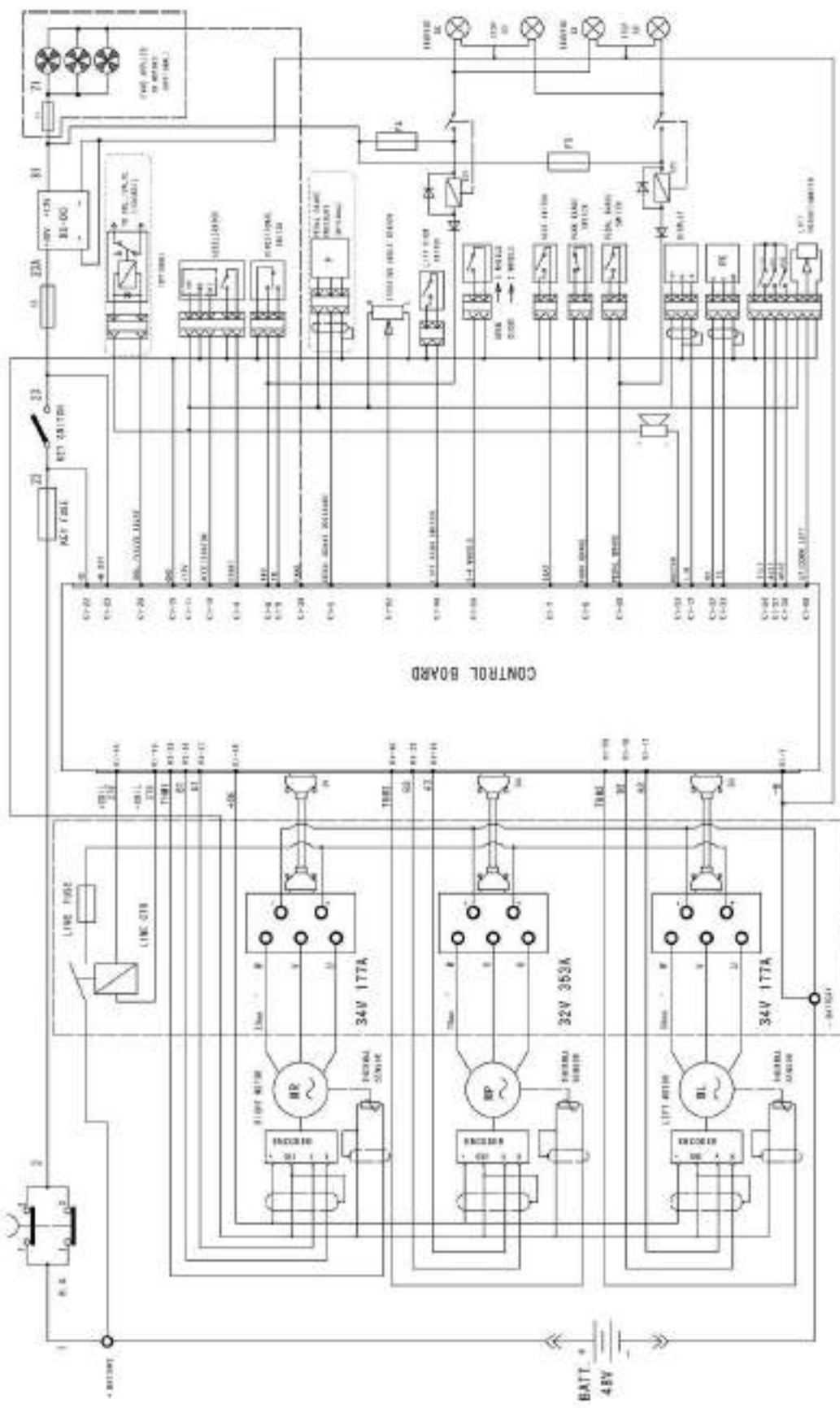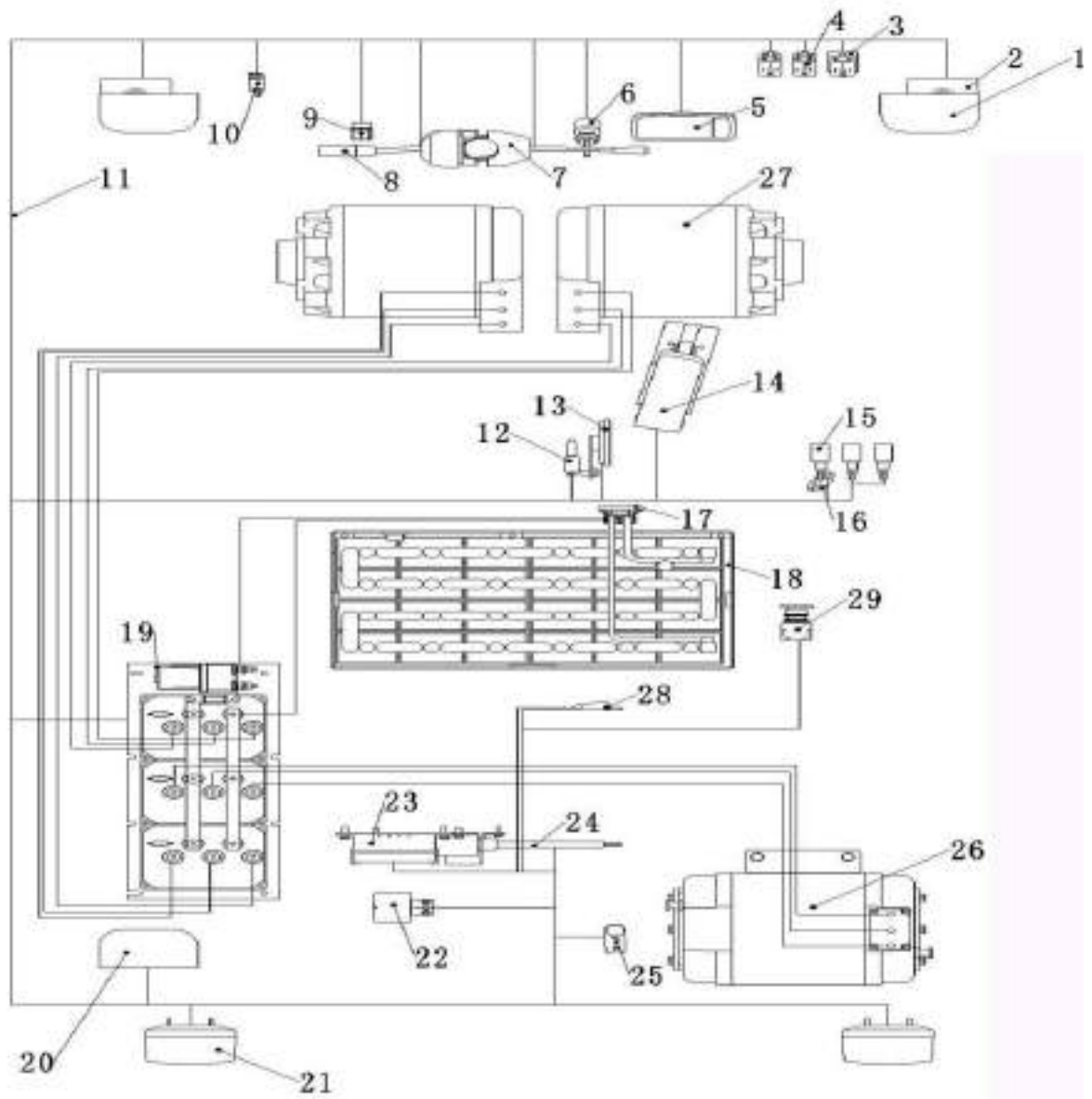
Tilt cylinder
Disassembly
Clamp the cylinder in a vice positioned near the cylinder base. Unscrew the threaded connector on the cylinder head side (the threaded connector extends into the cylinder chamber). Remove the protective cover (15), and push the cylinder head (9) back slightly. Compress the snap ring (11) through the small hole on the cylinder liner using a plug remover, and remove the snap ring by lifting it with a screwdriver (see figure A). Pull hard on the piston rod to extract the cylinder head from the cylinder.

Steering unit

Priority valve

P

LS

CF

EF

To other circuit

Hydraulic motor

Hydraulic pump

Oil tank
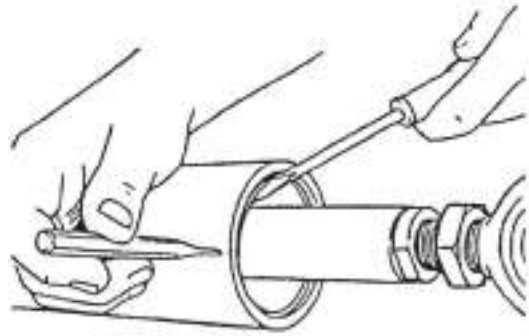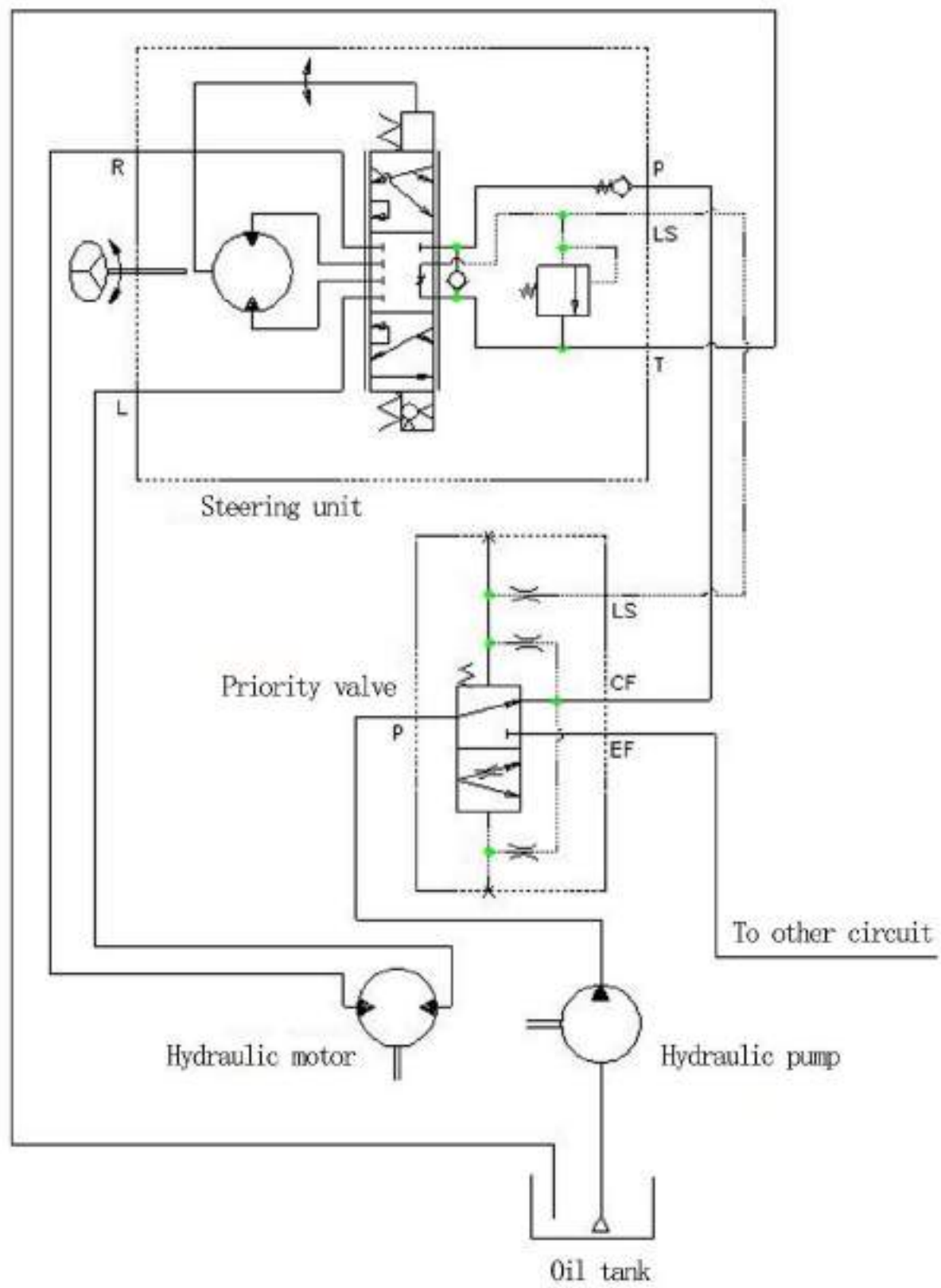
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