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Stand-on pallet stacker: T20/24 SP- T20/24 AP type 131

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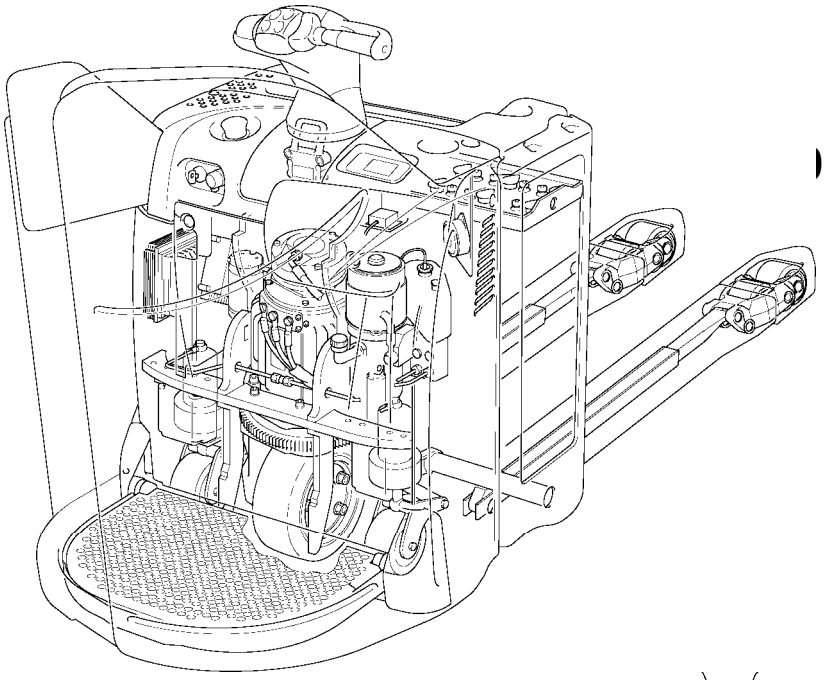
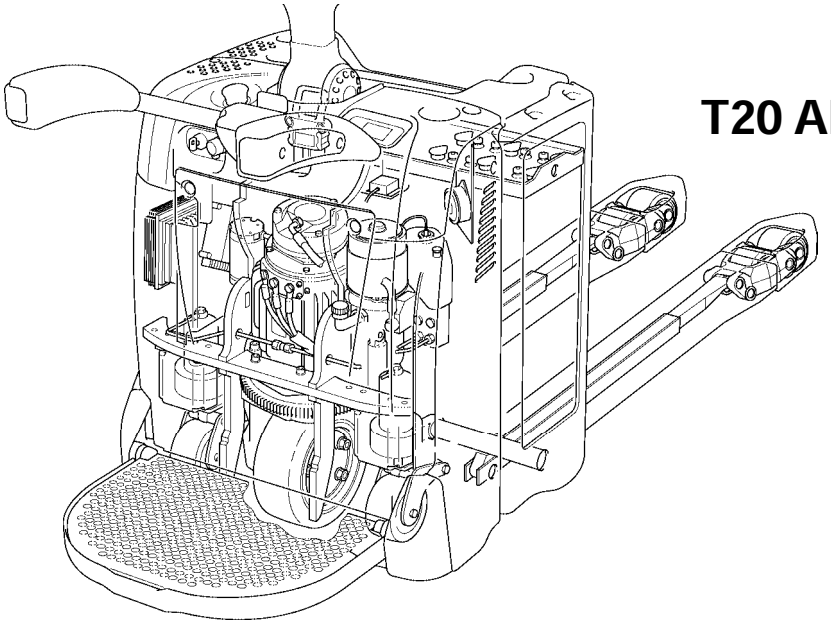


) SP



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STAND-ON PALLET STACKER T20/24 SP AND T20/24 AP TYPE 131

The **T20 SP/AP** type 131 trucks with nominal capacity of **2,000 Kg**, are configured as follows:

- Two chassis variants:
  . T20 **SP** with platform and fixed operator lateral guards. Driver stand equipped with a **handlebar**. Stand-on pallet stacker drive
  . T20 **AP** with platform and removable operator lateral guards. Driver stand equipped with a **tiller**. Stand-on or pedestrian pallet stacker drive

- Two types of battery compartments:
  . Vertical outlet for batteries up to 600Ah
  . Side outlet on rollers for batteries up to 480Ah

- L.A.C (Linde Alternate Control) controller with microprocessors for controlling:
  . the traction
  . the lift
  . the stabiliser control.

- Asynchronous traction motor (AC) 3 KW
- Pump motor group 1.0 KW (S3:15% usage) without maintenance.

- Controlled hydraulic stabilisers

- L.E.S (Linde Electrical Steering) controller with microprocessors for controlling the electrical steering:

- Steering control by a:
  . handlebar (T20 SP)
  . tiller (T20 AP).

- Steering motor 0.185 KW

- Checks, parameterisation and troubleshooting with the help of a PC, equipped with Pathfinder diagnostics software, connected to different control boxes (LAC, LES, multifunction indicator) via a CAN bus link.

The **T24 SP/AP** type 131 trucks are configured like the T20 SP/AP models but with a nominal capacity of **2,400 Kg** and a pump motor unit 1.5 kW (S3:15%)

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SAFETY

The terms **DANGER, CAUTION, ATTENTION** and **NOTE** are used to indicate special danger or special information for a special object:

DANGER means non-observance entails risk of death or injury, and/or risk of heavy material damage.

CAUTION means non-observance entails risk of serious injury and/or severe product damage.

ATTENTION means non-observance entails risk of damage to or destruction of the product.

NOTE: Indicates a special technical point which may not be immediately obvious, even to an expert.

SAFETY SIGNS

Most accidents and injuries that take place in workshops are caused by non-observance of certain essential prevention and safety rules. In most cases, these accidents could be prevented. It is necessary to know how to anticipate potential dangers and to take necessary precautions to keep risks to the minimum.
An attentive and cautious operator can prevent a high number of dangers.

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SAFETY INSTRUCTIONS

DANGER: Before undertaking any repair, apply the parking brake, switch off the ignition, disconnect the battery and, unless operation does not allow it, wedge the ground wheels firmly at the front and back.

DANGER: Before undertaking electrical tasks or checks, lift the truck so that the drive wheel no longer touches the ground, and wedge the truck firmly in this position.

DANGER: Take all necessary precautions against fire when working with batteries.

DANGER: Before undertaking repairs or checks on the extension chassis, the fork arm carriage or the mast in raised position, always make sure that these components are blocked firmly against any accidental movement.

DANGER: Make sure that all lifting equipment used has the adequate capacity and appropriate certification. All the wedges, jacks, chains etc. must be inspected regularly and must be used only for the stipulated purpose.

DANGER: While towing or lifting, use only the prescribed fixing points. Attach the connections carefully. Make sure that the provided pins and screws or studs are fixed tightly before applying any load. Never stand close to traction bars, slings or chains to which a load has been applied.

WARNING: Before disconnecting hydraulic connections, make sure that there is no pressure in the system.

CAUTION: Do not allow hydraulic oil under pressure to penetrate the skin (for example, in case of leakage). See a doctor immediately if this happens.

DANGER: Never wear rings, wristwatches, jewellery, loose or hanging clothing such as ties, torn clothes, scarves, unbuttoned jackets that can get caught in the parts during movement. Always wear the recommended safety garments.

DANGER: Never carry out maintenance or service operations on the truck with anybody seated on the seat unless the person in question is a duly authorised and trained technician and is participating in the current task.

DANGER: Never start the machine or control the operation of any of the accessories from a position other than the driver's seat.

DANGER: The step-ladders or access platforms used to access the machine during the servicing at the workshop or on the ground must conform to the applicable rules.

DANGER: Label the relevant controls to clearly indicate that a service or repair task is in progress.

DANGER: Never use white gasoline or diesel fuel as cleaners. Only use non-inflammable and non-toxic solvents sold in the market.

CAUTION: It is compulsory to wear safety equipment, i.e. goggles and respiratory mask when working with compressed air.

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HANDLING FUELS, LUBRICANTS AND COOLANTS

These fluids must always be used in conformance with the instructions supplied by the manufacturer.
They must be stored only in regulation containers, and only in the locations designated for this purpose.
They can be inflammable and hence must not be exposed to hot objects or to flames.
Clean the relevant parts before carrying out lubrication, changing filters, or working on the hydraulic system.
Use only proper receptacles to fill up fuels or lubricants.
Observe the instructions supplied by the manufacturer for safety, usage and disposal of lubricants and cleaning products.
Avoid overturning fuel or lubricants. In case the fluid has overturned, use an absorbent material to clean the ground and to dispose off the product in the stipulated manner.
Always dispose off used or contaminated lubricants in the stipulated manner. Observe the applicable laws and regulations.
Dispose off replaced parts, filters, etc. without destroying the environment.

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1 TRACTION MOTOR

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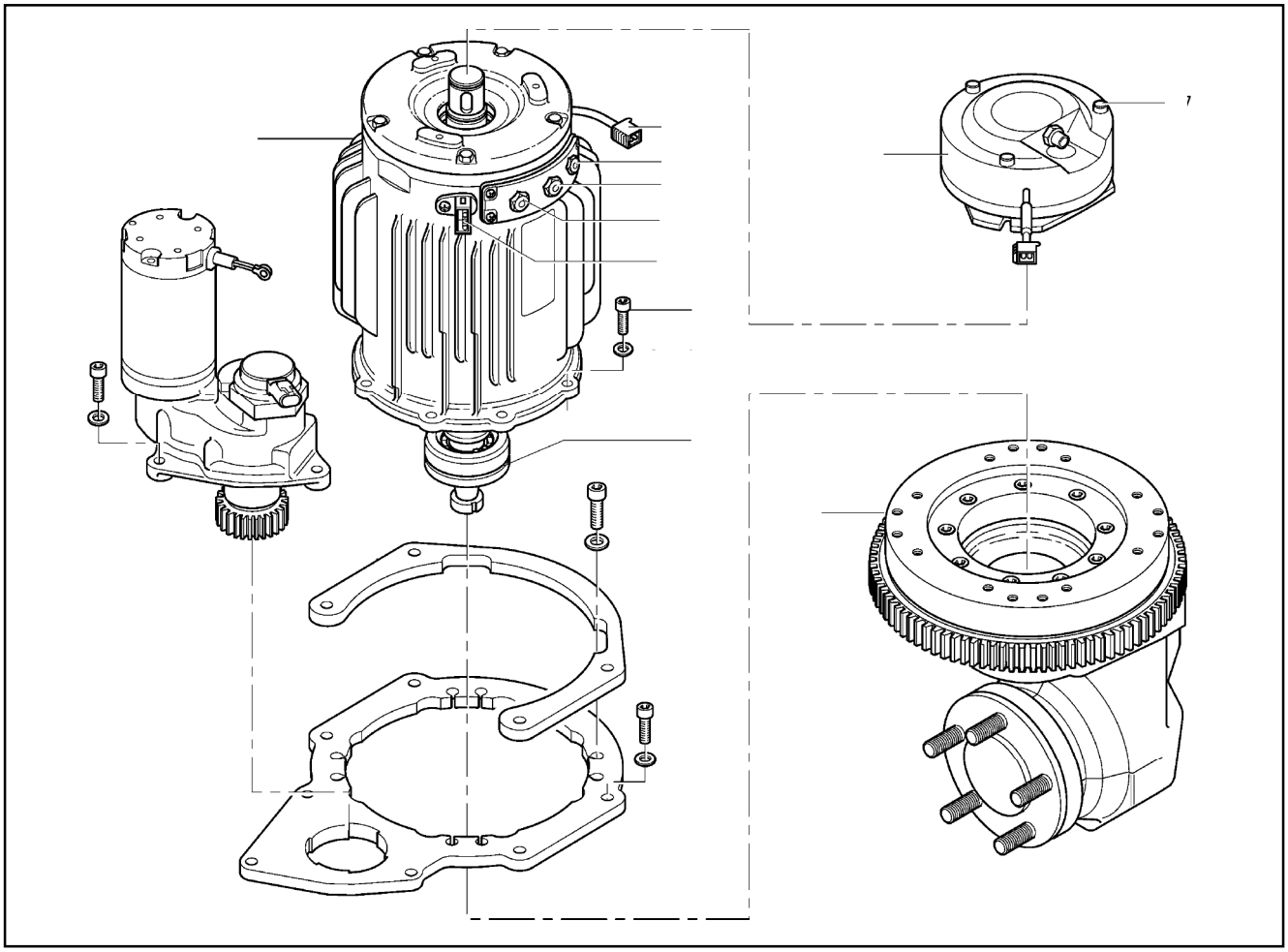
1.1 DESCRIPTION



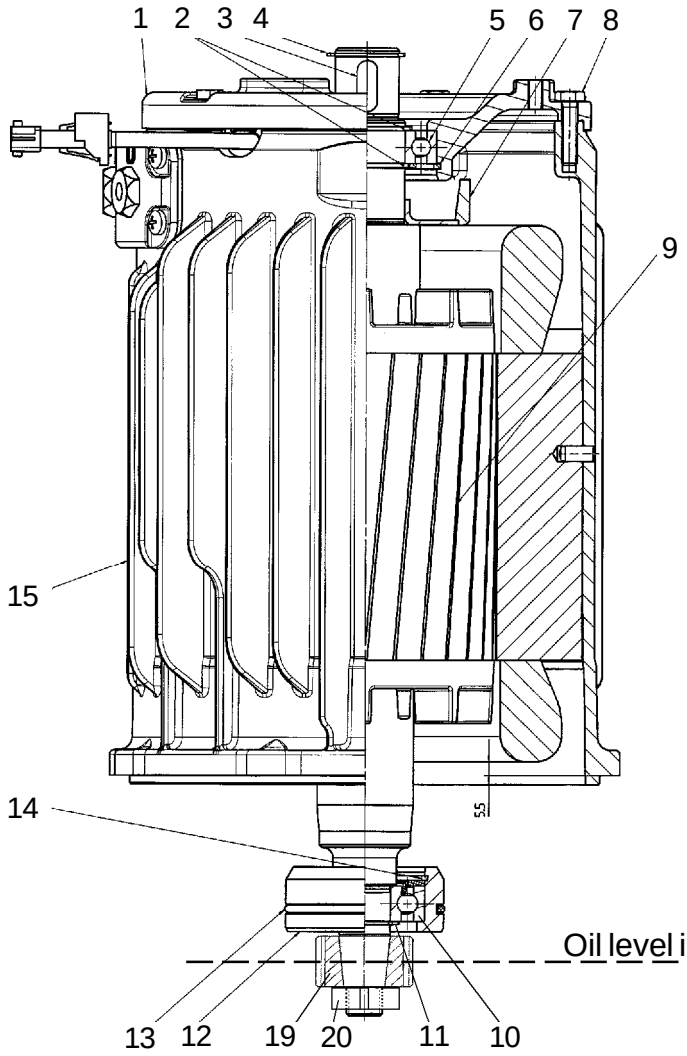
Asynchronous traction motor (AC) mounted vertically on the reduction gear, which is fixed on the motor unit support.

Electrohydraulic brake mounted directly on the motor shaft.

Motor without maintenance controlled by:
- 1 speed sensor (1B2)
- 1 temperature probe (1B6).

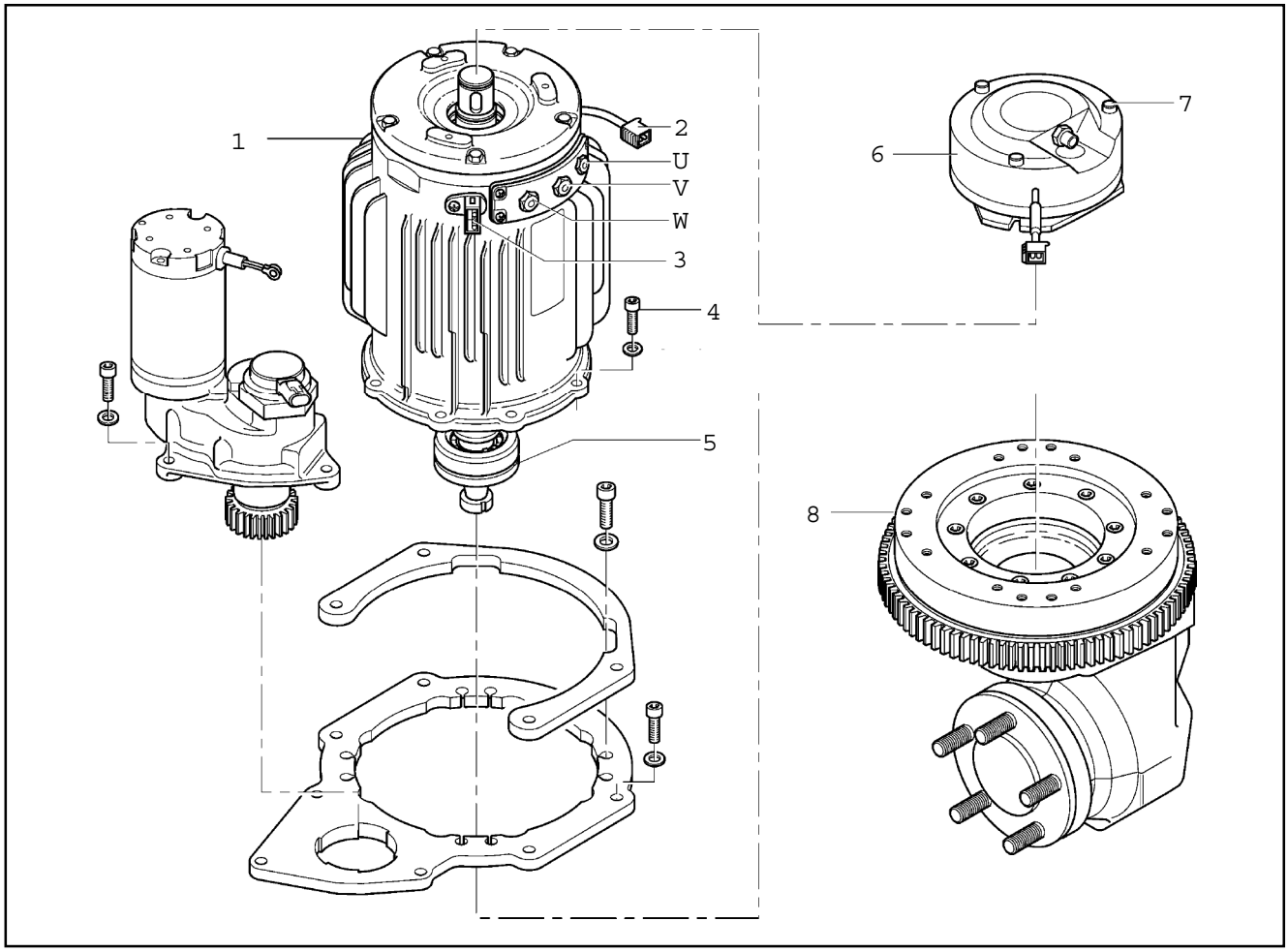
1.2 TECHNICAL DATA

Asynchronous motor (AC)	24 volts
Power consumption	3 KW
Maximum speed	4,865 rpm
Torque at max. speed	5.2Nm
Max. torque	35 Nm (590 rpm)



1 Flange
2 Circlips - 30 x 1.5 FST - DIN 471
3 Key - 8 x7 x 20 DIN 6825
4 Circlips -25 x 1.2 FST - DIN 471
5 Ball bearing - 6006 2 RS1/ C3GJN DIN 625
6 Circlips 55 x 2 FST - DIN 472
7 Crown wheel (for measuring the speed)
8 Screw D M 6x25-St-A2E - DIN 7500
9 Rotor
10 Ball bearing ICOS-D1B04 TN9
11 Circlips 20 x 1.2 FST - DIN 471
12 Antifriction bearing (reduction gear housing)
13 O-ring 56 x 3.90 SHORE A
14 Circlips 47 x 1.75 FST - DIN 472
15 Stator
16 Connector (1X25): motor temperature probe 1B6
17 Terminals for the motor supply cables
18 Connector (1X2): Speed sensor 1B2
19 Drive pinion gear 21 teeth
20 Nut M14 X 1.5 (tightening torque 50 Nm)

1.3 REMOVAL OF TRACTION MOTOR



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1 Traction motor
2 Temperature probe connector (1X25) 1B6
3 Speed sensor connector (1X2) 1B2
4 Screw CHC M6 X 20 (quantity 8)
Tightening torque 9.5 Nm
5 O-ring
6 Electrohydraulic brake
7 Brake mounting bolt (quantity 3)
Tightening torque 9.5 Nm
8 Reduction gear

U, V, W Power cable terminals
for motor supply
Tightening torque 9 Nm

Note:
To remove the traction motor, it is recommended to first remove the motor unit (see section 2.1.1 Removal/installation of motor unit)

On clearing the chassis, the motor unit can be manipulated more easily:

- Unscrew the 8 motor / reduction gear mounting bolts (4).
- Sling the motor (1).
- Extract the traction motor from the top carefully and by using appropriate equipment.

WARNING
Dangerous handling. The motor is heavy, proceed with caution to remove the reduction gear motor. It is recommended to wear gloves.

Installing the traction motor

- To install the traction motor, proceed in the reverse order as for removal.

- Replace the O-ring (5) and grease it before refitting the motor (1) in the reduction gear (8).

- Check the tightening torque of all the joints and connections of the motor (see section 2).

CAUTION
- To prevent a short-circuit, it is important to clamp the 3 terminals U, V, W of the traction motor supply cables (tightening torque 9 Nm).

- It is always possible to use an open-end wrench to hold them while tightening.

- Make sure that all the fixtures are tightened at the correct torque of 9.5 Nm

- Check the electrohydraulic brake air gap setting (see section 4).

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2 DRIVE - TRANSMISSION

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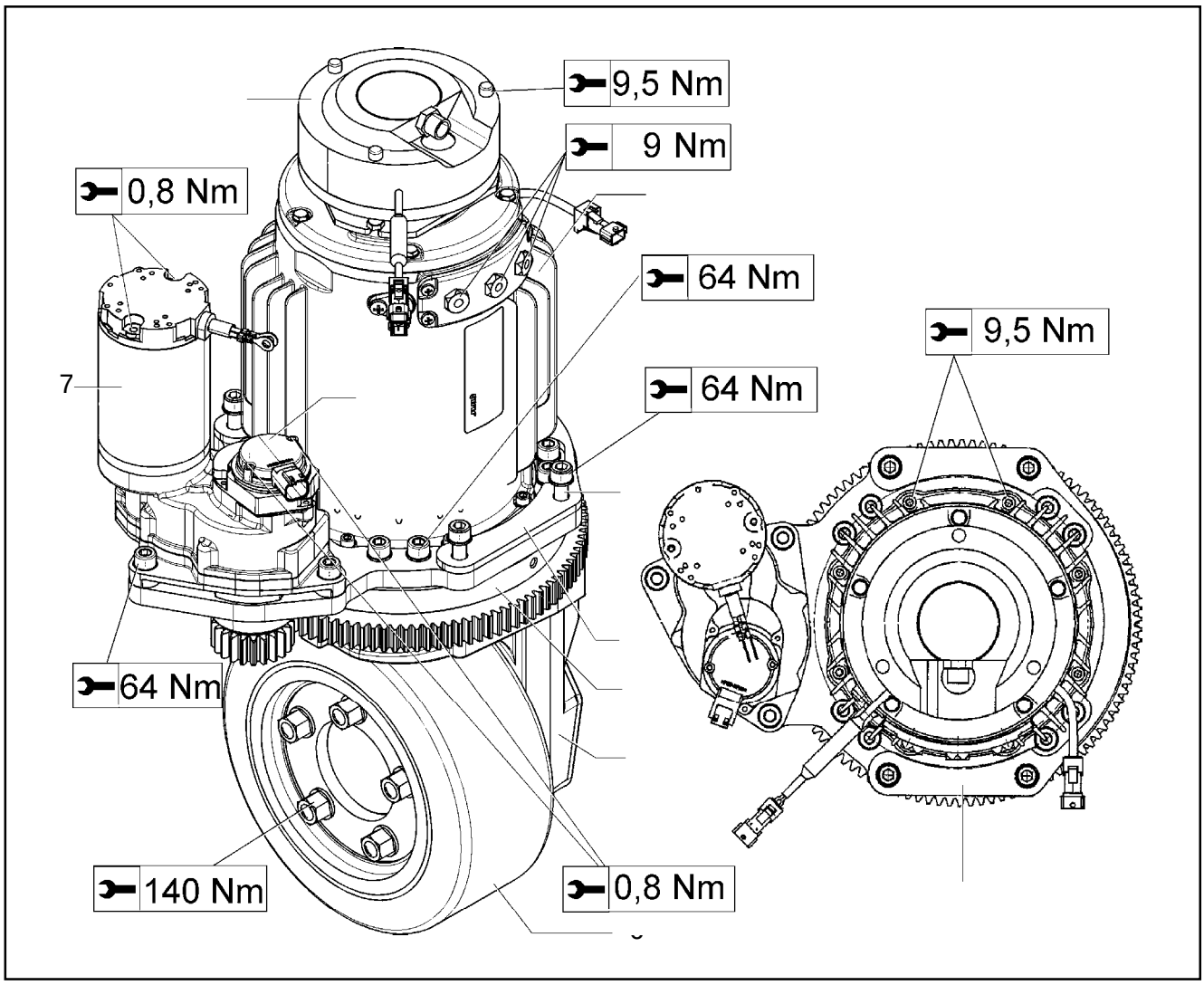
2.1 DRIVE UNIT



Drive unit mounted on a turntable (4); steering ensured by an electrical gear motor (7), which positions the turntable.

Motor wheel (6) powered by a single-stage reduction gear (5) and a conical ring gear.

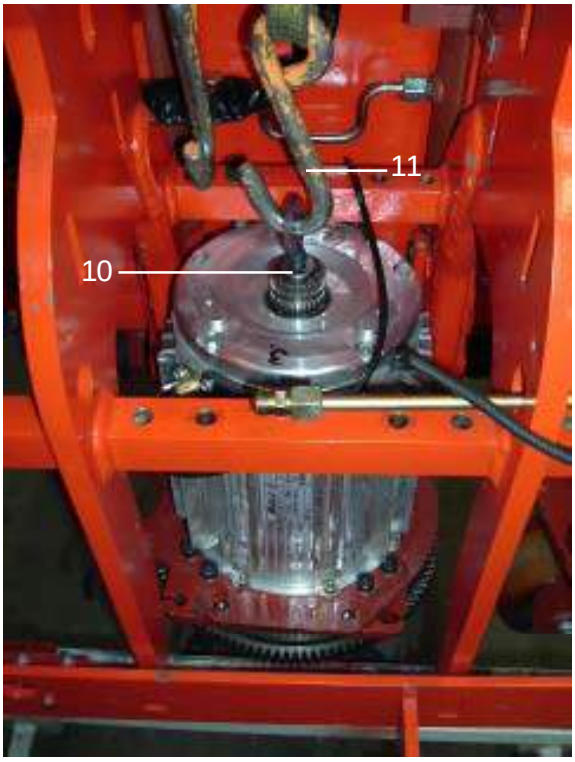
Asynchronous 3 kw traction motor (1) mounted vertically on the reduction gear (5).

CAUTION
For a rubber or unbranded rubber motor wheel , a shim (3) is added.

2.1.1 Removing/replacing the drive unit

CAUTION
Compulsory lifting potentiometer

- Sling the truck at least 60 cm from the ground and brace it on platforms to extract the drive unit and its support from the bottom.
- Turn the variator plate and the handlebar plate to the back.
- Dismantle the left stabiliser (see section 4).
- Disconnect the steering potentiometer (8), the steering motor (7) and the traction motor (1).
- Disengage the electrohydraulic brake (2) (see section 4).



CAUTION
To prevent hydraulic leaks on the brake linings, don't dismantle the brake hydraulic hose pipe.

- Screw on a slinging ring (10) at the end of the motor spindle.
- Fasten 1 sling (11) and stretch it slightly with the hoist.
- Unscrew the 4 fixing screws (9) of the motor/ chassis support unit.
- Extract the entire drive unit carefully from the bottom (80 Kg).

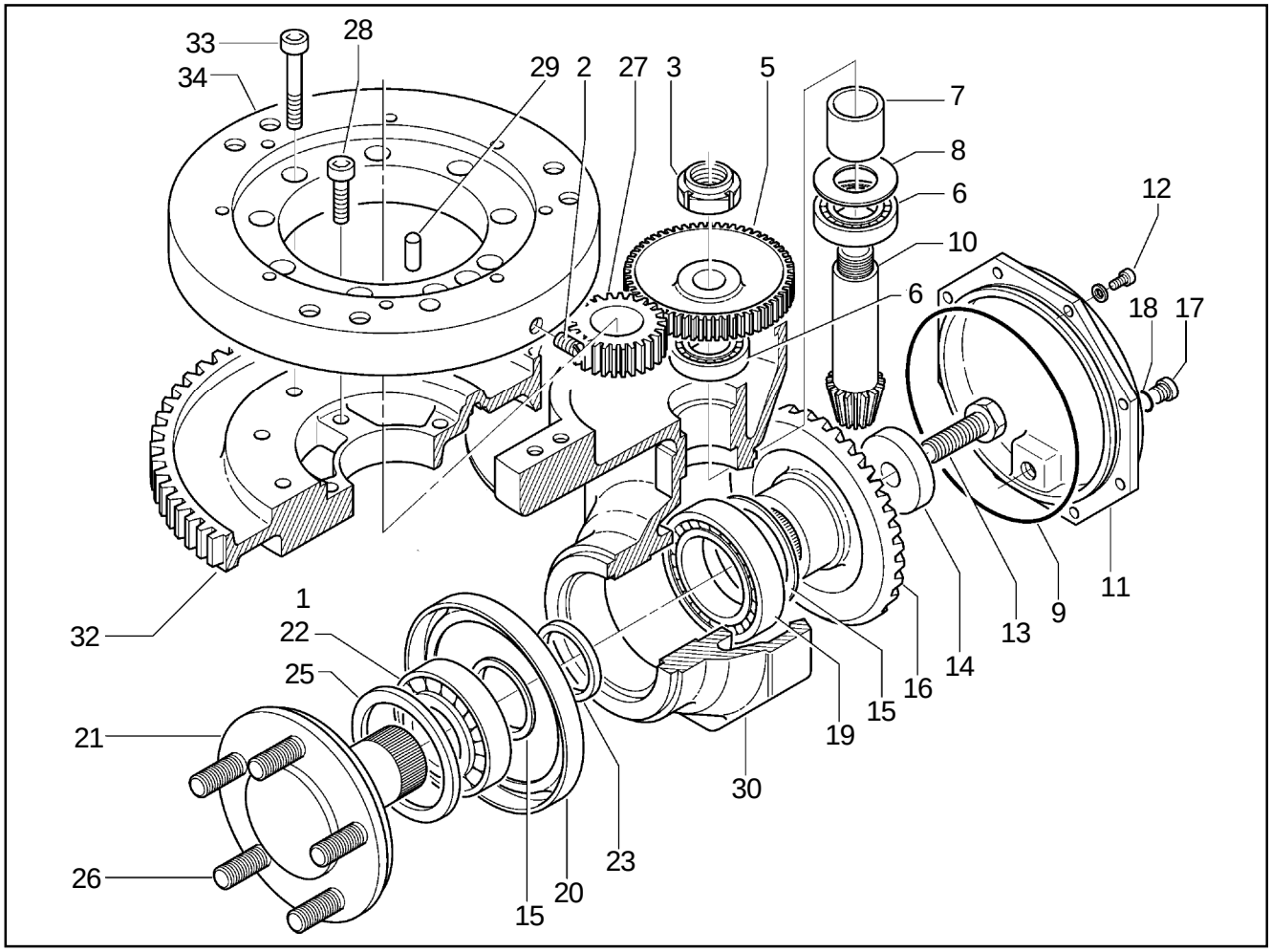
WARNING
Dangerous handling. The drive unit is heavy, proceed with caution to disengage it from the chassis.
It is recommended to wear gloves.

To reinstall the drive unit, proceed in the reverse order as for removal.

CAUTION
To prevent a short-circuit, it is important to clamp the 3 terminals U, V, W of the traction motor supply cables (tightening torque 7.5 Nm).
- It is always possible to use an open-end wrench to hold them while tightening.

- Check the electrohydraulic brake air gap setting (see section 4)

2.2 REDUCTION GEAR

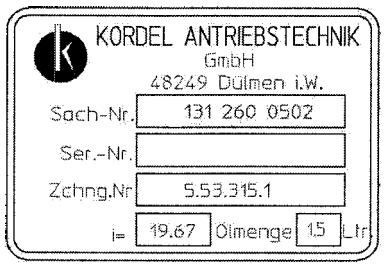


Motor wheel powered by a single-stage reduction gear and a conical ring gear.

Reduction gear in rotation by a slew ring fixed on the chassis.

Maintenance:
Permanently greased slew ring.

The type and serial number are identical on a sign plate fixed on the reduction gear.



2.2.1 Technical data

Reduction gear	T20 / T24
Load on the drive wheel	1.5 T maxi
Number of teeth: slew ring	108
Speed reducing ratio	19.67
Oil volume	1.5 litres
Maximum torque at the wheel (static)	1,375 Nm
Maximum torque at the wheel (dynamic)	916 Nm
Torque at wheel:	229 Nm

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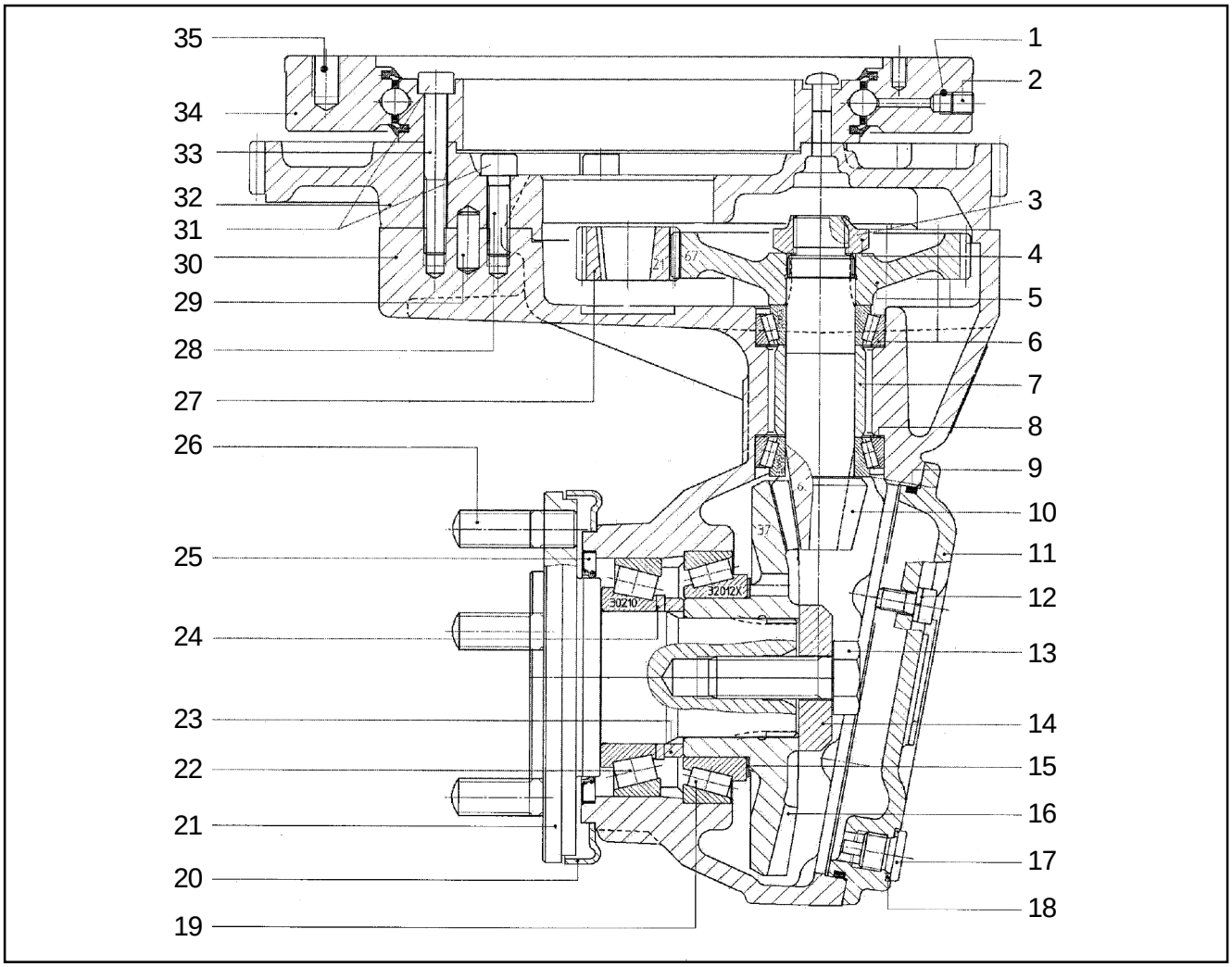
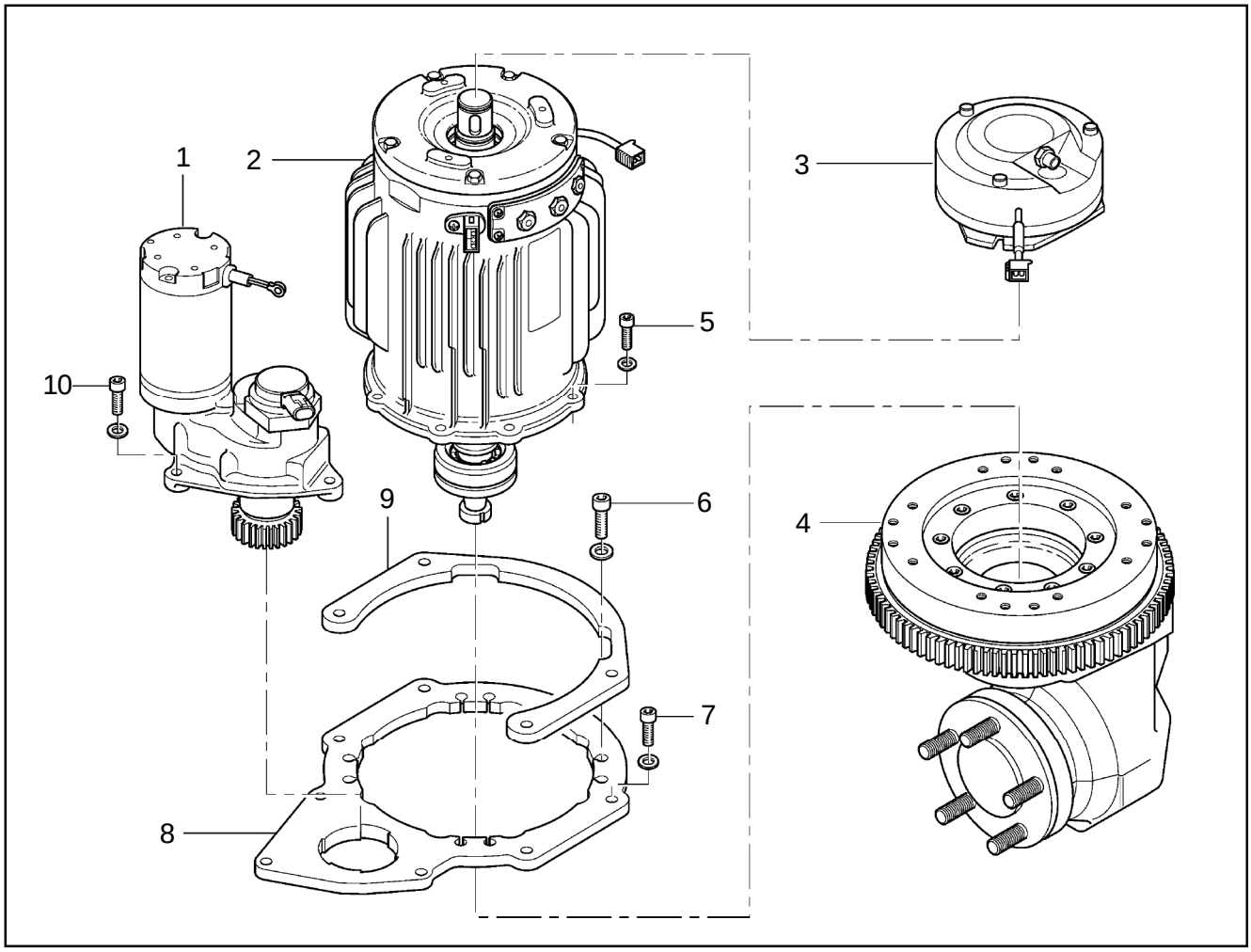


1 Grease duct
2 Headless screw M8X1.8
(for special applications, 2 lubricators can be mounted in place of the screws).
3 Tightening torque 170 Nm
4 Lock nut
5 Right pinion
6 Trolleys with tapered rollers
(internal bushes mounted with loctite 603)
7 Spacer
8 Shim
9 O-ring
10 Tapered pinion with tail
11 Cover
12 CHC M8X16 screws (tightening torque 23 Nm)
13 H ISO 4017 M16x45 screws - 8.8-A2C
(Tightening torque 290 Nm)
14 Lock washer
15 Control shim
16 Conical ring gear
17 Drain plug
18 Drain plug joint
19 Trolley with tapered rollers
20 Cover
21 Wheel shaft
22 Trolley with tapered rollers
23 Spacer (60 / 7.5)
24 Shim
25 Seal ring (mounted with loctite 574)
26 Wheel bolt (tightening torque 35 Nm)
27 Input pinion
28 CHC M8X30 fixing screws toothed ring (see tightening torque mark 31)
29 Centring bolt
30 Reduction gearbox case
31 Tightening torque 23 Nm
32 Steering toothed ring (z=108; m=2.5)
33 CHC M8X60 mounting screws, pivot bearing
(see tightening torque mark 31)
34 Slew ring
Note: Lifetime lubrication
35 Shim mounting tapped holes

2.2.2 Removal / reinstallation of reduction gear



1 Steering motor reducer
2 Traction motor
3 Electrohydraulic brake
4 Reduction gear
5 Screw CHC M6 X 20 (quantity 8)
Tightening torque 9.5 Nm
6 Screws Chc M10X30 (quantity 8)
Tightening torque 64 Nm
7 Screws Chc M10X35 (quantity 4)
Tightening torque 64 Nm
8 Drive unit support plate
9 Shim (for rubber or non-branded rubber drive wheel).
10 Screws Chc M10X30 (quantity 3)
Tightening torque 64 Nm

Note:
To remove the reduction gear, it is recommended to first remove the drive unit (see section 2.1.1 Removal/installation of motor unit)

On clearing the chassis, the motor unit can be manipulated more easily:

- Drain the reduction gear (4)
- Remove the steering motor reducer (1)
- Remove the traction motor (2)
- Pull out the support plate (8)

CAUTION
The traction motor and the reduction gear are heavy. Use handling gloves to disengage the motor and the reduction gear from the chassis.

To reinstall the reduction gear, proceed in the reverse order as for removal.

Note:
In the chassis, the position of the drive wheel is at the left and the reduction gear is at the right.

- Fill the reduction gear with the stipulated oil quality (SAE 80 W 90, API, GL5, MIL.L 21DSC quantity 1.5 l).

CAUTION
Following this operation, it is absolutely necessary to check the electric steering control.
(see section 4.5: steering motor reducer).

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3 TRUCK STRUCTURE

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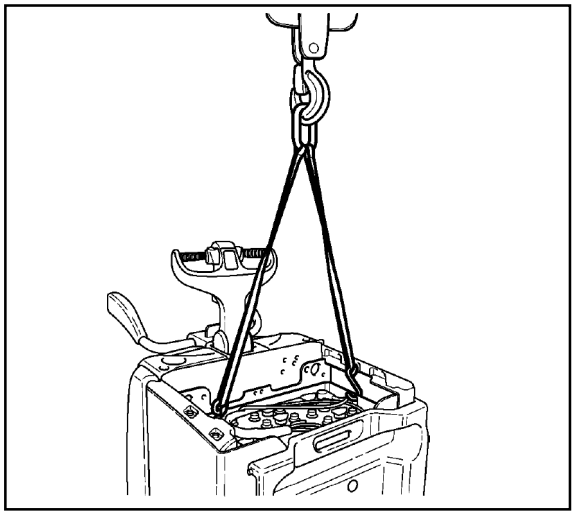
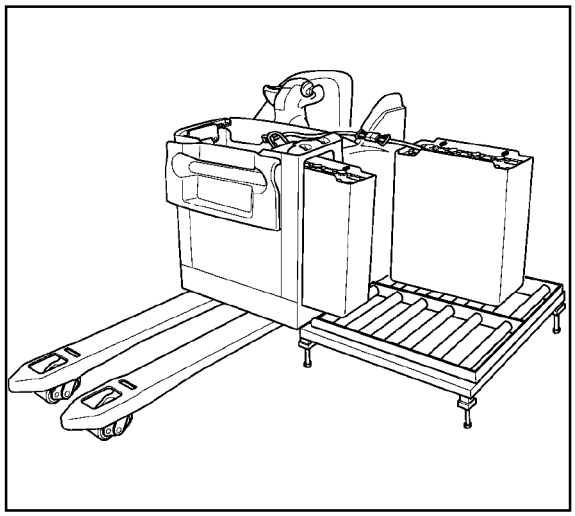
3.1 BATTERY COMPARTMENT.

Two types of battery compartments:
- with vertical outlet for batteries with capacity up to 600 Ah mounted in conventional cases.



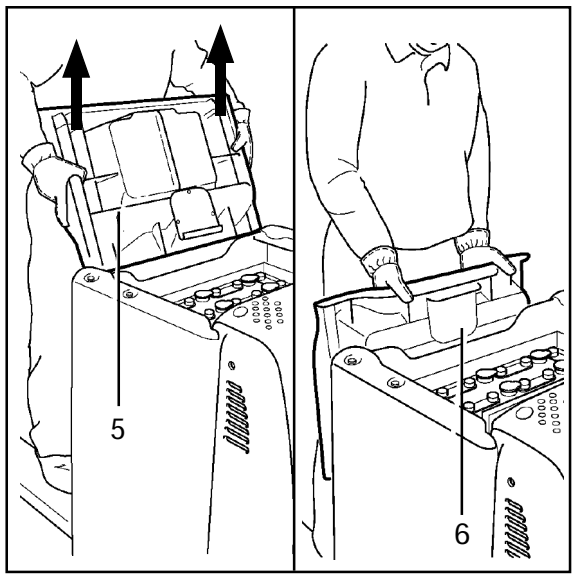
- with side right or left outlet (option) for batteries with capacity up to 480 Ah mounted in special cases equipped with attachment pads.



In each case, the battery cover (5) enables easy access to the battery elements:
- Disconnect the contact and press the emergency isolator.

Open cover:
- Raise the cover to the forks until raised vertical position stop.

Close cover:
- Pull the cover to horizontal position with the help of its handle.



☞ NOTE
- It is possible to remove the cover (5) after completely opening it, remove it vertically to access the battery elements more easily.

- A bar (6) helps suspend the cover on the rim of the battery box.

3.1.1 Battery with side outlet:

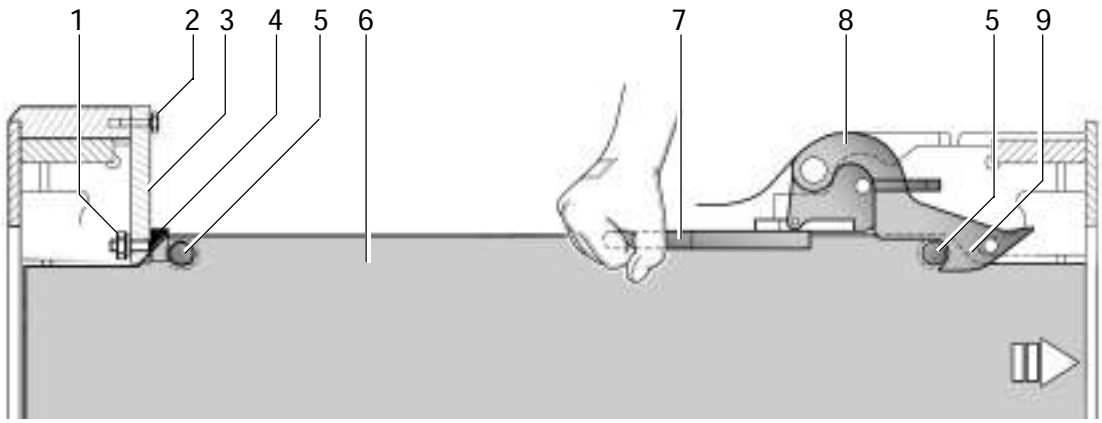


Figure 1

The locking system ensures the maintenance of the battery in its compartment.

With the battery side outlet, the locking contact (10) automatically controls the blocking of the hydraulic stabilisers for a change in safety.

When the battery is not locked well, the truck speed is restricted to 1 km/h and the battery cover does not close.

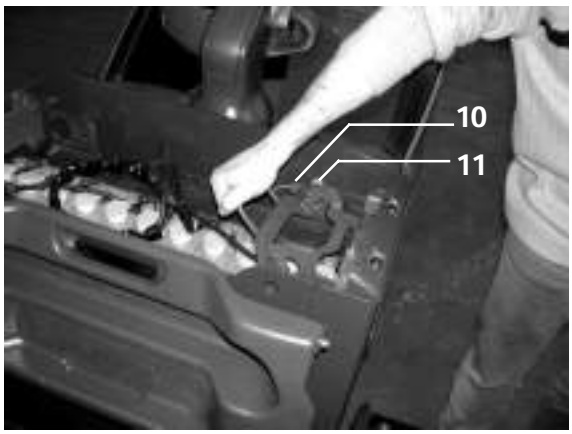
The battery can be removed from the left or right of the compartment. The components of the locking device are interchangeable.

MAINTENANCE:
To ensure that the battery lock works properly, it is important to:

- control, clean and lubricate the locking handle mechanism (8).
- check the status of the attachment pads (5) of the case with battery (6).
- check the control of the rubber bumpers (4). Battery locked and the handle (7) pulled in on the battery element side, the attachment pads (5) must be against the rubber bumpers (4)
- check the battery stop fixtures (3)
- clean and lubricate the battery trolley wheels.

Figure 1:

1 Rubber bumper counter-nut
2 Mounting screws HM8X16 for the battery stop (3)
3 Battery stop
4 Adjustable rubber bumper
5 Attachment pad welded onto the battery box
6 Battery box
7 Battery locking handle
8 Battery locking lever
9 Battery locking lever hook
10 Battery locking contact 1S19 (magnetic sensor)
11 Mobile magnet



3.2 DRIVER PLATFORM

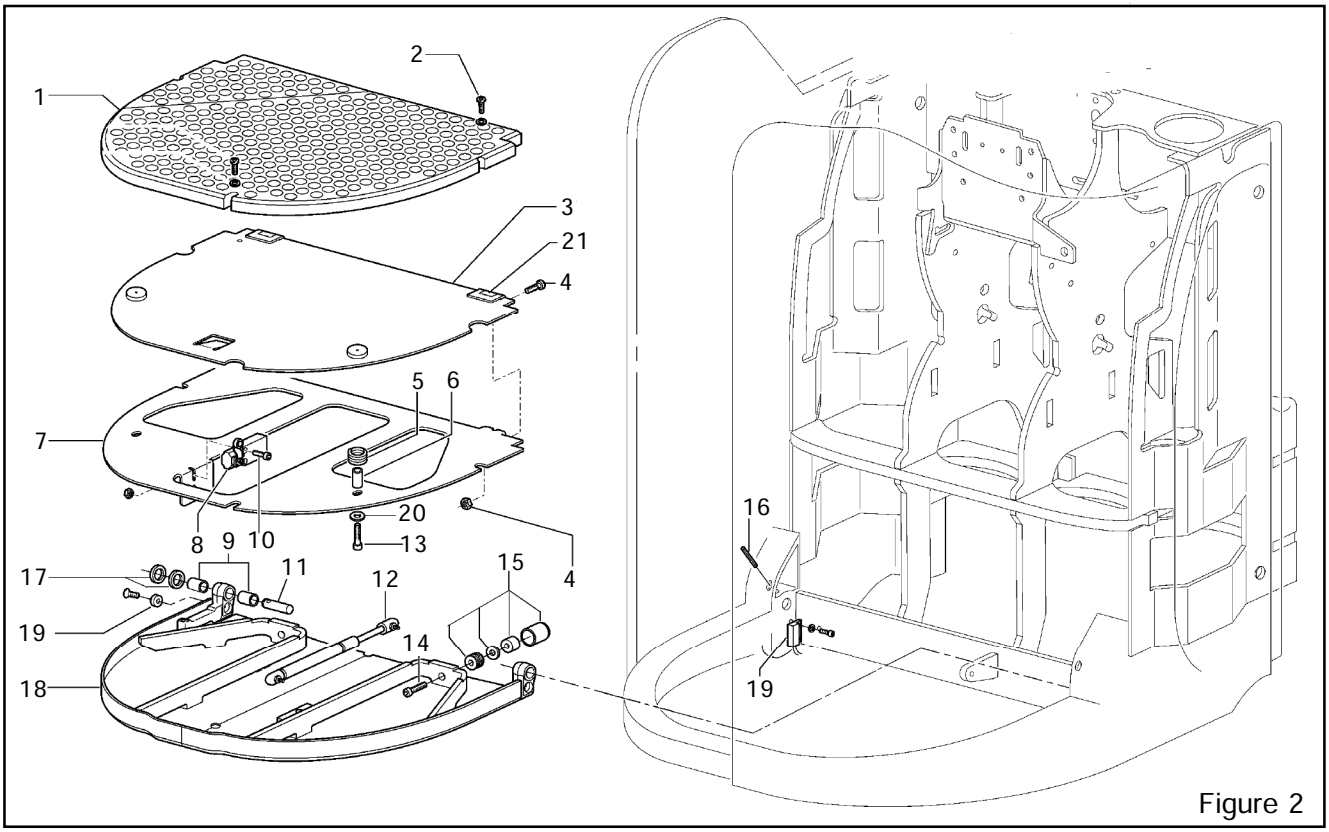


Figure 2

Driver stand equipped with a suspended platform (18) with an integrated operator presence device.

- Fixed platform in T20 SP.

- Removable platform in T20 AP.
  A gas cylinder (12) pulls up the platform in raised position.
  A contact 1S15 (19) determines the high or low position of the platform

The platform in low position rests on 2 cushion pads (15) to absorb the shocks and vibrations.

A flexible and non-skid rubber carpet (1) covers the floor.
NOTE:
A non-skid plate with wire meshing replaces the rubber carpet in the cold chamber versions.

Figure 2 and 3:

1 Rubber mat
2 Floor mounting plate fixed (7) on (21) (3 round headed screws M6x12)
3 Mobile floor plate
4 Floor mounting plate mobile (3) on (7) (2 round headed screws M8x20 +2 nuts H M8)
5 Mobile floor retraction spring
6 Spacer
7 Fixed floor plate
8 Operator presence contact 1S9
9 Platform articulation rings
10 Contact CHC M4x20 mounting screws 1S9
11 Platform articulation axes
12 Platform return gas cylinder (only in T20AP)
13 Mobile floor mounting screws M6x30
14 Mounting screws CHC M8x60 for platform cushion pads
15 Platform cushion pads
16 Spiral stop dowels for articulation axes (11) of the platform
17 Platform articulation rings
18 Suspended platform
19 Platform position contact (1S15) (only in T20AP)
20 Washer
21 Mobile floor hinge

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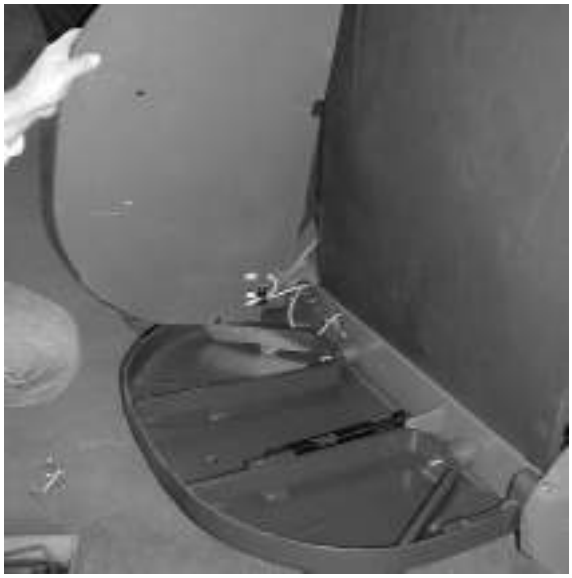
3.2.1 Removal/Installation of the platform



- Remove the 3 screws (2).
- Remove the floor (3) and (7)
- Disconnect the connector (1X9) of the operator presence (8) contact.

T20AP:
- disconnect the connector (1X20) of the platform position sensor (1X20).
- Remove the gas cylinder (12).

- Chase the stop dowels (16) for articulation axes (11) of the platform.

- Lock the platform with full safety.
- Extract the 2 articulation axes of the platform with the help of an extractor.
- Retrieve the 2 teflon rings (17).

To reinstall, proceed in the reverse order as for removal.

REMARKS
Before remounting the articulation axes (11):
- Align the axes with the dowel holes of the chassis.
- Don't forget the teflon rings (17).

T20 AP:
- To refit the gas cylinder, lift the platform in vertical position.
- In PathFinder, check that the platform position contact (1S15) is working properly.

3.2.2 Truck operator presence device

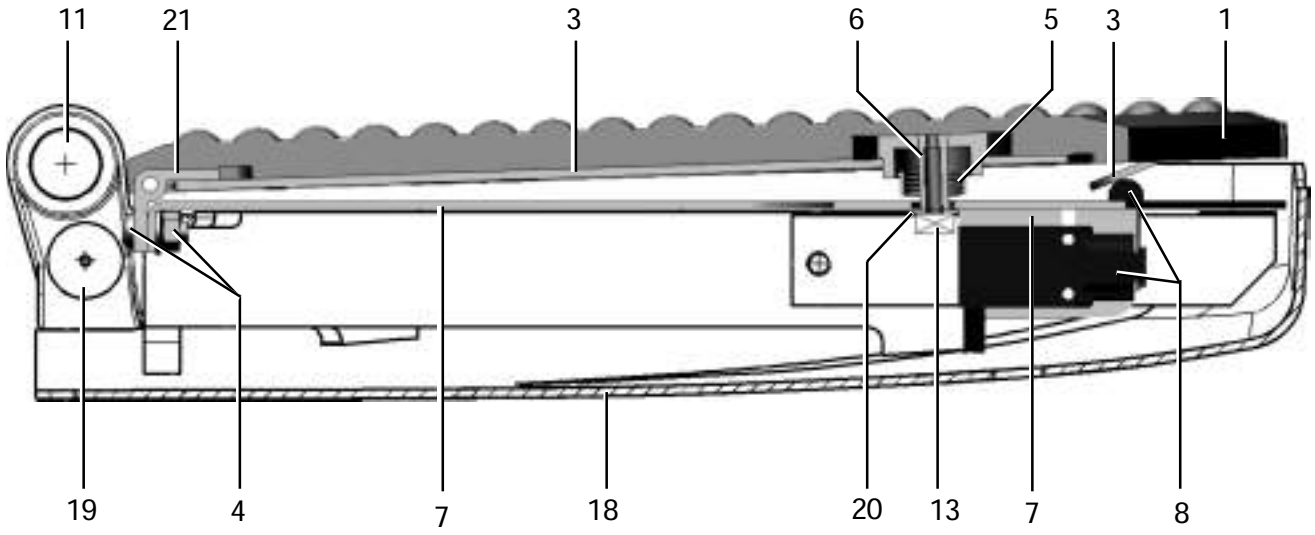


Figure 3

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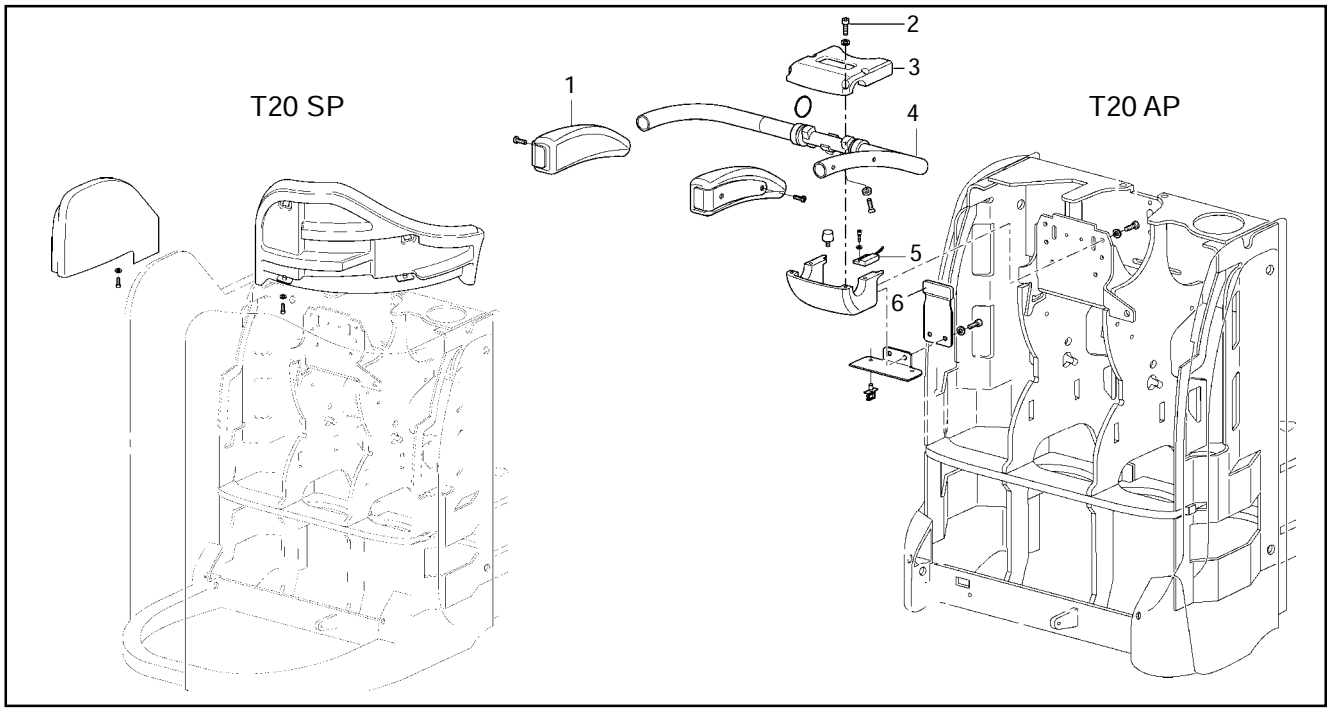
The operator presence detection system includes:
- 1 fixed floor (7)
- 1 operator presence contact 1S9 (8)
- 1 articulated mobile floor (3)
- 1 mobile floor retraction spring (5) in high position

Operator not present on the platform:
- Mobile floor in high position
- Contact 1S9 not activated
- Traction not authorised.

Operator present on the platform:
- Mobile floor in low position
- Contact 1S9 activated
- Traction authorised.

Truck operator presence contact control 1S9:
- Lock the truck
- Connect the PC to the diagnostics connector on the instrument panel
- Check the switching of 1S9 in the Pathfinder menu.

3.3 LATERAL GUARDS



T20 SP:
- Fixed lateral guards
- Driver always on the platform.
- Translation speed 10 km/h in the two directions of travel.

T20 AP:
- Removable lateral guards:
- Using the pedestrian or stand-on pallet stacker.
- Translation speed restricted to 6 km/h in the two directions of travel if the lateral guards are pulled in.

Figure 1:

1 Guard rail cushion
2 CHC M8X20 mounting screws, cover (3)
3 Lateral guard cap
4 Monoblock lateral guards (rails)
5 Guard rail position contact 1S18
6 Guard rail locking tab in raised position

T20 AP: Removing the lateral guard

To access the position contact for lateral guard rails (1S18):
- Remove the 4 screws (2).
- Pull out the cap (3)
- Pull the guard rail by lifting it by the left and right pads (1).

In PathFinder, check that the position contact (1S18) of the lateral guard is working properly.

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Service Training

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4 STEERING, BRAKING AND MOVING

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Service Training

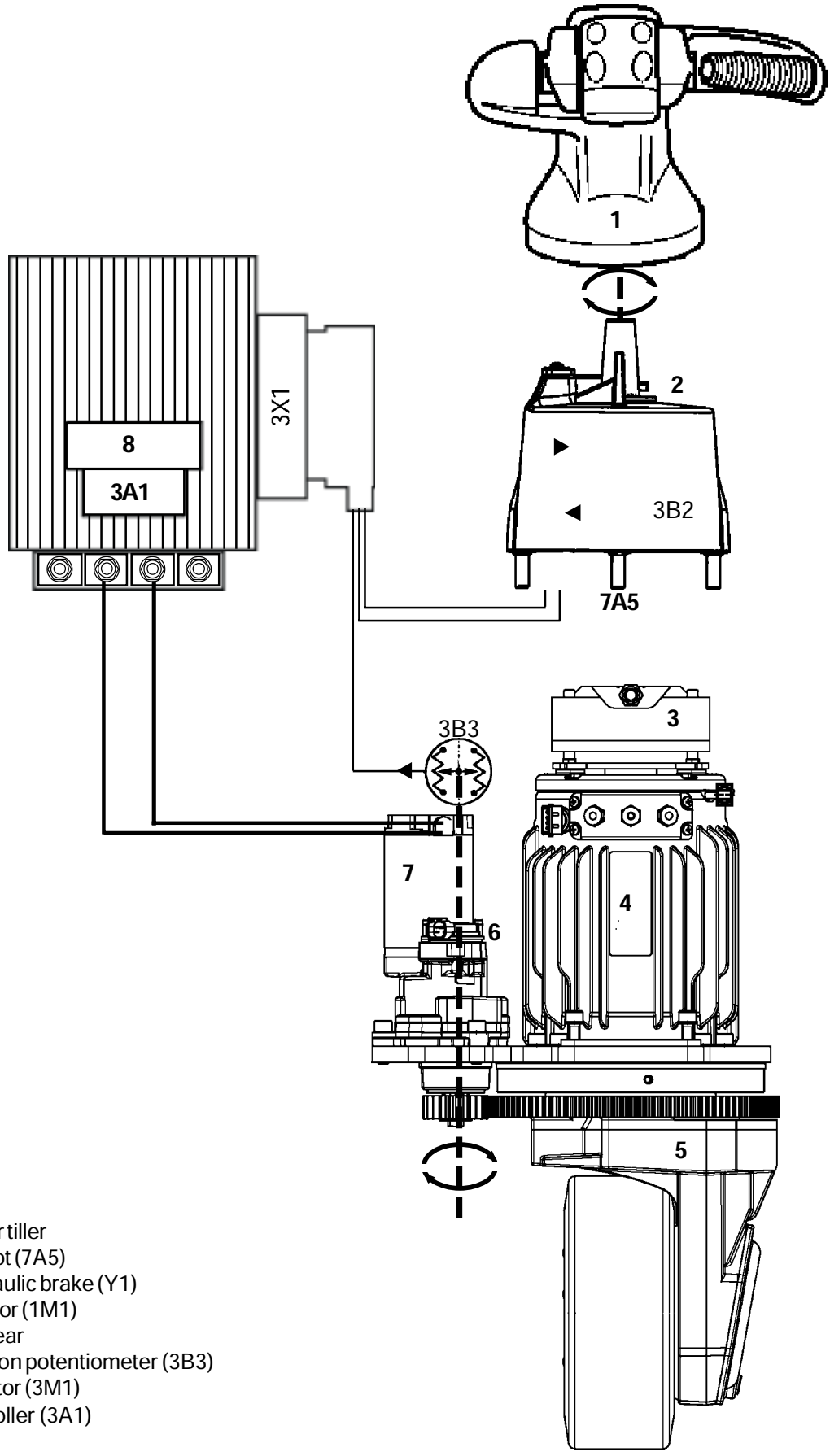

Figure 1:

1 Handlebar or tiller
2 Steering pivot (7A5)
3 Electrohydraulic brake (Y1)
4 Traction motor (1M1)
5 Reduction gear
6 Wheel position potentiometer (3B3)
7 Steering motor (3M1)
8 L.E.S. controller (3A1)

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4.1 ELECTRICAL STEERING

The L.E.S electrical steering (Linde Electrical Steering) comprises of the following components:

- A control **handlebar** in T20SP (1)
- A control **tiller** in T20AP (1)
- **A steering pivot** with set value potentiometer controls the steering, a magnetic system gives the resistant stress.
- **A steering motor reducer** (7) makes the drive unit slew ring rotate.
- **A steering wheel (6) position** read potentiometer mounted on the steering motor reducer.
- **An L.E.S control unit** (8) for supplying power to the steering motor (7).

The electrical steering (LES) is controlled:
- By an erognomic handlebar, "free left hand" in the T20 SP.
- By a tiller adapted to the standing and pedestrian type steerings in the T20 AP.

The motor unit is mounted on a slew ring; the steering is ensured by the steering motor reducer.
The steering motor (7) with permanent magnets controlled by the L.E.S. controller (8), receives, from one direction, the information from the handlebar or from the tiller and from the other, the angular position of the wheel.

The truck speed is automatically reduced on turning.

4.1.1 T20 SP handlebar

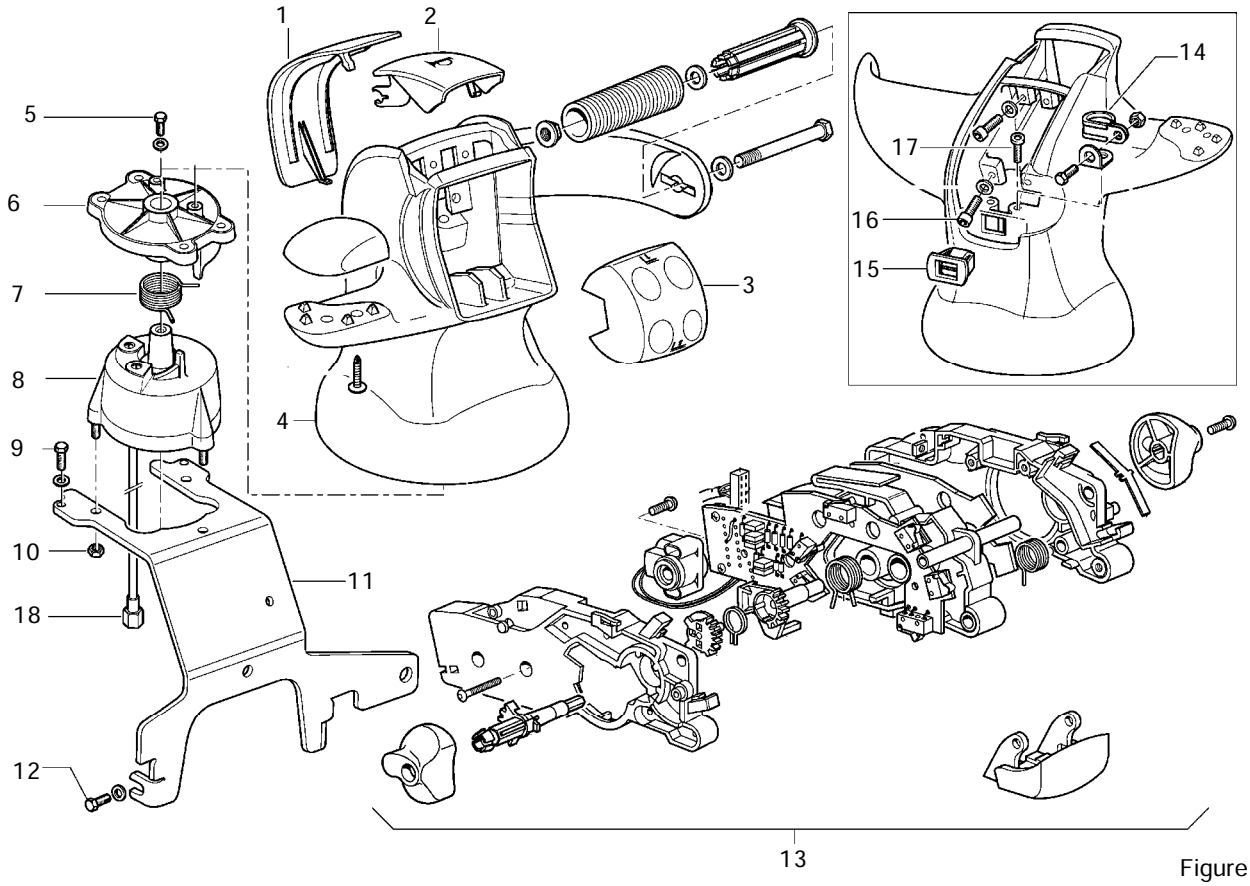

Figure 2

The electrical steering is controlled by an erognomic handlebar, "free left hand".

It is controlled with one hand and prefers the drive at 45°.

Handlebar rotation stress variable according to the speed and steering angle.

Automatic return to neutral on releasing the handlebar.

NOTE
The control unit support (11) must be removed to enable access to the traction motor or for adjusting the brake air gap setting.

Figure 2:

1 Handlebar cover
2 Horn control
3 Fork arms lift/lower controls
4 Handlebar housing
5 H M8x30 screws (tightening torque 23 Nm)
6 Handlebar support
7 Retraction spring at neutral handlebar
8 Steering pivot (7A5)
9 Control unit bracket mounting screws CHC M8x20
10 Steering pivot H M8 mounting nut
11 Control unit support
12 Control unit bracket mounting screws CHC M8x20
13 Control module
14 Control module harness collar
15 Handlebar cover mounting clamp
16 Control unit (13) /handlebar housing mounting screws CHC M4x30
17 Handlebar housing (4) / support (6) self-tapping A7 x 40 (TORX) mounting screws
18 Steering pivot connector (X13)
19 Drive pin
20 Pin slot (19)

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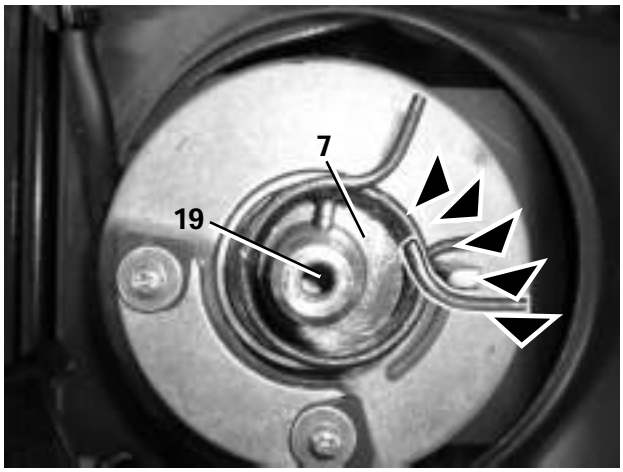
Removing the handlebar T20SP

- Disconnect the battery connector
- Remove the handlebar cover (1)
- Remove the horn button (2) (extraction: push – pull)
- Unscrew the harness collar (14)
- Remove the 4 screws (16).
- Pull the control module (13)
- Remove the 4 TORX screws (17).
- Remove the handlebar (4) from its support (6)



Dismantling the steering pivot

- Remove the central screw (5)
- Dismantle the handlebar support (6)
- Pull the retraction spring (7)
- Remove the motor compartment cover and the dashboard
- Disconnect the steering pivot (8) connector (X13)
- Remove the 3 steering pivot (8) mounting screws (10).
- Pull the steering pivot (8)

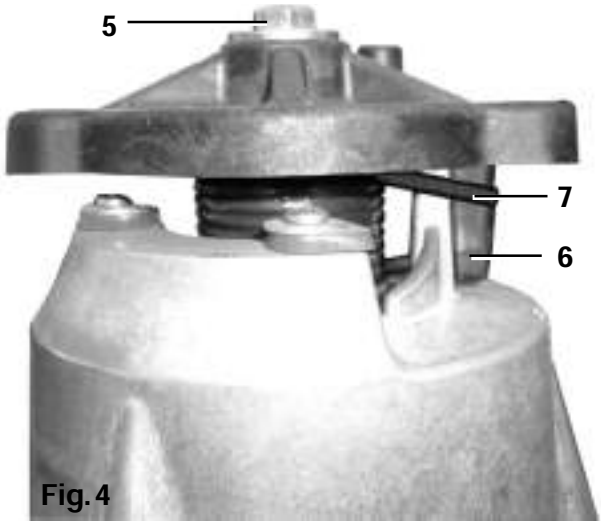


Fig. 4

Removing the T20 SP handlebar

Proceed in the reverse order as for removal.

REMARK:
No pre-setting of midpoint of the steering set point potentiometer.

To install the handlebar support (6):
- Grease and stretch the retraction spring (7) as indicated in the figure (3)
- Fit the handlebar support (6) on the steering pivot (8):
  . the pin (19) must be pushed into the black handlebar support slot (20).
  . The handlebar support is positioned automatically
  . The retraction spring (7) is centred by the handlebar support (see Fig.4).

- Retighten the screw (5) with slight Loctite brake-filet **(tightening torque 23 Nm**).

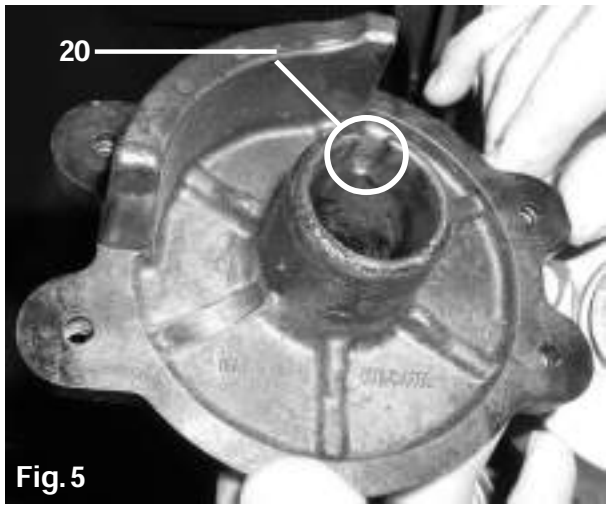


Fig. 5

4.1.2 T20 AP tiller

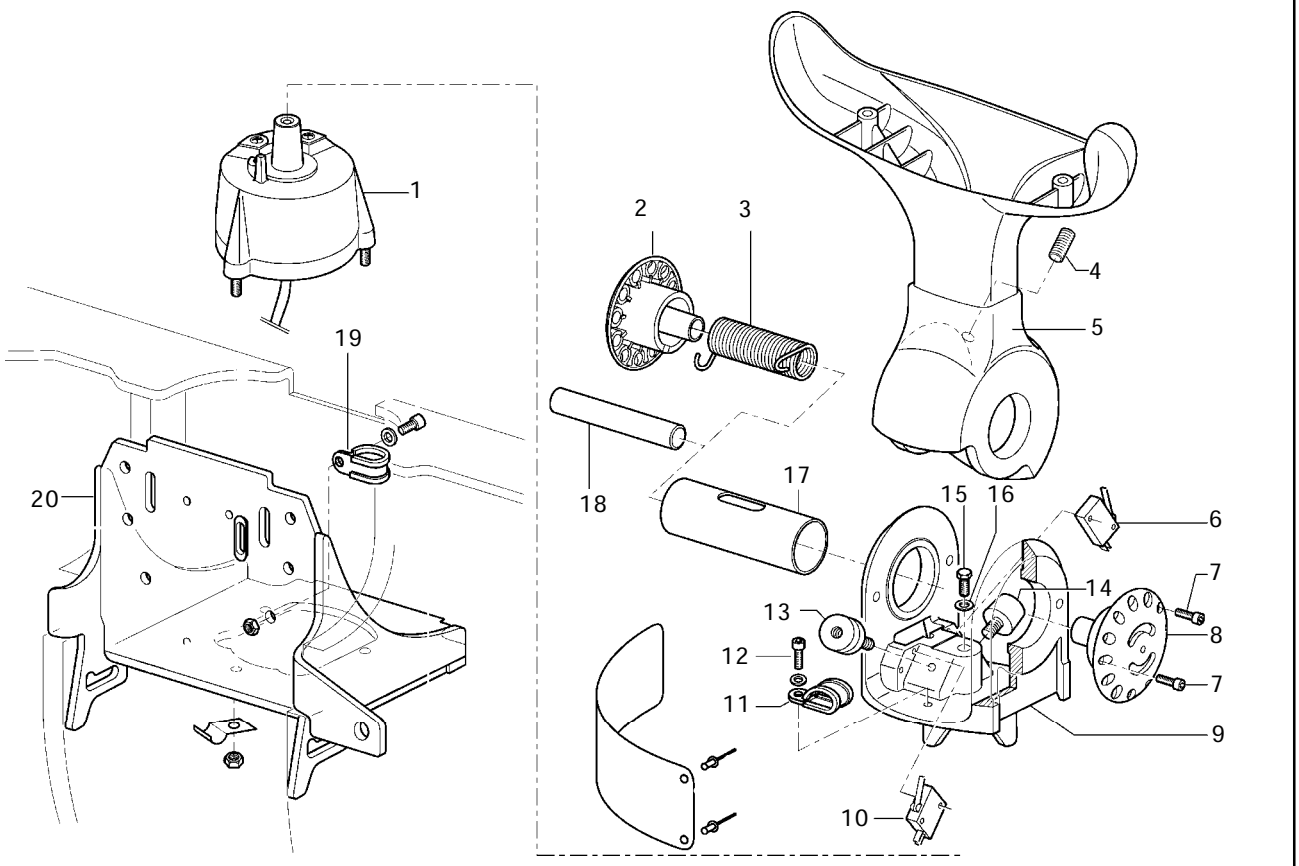


Figure 6

The electrical steering is controlled by a tiller adapted to the stand-on and pedestrian steering.

Tiller rotation stress variable according to the speed and steering angle.

The spring (3) automatically retracts the tiller to brake vertical position.

Two microswitches 1S4 (6) and 1S4-A (10) ensure the tiller base safety.

The emergency brake is applied when the tiller crashes the rubber stop (13) or when the tiller is released.

NOTE
The tiller support (20) slides and pivots to the rear to enable access to the traction motor or for adjusting the brake air gap setting.

Figure 6:

1 Steering pivot (7A5)
2 Tiller articulation left flange
3 Tiller retraction spring
4 Left articulation flange stop screws HC M10x35 (2)
5 Tiller arm
6 Tiller base microswitch (1S4)
7 Right articulation flange stop screws CHC M6x12 (2)
8 Tiller articulation right flange
9 Tiller yoke
10 Tiller base microswitch (1S4-A)
11 Control module harness collar
12 Collar CHC M6x12 mounting screws
13 Tiller low end of course rubber stop
14 Tiller vertical end of course rubber stop
15 H M8X30 mounting screws, yoke (9) / pivot (1)
16 Ring 8.4x24x2 mm
17 Plastic articulation guard
18 Retraction spring guide pin (3)
19 Tiller harness collar
20 Tipping tiller support

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You must remove the tiller arm (5) to access:
- the rubber stops (13) and (14)
- the tiller base microswitches (10) and (6)
- the tiller retraction spring (3).

Removing the tiller arm

- Disconnect the battery connector
- Dismantle the platform lateral guards (see section 3).
- Dismantle the tiller control housing (handles + control module)
- Remove the 2 screws (7) (figure 7)
- The tiller retraction spring (3) relaxes.
- Pull in the following order (figure 8):
  . the flange (8)
  . the tiller retraction spring (3)
  . the tiller articulation left flange (2)
  . the tiller arm (5)
  . the plastic articulation guard (17)

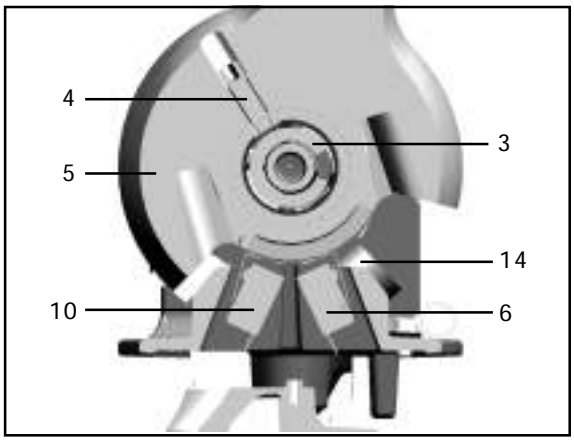


figure 7


figure 8


figure 9

To reinstall, proceed in the reverse order as for removal.

REMARKS:
To enable the spring (3) to automatically retract the tiller to brake vertical position, stretch it.

To do this:
- First screw on one of the 2 screws (7) on the articulation yoke (9).
- Use lock pliers to (figure 9):
  . Remove the right flange (8) from the yoke (9)
  . Turn the 5 holes flange (8) to the right.
  . Release the flange (8)
  . Fix the second screw (7) on the yoke.

Release the tiller, it automatically returns to high position.

4.1.3 Steering pivot

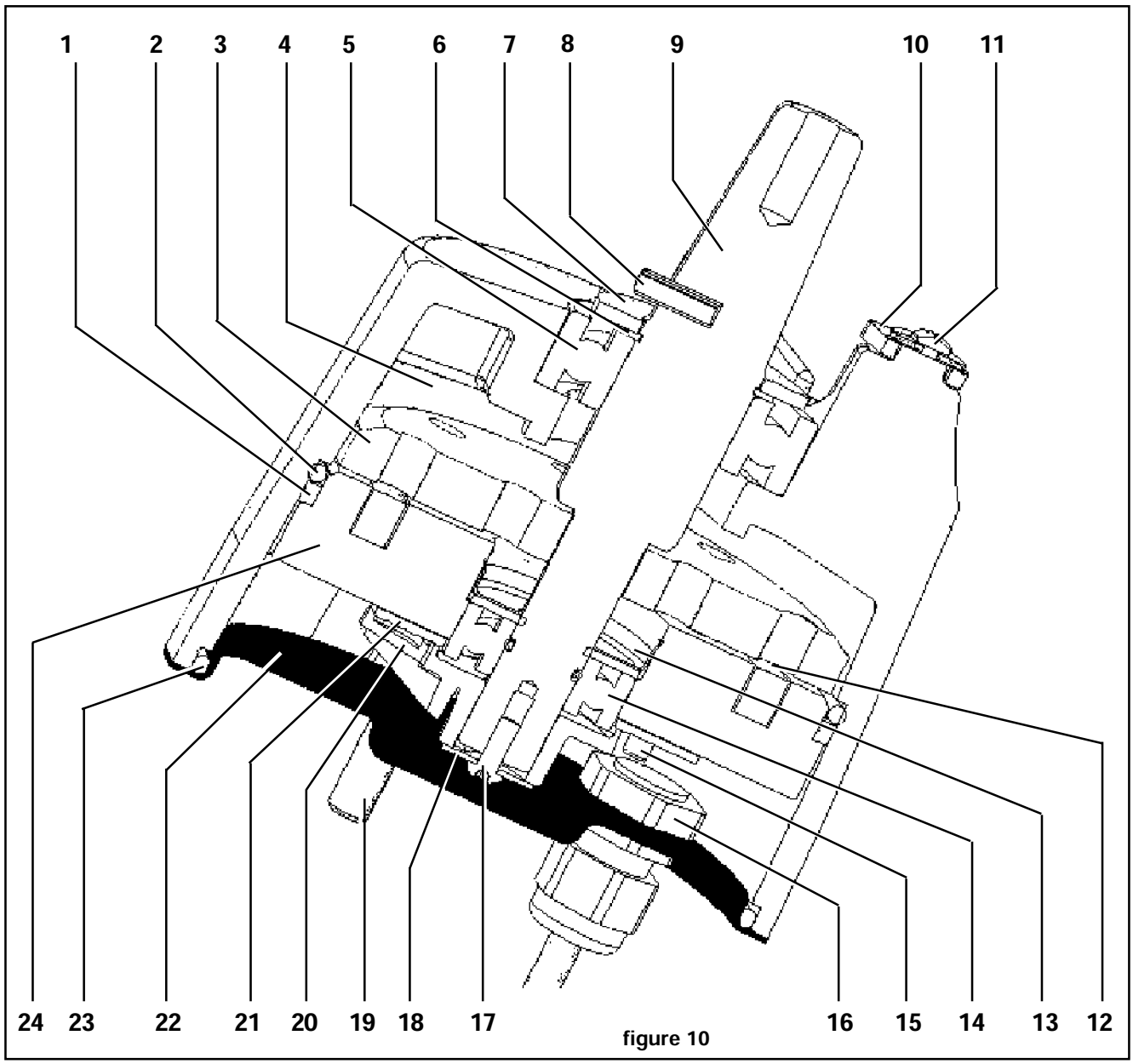

figure 10

The steering pivot (7A5) transmits steering angle information to the L.E.S. controller via a set point potentiometer.

- A steering control set value potentiometer (3B2)
- A magnetic system transmits a resistant force to the driver via the handlebar or tiller.

NOTE
The components of this pivot are not given in detail in spare parts.

CHARACTERISTICS

- The potentiometer 3B2 (20)(21) is double (redundancy) by safety, without mechanical control.

- The resisting torque of the handlebar or tiller can be set, it increases or decreases according to the truck translation speed.

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Figure 10:

1 Square section seal
2 O-ring
3 Brake disk
4 Chamber containing magnetic metallic powder
5 Steering pivot axis bearing
6 Upper bearing stop circlips
7 Washer
8 Handlebar support mark pin
9 Steering pivot axis
10 Steering mechanical stops
11 Steering stop mounting screws
12 Friction surface of magnetic particles
13 Seal ring
14 Lower steering pivot axis bearing
15 Steering potentiometer link stops
16 Cable outlet
17 Potentiometer link block mounting screws
18 Top washer
19 Steering pivot mounting pin
20 Potentiometer link block (3B2)
21 Potentiometer tracks (3B2)
22 Box cover LORD
23 O-ring box LORD
24 Resistant torque electromagnetic block

4.1.4 Steering motor reducer

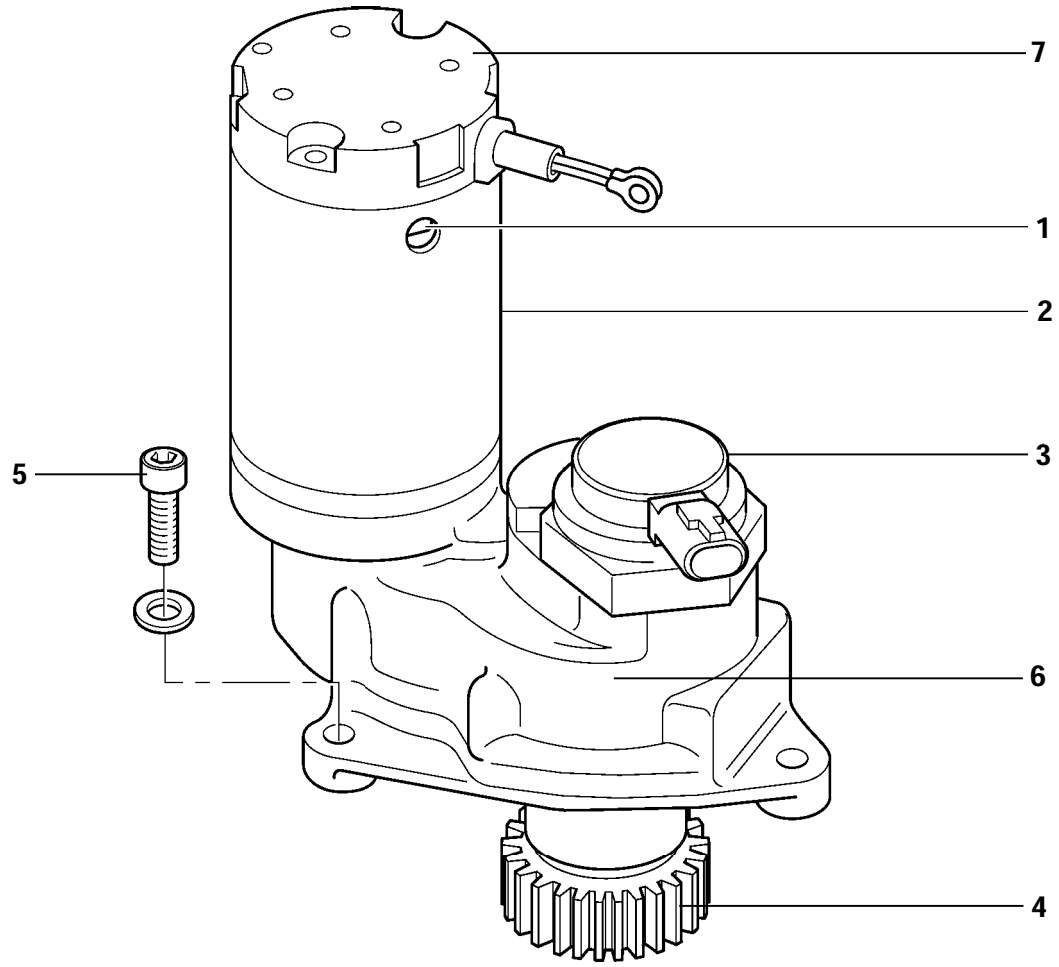

figure 11

The steering motor reducer makes the drive unit slew ring rotate with notched pinion.

The steering motor (2) with permanent magnets ensures a high power and a reduced size.

An inspection hole (1) lets you check the wear status of the motor brushes.

Figure 11:

1 Peep hole for motor brushes check
2 Steering motor with continuous current (3M1)
3 Wheel position potentiometer (3B3)
4 Drive pinion gear (22 teeth)
5 Mounting screws for motor reducer / drive unit support (tightening torque: 64 Nm)
6 Reduction gear
7 Collector side motor flange

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Removing/replacing the steering motor reducer

- Disconnect the battery connector
- Turn the variator plate to the back
- Disconnect the steering motor and the potentiometer (3) connector (3X3).
- Remove the steering motor reducer through the top of the motor compartment.

To reinstall, proceed in the reverse order as for removal.

ATTENTION
- Manually align the drive wheel in "right line" position (figure 12).
  Reduction gear to right in the chassis.

- Setting the midpoint of the wheel potentiometer (figure 13):
- Manually turn the pinion (4) until the line marked on the tooth (9) corresponds with the marking on the motor reducer (8).

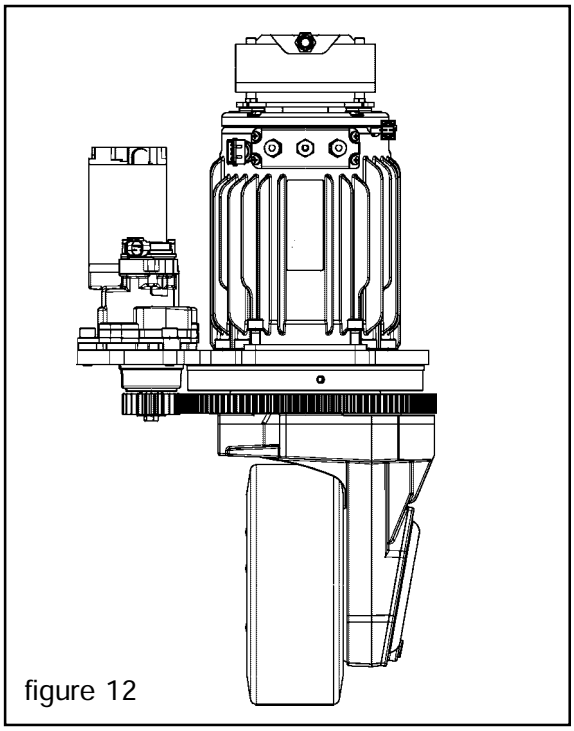
figure 12

NOTE
The tightening torque of 3 screws (5) is: 64 Nm.

CAUTION
- It is mandatory to check the steering electrical controls in PATHFINDER.

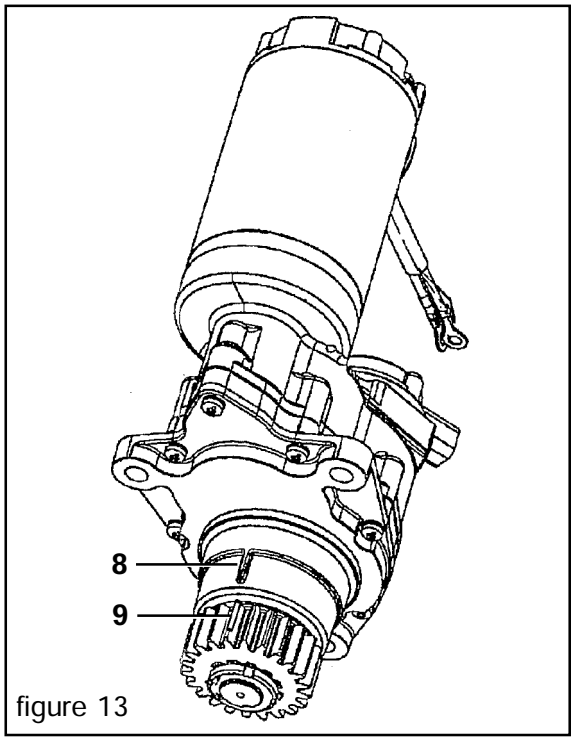

figure 13

4.1.5 Wheel position potentiometer (3B3)

The potentiometer (3) positioned in the steering motor reducer returns information about the drive wheel position to the L.E.S controller.

Replacement of the potentiometer (3) does not require mechanical control during assembly.
Connecting the potentiometer, see Figure 14.

Fixing the potentiometer using 2 screws CHC M4 tightened with torque C=0.8 Nm.

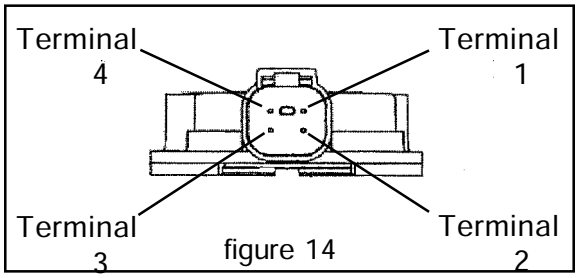

figure 14

4.1.6 Steering motor (3M1)

ATTENTION
- Never replace the steering motor alone; poor clamping of the motor (2) / reduction gear (6) can disturb the pinion rotation speed (4). (example: the drive wheel that turns faster to the left than to the right).

- Observe the polarities of the motor "+" and "-" when connecting to the controller L.E.S.: red wire (+): terminal M2 and black wire (-): terminal M1.

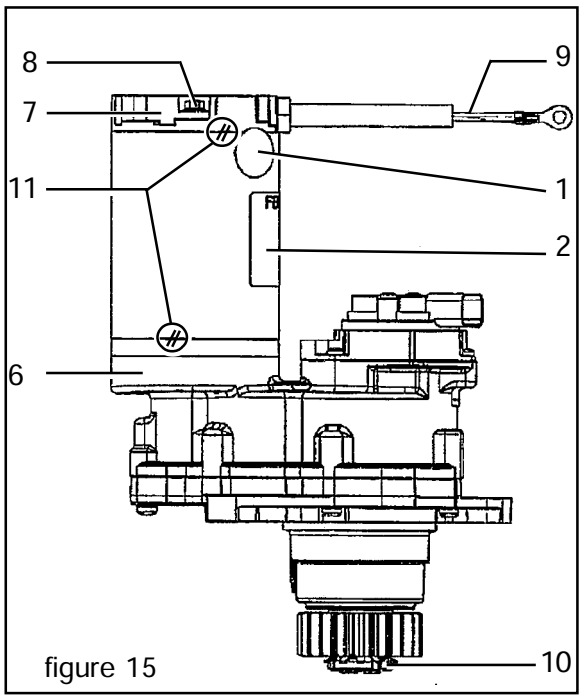

figure 15

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Checking the steering motor brushes (see fig. 16)

- Disconnect the battery connector
- Remove the protection cover
- Check that there are no traces of overheating in the brush connections
- Check that the brushes move freely in their channels (14) by pulling gently on their connectors (12).
- Check brush wear (13):
  .new height: flushed with the channel
  .used height: 8mm pressed into the channel.

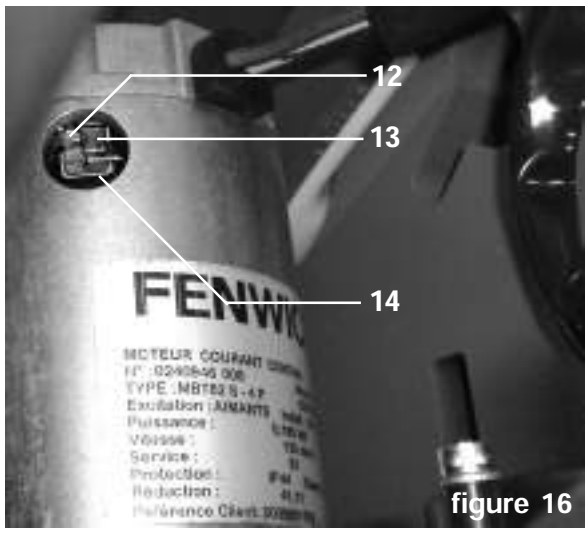

figure 16

Replacing the brush holder assy.

When the brushes have worn out, replace the complete brush holder assy (17), brushes.

- Disconnect the battery connector
- Switch off the motor power supply to the controller LES: red wire (+): terminal M2 and black wire (-): terminal M1.

IMPORTANT:
Before opening the steering motor, mark the position (mark11 fig.15) on the flange (7) / body of the motor (2) / steering reduction gear (mark 6 fig.15).

- Remove the 2 (8) and pull the flange (7), collector side.
- Pull the brush holder assy (17)
- Check that the collector is not broken and shows no traces of sparks.

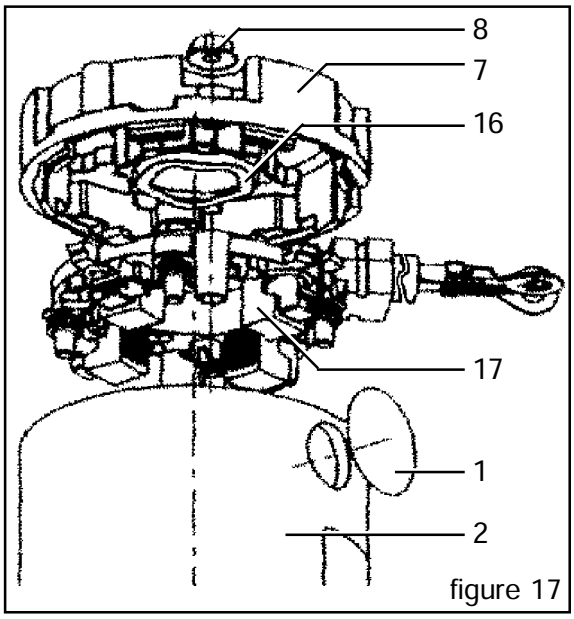

figure 17

Installing the brush holder assy

NOTE
The new brush holder assy (17) is equipped with a channel (19) to enable installing the brushes on the motor collector

- Place the new holder assy (17), motor brush at the bottom; on the bearing (18) and the onduflex ring (16).
- Unclip the channel (19)
- Slide the assy along the collector.
- Pull the brush channel (19)
- Mount the collector side flange (7).

ATTENTION
- Match the marking lines (11) between one another.

- **Tightening torque of 2 flange screws (8): 0.8 Nm.**

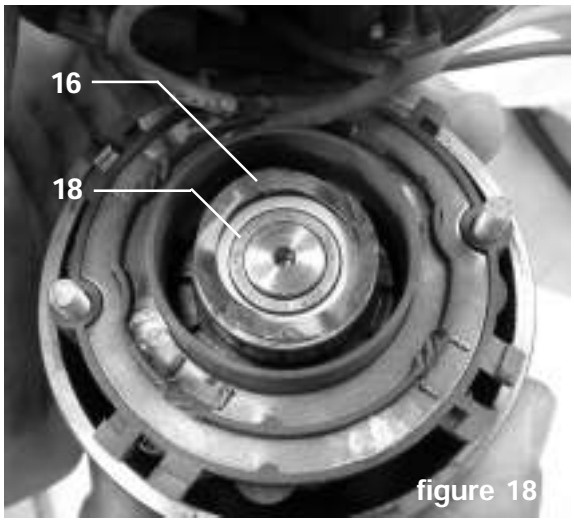

figure 18

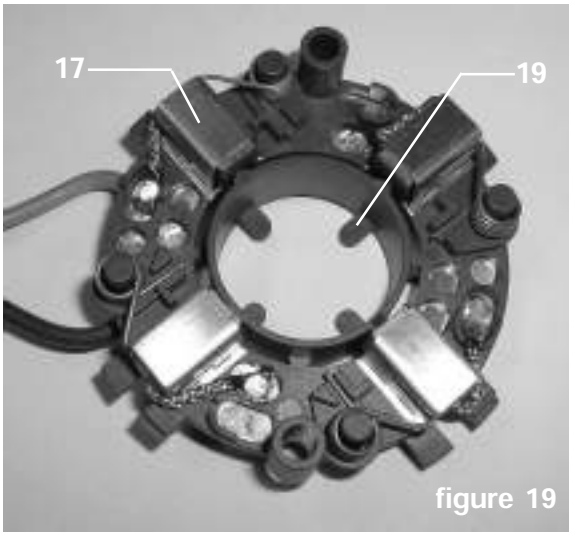

figure 19

4.2 ELECTROHYDRAULIC BRAKE

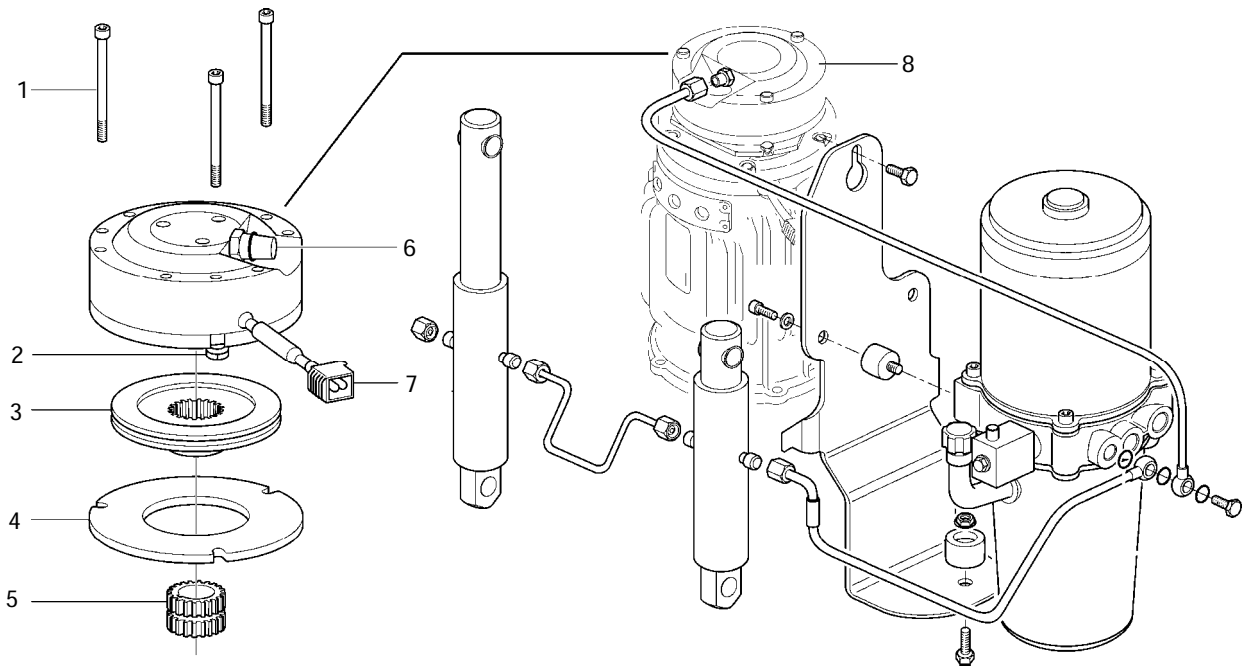

figure 20

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Currentless electromagnet brake with hydraulic assistance:

- A mini-jack integrated with the elecrobrake increases the brake torque.

- Brake torque proportional to the transported load (piston attached to the lift hydraulic system).

The safety brake is applied automatically when at least one of the following conditions is fulfilled:
- Emergency isolator pressed
- Driver leaves the platform.
- Direction of travel reverser is in neutral position and the truck stops
- Tiller is released in high thrust (T20 AP only)

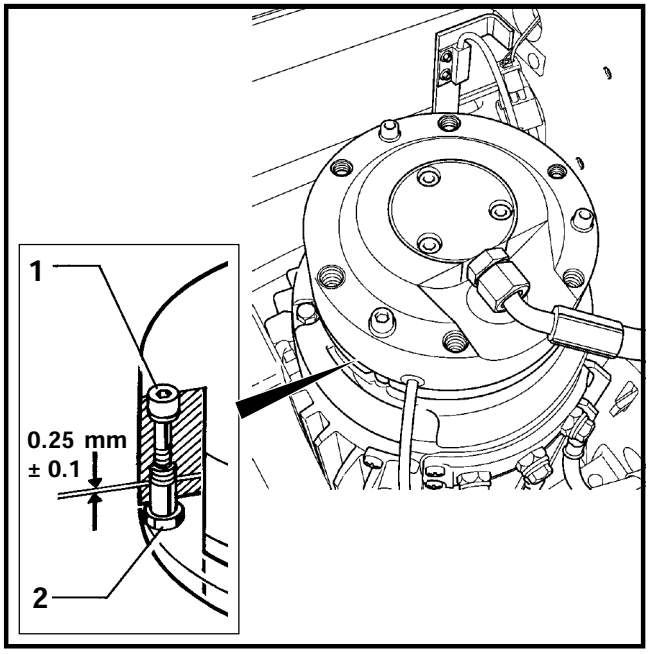
Figure 20:

1 Screw for mounting electrobrake on the traction motor (tightening torque: 9.5 Nm)
2 Air gap setting screw
3 Friction disc
4 Brake flange
5 Friction disc / traction motor rotor pairing
6 Hydraulic connection
7 Brake block connector (7X6)

Characteristics

- Nominal brake torque (spring +Pmini): **13 Nm**
- Nominal brake torque (spring +Pmaxi): **48 Nm**
- Service pressure (empty): **34 bars**
- Service pressure (loaded, 2.5T): **155 bars**
- Maximum operating pressure: **180 bars**
- Power supply voltage in V (DC): **24 ± 30%**
- Power: **39.2 W**
- Piston: **Ø 10mm**

Setting the gap



The brake must be checked in the "brake on" position, i.e. with no load on the forks and with the power cut off.

Check the air gap of the brake with a set of feeler gauges.
The original air gap is 0.25 ± 0.1 mm, the max. air gap after partial wear of the disk is 0.5 mm; thereafter there is a risk of incomplete brake release and of overheating.

If the air gap is close to the maximum value of 0.5 mm, it must be adjusted.
- Turn the tiller * support backwards
- Loosen the three securing bolts (1).
- Turn the 3 hollow screws (2) to adjust the air gap to the original value of 0.25 mm
- Tighten the 3 fixing screws (1)
- Check the air gap at 3 points 120° apart
- Ensure the air gap is even all around the brake
- Reposition the tiller * support

NOTE
Use a bent cylinder wrench to work on the bent screw (2) from the base close to the chassis.

* only for the AP version

4.3 MOVABILITY

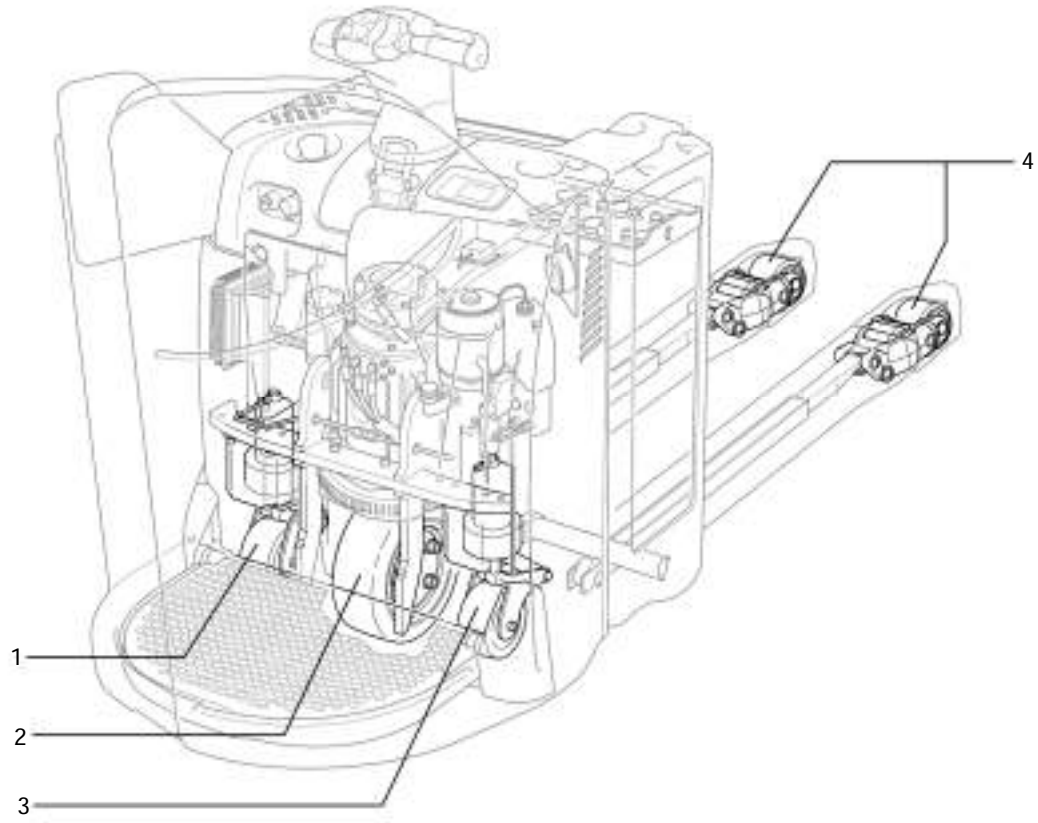


figure 21

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Link to the ground ensured by:
- 1 central drive wheel (2)
- 2 suspended lateral stabilisers (1) and (3)
- 2 load wheels (4)

The stability of the empty and loaded truck is obtained due to the stabilisers suspended hydraulically and controlled by the LAC controller.

Figure 21:

1 Left suspended stabiliser
2 Drive wheel
3 Right suspended stabiliser
4 Arm rollers

4.3.1 Drive wheel

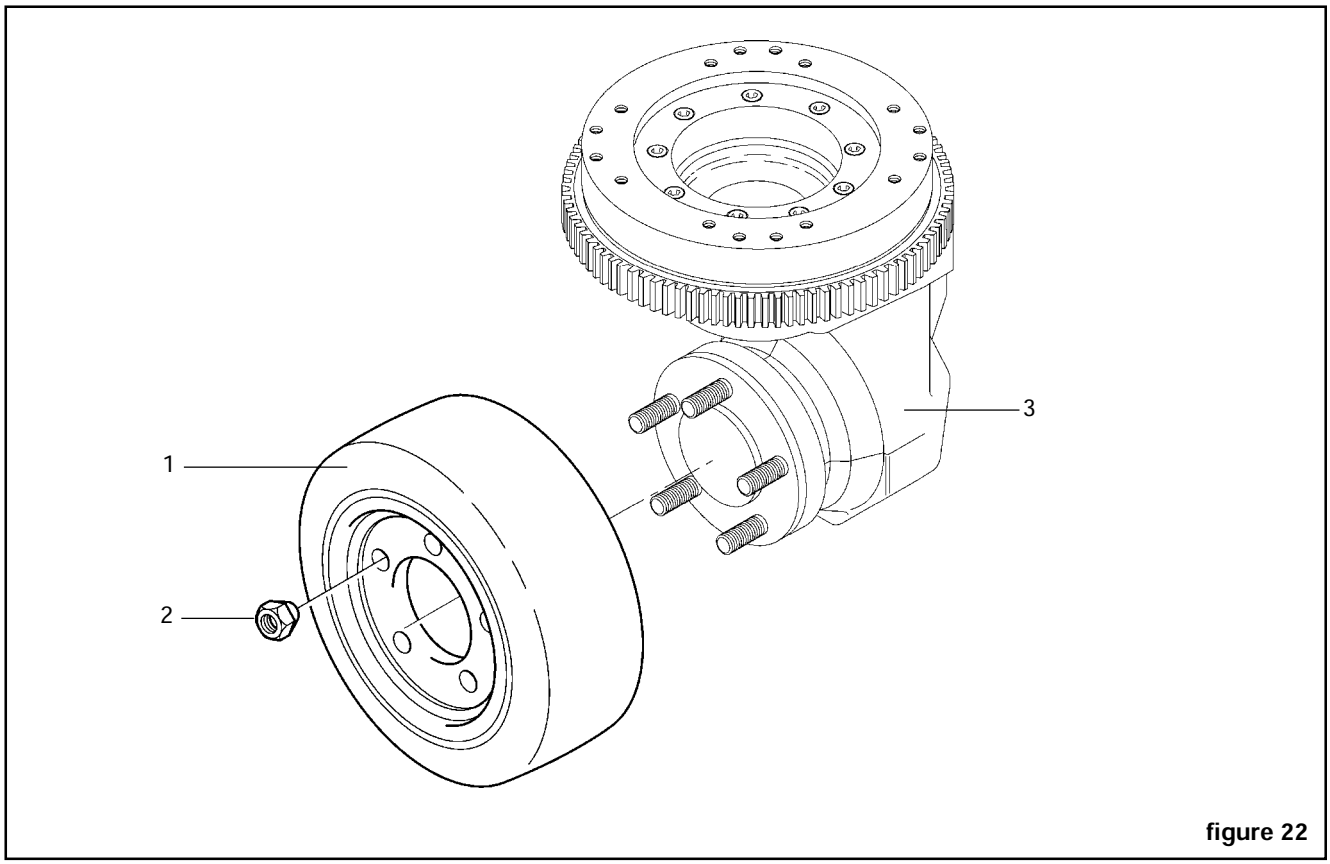


figure 22

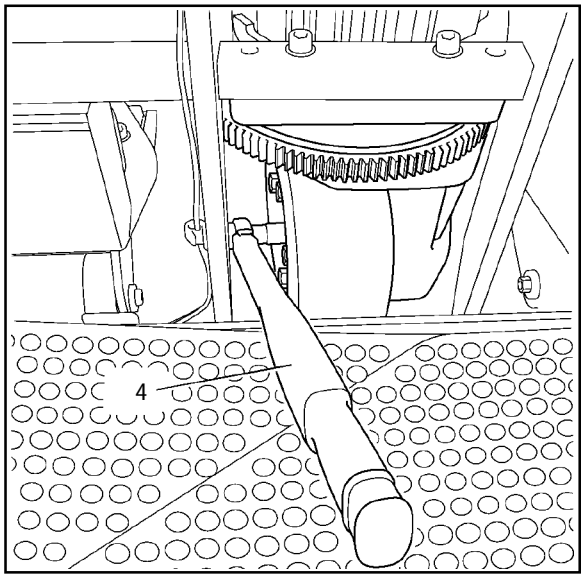
4 versions of drive wheel:
- Rubber
- Unbranded rubber
- Polyurethane
- Slippery ground polyurethane

Figure 22:

1 Drive wheel (dimensions: Ø 254 X 102 mm)
2 Wheel bolt (tightening torque 140 Nm)
3 Reduction gear

Removal of the drive wheel

- Disconnect the battery connector
- Lock the truck at around 20 cm from the ground.
- Remove the front cover
- Harness the drive wheel manually to have access to the wheel nuts (2).
- Loosen the wheel nuts by moving the key (4) above the platform.
- Remove the drive wheel by disengaging it under the reduction gear (3).
- Extract it from below the truck from the left side.



4.3.2 Stabilisers

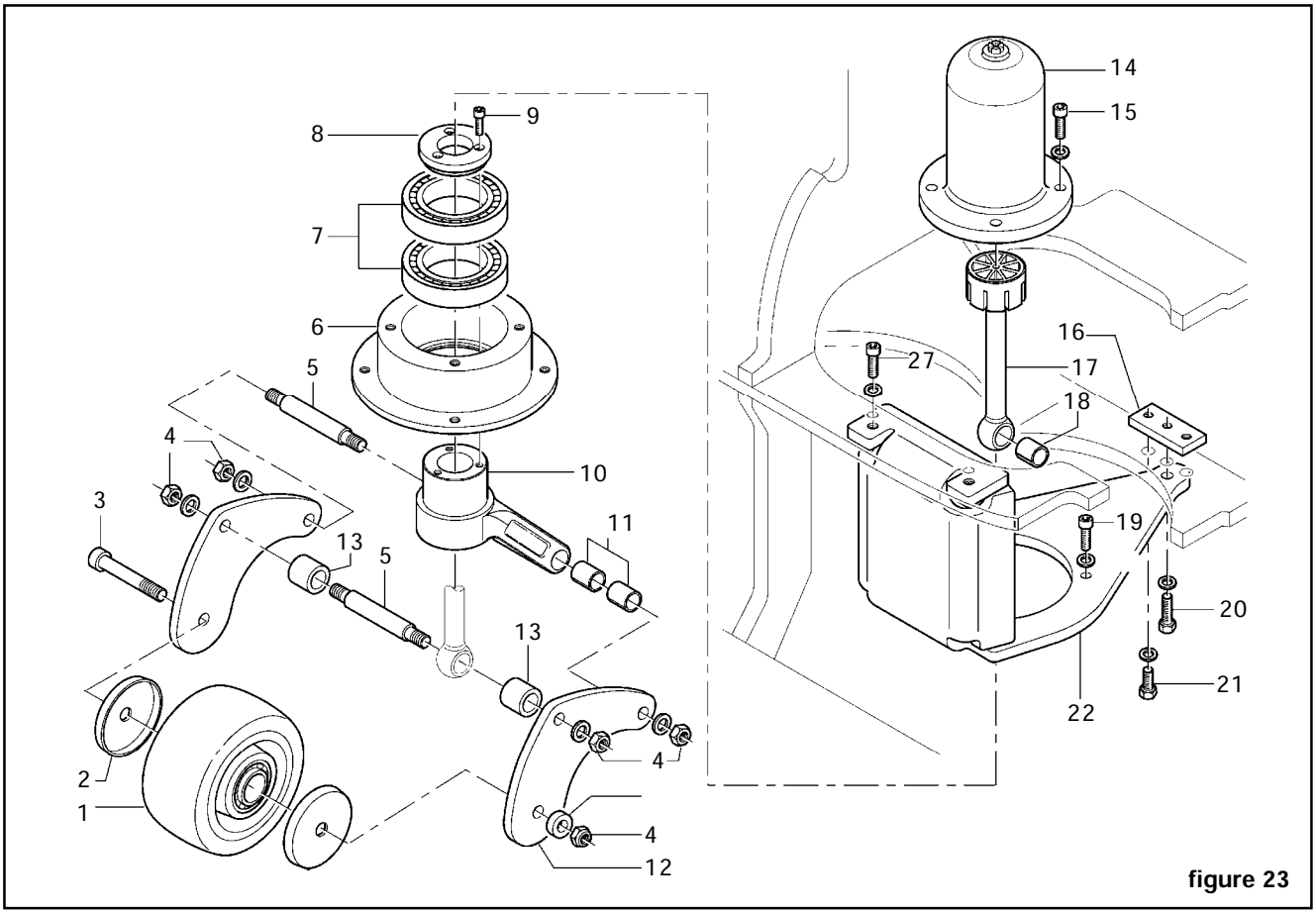


figure 23

Two suspended stabilisers compensate the ground unevenness.

The suspension controlled by a hydraulic system blocks the external speed stabiliser to ensure maximum stability of the appliance.

Figure 23 and 24:

1 Stabiliser wheel (125x62-20)
2 Wire cutter
3 Screws CHC M12x110
4 Nuts H M12
5 Axes
6 Support bearing
7 Pivot roller bearings
8 Cover
9 Cover mounting screws CHC M5X16
10 Rotation ring yoke
11 Slotted rings 15x17x20
12 Stabiliser wheel flanges
13 Spacers
14 Stabiliser jack
15 Mounting screws CHC M10x30 for jack (14) / bearing (6)
16 Stabiliser support mounting flat bar (22)
17 Connecting rod
18 Slotted ring 15x17x20
19 Mounting screws CHC M10x20 for bearing (6) / support (22)
20 H M10x40 mounting screws, support (22) / flat bar (16)
21 H M10x30 mounting screws, flat bar (16) / chassis
22 Stabiliser support
23 Pressure spring
24 Jack piston (14)
25 Jack chamber (14)
26 Jack hydraulic supply collar
27 Mounting screws CHC M10x30 for support (22) / chassis.

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Operation

The wheel stress (1) is transmitted by the connecting rod (17) to the piston (24) that pushes back the spring (23).

The chamber (25) is filled with hydraulic oil.

A solenoid valve, controlled by the L.A.C. controller, closes the chamber (25) that results in blocking the stabiliser when maximum stability is required.

Removing the left stabiliser

CAUTION
The stabilisers are heavy.
Use handling gloves to remove them the chassis.

- Drain the stabiliser hydraulic system (see section 7).
- Turn the electric panel to the back.
- Unscrew the jack supply connection (26).
- Screw on 1 sling ring (28) M14 x 1.5 in the hydraulic supply orifice (26) of the stabiliser to manipulate it better (figure 25).
- Raise and lock the truck.
- Remove the lower screw (20) and the 2 upper screws (27) from the stabiliser.
- Remove the stabiliser from the back, battery side.

To reinstall, proceed in the reverse order as for removal.

CAUTION
Take care that no contamination enters the hydraulic system.

NOTE
The tightening torque of screws (20) and (27): 77 Nm.

IMPORTANT
- Install maximum the stabiliser wheels before connecting the hydraulic supply to the stabiliser.
- Empty the circuit (see section 7).

Removing the right stabiliser

Removal is same as the left stabiliser.

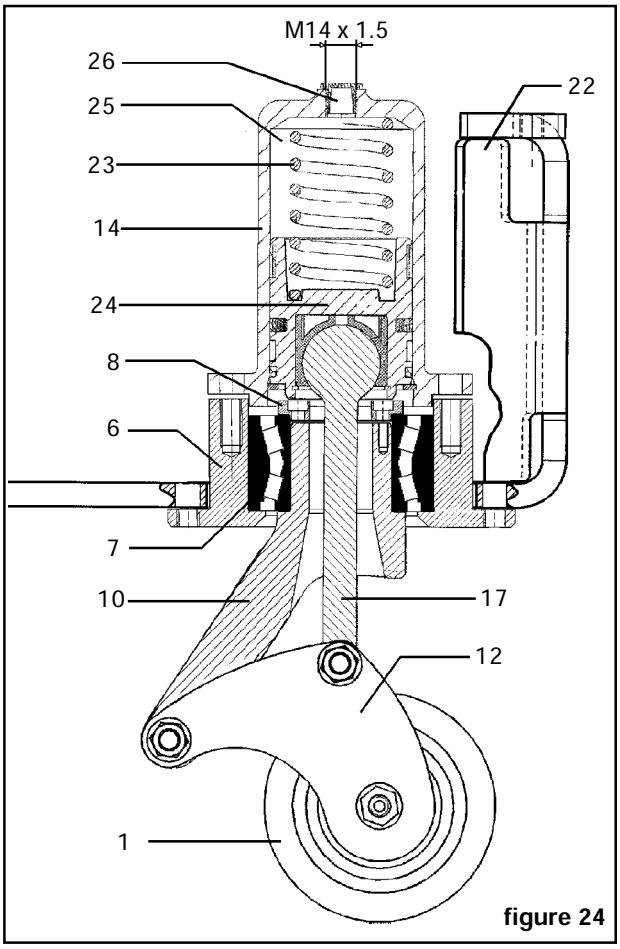

figure 24

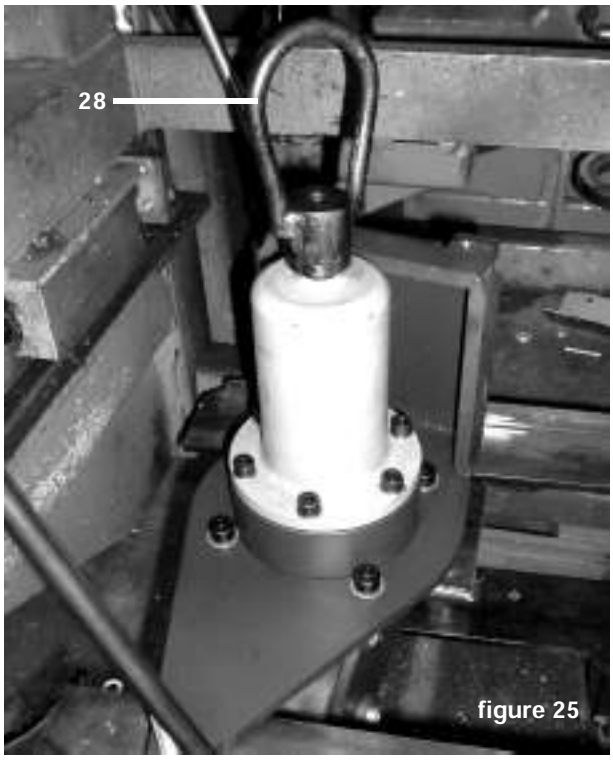

figure 25

4.3.3 Stabilizer wheels

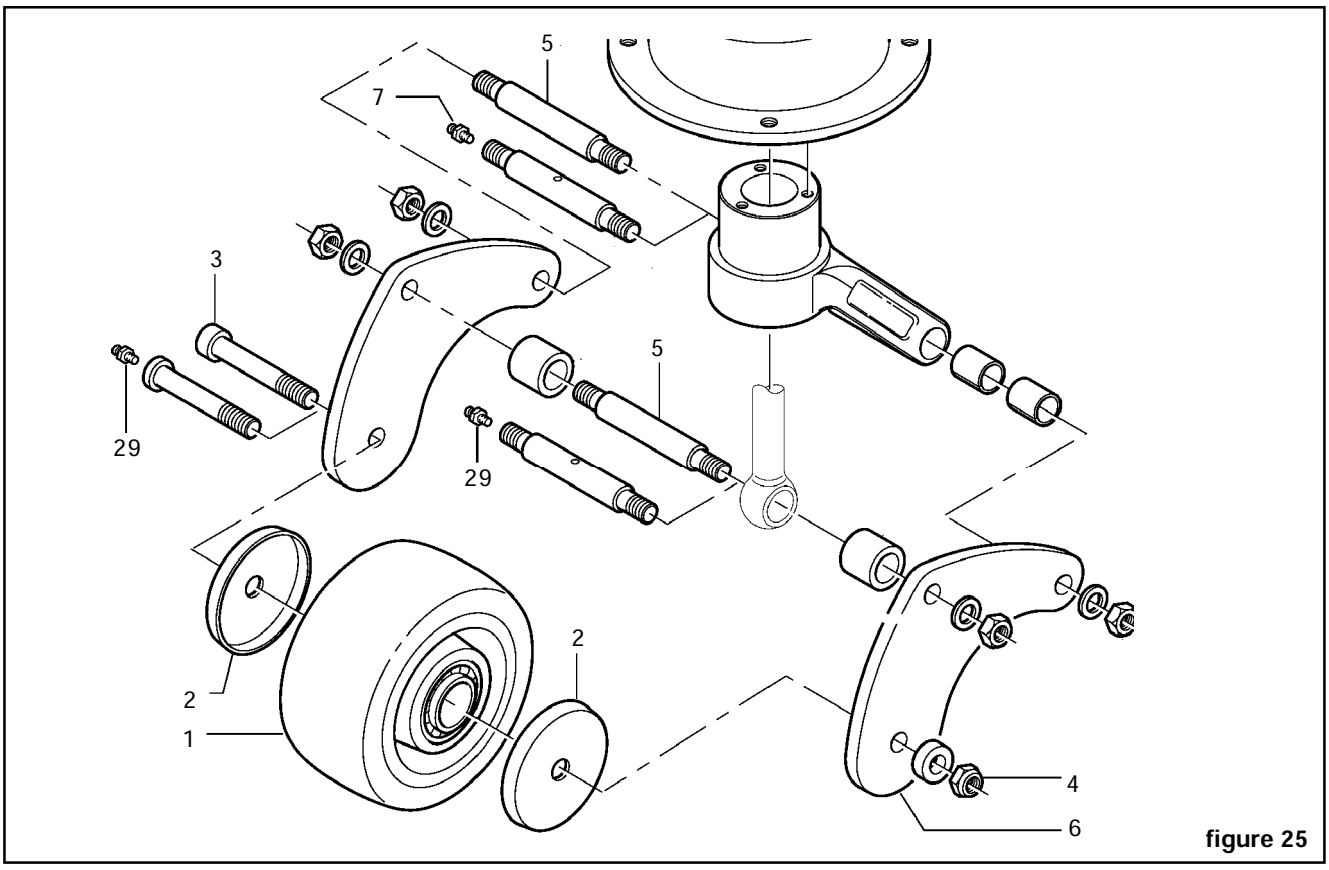

figure 25

Stabiliser wheels only available in polyurethane version.

Non-greased version is standard
- The axes (3) and (5) are equipped with lubricators.

Figure 25:
1 Stabiliser wheel (dimensions: 125x62 mm)
2 Wire cutter
3 Screws CHC M12x110
4 Nuts H M12
5 Axes
6 Stabiliser wheel flanges
7 Lubricator AM6 *
*** Option**

Removing a stabiliser wheel

- Disconnect the battery connector
- Lock the truck at around 20 cm from the ground.
- Remove the front cover
- Harness the stabiliser wheel manually to have access to the wheel nuts (4).
- Loosen the wheel nuts by moving the key above the platform.
- Remove the wheel axis (3)
- Remove the stabiliser wheel.

Tightening torque for stabiliser wheel axis: 75 Nm.

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4.3.4 Ground wheels

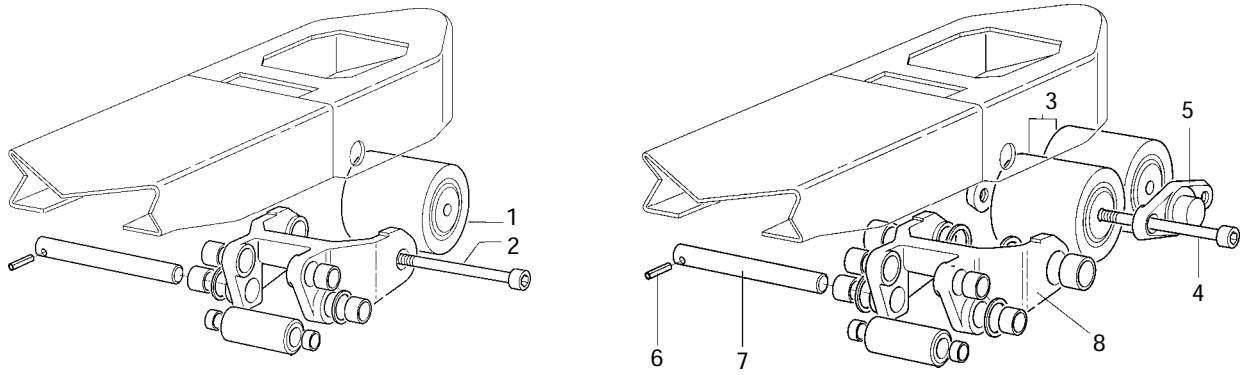

figure 26

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Ground wheels, single or bogie with polyurethane load rollers.

- Non-greased version is standard

- Greased version as option
  The screws (2) and (4) are replaced by axes equipped with lubricators.

Removing a load roller
- Fully raise the forks
- Lock the fork arms
- Remove the screw (2) or the screw (4) according to the assembly.
- Remove the screw
- Rmove the load roller.

Tightening torque for load roller axis: 50 Nm.

REMARKS
If the screw head imprint marking (2) and (4) is damaged, reassemble with new screws.

Figure 26:

1 Single load roller (85x105 mm)
2 CHC M12x130 axis screws for single wheel
3 Bogie load rollers (85x85 mm)
4 CHC M12x100 axis screws for bogie ground wheels
5 Compensating arm (bogie).
6 Axis stop pin (7)
7 Bogie yoke axis
8 Bogie yoke

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6 ELECTRICAL EQUIPMENT

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Service Training

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6.1 TRACTION

6.1.1 Description and operation

ATTENTION: Before starting any work on the control system, always disconnect the battery connector. Non-compliance with this procedure could damage the CAN interface controls. DO NOT remove or replace the components when the truck is switched on.

6.1.1.1 Speeds / reduction of speeds

Stand-on pallet stacker speed =>	lowered platform and raised guard rail / SP version	=>	10Km/h
Stand-on pallet stacker speed =>	lowered platform and lowered guard rail	=>	8Km/h
Pedestrian pallet stacker speed =>	raised platform and lowered guard rail	=>	6Km/h

Speed reduced on turning	=>	6Km/h
Speed reduced / anti-crush 1S3 activated	=>	4Km/h
Speed reduced / battery unlocked	=>	2Km/h
Speed reduced / stabiliser oil level too low	=>	2Km/h

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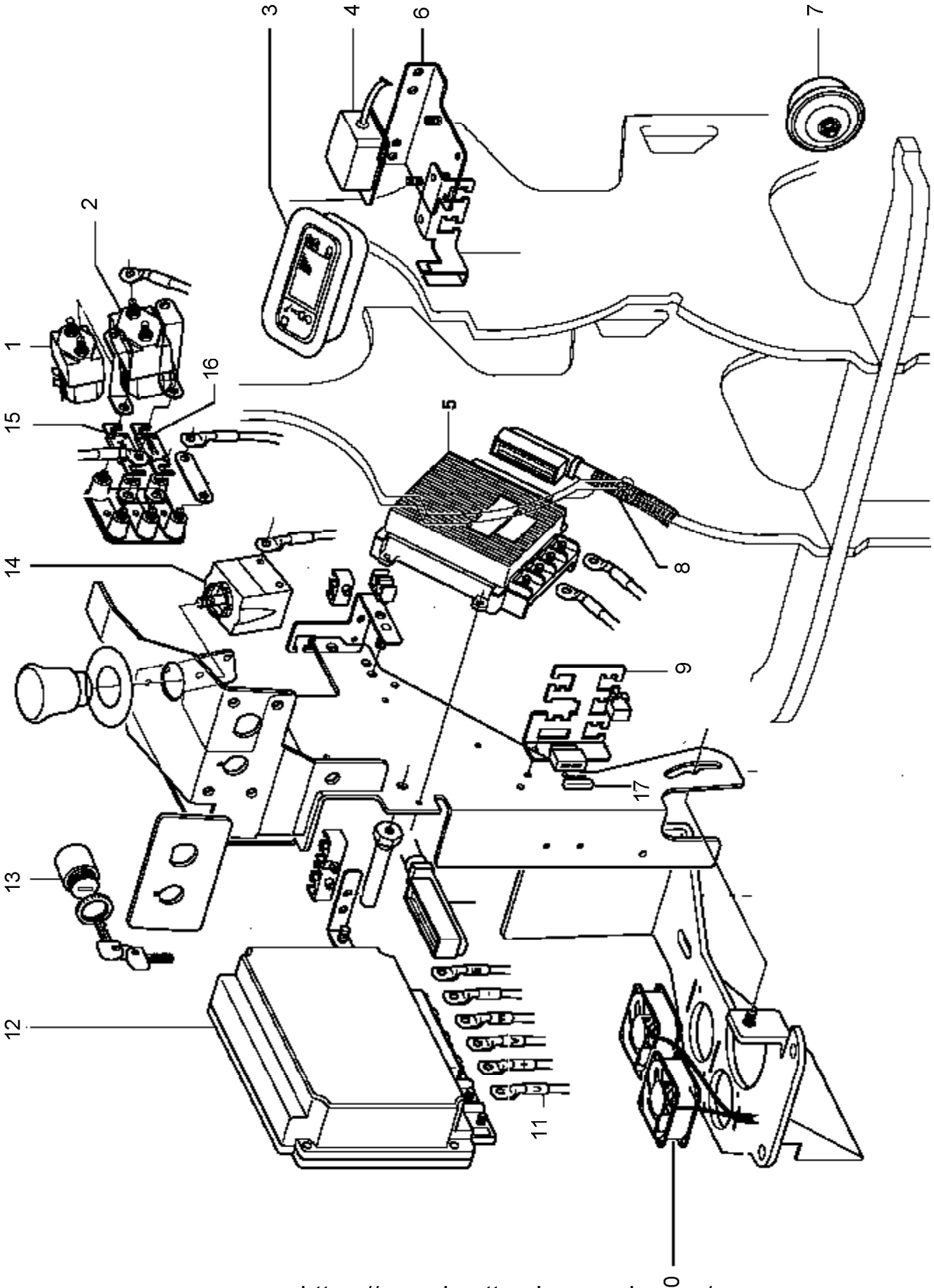
6.1.1.2 **Tiller rear safety control – 1S3**

By activating the tiller safety contact, the truck moves in the direction of the fork arms at reduced speed while the tiller safety switch is not released. Once released, the truck is in safety and can restart only if the accelerator throttle moves back to neutral position. The anti-crash safety can be activated or deactivated with the lowered platform (stand-on).

6.1.1.3 Control for lowering fork arms - 2S7

In SP and AP versions, in the lowered platform configuration, the lowering of the fork arms is possible only if the driver is present on the platform.

6.1.2 Electric plate



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No.	Description
1.	Line contactor LES - 3K1
2.	Line contactor LAC – 1K2
3.	Hour meter indicator - 6P1
4.	Inclinometer - 1A8
5.	Steering controller LES – 3A1
6.	Inclinometer support
7.	Horn - 4H1
8.	29-track connector for LES -3X1
9.	Connector support
10.	LAC fans - 9M1 9M2
11.	Power cables for traction motor and pump motor
12.	Traction and hydraulic controller LAC - 1A1
13.	Key switch - S1
14.	Emergency stop button -7S1 / 7S5
15.	Power fuse LES - 3F1
16.	Power fuse LAC - 1F1
17.	Control fuse - 1F3

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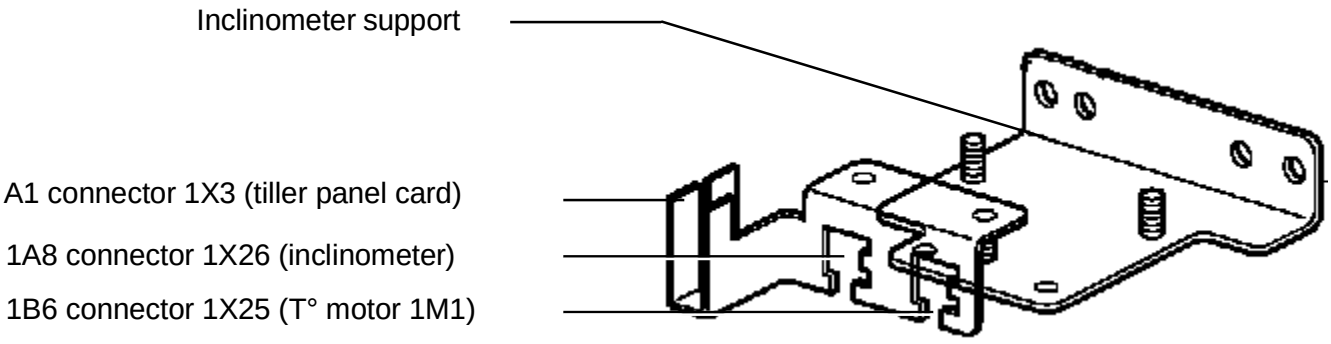
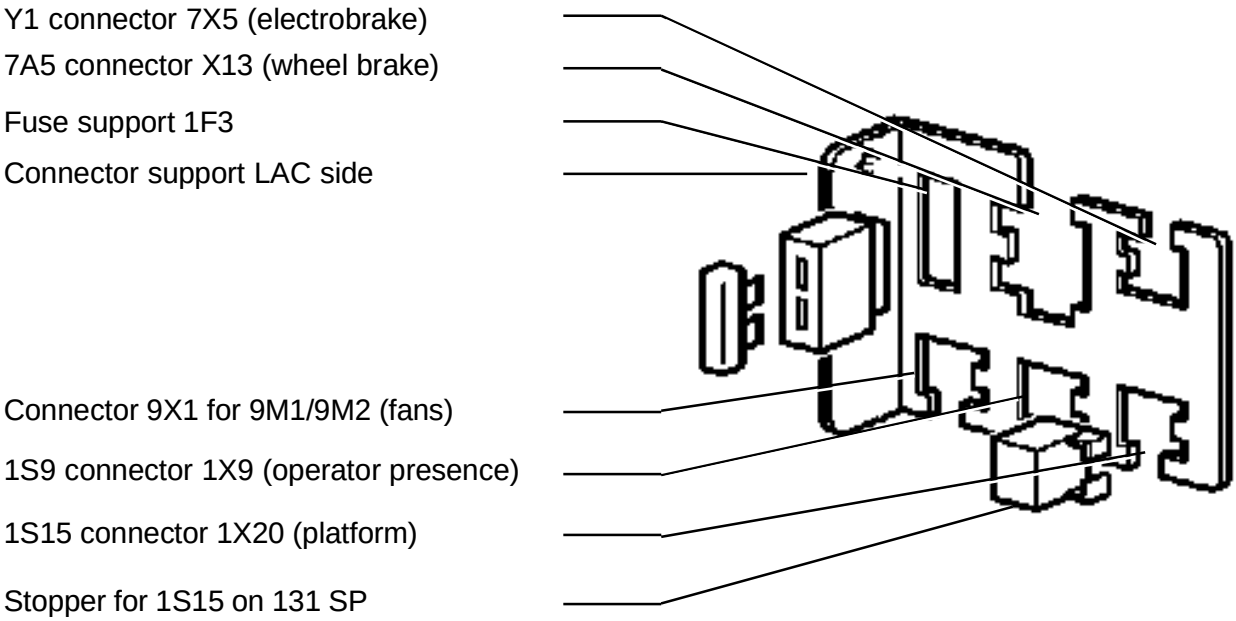


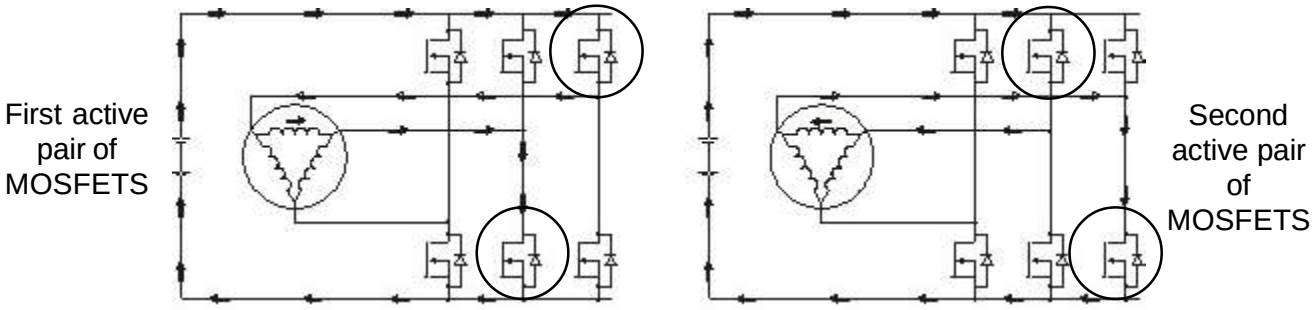


6.1.3 **A.C. control – Operating principle**

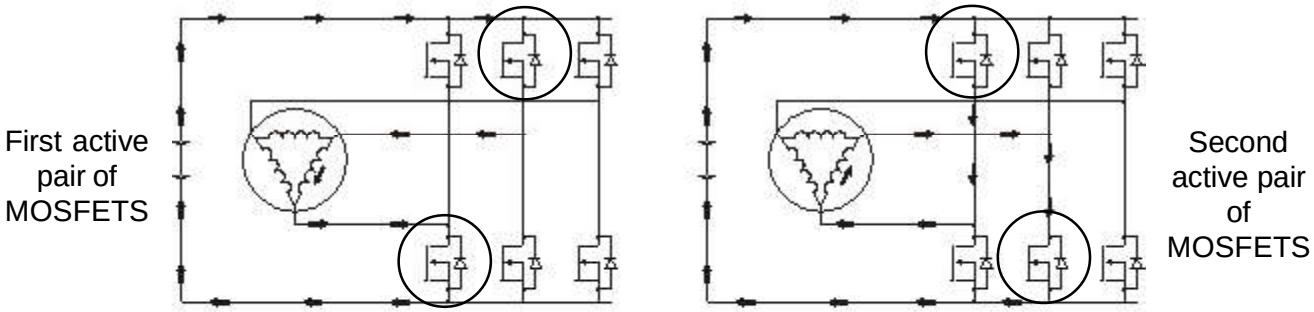
6.1.3.1 Traction and hydraulic power module - 1A1

For an asynchronous motor with typical three-phase current, the conducting path in the three windings is controlled by a “bridge” of six MOSFETS. By controlling when each of the six MOSFETS is activated or deactivated, it is possible to control in one direction then in the other, the current in each of the three motor windings (phases).

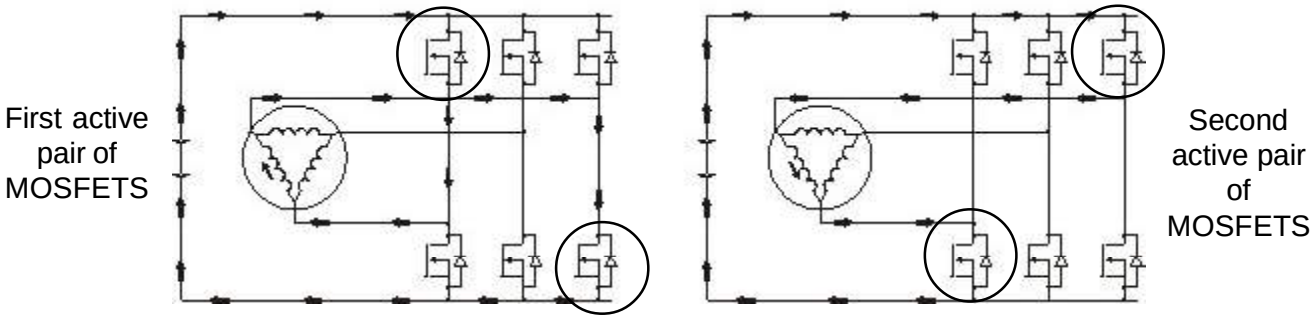
MOTOR WINDING (PHASE) – ONE



MOTOR WINDING (PHASE) – TWO



MOTOR WINDING (PHASE) – THREE



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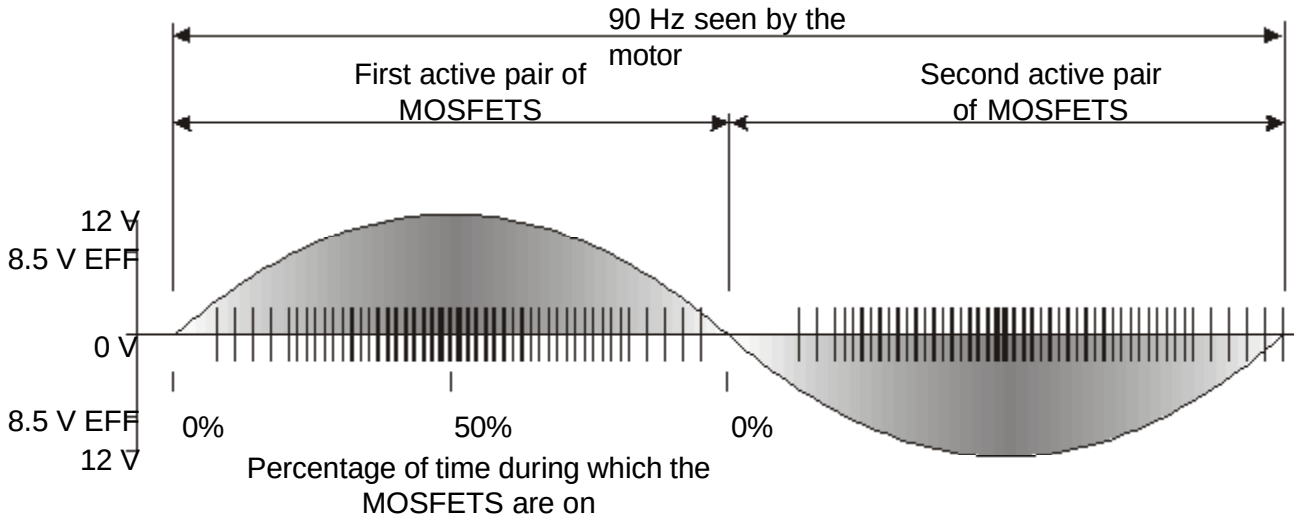
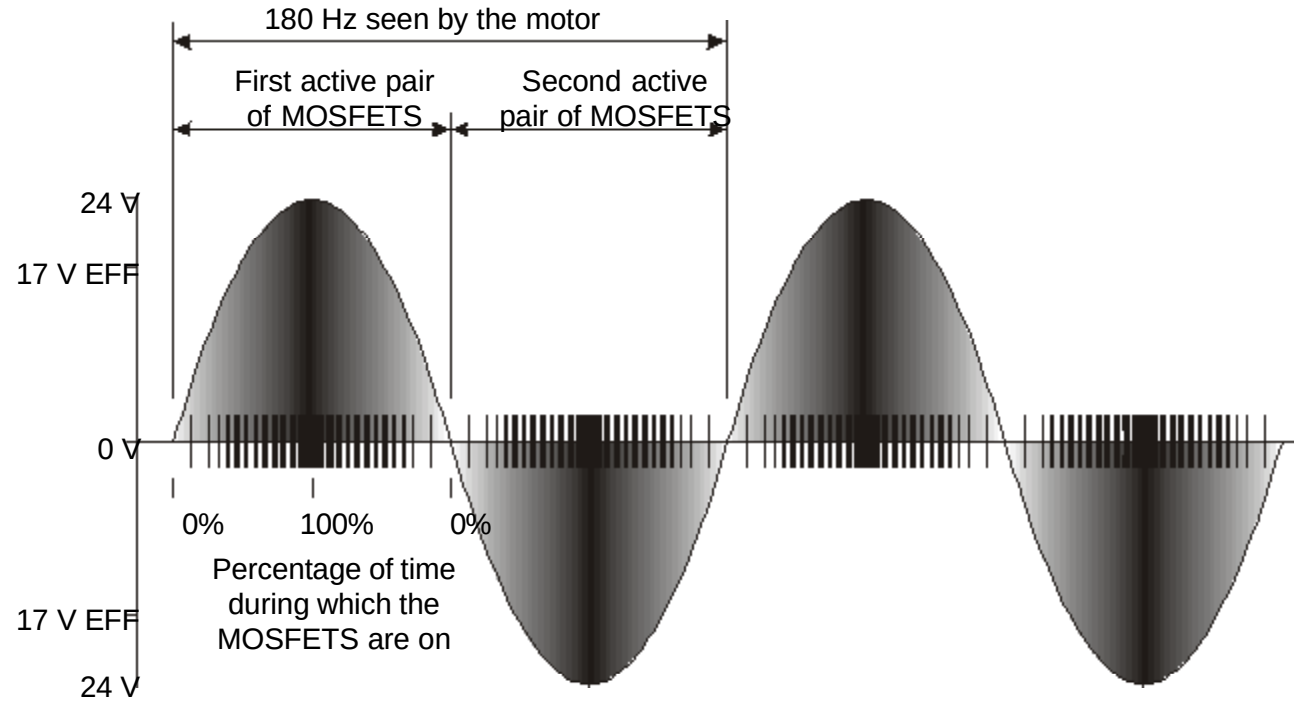
Moreover, by varying the time during which each MOSFET is on, it is possible to control the average voltage applied to each motor winding at any moment. In this manner, an almost sinusoidal voltage is applied to each winding when the motor is running.

The frequency at which the six MOSFETS are activated and deactivated ON and OFF is much faster than that of the AC supply seen by the motor. Typically, the traction motor will see an AC frequency of 180 Hz at the maximum speed, while the MOSFETS will be switched at ON and OFF status at 8 KHz.

MOTOR RUNNING AT SEMI-SPEED (A SINGLE PHASE SHOWED FOR REASONS OF CLARITY)



MOTOR RUNNING AT FULL-SPEED (A SINGLE PHASE SHOWED FOR REASONS OF CLARITY)



High speed calculation microprocessors are used to make complex mathematical calculations required to arrange this operation in sequences. It generates a revolving magnetic field variable at three phases. The synthesised AC supply applied to the motor windings is thus an AC supply with variable frequencies and voltages. The motor rpm and the available torque are controlled very accurately during the drive and also while braking through recovery.

6.1.3.2 Speed control and direction of travel

The truck speed is proportional to the frequency of the power supply applied to the motor. The direction of travel depends on the conducting path through the three motor windings, one with relation to the other.

When the AC frequency applied is low, the average AC voltage applied to the motor windings is also low. On pressing the accelerator initially, the voltage and the AC motor frequency will be low. Gradually, as the truck speed grows, the frequency and AC voltage also grow simultaneously.

With the AC asynchronous type of motors used in the truck 131, the maximum torque is obtained when the motor rotating speed is slightly less than what is determined by the AC voltage generated by the controller, i.e. the “synchronous speed”. The minor difference is called “creep speed”. The controller regulates the voltage and the motor frequency to ensure that this creep speed is maintained at the optimum value to have efficient performances.

The controller monitors the motor current and to ensure that it does not become excessive, it automatically assumes priority on the accelerator loading to reduce the frequency and the AC voltage when necessary.

6.1.4 Fuses - 1F1 - 1F3 - 3F1

The power circuit fuses are located on the LAC plate under the emergency stop.
The small control fuse is located on a bracket below the controller of the LES, it protects the entire control harness (LAC and LES).

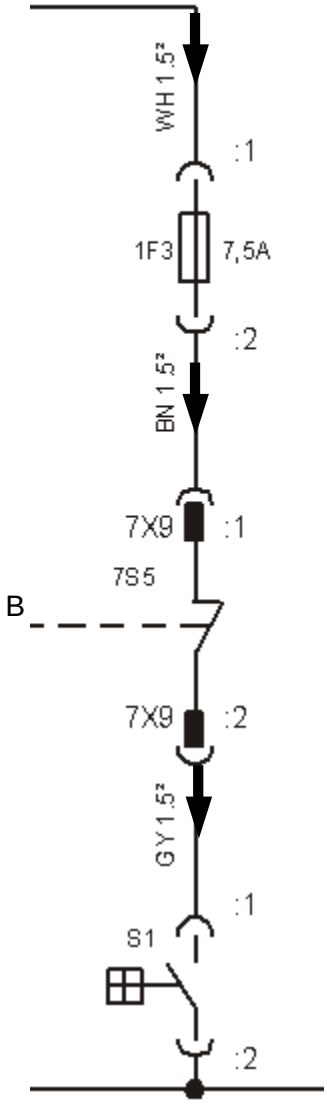
1. The nominal power of the fuse 3F1 (steering) is 100 A
2. The nominal power of the battery main fuse 1F1 is 225 A
3. 1F3 7.5A Key switch, traction/hydraulic and steering control circuits

NOTE: Although this control fuse might be interchangeable with the fuses with automobile type plate, the USE OF AUTOMOBILE FUSES IS FORBIDDEN. Only original Linde fuses have the adequate capacity to enable proper functioning with the voltages present in the truck.

POWER FUSE LES 3F1

POWER FUSE LAC 1F1

CONTROL FUSE 1F3



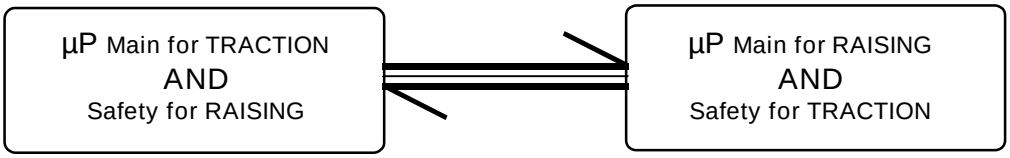
6.1.5 Traction and hydraulic controller - LAC / 1A1

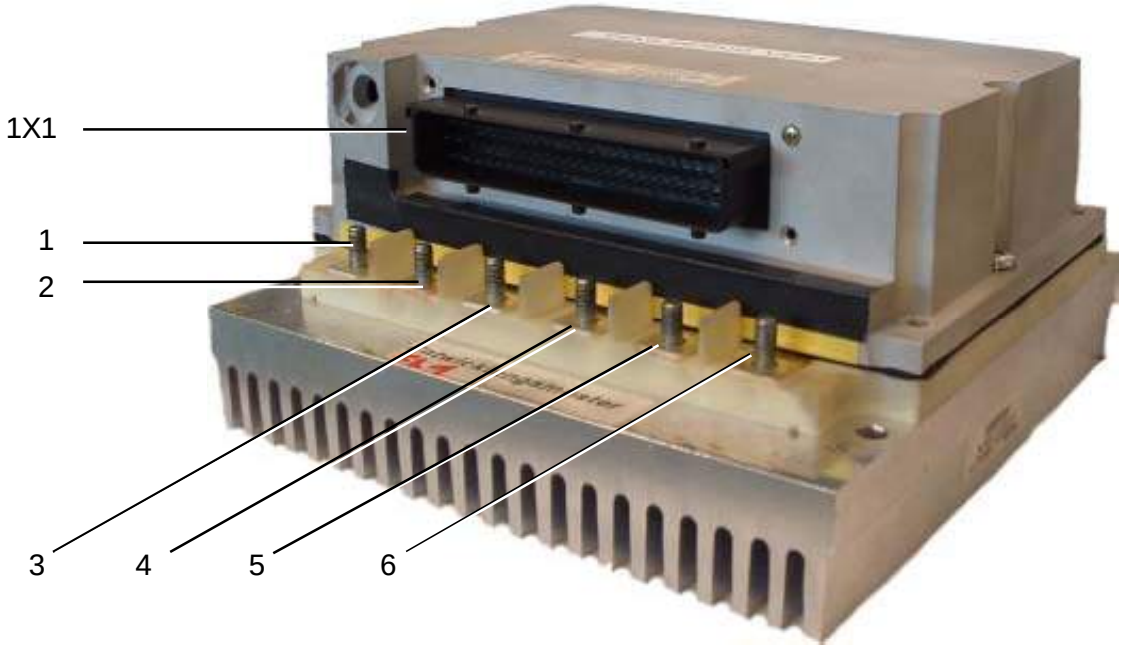
6.1.5.1 Description

The 1A1 controller, the LAC (Linde Asynchronous Control), comprises of a control card LTC (Linde Truck Control) and a power stage for the traction and the hydraulics.

The transistors' control is performed by an electronic circuit called DRIVER, forming the interface between the power and control parts.

The numeric control module LTC uses two microprocessors (Traction and Hydraulic) that are auto-controlled. If a fault occurs, it is detected instantly and the control system puts the truck in safety, which can be a reduction in performance or the halting of a controller, depending on the type of fault. The control module is equipped with a connector 1X1 of 70 pins.





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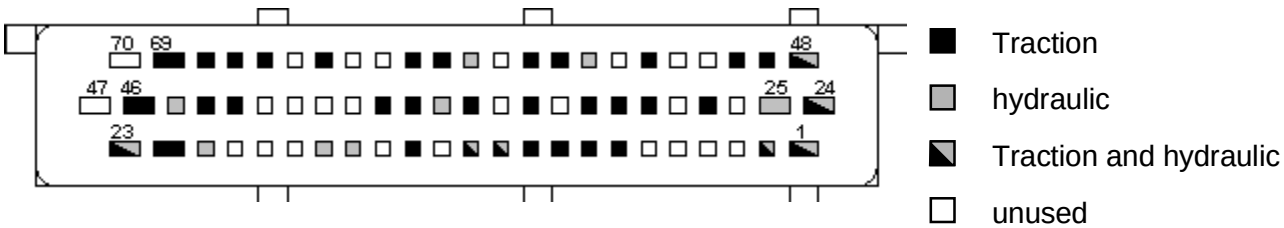
Control circuit connector 1X1



6.1.5.2 Main circuit terminals

1 :U the phase L1 of the traction motor

2 :+ positive power supply terminal +24V for the power unit

3 :V the phase L2 of the traction motor

4 :W the phase L3 of the traction motor

5 :- negative power supply terminal for the power unit

6 :Lift control terminal of the lift motor

6.1.5.3 Connector terminal functions 1X1

TERMINAL	COLOUR	TRAC/HYD.	FUNCTION	ASSOCIATED WITH
1	BU(329)	Traction/hyd.	Positive +24V for internal relay of LAC	Provided by the internal relay of the steering LES
2	YE(2)	Traction/hyd.	Connected to the traction contactor coil	Battery negative 0V
7	WH(7)	Traction	Tiller base	Connected to the battery negative 0V
8	WH(8)	Traction	Operator presence	Connected to the battery negative 0V
9	WH(9)	Traction	Speed sensor track A	Variable signal 0V-6V
10	WH(10)	Traction	Speed sensor track B	Variable signal 0V-6V
11	RD(11)	Traction/hyd.	Push button control	Connected to the battery positive 24V
12	WH(12)	Traction/hyd.	Locking battery	Connected to the battery negative 0V
14	YE(14)	Traction	Anti-crash safety	Connected to the battery negative 0V
16	WH(16)	hydraulic	Cut-off of the LI on top	Connected to the battery negative 0V
17	WH(17)	Hydraulic	Traction speed reduction LI low	Connected to the battery negative 0V
21	WH(21)	Hydraulic	CAN high (elevation)	Connected to the bus CAN high (elevation) LAC
22	YE(22)	Traction	Accelerator supply	Connected to the +8.2V
23	RD(23)	Traction/hyd.	Supply voltage LAC	Connected to the battery positive +24V
24	RD(24)	Traction/hyd.	Power supply to external components	Connected to the battery positive +24V
25	GY(25)	Hydraulic	Lowering valve negative supply	Connected to the battery negative via internal transistor
27	YE(27)	Traction	Left stabiliser negative supply	Connected to the battery negative via internal transistor
29	BK(29)	Traction	Traction speed reduction no. 1	Connected to the battery negative 0V
30	BK(30)	Traction	Seat	Connected to the battery negative 0V
31	WH(31)	Traction	Platform	Connected to the battery negative 0V
33	WH(33)	Traction	Stabiliser oil level	Connected to the battery negative 0V
35	BU(308)	Traction	Signal status of the LES	Connected to the battery negative 0V via LES
36	YE(36)	Hydraulic	Lift control LI	Connected to the battery positive +24V
37	YE(37)	Traction	Accelerator signal	Variable signal 1V-4.1V-7.1V
38	PK(54)	Traction	Accelerator micros	Connected to the battery positive +24V
43	WH(43)	Traction	CAN high (traction)	Connected to the bus CAN high (traction) LAC
44	BN(44)	Traction	CAN low (traction)	Connected to the bus CAN low (traction) LAC
45	BN(45)	Hydraulic	CAN low (elevation)	Connected to the bus CAN low (elevation) LAC
46	YE(46)	Traction	Speed sensor supply	Connected to the +8.2V
48	BK(48)	Traction/hyd.	Negative supply LAC	Connected to the battery negative 0V
49	YE(49)	Traction	Electric brake negative supply	Connected to the battery negative via internal transistor
50	YE(50)	Traction	Right stabiliser negative supply	Connected to the battery negative via internal transistor
53	WH(53)	Traction	Guard rails	Connected to the battery negative 0V
55	GN(55)	Hydraulic	Battery discharge status signal	Connected to the battery negative 0V via indicator
56	YE(56)	Traction	Anti-crash safety	Connected to the battery positive +24V
57	BK(57)	Traction	Traction speed reduction no. 2	Connected to the battery negative 0V
59	YE(59)	Hydraulic	Lower control LI	Connected to the battery positive +24V
60	WH(60)	Traction	Traction motor temperature signal	Variable signal
61	BU(317)	Traction	Steering angle signal	Signal coming from the steering 6V in right line
64	WH(64)	Traction	Inclinometer signal	Signal from 4.1V truck flat
68	YE(68)	Traction	Supply 0 V for accelerator	Supply 0 V for accelerator
69	WH(69)	Traction	Speed sensor supply 0V	Speed sensor supply 0V

6.1.5.4 Starting the controller LAC - 1A1

- Emergency stop is made => The positive +24V arrives at the input of the line contactor 1K2 and the key switch.

- The key is turned => the positive +24V pass through the key and the auxiliary microswitch of the emergency stop 7S5. 7S5 ensures the complete halt of the truck if the operator activates the push button (it is an auto feed of the electronics when the traction motor is generator).

- The LAC is then fed => +24V terminals 1X1:23/11, and terminal direct negative 1X1:48.

- An internal voltage regulator provides the +8.2V => accelerator potentiometer supply in terminals 1X1:22/68, and supply of the speed sensor and the inclinometer terminals 1X1:46/69.

- The 2 microprocessors for traction and hydraulic are supplied in +5V by a second regulator. The two controllers start and launch the LAC internal test program.

- If there is no serious internal fault at the LAC => the start-up conditions are consolidated.
The internal safety relay is then controlled. Its contact is connected between the terminals 1X1:1/24.
This relay provides the supply positive +24V for => the line contactor 1K2, the electrobrake Y1, the lowering valve 2Y2 and the two valves of the left and right stabilisers 2Y8 and 2Y9.

- The line contactor 1K2 is supplied to negative terminal 1X1: 2 => after closing 1K2, the power stage is supplied +24V in terminal:+.

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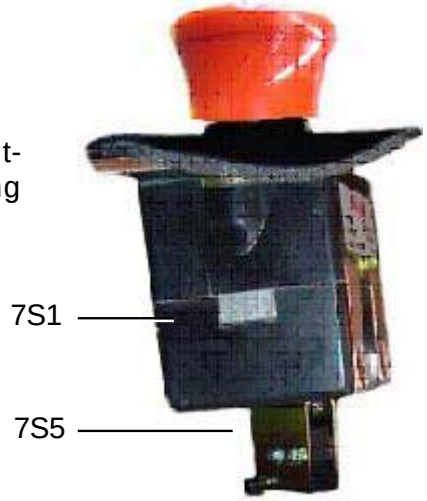
EMERGENCY CIRCUIT BREAKER -7S1 / 7S5

ATTENTION: Always make sure that the emergency circuit-breaker is pressed before disconnecting or reconnecting the battery.

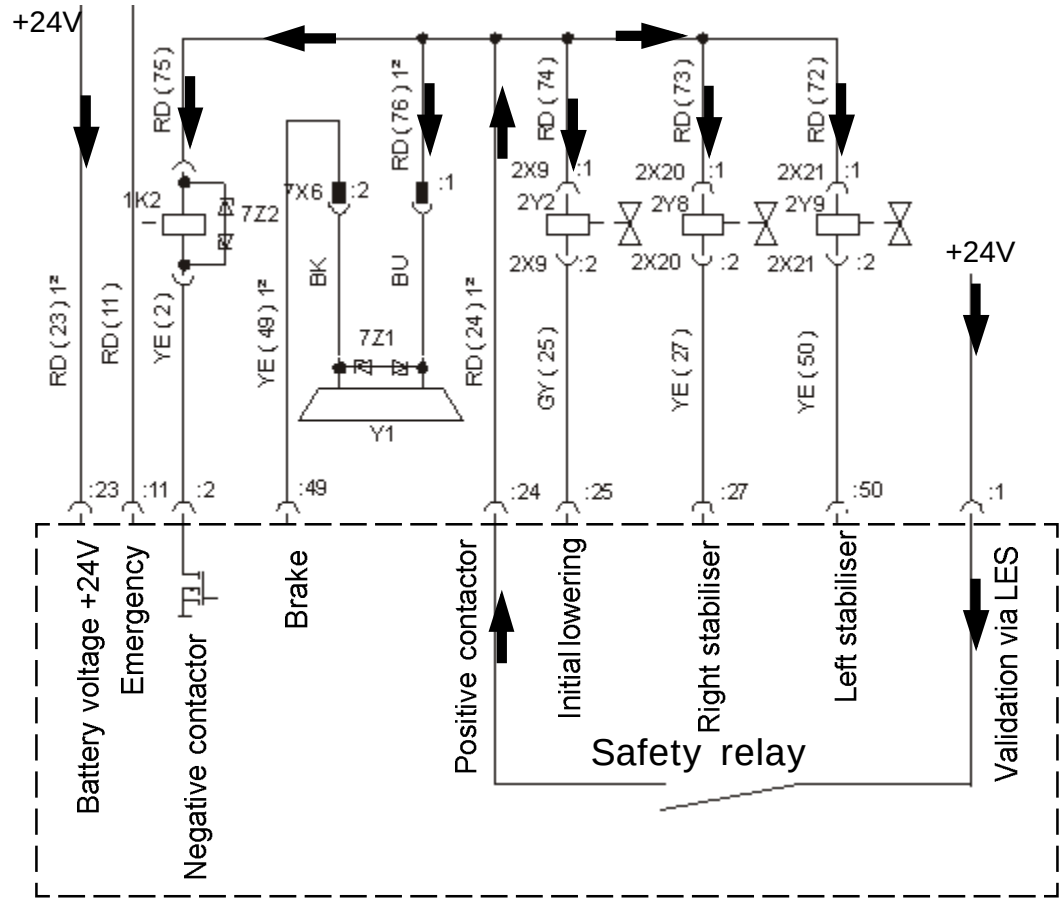


TRACTION / HYDRAULIC LINE CONTACTOR 1K2

Characteristics of the contactor coil:

Resistance (20° C)	44 Ohms
Coil interference	Only free wheel diode.
	No series resistance.

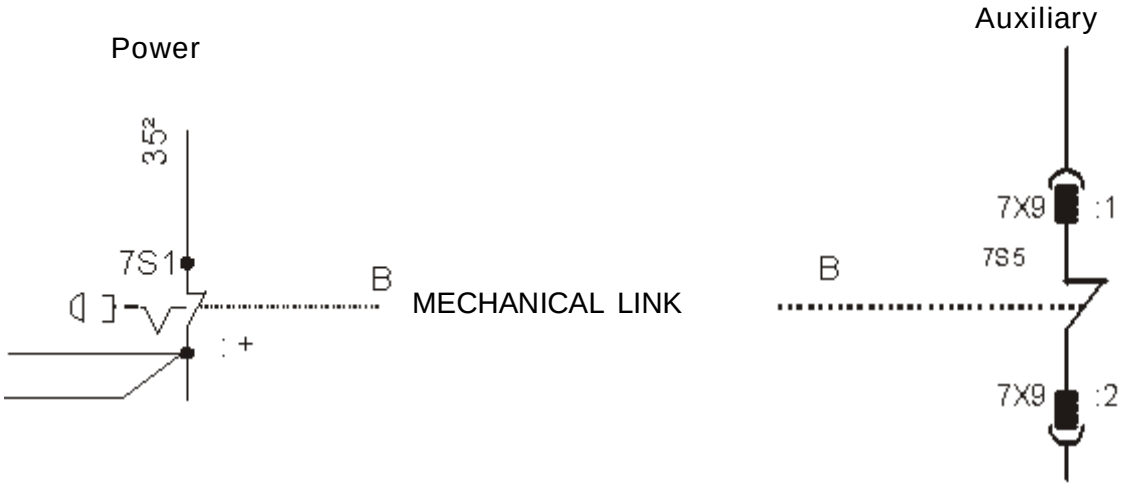
SUPPLY AFTER THE KEY AND 7S5



EMERGENCY STOP -7S1 / 7S5

Connector 7X9

Terminal	Colour	Function
1	BN	Microswitch input 7S5
2	GY	Microswitch output 7S5



6.1.6 Traction start-up conditions (Validation)

The LAC needs some information to start the traction. This information is associated with the operating status of the electric steering and the driver's position in the truck.

- The first LAC validation condition is an LES electric steering in good condition, controlled by the traction in terminal 1X1:35. The signal sent by the steering is a negative coming from the terminal 3X1:8.

- The second condition, to obtain the traction, is linked to the Platform/ guard rail/operator presence / tiller base (inputs of terminals 1X1: 31 / 53 / 8 / 7 of the LAC).

In the table:
- Value 1 means that the input is linked to the battery negative
- Value 0 means that the input is disconnected
- A "-" means that the value can be 1 or 0

Platform	Operator presence	Guard rails	Tiller base	Reaction of the truck	Status
1X1: 31	1X1: 8	1X1: 53	1X1:7		
-	0	0	0	No traction	1
0	0	0	1	Walkie mode (AP)	2
-	0	1	-	No traction	3
0	1	-	-	Stop +Error :1X1:31/8 incompatible	4
1	0	-	-	No traction	5
1	-	-	0	No traction	6
1	1	0	1	Speed 6Km/h (AP)	7
1	1	1	1	Speed 10Km/h (AP + SP)	8
1= Low position	1= Activated	1= Position High	1= Position Steering		

Reaction of the truck when you go from one status (from 1 to 8 in the table) to another:

Truck status	Action	Reaction
- The truck moves to status 2, 7 or 8	release the tiller (1X1:7=0)	- apply the electrobrake.
- The truck moves to status 7	raise the guard rail (1X1:53=1)	- if the accelerator is released in neutral position then reactivated move to status 8.
- The truck moves to status 8	lower the guard rail (1X1:53=0)	- move to status 7.
- The truck moves to status 7 or 8	leave the presence	- the motor brakes, then when the truck halts, the brake (1X1:8=0) is applied, you go back to status 5.
- The truck moves to status 7 or 8	raise the platform	- the motor brakes, then when the truck halts, the brake (1X1:31=0) is applied, you go back to status 4.

TILLER BASE MICROSWITCHES IN VERSION AP

The tiller base is equipped with two microswitches, 1S4 and 1S4A, mounted in series. When the tiller is in vertical position, 1S4 is open and disconnects the terminal 1X1:7 of the LAC (rest position of the truck electrobrake applied). While moving, if the driver has to brake in an emergency, it is enough to press the tiller downwards in horizontal position. The microswitch 1S4A opens and disconnects the terminal 1X1:7. The tiller base microswitches are replaced by a wire to the connector 1X3 between the terminals :10 and :12 in version 131 SP.

PLATFORM AND GUARD RAIL

The platform and guard rail microswitches are replaced by a wire to the connector 1X20 between the terminals :1 and :2, and 1X3 between the terminals :15 and :14 in version SP.

1X1:31= 0V => Platform low

1X1:53= 0V => Guard rail high

1X1:8 = 0V => Active presence

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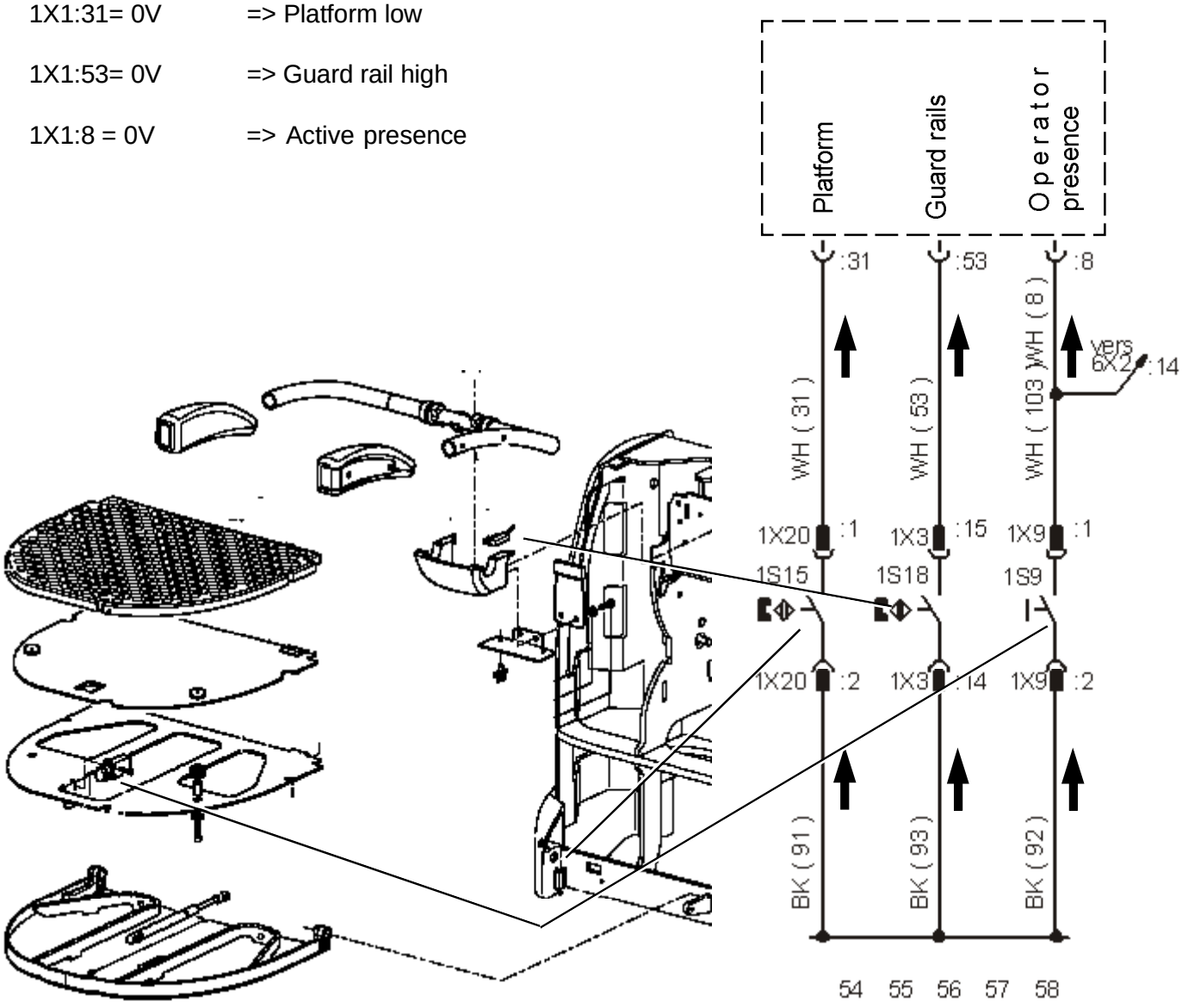
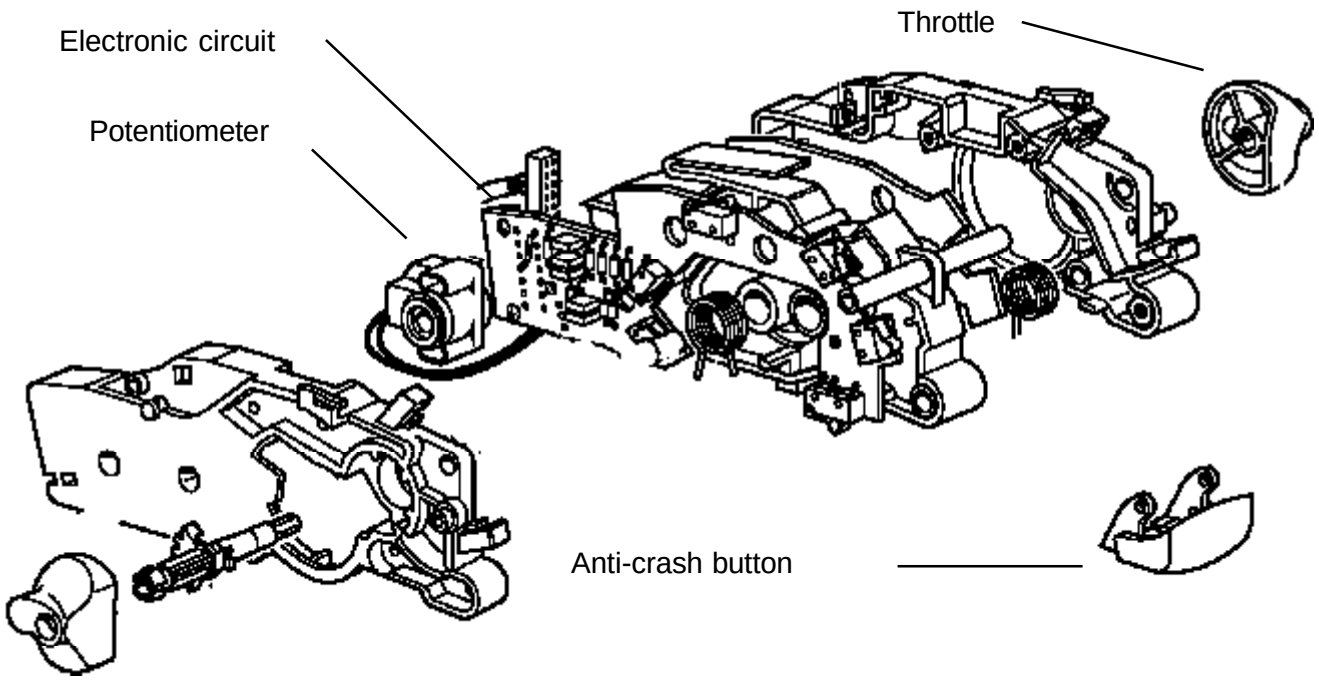


6.1.7 **Control module – tiller in version AP- Handlebar in version SP - A1**

6.1.7.1 Description

The control unit is identical to the old range of trucks and is common to the two versions, AP and SP. Only the traction potentiometer 1B1 can be and must be regulated while changing the control unit or a replacement of the LAC. The potentiometer value must be regulated precisely and this precision can only be obtained by using the PathFinder software.
The anti-crash safety microswitch 1S3 for the operator is located behind a red button that can be activated in the AP version, and behind a black cover in the SP version forbidding the use of this safety (the driver is protected by the outer hull of the truck).



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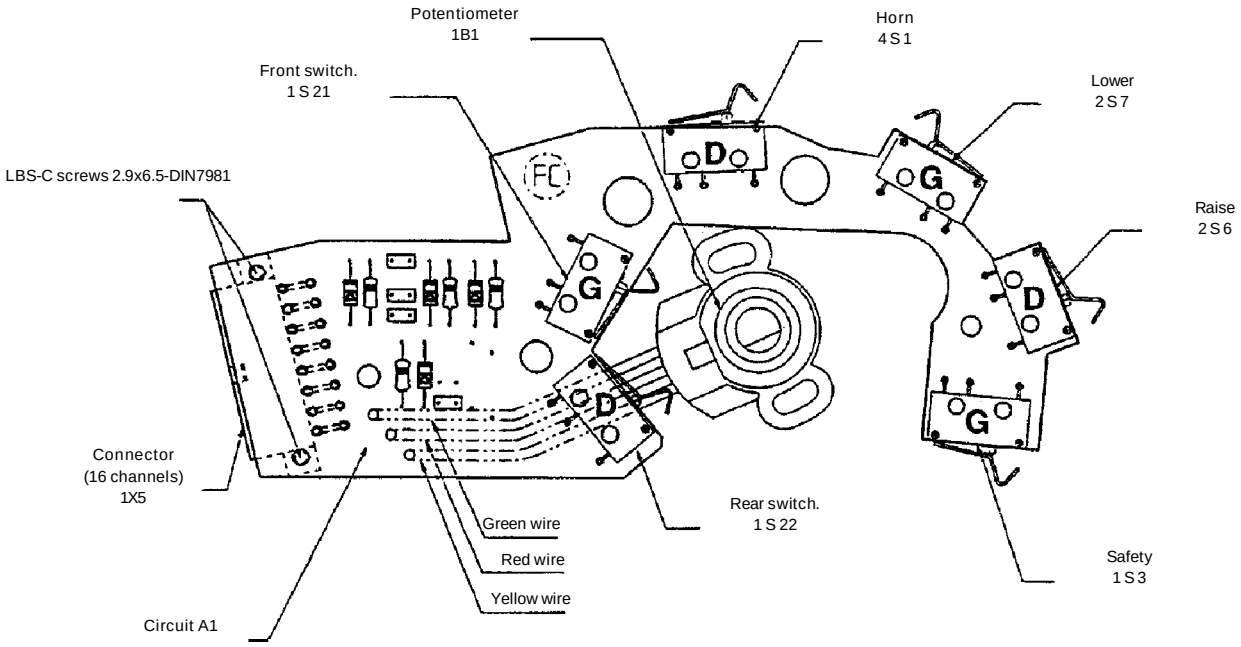
Connector 1X5

Terminal	Colour	Function
1	PK	Horn output positive
2	VT	Initial lift output positive
3	WH	Initial lowering output positive
4		
5	WHRD	Anti-crash switch output positive
6	GY	Accelerator potentiometer supply negative
7	OG	Link potentiometer (mid point)
8	YE	Supply +10 V accelerator potentiometer
9	BU	Forward / reverse movement switch output positive
10	RD	Card supply input positive A1
11	BK	Anti-crash switch input negative
12	BK(801)	Output negative to tiller base microswitch
13	GN	Tiller base input negative
14	WHBU	Anti-crash signal output negative
15	GY(802)	Input negative via tiller base
16	BN	Tiller base signal output negative

VIEW OF THE TILLER ELECTRONIC CARD



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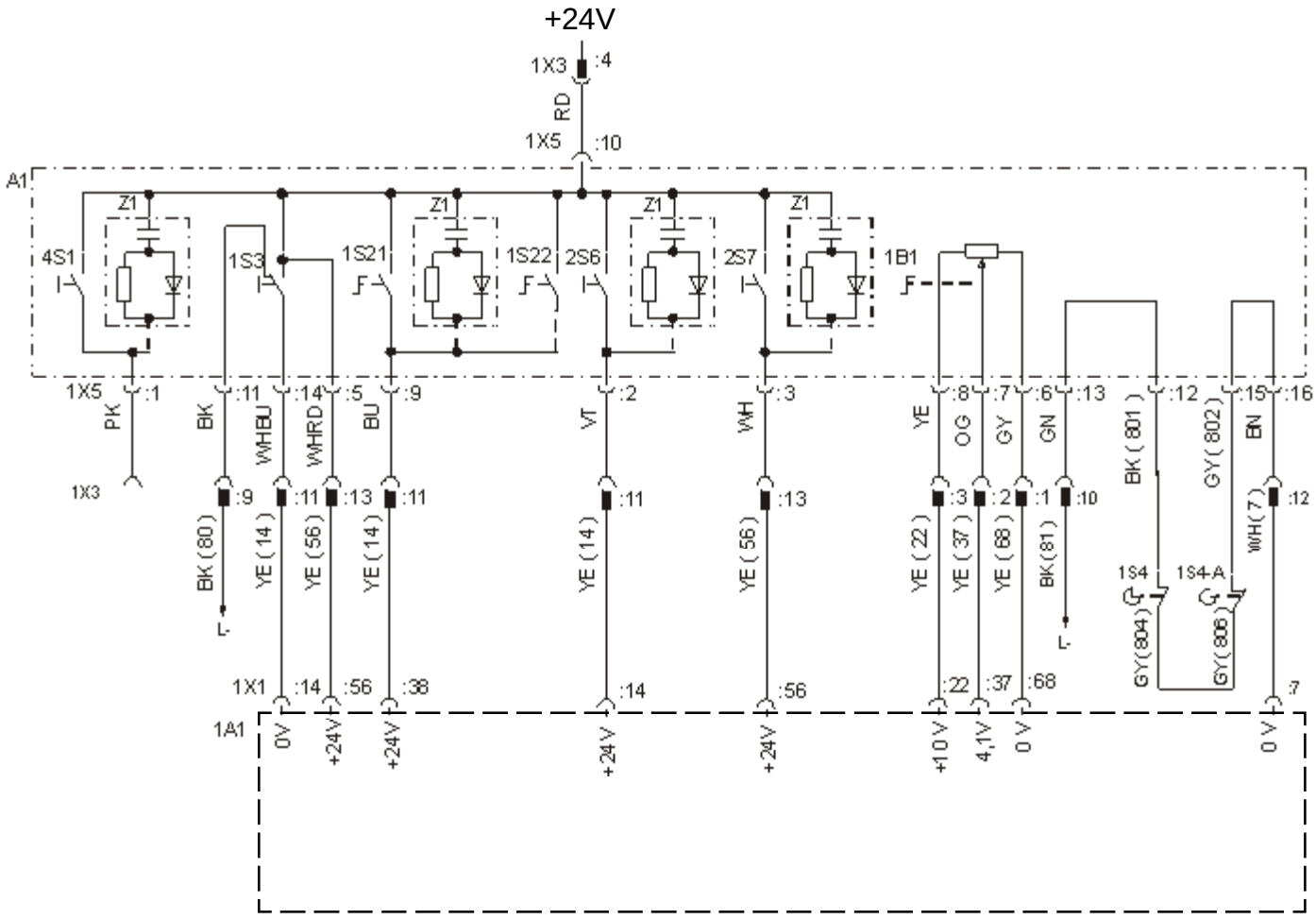
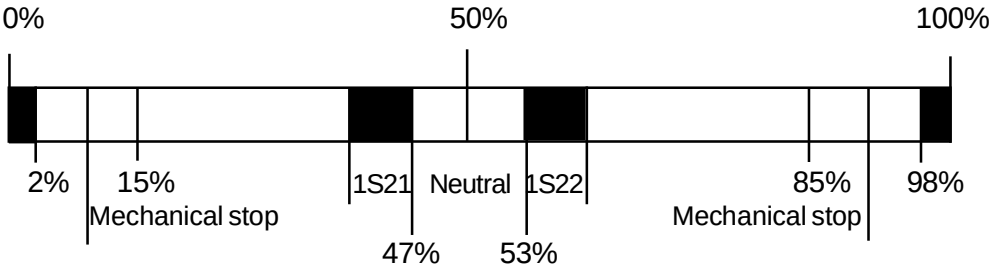


6.1.7.2 Potentiometer 1B1 and microswitches 1S21 - 1S22 of the accelerator

The accelerator is controlled by a radiometric value, a % of the supply voltage. This control mode always helps to be at the important values for carrying out the acceleration and the regulation of the potentiometer. The radiometric values are always true regardless of the variations in the supply voltage. They can be displayed with the PathFinder application. The accelerator must be calibrated with the diagnostics software.

%	Action
47 to 53	Neutral position
47 to 43 // 53 to 57	Close 1S21 or 1S22. Brake control Y1
43 to 15 // 53 to 85	Acceleration of the truck up to normal speed
15 to 2 // 85 to 98	Truck moves at maximum speed
2 to 0 // 98 to 100	Power supply harness breaks / outside range



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6.1.7.3 **Tiller rear safety control – 1S3**

The anti-crash is available in the AP version. This safety works when the truck is in walkie configuration, with raised platform and lowered guard rail. With the PathFinder software, you can also activate this safety in stand-on configuration.

While moving, the action on the tiller rear safety control causes the following reaction:
- action on the tiller safety contact, the truck moves in the direction of the fork arms at reduced speed while the tiller safety switch is not released.
- on releasing the tiller safety contact, if the accelerator is still activated, the truck moves with free wheel until it stops.

Note 1: To retrieve the full drive, it is necessary to release the accelerator at zero and to reaccelerate.

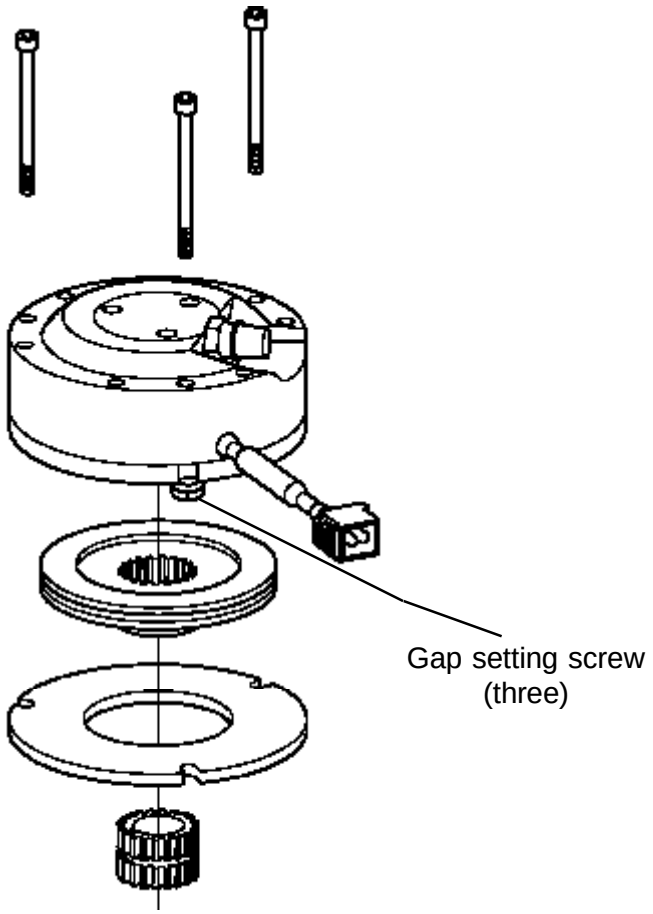
6.1.8 **Electrohydraulic brake – Y1**

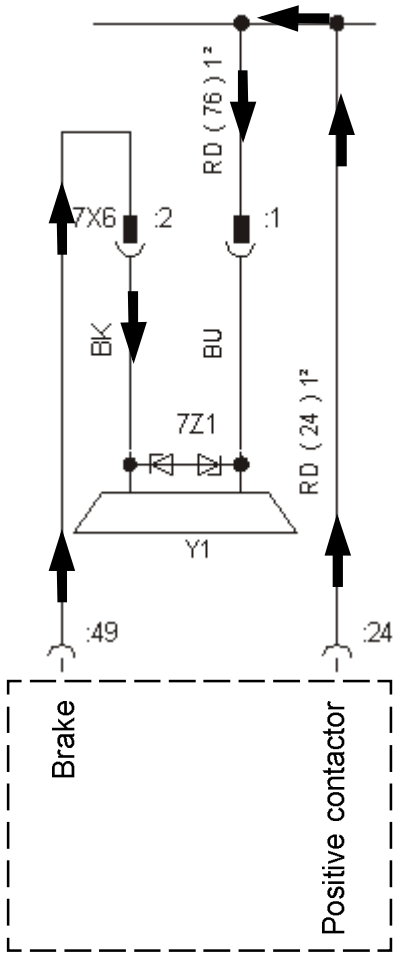
This brake is an electromagnetic brake with no current with hydraulic assistance.
The electrohydraulic brake is used as parking brake and also for emergency braking.
The hydraulic piston helps increase the brake torque according to the load on the fork arm, the hydraulic pressure in the lifting jacks activate the piston and increase the braking.

The brake release is done by the action of the accelerator, to enable start-up on side without the truck moving. The brake is reapplied if the accelerator is released and if the truck speed is zero.

The air gap setting must be between 0.2 mm and 0.6 mm.

ELECTROMAGNETIC BRAKE





Connector 7X6

Terminal	Colour	Function
1	BU	Positive +24V of Y1
2	BK	Negative -Ub of Y1

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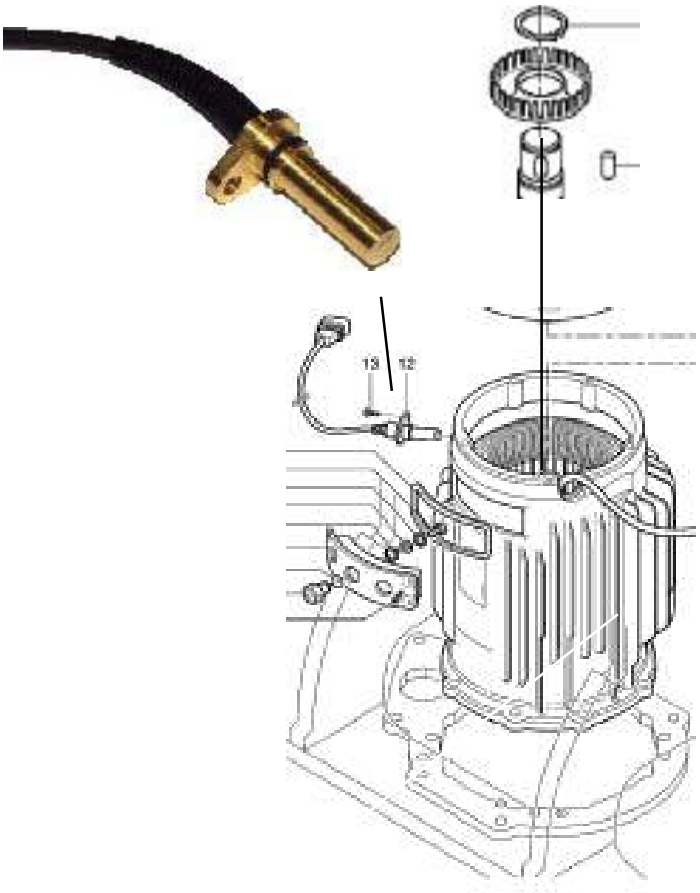
6.1.9 Traction motor speed sensor – 1B2

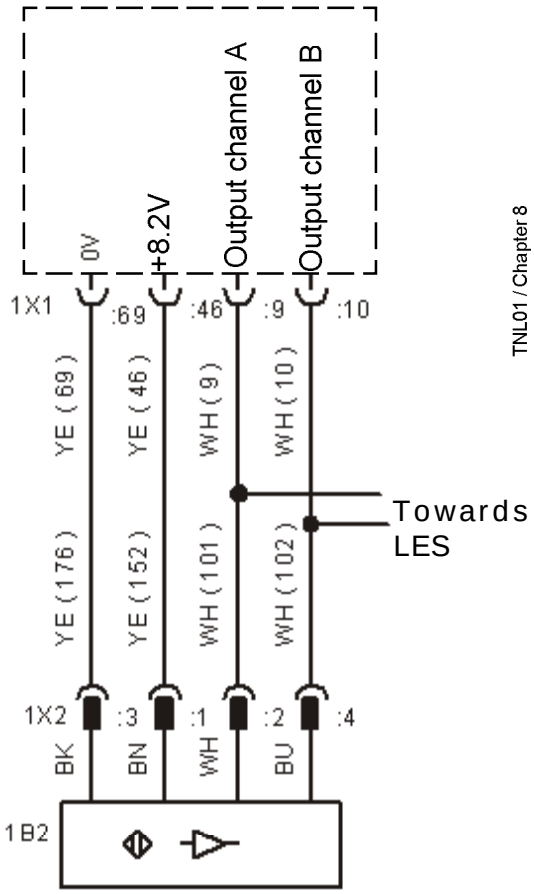
A sensor 1B2 is mounted on the traction motor. This sensor is controled by the cog wheel mounted on the rotor.

The sensor is supplied with +8.2V (outputs terminals 1X1: 46 / 69 of the LAC) and provides two pulse outputs with dephased time slots of 90°. These signals are transmitted to the traction control module (inputs terminals 1X1:9 / 10 of the LAC) as well as to the controller LES where they are processed to determine the speed and the direction of rotation of the traction motor. No regulation is provided for the speed sensor.

CAUTION: If the sensor is not mounted properly or if the connector 1X2 is disconnected, it will be followed by a traction speed of 0.2Km/h and the motor effective current will increase to the Imax current of 270A (with a standard factory truck parameterisation).

TRACTION SPEED SENSOR





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Connector 1X2

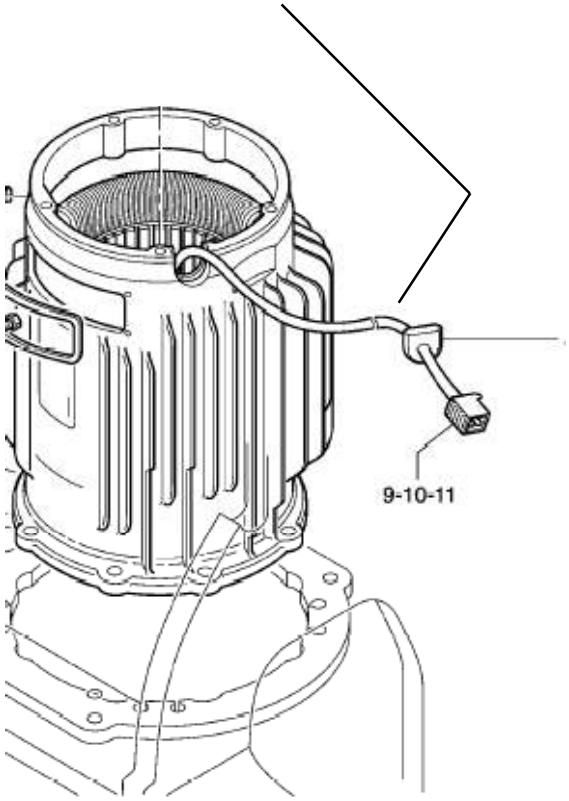
Terminal	Colour	Function
1	YE(152)	Supply +8.2 V
2	WH(101)	Output channel A
3	YE(176)	Negative
4	WH(102)	Output channel B

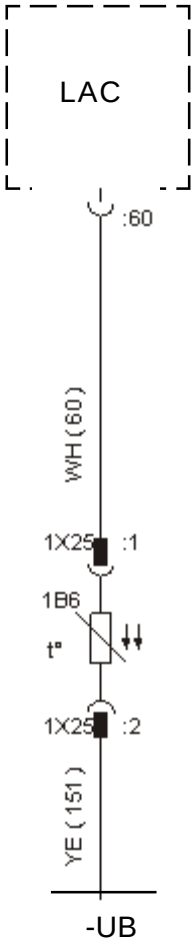
6.1.10 Traction motor temperature control – 1B6

A resistance probe 1B6 integrated in the stator windings controls the temperature and reduces the performances when it is too high.

- If the motor temperature exceeds 160°C, the truck speed is reduced to 2Km/h.
- If the temperature probe is defective or if the harness is disconnected, the LAC controller will reduce its speed to 4Km/h.

TRACTION MOTOR TEMPERATURE SENSOR





Connector 1X25

Terminal	Colour	Function
1	WH(60)	Temperature signal
2	YE(151)	Temperature probe

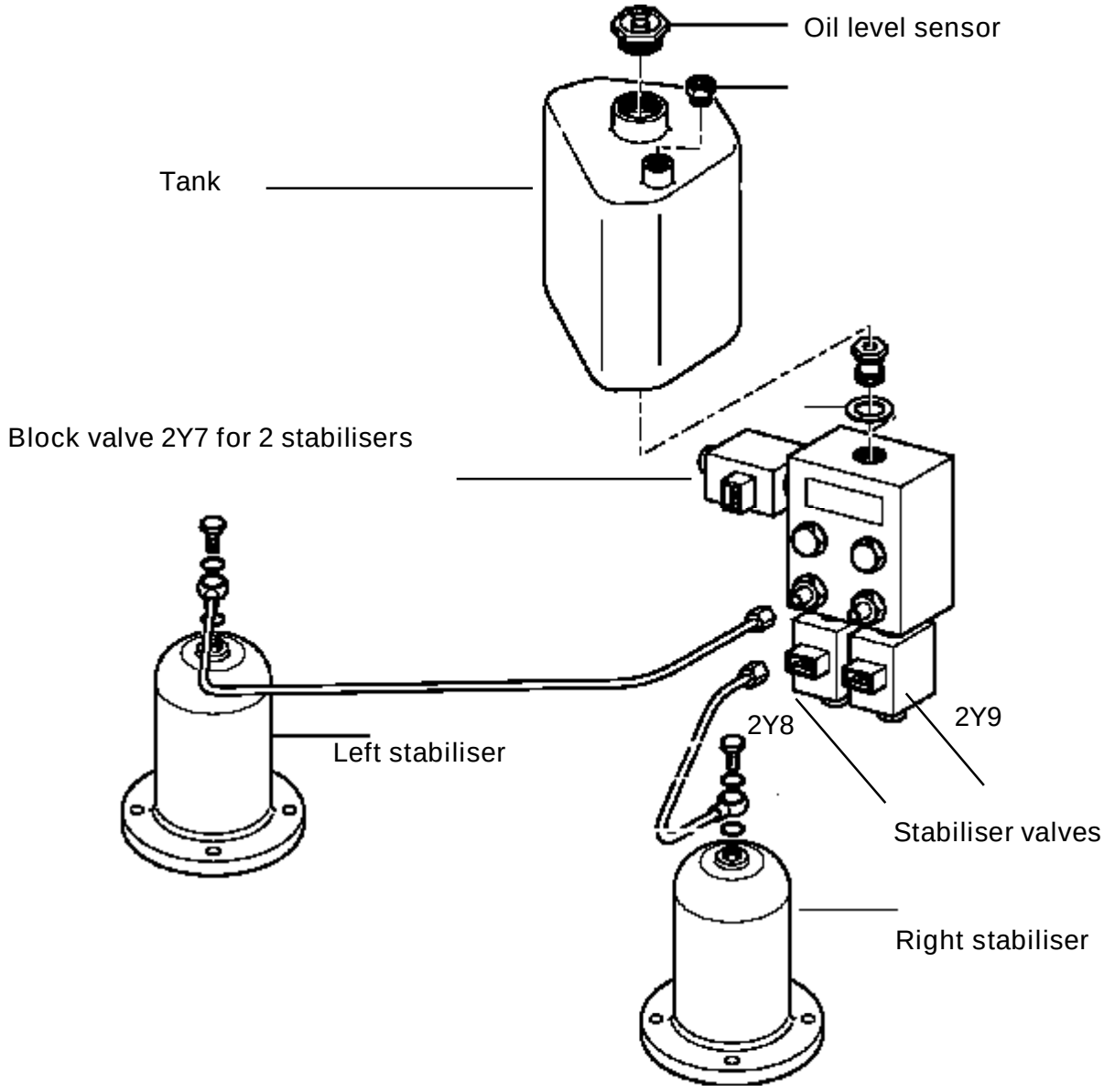
6.1.11 Truck hydraulic stabilisers

6.1.11.1 Description

The new stabiliser system is mounted to compensate the wear of stabiliser wheels, to increase the motoricity of the truck and to get a high stability while turning.
The stabilisers work as vehicle dampers with an oscillating movement very limited by the hydraulic oil. However, when the truck takes a curve, the external stabiliser spring crashes at the turn and the truck bends. This tilt is detected by an inclinometer, the LAC controls the closing of the valve that blocks the stabiliser and gives support to the truck.

The stabiliser valves are marked by a colour code:
- Right yellow stabiliser, pump side
- Left green stabiliser, LAC side

If the oil level is too low, the maximum speed of the truck is 2km/h.



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6.1.11.2 Stabiliser valves 2Y8 and 2Y9

The stabiliser valves are supplied in positive after the internal safety relay, and in negative by the Mosfet transistors.

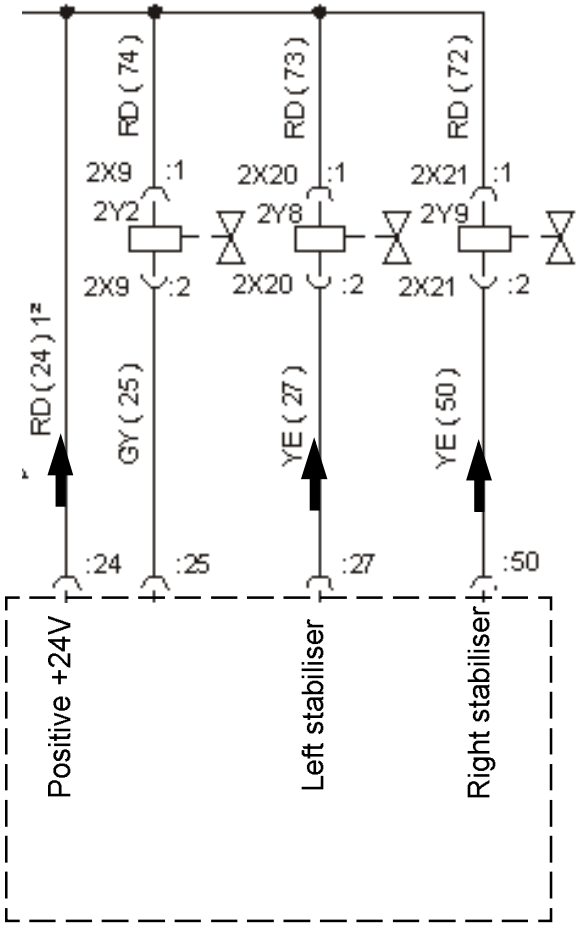
- When the valves are not fed, the stabilisers are free.
- When a valve is fed, the corresponding stabiliser is blocked.

Connector 2X20

Terminal	Colour	Function
1	RD(73)	Power supply +24V
2	YE(50)	Negative supply

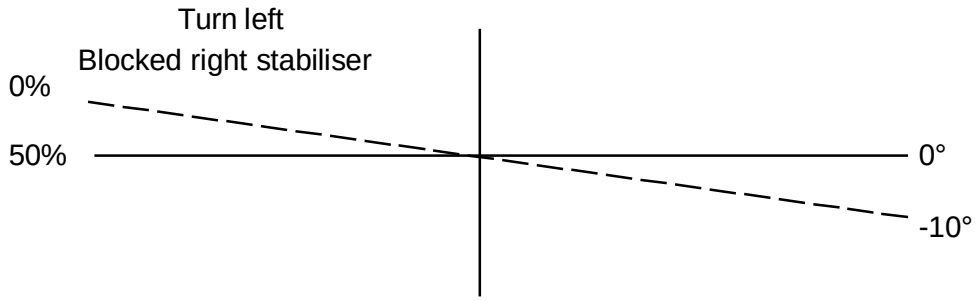
Connector 2X21

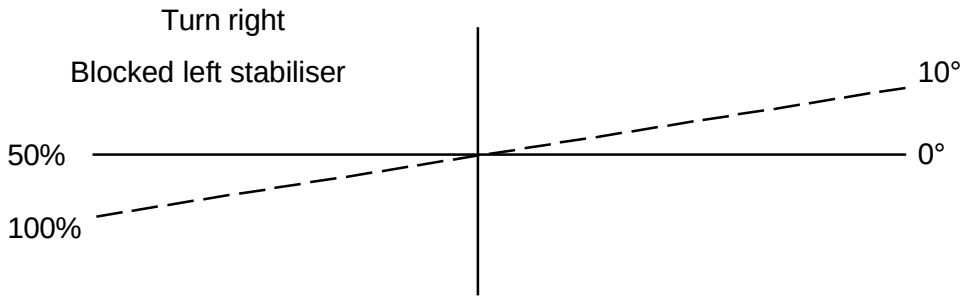
Terminal	Colour	Function
1	RD(72)	Power supply +24V
2	YE(27)	Negative supply



6.1.11.3 Inclinometer - 1A8

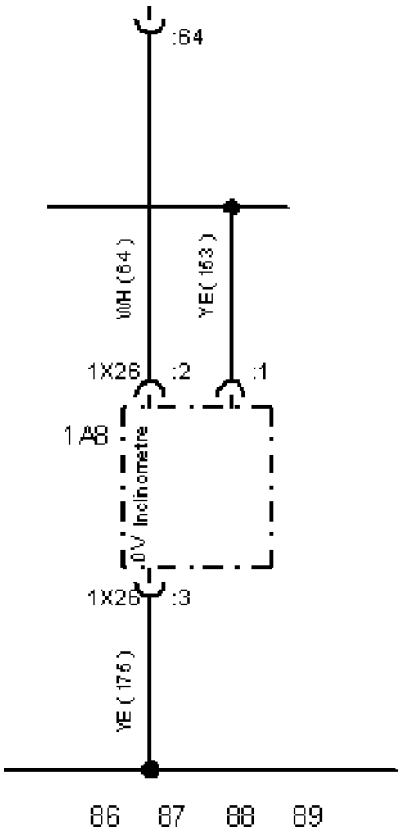
The inclinometer is a bubble level that transmits the inclination degree of the truck to the LAC.
The values displayed in % are ratios of the supply voltage. The inclinometer must be calibrated if it is changed or if the LAC is changed. No mechanical regulation is possible.
A 50% value corresponds to a horizontal truck. The stabiliser blocking and unblocking thresholds can be controlled with the PathFinder software.





Connector 1X26

Terminal	Colour	Function
1	YE(153)	Positive supply
2	WH(64)	Signal
3	YE(175)	Negative supply



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6.1.12 Battery **locking sensor – 1S19**

1°) For trucks equipped with a side battery outlet, battery locking sensor B1 is mounted to ensure that the battery box is firmly locked in place.
- If the battery is not locked, the traction is reduced to 4Km/h and the left and right stabilisers are blocked by the supply to the valves 2Y8 and 2Y9 to prevent the truck from bending when charging the battery.
- If the truck supply is cut off, the valve 2Y7 (closed without supply) will block the stabilisers.

2°) If the side output function of the battery is not mounted:
- 2Y7 is replaced by a stopper
- 1S19 is replaced by a wire to the connector X2 between the terminals :1 and :2.
- On stopping, supply cut off, the stabilisers are free.

The battery locking sensor B1 is supplied by a direct positive. A negative output signal is added to the control card when the battery is locked (input in terminal X1:12).

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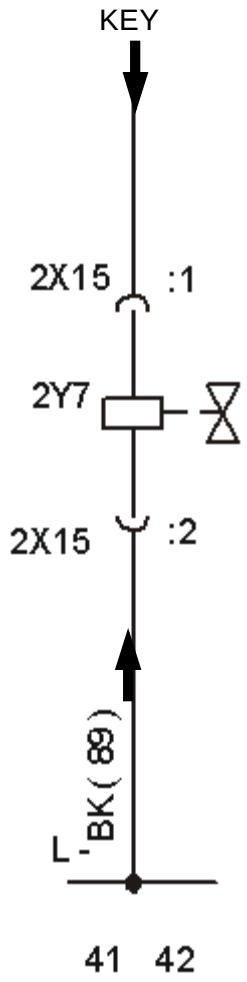
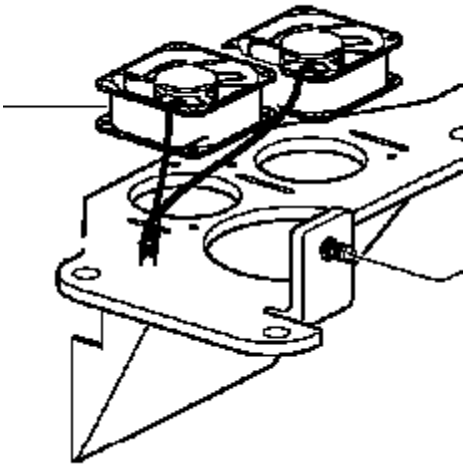
Connector X2

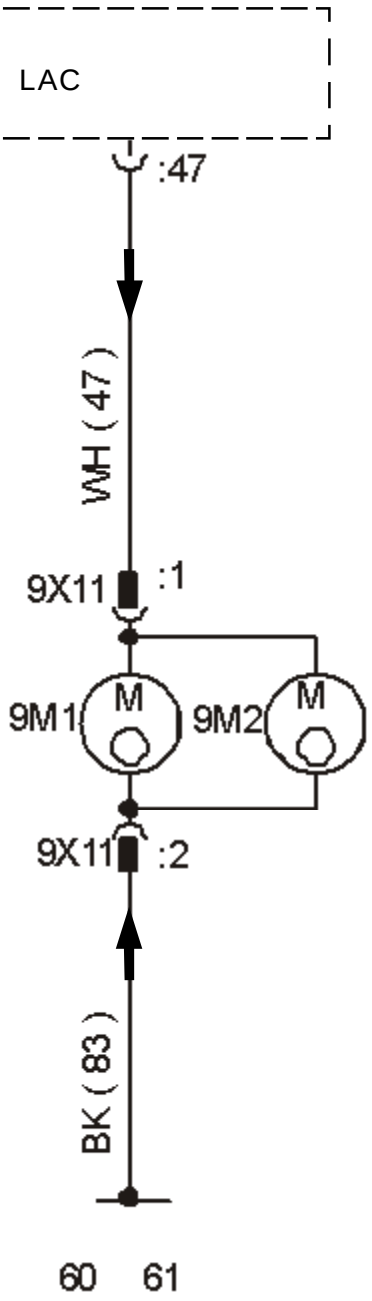
Terminal	Colour	Function
1	WH(12)	Signal
2	BK(88)	Negative supply



6.1.13 L.A.C. cooling fans - 9M1, 9M2

The 24V DC fans without brush, equipped with highly durable bearings are used to cool the LAC traction and hydraulic controller.
The L.A.C. controls the fans when the internal temperature of the power stage exceeds 50°C, and stops them when the temperature drops below 40°C.





9M1-9M2 ON =LAC > 50°C
9M1-9M2 OFF =LAC < 40°C

Connector 9X11

Terminal	Colour	Function
1	WH(47)	+24V variator output signal
2	BK(83)	Negative supply

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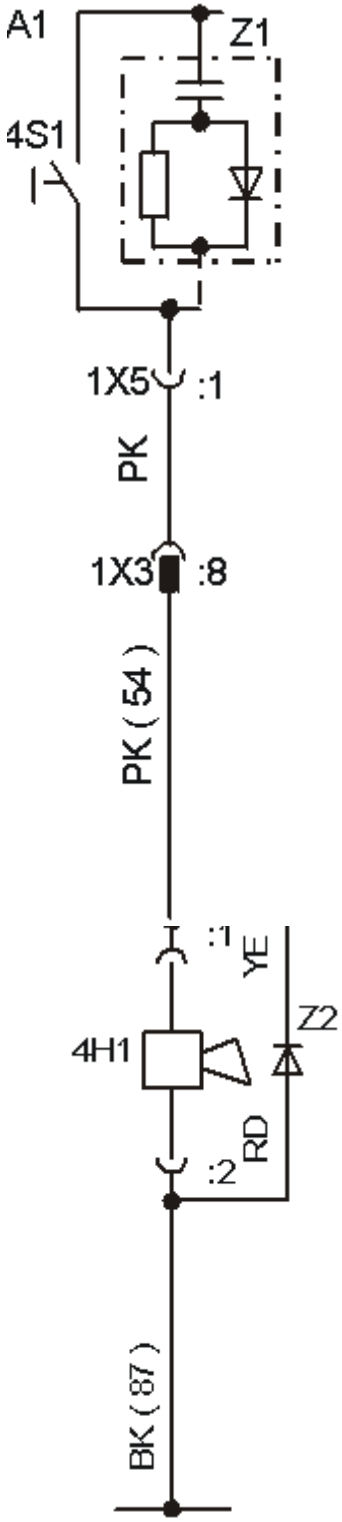
6.1.14 Horn **operation – 4H1**

The horn circuit is supplied directly from the emergency stop contact. The push button 4S1 is above the control panel. Pressing 4S1 applies a voltage +24V to the horn 4H1.

HORN



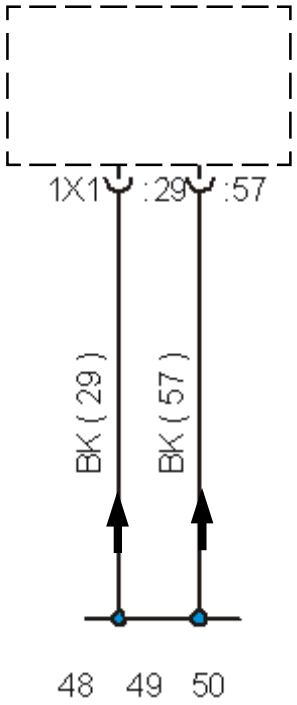
Connector 1X3

Terminal	Colour	Function
8	BK(80)	+24V Signal

6.1.15 Speed limitation no. 1 and no. 2 (options)

The LAC controller is equipped with two speed limitation inputs that will be parameterised with the diagnostics software. In the truck standard configuration, these speed limitations are deactivated by the controller when the terminals 1X1: 29 / 57 are permanently connected to the battery negative.
Deleting one of the negatives activates the corresponding speed limitation.

Speed limitation No. 1 => 1X1: 29
Speed limitation No. 2 => 1X1: 57



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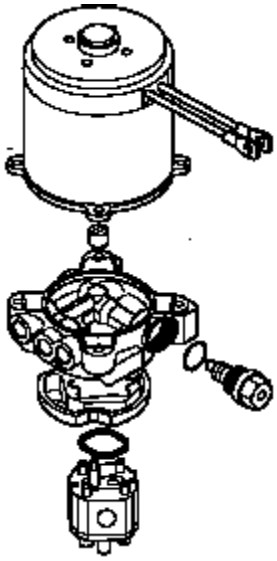
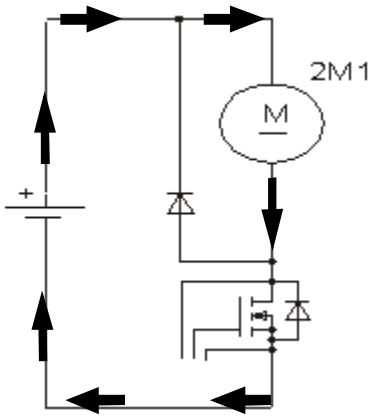
6.2 LIFTING

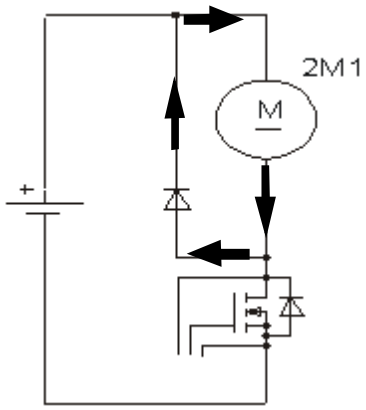
6.2.1 **Operating the initial lift of the truck – 2M1**

The motor pump is supplied in positive +24V by the line contactor 1K2, and in negative by the MOSFET power transistor mounted inside between the terminals**": Li "** and**":- "**.
A free wheel diode that helps free the stored energy by the armature during the FET transistor passing phases, is connected between the terminals **" :+ "** and **" : Li "**.
The motor start-up then is gradual, which prevents current surges and extends the life of the motor.
Note: Putting the traction in safety stops the hydraulic function.

MOTOR PUMP UNIT



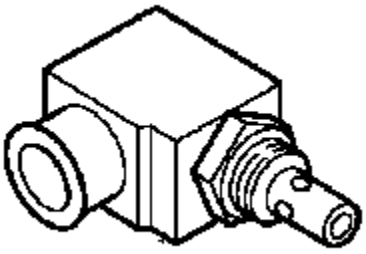




6.2.2 **Operating the lowering of the truck initial lift – 2Y2**

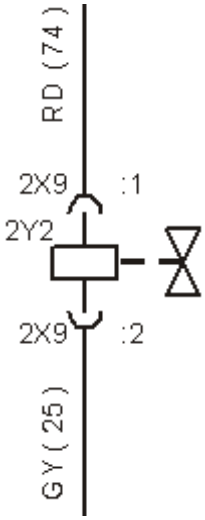
The lowering function is realised by controlling the valve 2Y2.
The supply positive +24V is direct after the LAC internal relay, the negative is controlled, when you press the button 2S6, through a FET transistor in output 1X1 : 25.
The lowering speed fixed by the flow restrictor diameter: in the T20AP/SP-2.2 mm diameter, and in the T24AP/SP- 2.4 mm diameter.

VALVE 2Y2



Connector 2X9

Terminal		Colour	Function
1	RD(24)	Positive supply +24V	
2	GY(25)	Negative supply 2Y2	

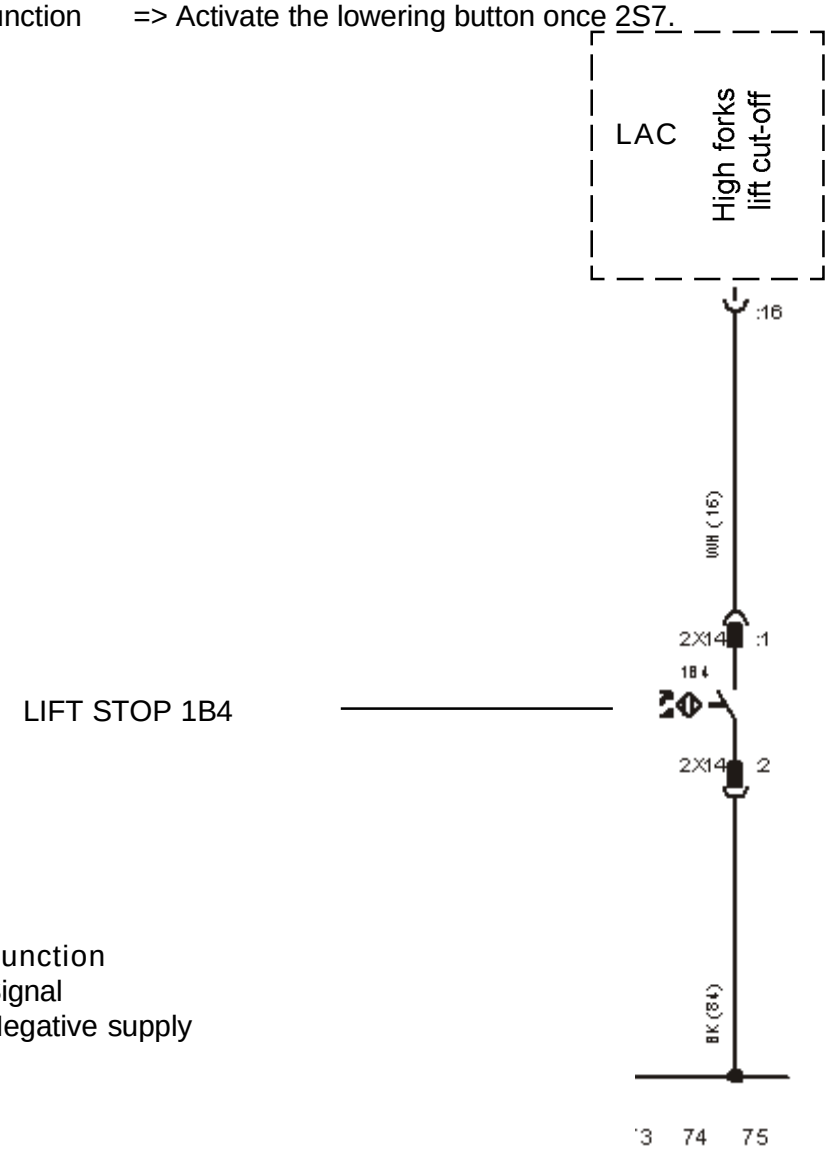


6.2.3 **Raised forks position sensor – lift stop - 1B4**

The 1B4 sensor, mounted on all the trucks, stops the lift before the mechanical stop of the elevator system to limit the pressures in the circuit and to handle the pump motor.
It also has the function of preventing too high pressure in the brake hydraulic system (forced braking without load).

Operation

- The lift is controlled via 2S6 => The fork arms climb.
- Arrives in high position => The sensor 1B4 is activated.
- The lift is stopped via 1B4 => The lowering function is engaged (controlling 2Y2).
- The fork arms lower => They leave the high position.
- The sensor 1B4 is deactivated. => The lowering function is stopped.
- The lift is no longer authorised. => The motor is no longer supplied, even if 2S6 is activated
- To retrieve the lifting function => Activate the lowering button once 2S7.



Connector 2X14

Terminal	Colour	Function
1	WH(16)	Signal
2	BK(84)	Negative supply

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6.3 STEERING

6.3.1 LES **steering – Operating principle**

Steering power part – 3A1

The new electric steering system is equipped with a motor with permanent magnets. The armature is controlled by 4 MOSFET transistors that controlled 2 by 2 turn the motor in the 2 directions of rotation, left and right. The steering motor rotation speed depends only on the difference between the position of the set value potentiometer and the position of the wheel potentiometer.
The motor stops turning when this difference is zero (with a certain tolerance range, to prevent permanent steering correction, and to push the motor too much).
The use of a motor with permanent magnets helps have a larger power, for a smaller size than the old system.

ATTENTION : Before opening the motor, mark the position of the bodywork, this position is adjusted in the factory to optimise switching (brush setting). Only a service hatch is provided for blowing the brushes.

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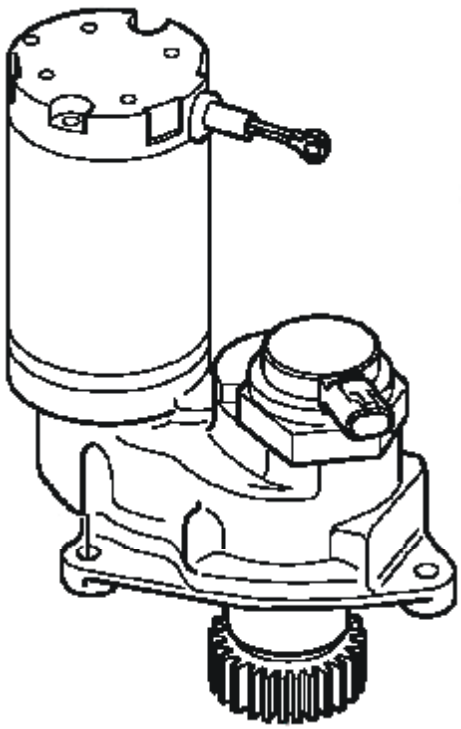
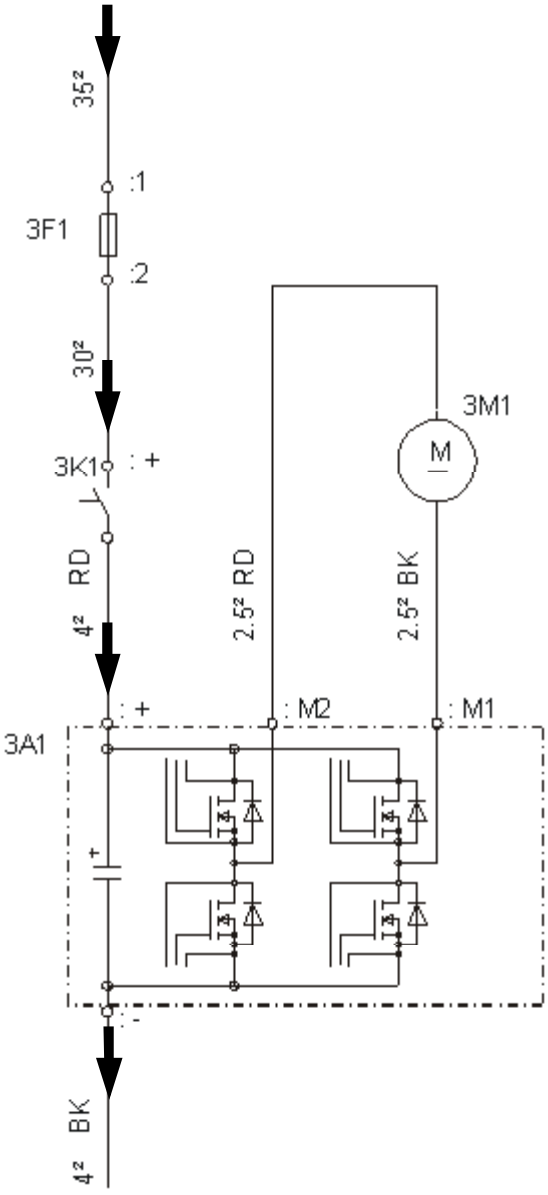
STEERING MOTOR REDUCER





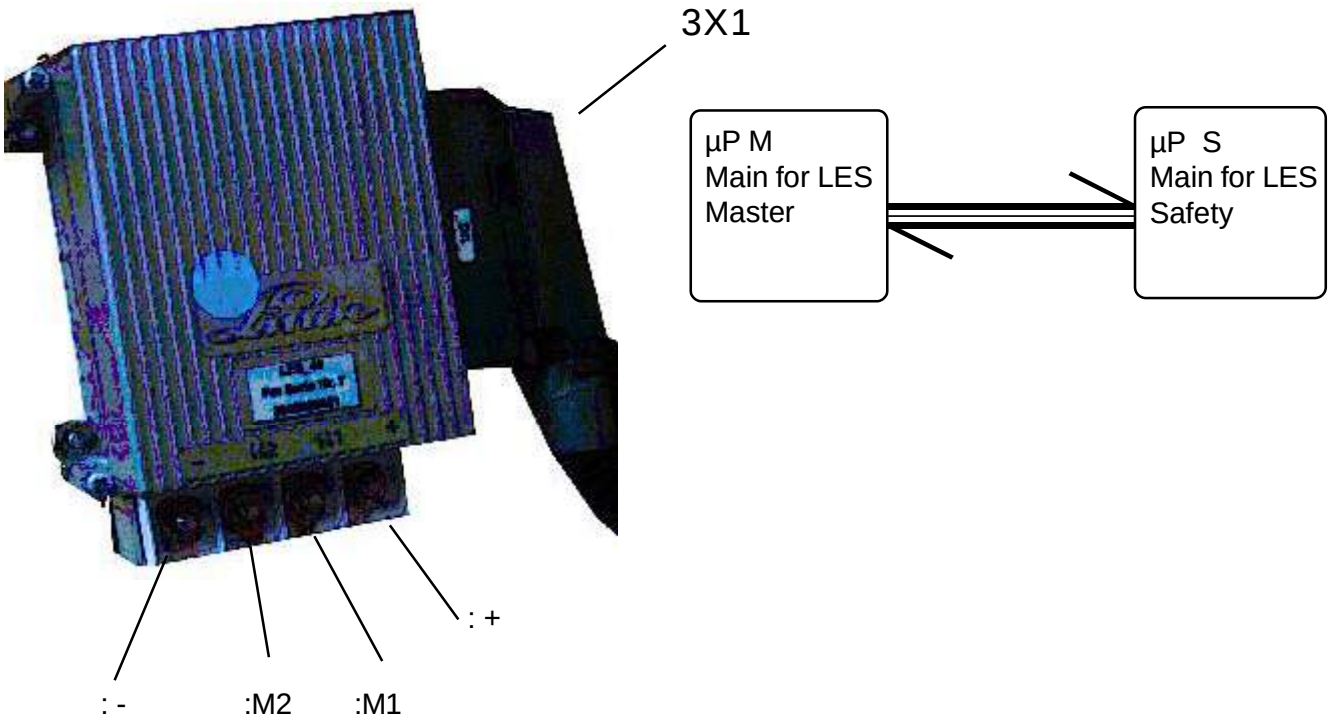
6.3.2 Steering controller LES / 3A1

6.3.2.1 Description

The LES (Linde Electrical Steering) steering controller is composed of a control card with two microprocessors, a main “CP” and a safety “CS”, and a power stage with 4 Mosfet transistors. The transistors are controlled by an electronic circuit called DRIVER (optocoupled for galvanic insulation) located in the power stage.

If a fault appears, it is detected instantly and the control system is put in safety and controls the truck stop. The control module is equipped with a connector 3X1 of 29 terminals.

Control circuit connector 3X1



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6.3.2.2 MAIN CIRCUIT CONNECTIONS

1 :+ Positive connection for the power unit via the line contactor 3K1, the power fuse 3F1 and the circuit-breaker button.
2 :- Power part negative supply
3 :M1 Connection coming from the motor armature.
4 :M2 Connection coming from the motor armature.

6.3.2.3 CONNECTOR TERMINAL FUNCTIONS 3X1

TERMINAL	COLOUR	FUNCTION	ASSOCIATED WITH	
1		RD(301)	Control card supply	positive +24V after key switch
2		BU(302)	Potentiometer negative supply	Battery negative 0V for set value
3		BU(303)	Set value signal track 1	Variable signal between 0V- 8.2V
4		BU(304)	Set value signal track 2	Variable signal between 0V- 8.2V
5		WH(305)	Speed sensor track A	Variable signal 0V-6V
6		WH(306)	CAN 2 high (steering)	Connected to the bus CAN 2 high (steering) LES
7		BN(307)	CAN 2 low (steering)	Connected to the bus CAN 2 low (steering) LES
8		BU(308)	Traction signal go	Battery negative 0V if LES OK
9		BU(309)	Contactor control 3K1	Negative for steering motor contactor
10		RD(310)	Positive supply for 3K1	positive +24V after internal relay for 3K1
11		BK(311)	Negative supply of the card	Connected to the battery negative 0V
12		BU(312)	Potentiometer negative supply	Battery negative 0V for current value
13		BU(313)	Current signal value track 1	Variable signal between 0V- 8.2V
14		WH(314)	Speed sensor track B	Variable signal 0V-6V
16		WH(316)	CAN 1 high (steering)	Connected to the bus CAN 1 high (steering) LES
17		BU(317)	Steering angle signal	Signal for traction speed reduction
18		RD(318)	Positive supply for internal relay	Positive +24V towards 3K1 via the internal relay A
19		RD(319)	Positive input for internal relay	Positive +24V towards the LAC via the internal relay B
20		BU(320)	Stabilised power supply	+10V for set point potentiometer
21		BU(321)	Stabilised power supply	+10V for wheel potentiometer
22		BU(322)	Current signal value track 2	Variable signal between 0V- 8.2V
27		BN(327)	CAN 1 low (steering)	Connected to the bus CAN 1 low (steering) LES
29		BU(329)	Positive output of internal relay	Positive +24V towards the LAC via the internal relay B

6.3.3 Starting the controller LES

The LES steering is the main safety unit, if it has broken down, the truck is stopped and no more operation is authorised (lifting included).
Procedure for start-up: (the steps written enable quick diagnostics during breakdown)

- Starting the LES after the key in inputs 3X1: 1 / 18 / 19 =>+24V.
  the supply negative is directly in input 3X1: 11 => -Ub

- The LES generates a stabilised voltage on the outputs 3X1: 20/21 => +8.2V for the positive and for the outputs 3X1: 2/12 => -Ub for the negative

- The steering controls the proper operation of the 2 set value and wheel potentiometers by the double signals (redundant potentiometers) in inputs 3X1: 3/4 and 3X1: 13/22 => 4.1V (voltages measured when the set value and the wheel are in the alignment of the fork arms).

- The LES controls a first safety internal relay (A), this relay provides the supply positive in output 3X1 : 10 =>+24V (for the line contactor 3K1) and a negative via a Mosfet transistor in output 3X1: 9 => -Ub (for the line contactor 3K1)

- The steering contactor 3K1 and the wheel brake system coil (F.V.) 7A5 are then fed.
  The power stage is controlled, motor at stop, outputs:M1 and :M2 => 12V
  The brake pivot is then controlled in current (between 5 and 750 mA), if the harness breaks, the truck is brought to a halt by the CAN BUS link.

- The LES gives the two traction operation activation signals:
  The steering controls the second safety relay (B) giving the positive for the traction (input positive 1X1: 1 for the internal relay contact to the LAC) in output 3X1:29 => +24V and a negative signal of “OK” controlled by a Mosfet in output 3X1: 8 => -Ub

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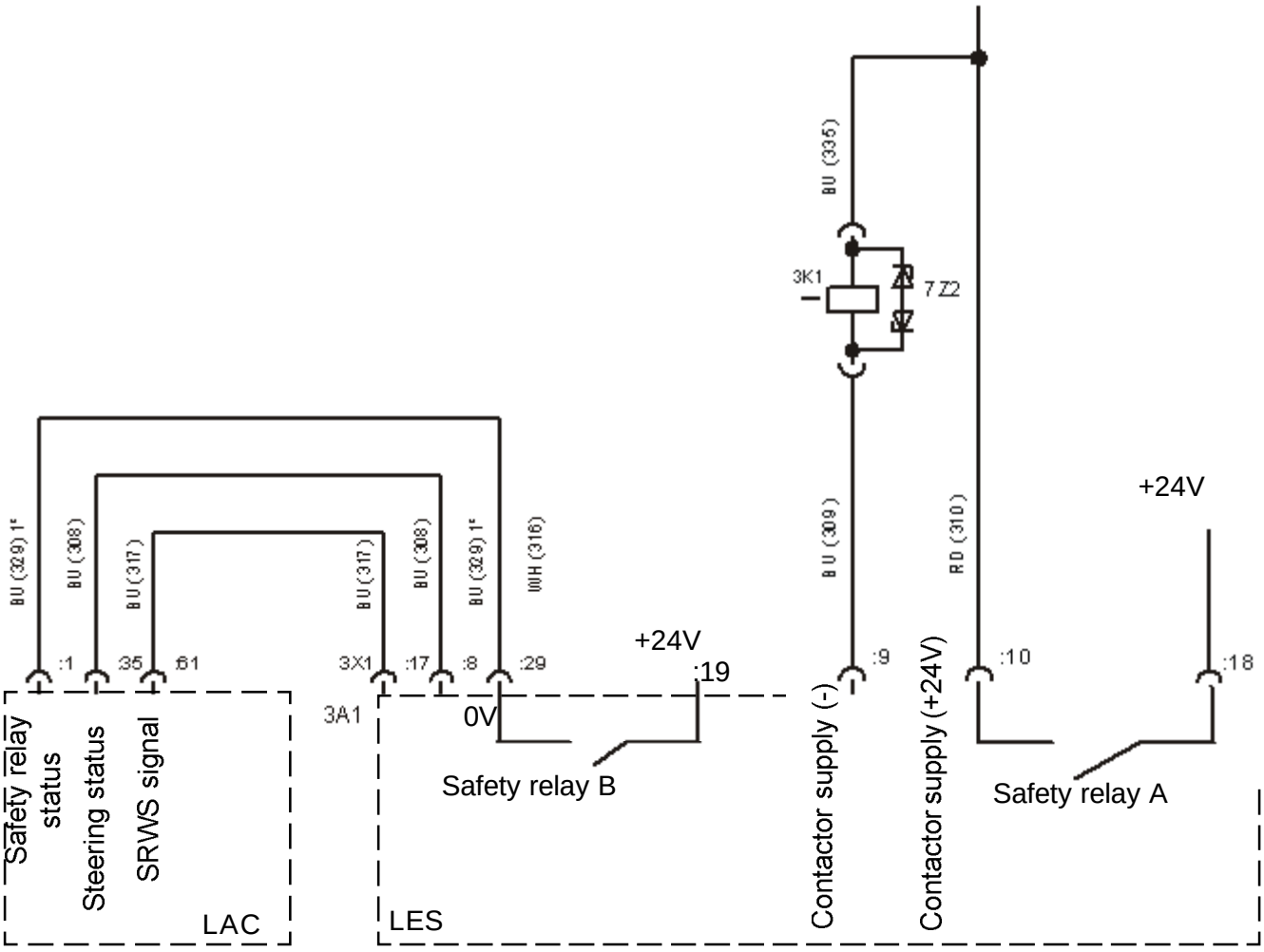
6.3.4 Validation of the traction and the hydraulic

For safety reasons, the validation of the traction and the hydraulic is done with two different signals, one, positive coming from the safety relay B of the LES that supplies the line contactor of the traction and hydraulic, the other, negative is controlled by a transistor giving the steering status to the LAC controller. Then a final traction authorisation is sent by the LES via the CAN BUS, this authorisation only pertains to the traction.

STEERING LINE CONTACTOR 3K1 AND TRACTION AUTHORISATION



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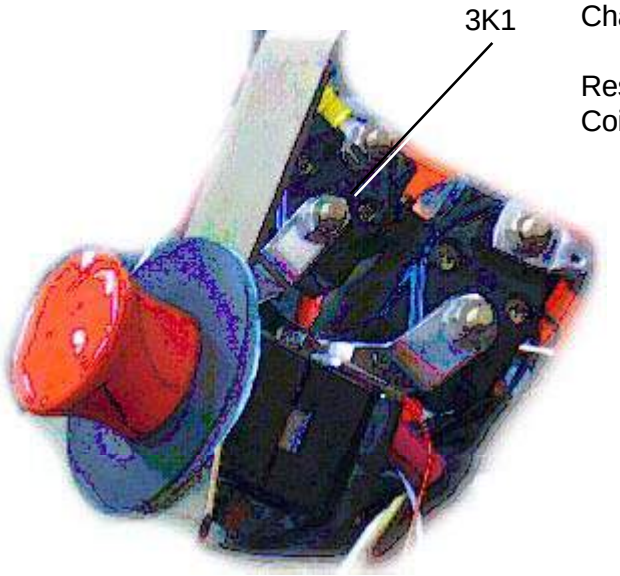
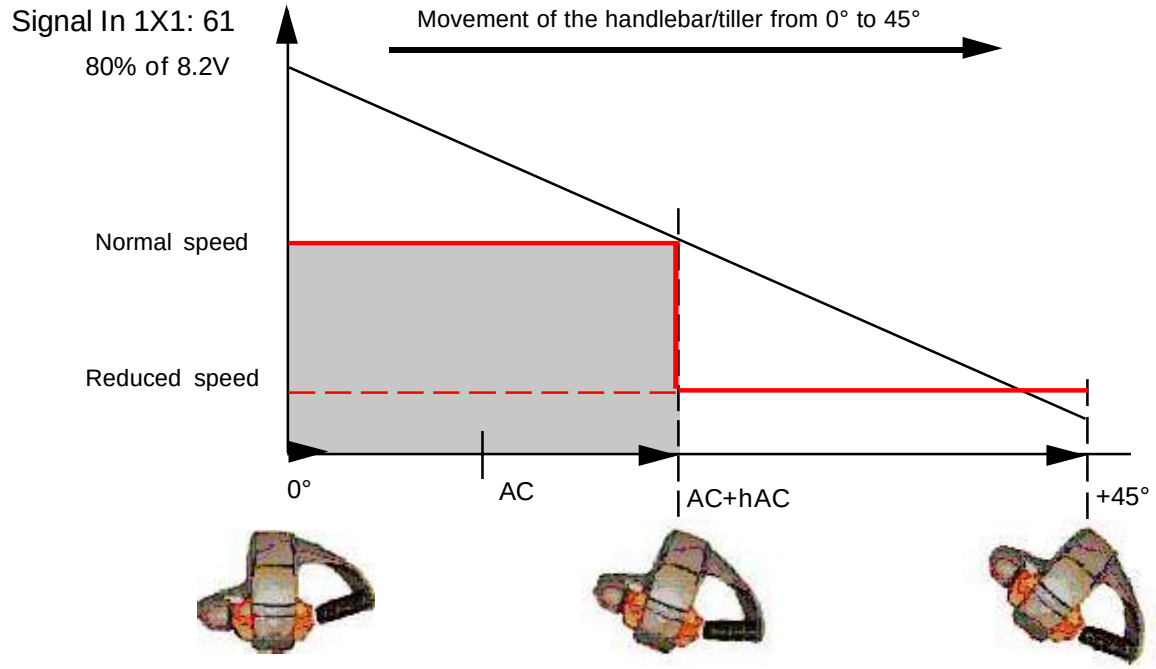


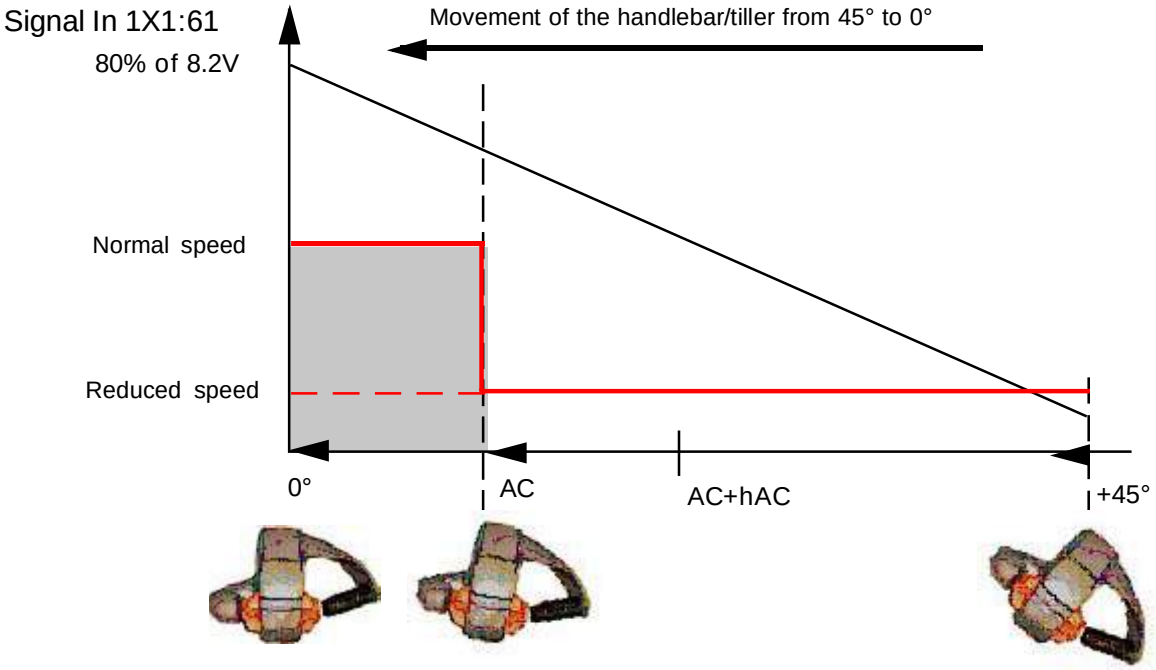
Characteristics of the line contactor coil:

Resistance (20° C)	44 Ohms
Coil interference	Diode
	No series resistance.

6.3.5 Speed reduction on turning

The truck is equipped with a safety system, the controller reduces the translation speed during turns. The electric steering calculates the steering angle according to the position of the set value potentiometer in the form of a voltage in 3X1:17.
The LAC receives this signal in terminal 1X1 : 61, then, according to the pre-regulated values, it reduces the truck speed during turns.
The traction speed reduction is controlled when the set value reaches or exceeds a steering angle AC+hAC, on either side of the midpoint of the steering. The speed limitation is suppressed when the set value returns to a position less than or equal to the angle AC. Beyond 45°, the translation speed is automatically reduced regardless of the control values. The AC and hAC points can be controlled with the PathFinder software. The signal in 1X1:61 is a percentage of the supply voltage stabilised from the set value potentiometer.





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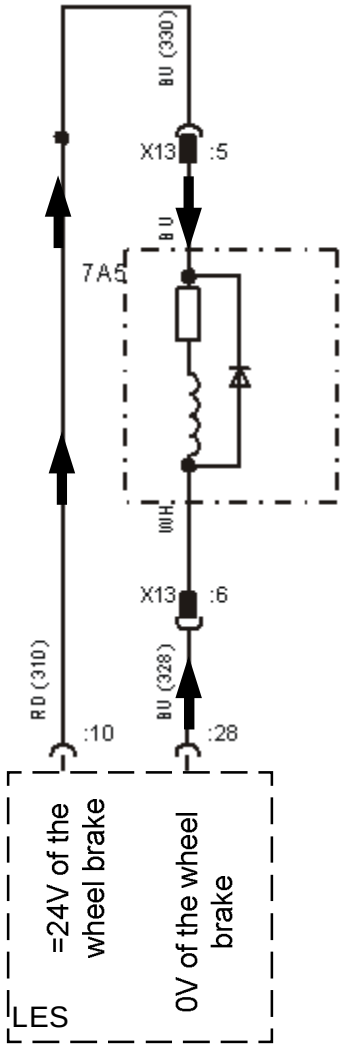
6.3.6 S**teering brake pivot – wheel brake (f.v.)- 7A5**

An electromagnetic device helps create and adjust the resistant torque at the handlebar/tiller level.
The resistant torque increases or decreases according to the truck traction speed, the handlebar/tiller rotation speed and the steering angle.
It is a brake system with propellant controlled by a coil. This coil is supplied by a current between 5mA for an almost negative torque and 750mA for the maximum torque. The current generated by the LES steering varies according to the different parameters described above, the internal series resistance with the wheel brake coil is 18 ohms.
The brake pivot box also contains the set value potentiometer.

WHEEL BRAKE SYSTEM (LORD)



Connector X13

Terminal	Colour	Function
5	BU(330)	Positive supply +24V
6	BU(328)	Square signal according to hardness

6.3.7 Set **value potentiometer (handlebar/tiller) – Wheel potentiometer**

The electric steering is equipped with two potentiometers,
- a potentiometer placed in the brake pivot called set value potentiometer, without mechanical control.
- a potentiometer placed in the steering reduction gear called wheel potentiometer, without mechanical control.

The operating principle is simple, the LES controls the motor to bring the wheel to an angular value corresponding to the one requested by a handlebar or the tiller. The steering potentiometers provide a voltage enabling the LES to calculate this steering angle. Each potentiometer is double (2 tracks, to obtain redundancy, for safety reasons)

The steering permanently controls the status of each potentiometer by the total of the values of link voltages no. 1 + no. 2, this total must correspond to the supply voltage.

The value of the stabilised voltage (potentiometer supply) as well as that of the links are converted into % : "radiometric voltage".
- The stabilised voltage is 100%
- The links are in “right line” position: the values are 50%
- Thus no.1 + no.2 = stabilised voltage ==> 50% +50% = 100%

SET VALUE POTENTIOMETER

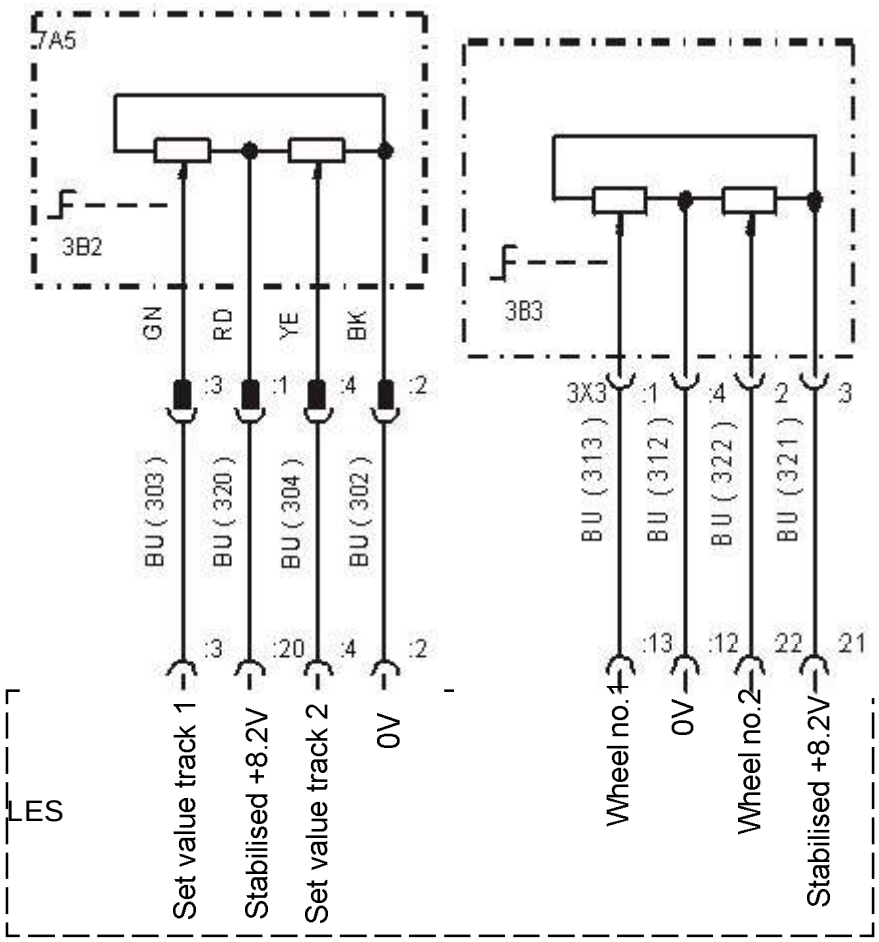
Connector X13

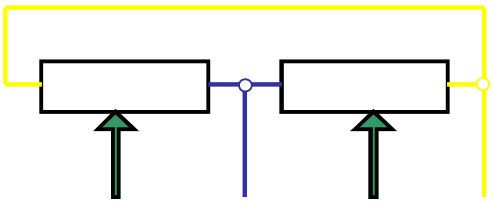
Terminal	Colour	Function
1	BU(320)	Supply +8.2 V
2	BU(302)	Negative
3	BU(303)	Set value (link) no.1 calculates the angle
4	BU(304)	Set value (link) no.2 redundancy

WHEEL POTENTIOMETER (CURRENT VALUE)

Connector 3X3

Terminal	Colour	Function
1	BU(313)	Link no.1 calculates the angle
2	BU(312)	Link no.2 redundancy
3	BU(321)	Supply +8.2 V
4	BU(312)	Negative





4.1V + 4.1V = 8.2V

6.3.8 LES OFF mode

To prevent premature wear of the steering motor and a wasted current consumption during the phases when the truck is not used, the LES is put in off mode. It disconnects the power stage but verifies the control card input information to reactivate the motor if necessary.

This power reset information comes from:

- either a movement of the set value potentiometer (variation of the two links in inputs 3X1:3/4)
- or detection of a truck traction movement by the speed sensor signals in inputs 3X1:5/14)
- or a major movement of the motor wheel corresponding to a variation of the two links of the real value potentiometer in inputs 3X1: 13/22.

If all the reset conditions are met, if there are no more steering responses after a timeout of 30 seconds.

6.4 MULTIFUNCTION INDICATOR TIN Version 1 (Not linked to the truck Can-Bus)

6.4.1 Description

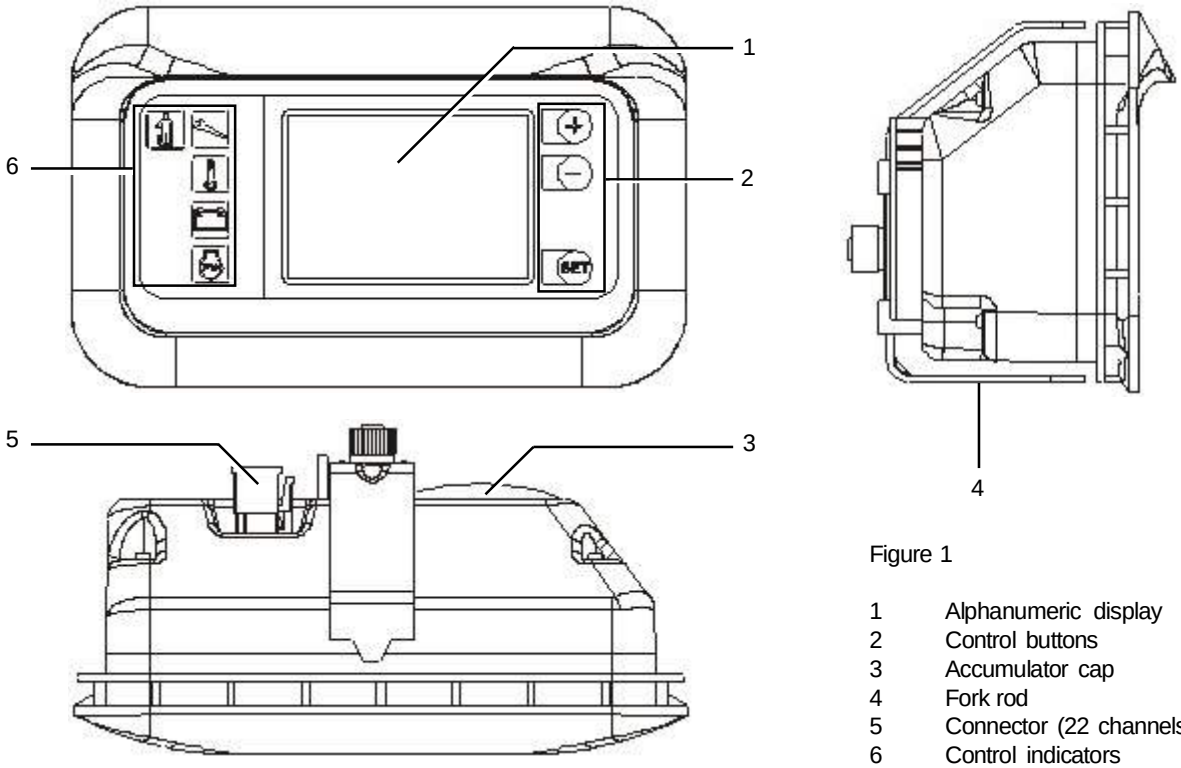


Figure 1

1 Alphanumeric display
2 Control buttons
3 Accumulator cap
4 Fork rod
5 Connector (22 channels)
6 Control indicators

CHARACTERISTICS

General protection: IP 66 Frontal and
IP 54 lateral and rear

Nominal power supply: 24 V

DESCRIPTION

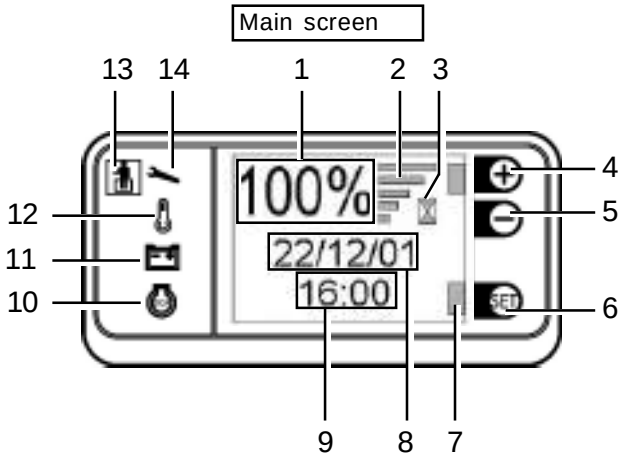
Raised instead of and in place of the ILDB on the speed control plate cover, the TNL multifunction indicator has the following functions:

- Battery discharge indicator with low level alarm and lifting cut off

Important: - Full load: 100% displayed
- Discharged: 0% displayed corresponds to the limit of 80% of battery discharge (recharge mandatory)

- Date, time
- Truck operation hours (hour meter)
- Display of information messages and tips
- Wheel position indicator
- Service interval indicator with service alarm to be provided
- Truck operator presence indicator
- Alarms with messages indicators

Service Training



	Description	Meaning	Remarks/ Screen messages
1	Battery charge level in %	Full load: 100% - Weak load: 10% - Discharged: 0%	 -> Recharge to be provided -> Recharge mandatory
2	Charge level of battery represented by 5 bars	- Full load: 100% - Weak load: 10% - Discharged: 0%	 Note:0 % corresponds to 80% max discharge to protect the battery.
3	Egg-timer (flashing)	- Indicates hour meter operation	
4	Control button	- to display another screen	Other function: setting key
5	Control button	- to display the previous screen	Other function: setting key
6	Control button	- to access the control screens	
7	Marking of active buttons		
8	Display of date		->For setting, see page
9	Display of time		->For setting, see page
10	Alarm STOP (red)	- Speed control fault: Truck stop	Message: "Engine fault..." - Restart attempts by resetting contact key - Alarm always active: Call service technician
11	Alarm BATTERY (red)	- Blinking:charging < or = at 10% - Fixed: battery discharged	-> Recharge to be provided Message: Weak battery charge level -> Lifting cut -> Recharge mandatory Message: "Battery level=0% lift qualified"

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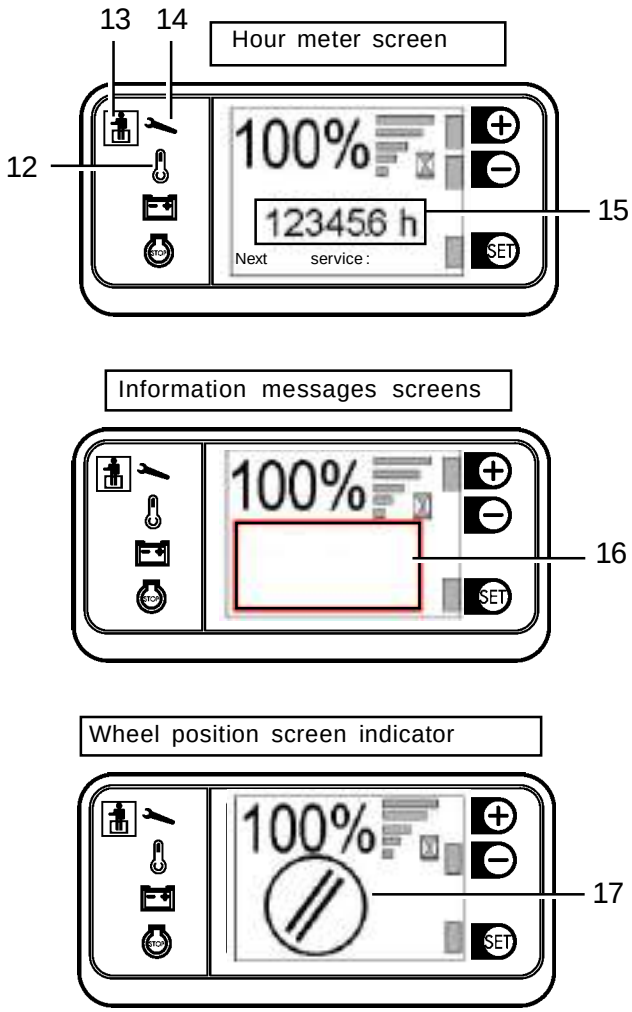

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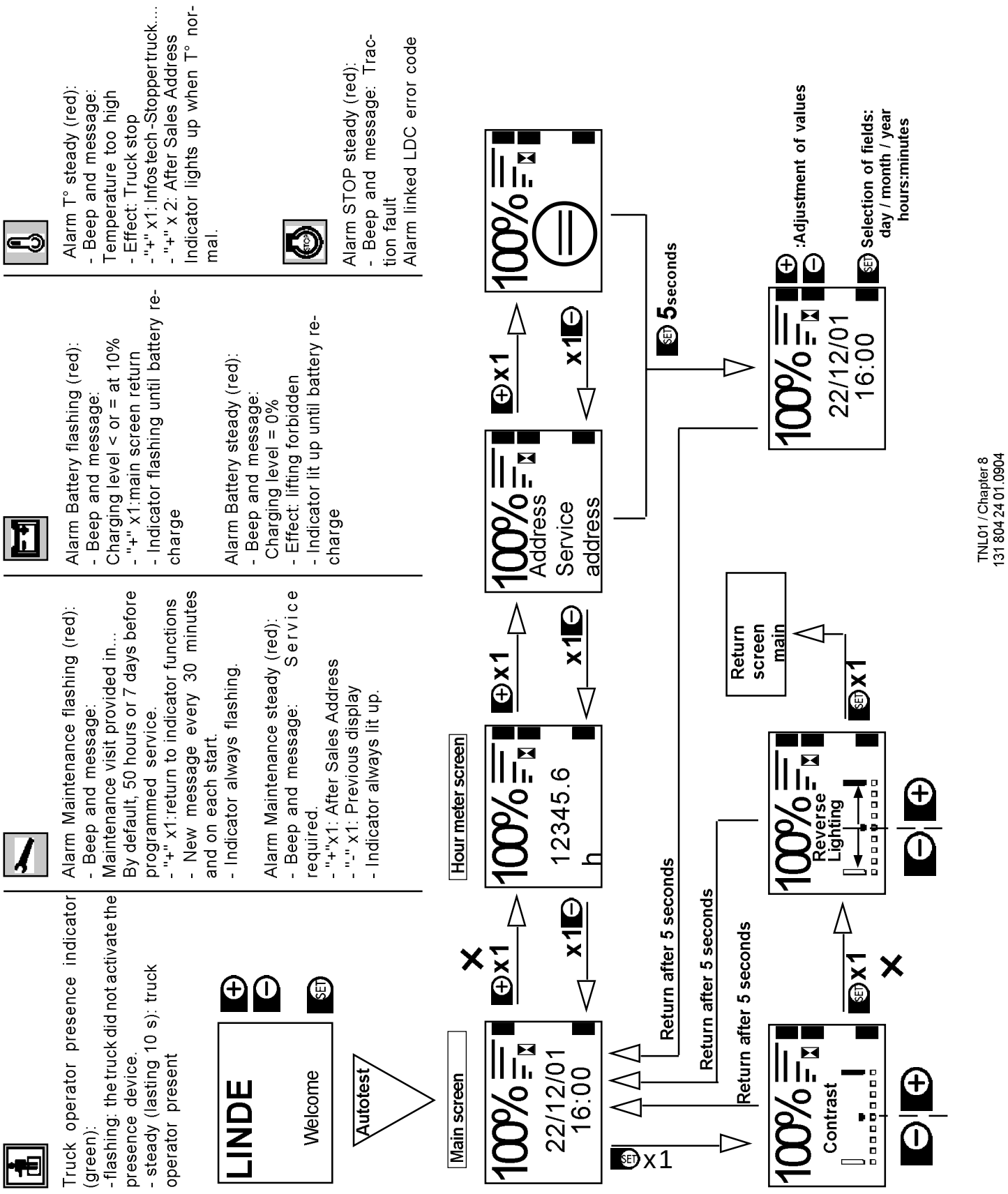
	Description	Meaning	Remarks/ Screen messages
12	Alarm T ° (red)	- Fixed: speed control overheating	-> Truck stop Message: " T° abnormal..." In general, wait few minutes before proceeding.
13	Truck operator presence indicator (Green)	- Flashing: presence non-activated - fixed (lasting 10 s): truck operator present	
14	Alarm Maintenance (red)	- Flashing: service required in:... - fixed: service required	-> Message: "Next visit in X days or in Y hours." -> Message: "Maintenance visit today"
15	Hour meter	- Truck operating hours	
16	Display of information messages		
17	Wheel position indicator	Position of steering wheel	Only for trucks equipped with a steering wheel.

Service Training

6.4.2 Alarms and linking of multifunction indicator screens



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6.4.3 Setting parameters for multifunction indicator / Factory settings

ON TRUCK OPERATION	IN FACTORY
The parameters must be customized:	The default parameters on leaving the factory are:
THE DISPLAY (see menus 2 and 5):	
- Homepage screen logo (Linde - Lansing)	-> Truck delivery country logo
- The menu language (French, English, German, Spanish, Italian, Dutch)	-> The delivery country language
- Date format (DDMMYY or MMDDYY)	
- Time	
- Service Point contact details	
PROGRAMMING NEXT MAINTENANCE VISIT (see menu 2):	
- Enabling or disabling the service reminder	-> Enabled
- Choosing the enable mode in hours or in days	-> at 500 hours
- Alarm Service X days or Y hours before enabling	-> 50 hours before
DISCHARGE INDICATOR (see menu 4):	
- Setting parameters according to the characteristics of the battery mounted on the truck	->Truck delivered with a battery: indicator set according to battery equipment ->Truck delivered without battery: by default set on the curve Varta – 2.09V - 20% - 0 mn.

6.4.4 Setting the multifunction indicator after a service visit

The technician must activate the next visit reminder (see menu 3) and through the same operation reset the service alarm.

The technician can open the Bloc Note (see menu 6-6) to store useful information for future interventions.

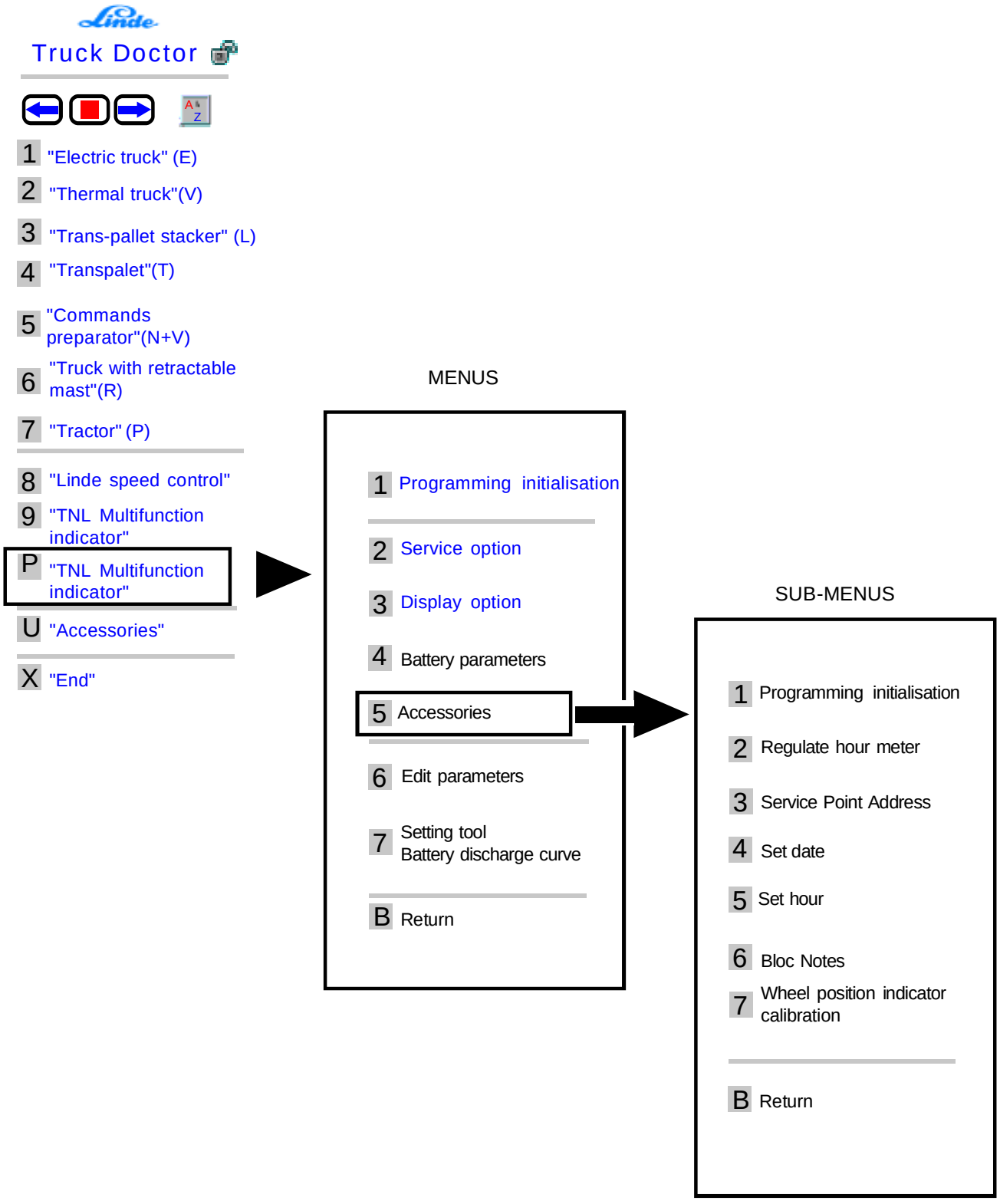
The technician can also edit the multifunction indicator parameters (see menu 7).

6.4.5 PC connection for multifunction indicator settings

- All the operating parameters are stored in the multifunction indicator memory.
- The multifunction indicator is programmable by using the Linde parameterisation software, Truck doctor version V1.1 P7 or later.

- Battery disconnected and contact cut-off
- Connecting the PC wire to the programming connector for multifunction indicator 6X4
- Connect the battery
- Start Truck doctor
- Select "TNL - Dashboard" (p) in the main menu

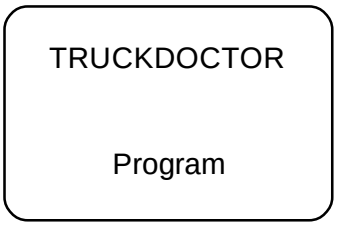
6.4.6 Selection of multifunction indicator menus in TRUCK DOCTOR



6.4.7 Using the Truck Doctor to set parameters for the multifunction indicator

MENU 1: Programming initialisation

- Open this menu so that the multifunction indicator goes to display mode in programming mode.



MENU 2: Service Options

The service indicator can be Enabled(*) or Disabled

Service indicator Enabled:
The next service visit can be enabled with a given hour meter on a precise date.

- On the screen choose: the hour meter (*) or the date.
- Enter the hour meter or the date of activation.

By the hour meter	By the date
Example: Next service visit activated at 1,050 hours (*) By default: at 500 hours	Example: Next service visit activated on 200802 (20 August 2002)

The service alarm can be triggered few days or few hours before the service visit.

- In the screen enter: the number of hours or the number of days before activating the visit.

Alarm by the hour meter	Alarm by the date
Example: The service alarm will ring 20 hours before the service (*) By default: 50 hours before	Example: The service alarm will ring 10 days before the service (*) By default: 7 days before

Delete service reminder alarm:
- Carry out programming of next service visit.

(*) By default

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Menu 3: Display options
This menu helps select and parameterise the information visible on screen:

- The display format for date and time	Choose:	European(*) / Anglo-Saxon
- The choice of display of the hour meter	Choose:	Displayed (*) / Non-displayed
- The choice of display of error messages	Choose:	Enabled(*) / Disabled
- The choice of language and logo	Choose:	- English Linde - English Lansing - French Fenwick - French Linde - German Linde - Spanish Linde - Italian Linde - Dutch Linde
- Wheel position screen indicator	Choose:	Enabled(*) / Disabled

Menu 4: Battery parameters
The discharge indicator must be compulsorily parameterised according to the battery characteristics.

1) CHOICE OF BATTERY TYPE
Various discharge curves are stored in the multifunction indicator memory:

1 Battery model: Lead acid standard battery (Varta, Fulmen, Oldham, Fenwick) (*)
- Standard control for lead acid battery.

2 Battery model: Battery PZs (Deta)
- Setting for the Hawker leak proof batteries (gel).

3 Battery model: Battery with increased capacity (PZs)
- To reserve for the trucks equipped with large capacity battery, with a long discharge duration

4 Battery model: Battery without service (Gel)
- Preferably use the model no. 2 or
- Consult the battery manufacturer to get the characteristics.

2) RESET VOLTAGE/CHARGED BATTERY NO-LOAD VOLTAGE

Possible choices:
2.00 – 2.03 – 2.06 – 2.09 (*) – 2.12 – 2.15 – 2.18 – 2.21 – 2.24 – 2.27 – 2.3 V.

(*): Standard setting

Note:
- The battery no-load voltage must be greater than the value selected to unblock the multifunction indicator.
- The reset voltage can be slightly lowered if the indicator does not reset for a charged battery.

(*) By default

3) LIFTING CUT-OFF

To protect the battery from too high discharge, set the residual capacity value (in %) at which the hoist cut is produced: [20(*)] - 25 - 30 - 35 - 40%.

- (*) Standard control for an open lead battery.
- Setting recommended for a leak proof battery (gel): 30%

TIPS TO ADJUST THE HOIST CUT
After checking the real status of the battery on the cut, gravity and voltage on an open lead battery, voltage on a gel battery, it is possible to fine-tune the setting according to real use of the battery:

- If the indicator cuts too early, reduce the residual capacity value (E.g.: 25% to 20%)
- If the indicator cuts too late, increase the residual capacity value (E.g.: 25% to 30%)

Remarks: - Minimum gravity, battery 80% discharged; 1,14
- Maximum gravity, battery 100% charged; 1.29 to 1.32 according to models.

4) RESET TIME

After cutting the discharge indicator, it can be reset only after a period of:
[0(*)] - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 minutes.

(*): standard setting

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MENU 5-1: Programming initialisation
Same as menu 1

Menu 5-2: Initialisation of an hour meter after replacement
On a new multifunction indicator, it is possible to program the hour meter from the old one.

NOTE:
The hour meter can be reinitialised only if there are less 2.9 hours.

Menu 5-3: Service Point Address
This menu shows the Service Point address closest to the truck user:
- Company
- Telephone No.
- Name of person to contact

Menu 5-4: Setting the date
Example: 011102 means 01.11.02

Menu 5-5: Setting of time
Example: 161202 means 16 hours 12 minutes and 2 seconds

(*) By default

Menu 5-6: Bloc Note
This menu records or accesses the information concerning the truck. (example: change the traction motor brushes on the next visit)

Menu 5-7: Reset
Do not use

Menu 6: Printing the multifunction indicator setting parameters
The setting parameters are displayed on the screen and can be saved in a file.

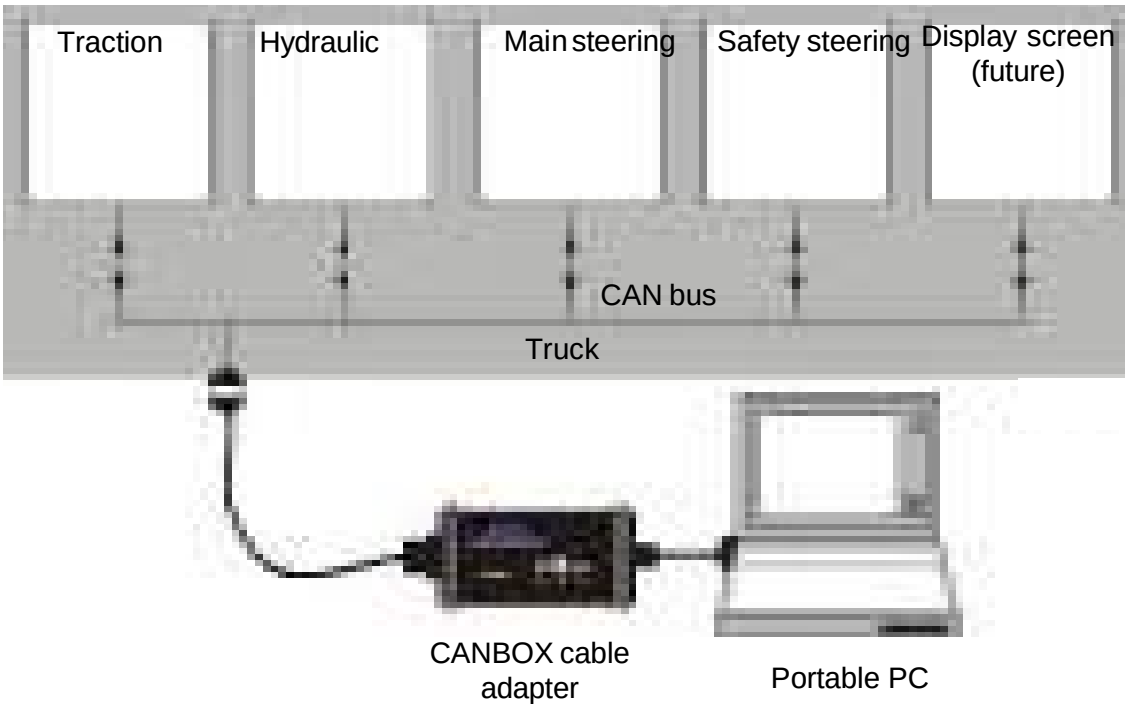
Menu 7: Setting tool table for battery parameters
To set the discharge indicator, this table can guide the technician while making the settings.

6.5 DIAGNOSTICS CONCEPT

NOTE: The Linde test module can no longer be used in 131 type of trucks. Only the portable PCs equipped with the PathFinder software can be used.

The diagnostics system uses the Linde diagnostics program for portable PC. The portable PC is now connected to the truck with the help of a cable/interface adapter (CANBOX) of version 2.00 minimum.

The diagnostics equipment is connected to a single connector 6X7 located in front of the truck after the key switch. This diagnostics connector offers an interface with the CAN bus and enables diagnosing all the modules.



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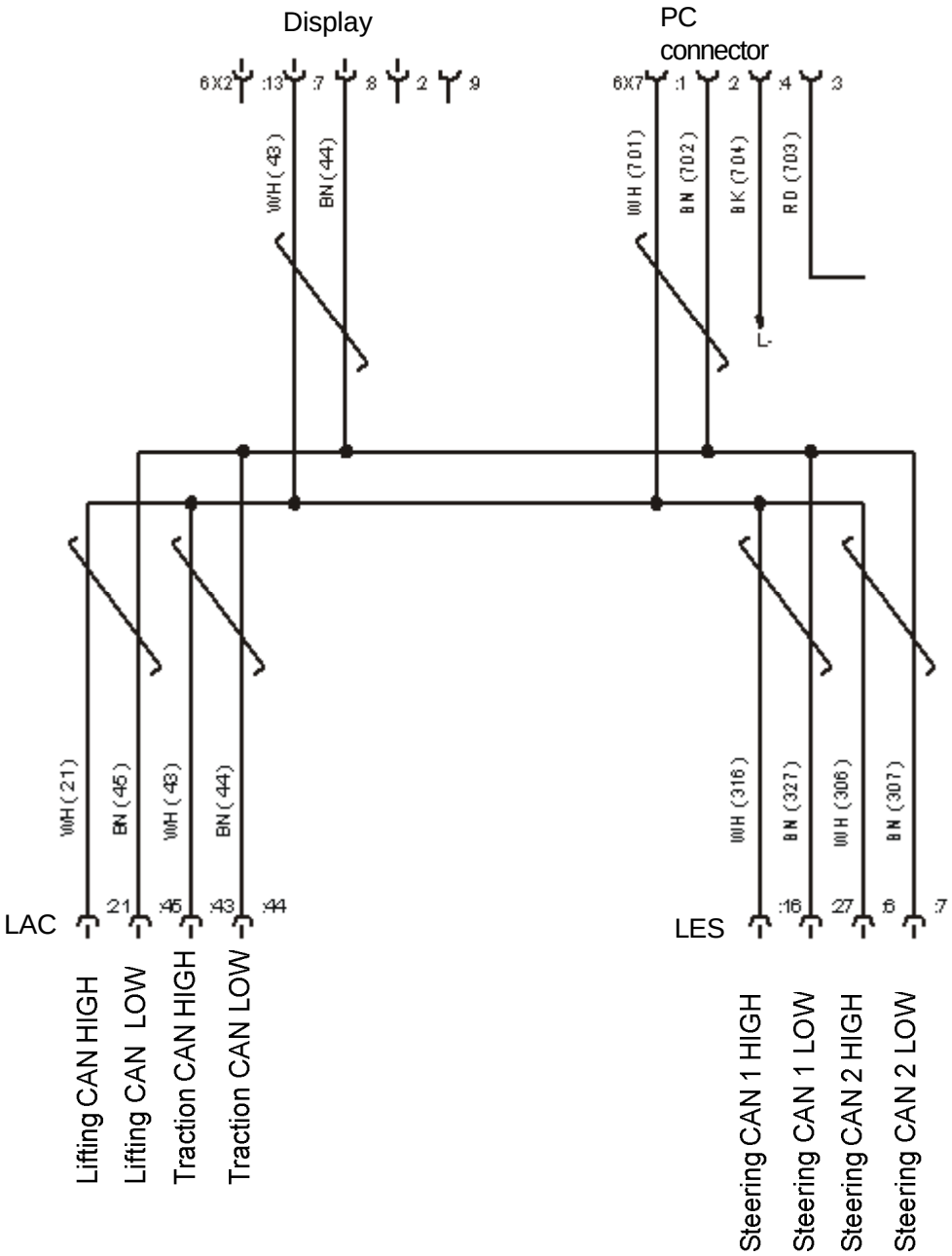
- Before starting the software, the truck must be started and connected to the PC.
- On starting the PathFinder software, a truck type selection table is displayed.
- Choose the type 131 and click Continue.
- The software now connects to all the controllers present on the truck.
- The start page is displayed.

The CAN BUS network between the different controllers is equipped with two lines «CAN HIGH», «CAN LOW» and two resistances of 120 Ohms mounted in parallel and located in the LAC (start of CAN network) and in the display (end of CAN network).
The ohmic value measurable on the diagnostics connector is 60 Ohms, the value is measured between the CAN high and the CAN low.



6.6 ERROR CODES:

The diagnostic system uses error codes between 1 and 499.

- The codes between 1 and 99 are the information codes.
They are never stored in the controller memory, hence can be displayed only in the [inputs/ outputs]=>[current error codes].

- The codes between 100 and 199 are the warning codes.
They are stored, they do not pertain to faults that can be repaired, but that need truck servicing: example, electrobrake air gap setting.

- The codes between 200 and 499 are the error codes.
They are grouped into 3 parts:

1- From 200 to 299: fault in a controller input or output (external component fault, internal transistor to control the output defective).
2- From 300 to 399: fault in controller power part.
3- From 400 to 499: internal fault between two microprocessors.

6.6.1 Traction error codes:

Information codes

1 Initial condition not yet satisfied: butterfly not in neutral position and / or belly switch on and / or potentiometer supply too low (< 7,5V)
2 Butterfly in neutral position (according potentiometer signal or redundant switch signal)
3 Tiller in neutral position (according input signal)
4 Booster function active
5 Butterfly, platform, guardrail and foot signals correspond whether to pedestrian nor ride on mode
6 Butterfly, platform, guardrail and foot signals correspond to pedestrian mode (=WALK)
7 Butterfly, platform, guardrail and foot signals correspond to ride on mode without guardrail (=FLY)
8 Butterfly, platform, guardrail and foot signals correspond to ride on mode with guardrail (=RIDE)
9 Power save on: if all switch inputs released and standstill the power module is deactivated
10 Analog steering angle signal and / or CAN steering angle value exceed threshold (default: 15°)
11 Speed reduction commanded by input X1:29 (reduction active when input connected to GND)
12 Speed reduction commanded by input X1:57 (reduction active when input connected to GND)
15 Speed reduction commanded by battery interlock at input X1:12 (reduction active when input connected to GND)
19 No speed signal though torque applied
reasons may be: speed sensor problem, motor / wheel / truck blocked
20 Belly function activated by platform, tiller and belly switches
In trucks without platform: Belly function activated by tiller and belly switches
21 Belly function active, reset not yet performed (for reset turn butterfly into neutral position)
27 Truck immobilization due to simultaneous activation of creep function forwards and / or creep function backwards and / or turning butterfly out of neutral position
28 Creep function backwards active (inputs X1:28 and X1:52 connected to GND)
29 Creep function forwards active (inputs X1:05 and X1:06 connected to GND)
30 Monitoring of rotor field according motor model
35 Battery voltage too low (< 12V)
40 High MOS temperature (> +95°C AND < +200°C)
45 High motor temperature (> +160°C AND < +200°C)
60 Truck immobilization because ok status signal from LES (X1:35) not set
61 Speed reduction requested from LES via CAN
70 Discharging of power module capacitors for test purposes is being performed
71 Switching on of main contactor contact could not be performed
80 [2] The Forks are down (Truck N20)
81 [2] The load is over 1 ton (Truck N20/4W)
82 [2] Creep Speed Buttons are active
83 [3] The Forks are over 1.5m
90 Teaching procedures have not been performed yet
91* Incorrect truck identification from traction controller
92* Incorrect CAN truck identification from steering controller LES
93* Incorrect truck identification from lift controller

Warning codes

110 Brake actuator failure (measured current rise when actuator switched on does not match with correct/ideal current rise)

Error codes

200 Truck identification incompatible with actual state of unused digital inputs
201 Potentiometer supply voltage (8.3V) too high (> 11V)
202 Potentiometer supply voltage (8.3V) too low (< 7V)
203 Tiller ok status not set at input X1:34 (not implemented in [1])
204 Emergency signal activated (input X1:11 open)
205 Oil level too low (input X1:33 connected to GND)
207 Driving speed too high (> 18 km/h)
208 Perturbation of speed sensor signals detected (inputs X1:09 and X1:10)
209 Digital inputs (except butterfly) switched with unrealistically high frequency (> 10 Hz)
210 Analog and CAN - bus steering angle signals incompatible
211 Steering angle (PWM signal at input X1:61) out of tolerated range
(< -45° or > +45°)
212 CAN - bus steering angle signal out of tolerated range
(< -90° or > +90°)
215 Inclinometer signal out of tolerated range (< 0,5V or > 9,5V)
219 No production test
220 Analog belly signal (input X1:14) value out of tolerated range
(in trucks with belly switch: > 1V AND < 9V)
(in trucks without belly switch: < 4V or > 7V)
221 Positive supply voltage (24V) for belly switch not insured
222 Analog belly signal value (input X1:14) ok but belly switch not built in
223 Positive supply voltage (24V) applied on input X1:56 but belly switch not built-in
225 Analog butterfly signal (input X1:37) out of tolerated range
(< 0,5V or > 9,5V)
226 Analog butterfly signal (input X1:37) and digital butterfly signal (input X1:38) are in contradiction to each other
228 Redundant creep forwards signals (inputs X1:05 and X1:06) incompatible
229 Redundant creep backwards signals (inputs X1:28 and X1:56) incompatible
230 No deceleration torque when required
231[2] Platform is enabled, but this truck has no Platform
232[2] Creep Speed Buttons are enabled, but this truck has no Creep Speed Buttons
233[3] Input Masthigh1 is enabled, but this truck has no Mast
240 MOS temperature signal out of tolerated range (< -50°C or > +200°C)
reasons may be: wire shortcut, wire open, sensor problem
241 MOS temperature signal too high (> +100°C AND < +200°C)
presumed MOS overheat
245 Motor temperature signal out of tolerated range (< -50°C or > +200°C) reasons may be: wire shortcut, wire open, sensor problem
246 Motor temperature signal too high (> +170°C AND < +200°C)
presumed motor overheat
251 Safety relay transistor remains OFF whereas it is commanded to switch ON
252 Safety relay transistor remains ON whereas it is commanded to switch OFF
255 Safety relay remains OFF whereas it is commanded to switch ON reasons may be: contact oxidized or damaged
256 Safety relay remains ON whereas it is commanded to switch OFF reasons may be: contact welded or short circuit to 24V
261 Main contactor transistor remains OFF whereas it is commanded to switch ON
262 Main contactor transistor remains ON whereas it is commanded to switch OFF
265 Main contactor remains OFF whereas it is commanded to switch ON
reasons may be: contact oxidized or damaged
266 Main contactor remains ON whereas it is commanded to switch OFF
reasons may be: contact welded or short circuit to 24V
271 Castor wheel left transistor remains OFF whereas it is commanded to switch ON
272 Castor wheel left transistor remains ON whereas it is commanded to switch OFF
281 Brake transistor remains OFF whereas it is commanded to switch ON
282 Brake transistor remains ON whereas it is commanded to switch OFF
283 No brake coil current whereas voltage applied
(applied voltage > 12V, coil current < 0,2A)

284 Brake coil current whereas no voltage applied
(voltage < 3V, coil current > 0,8A)
291 Castor wheel right transistor remains OFF whereas it is commanded to switch ON
292 Castor wheel right transistor remains ON whereas it is commanded to switch OFF311 Driver: Error Phase U transistor side low
302 Current - sensor problem, phase U (offset - correction exceeds upper limit)
303 Current - sensor problem, phase U (offset - correction exceeds lower limit)
304 Current - sensor problem, phase W (offset - correction exceeds upper limit)
305 Current - sensor problem, phase W (offset - correction exceeds lower limit)
310 Error message driver Phase U High Side
311 Error message driver Phase U Low Side
312 Error message driver Phase V High Side
313 Error message driver Phase V Low Side
314 Error message driver Phase W High Side
315 Error message driver Phase W Low Side
320 Error message undervoltage driver
330 Permanently error message of driver (Error 340 could not be reset after 3 attempts. One of Error messages 302 ... 320 should be shown now)
340 Internal driver error (one of error messages 302 ... 320 is set but not shown)
341 Capacitor Voltage too high (> 36V)
345 Measured voltage on phase U does not fit to voltage set by vector controller (not active in [1])
346 Measured voltage on phase V does not fit to voltage set by vector controller (not active in [1])
347 Measured voltage on phase W does not fit to voltage set by vector controller (not active in [1])
400 Monitoring of function processor: internal error
401 Monitoring of function processor: torque setpoint too high (traction control error)
402 Monitoring of function processor: torque setpoint too low (traction control error)
403 Monitoring of function processor: brake incongruously released (traction control error)
404 Monitoring of function processor: actual torque value too high (vector control error)
405 Monitoring of function processor: actual torque value too low (vector control error)
406 Cyclic disable test of relay, contactor and brake outputs failed
407 Internal serial communication disturbed
410 Internal serial communication disturbed
420 Binary inputs are different in main and safety controller
421 Butterfly signal (potentiometer) and / or belly signal and /or potentiometer supply voltage (8,3V) are different in main and safety controller
422 States of voltages for safety relay (X1:24) and / or contactor (X1:2) and / or brake (X1:49) are different in main and safety controller
423 LES steering angle and / or torque setpoint are different in main and safety controller
424 Actual motor speed is different in main and safety controller
425 Motor torque evaluation and / or motor voltage (stator) and /or motor frequency are different in main and safety controller

6.6.2 Lifting error codes:

Information codes

1 Start - Up - Tests not finished
4 Initial lifting OR initial lowering buttons pressed at start up
5 Initial lifting AND initial lowering signals are active at same time
(X1:36 > 16V and X1:59 > 16V)
8 Truck identification values are different on lift and drive controllers
9 not active in [1] and [2]
Mast Potentiometer in neutral position (X1:19 around 4,1V)
11 Truck in passive mode
13 Battery voltage low (< 12V) (detected by LAC03 internal supervision)
14 Battery discharged (detected by Battery Discharge Indicator = BDI)
16 Emergency STOP pressed
30 not active in [1] and [2]
Belly active (X1:14 > 16V)
35 not active in [1] and [2]
Foot switch not pressed (X1:8 > 16V)
36 not active in [1] and [2]
Platform down and foot switch not pressed (X1:8 > 16V, X1:31 < 1V)
40 not active in [1] and [2]
Mast over 1,5 m (X1:41 > 16V)
41 not active in [1] and [2]
Mast over 1,5 m (X1:41 > 16V)

Warning codes

Warnings not yet implemented

Error codes
220 No production test
225 Safety relay remains ON whereas it is commanded to switch OFF. Reasons may be: contact welded or short circuit to 24V
226 Safety relay remains OFF whereas it is commanded to switch ON. Reasons may be: contact oxidized or damaged
227 Contactor remains ON whereas it is commanded to switch OFF. Reasons may be: contact welded or short circuit to 24V
228 Contactor remains OFF whereas it is commanded to switch ON. Reasons may be: contact oxidized or damaged
229 FET of contactor is closed while opening is ordered
230 FET of contactor is open while closing is ordered
241 FET of initial lowering valve closed while opening is ordered
242 FET of initial lowering valve is open while closing is ordered
243 FET of initial lowering valve is active while no action is ordered by the user
244 not active in [1]
Internal serial communication disturbed
251 Internal powerpart error
252 Lift - Powerpart is active while no action is ordered by the user
260 Motor temperature signal out of tolerated range (< -30°C or > +200°C) reasons may be: wire shortcut, wire open, sensor problem
261 Motor temperature high (> 90°C)
262 MOS temperature signal out of tolerated range (< -30°C or > +200°C) reasons may be: wire shortcut, wire open, sensor problem
263 MOS temperature high (> 90°C)
273 Potentiometer supply voltage (8.3V) high (> 9,5V)
274 Potentiometer supply voltage (8.3V) low (< 7,5V)
281 Error from driving controller via SSC: torque setpoint too high
282 Error from driving controller via SSC: torque setpoint too low
283 Error from driving controller via SSC: brake control error
284 Error from driving controller via SSC: actual torque evaluation too high
285 Error from driving controller via SSC: actual torque evaluation too low
286 Error from driving controller via SSC: cyclic disable test of relay, contactor and brake outputs failed
287 Internal serial communication disturbed

300 not active in [1] and [2]
Truck without belly function, but belly - switch signal is active
(X1:14 > 16V)
305 not active in [1] and [2]
Truck without platform, but foot - switch signal is active
(X1:8 < 1V)
306 not active in [1] and [2]
Truck without platform, but platform - switch signal is active
(X1:31 < 1V)
307 not active in [1] and [2]
Truck without platform, but guardrail - switch signal is active
(X1:53 < 1V)
310 not active in [1] and [2]
Truck without mast, but signal of mast - switch at 1,5 m is active
(X1:41 < 2,5V)
311 not active in [1], [2] and [3]
Truck without mast, mast potentiometer signal is active (X1:19 > 0,5V)
315 not active in [1], [2] and [3]
Mast potentiometer signal out of tolerated range: X1:19 < 0,5V reasons may be: wire cut or shortcut to GND
316 not active in [1], [2] and [3]
Mast potentiometer signal out of tolerated range: X1:19 > 9,5V reason may be: shortcut to supply voltage

6.6.3 Main steering error codes:

Information codes

1 Power-Up -Tests not finished
3 Controller set to Passivemode by CAN-Flasher
7 Unteached Potentiometer or corrupped EEProm
8 incorrect EEProm truckidentifer value
9 incorrect CAN traction truckidentifer
10 Message from Powerpart (pwm to motor voltage fault, but not critical),
monitors set steering value from logic part to current steering value at steering motor
11 Setpotentiometer to actpotentiometer value difference

Warning codes
no error implemented

Error codes
220 no Productiontest (--OK--sign missing in EEPROM)
223 Safetyrelay closed without demand
224 Safetyrelay open but should be closed
225 ext. Safetyrelay closed without demand
226 ext. Safetyrelay open but should be closed
227 Contactor closed without demand
228 Contactor open but should be closed
240 Fatal plant behaviour error: Steering angle varies in the opposite direction to the commanded one (PWM). One of those components does not work properly: PWM unit, inverter, motor, gear or angle sensor or the steering axle is externally actively moved (should not occur normally)
244 Error from internal communication between controllers (SSC Watchdog)
250 Errorsignal from Powerpart (1 time occured),
Internal error of powerpart logic chip due to following reasons: undervoltage, high current by short cut, overtemperature
Note: LES tries to reset the powerpart chip up to three times to keep steering alive
251 Error from Powerpart (3 times errorsignal -> powerpart disabled),
see description of error 250
252 Error from Powerpart (capacitor voltage < Ubattery - 4V),
Measured capacitor voltage for steeringmotor reaches lower limit
254 Error from Powerpart (pwm to motor voltage fault),
Measured motor voltage does match to applied PWM duty cycle ratio and measured battery voltage whereas motor voltage and current are not both equal to zero (relay contact closed). One of those components does not work properly: PWM unit, inverter, voltage or current measurement.
255 Error from Powerpart (motorcurrent overrides limit),
Current sensor, motor voltage and steering angle signal courses do not suit to plant model. One of those signals is erroneous - presumably current signal if no further trouble code generated. The aim of this monitoring function is the detection of erroneous current signal.

260 Error from Powerpart (MOSFETS temperature to high)
Measured temperature at power mosfets has reached critical value (>90°C)
264 SWB (steer wheel brake) connection with short cut
265 SWB (steer wheel brake) connection open
266 SRWS (speed reduction with steering), angle for traction differs from wheelangle
267 SRWS (speed reduction with steering) connection with short cut
268 SRWS (speed reduction with steering) connection open
269 EnableTraction voltage wrong
270 Battery voltage low (<100% from 8.3V)
272 Ratiometric sensor voltage high (>104% from 8.3V),
Measured supply voltage (real 8.3V) for potentiometers overrides upper limit
273 Ratiometric sensor voltage low (<89% from 8.3V),
Measured supply voltage (real 8.3V) for potentiometers underrrides lower limit
274 Ratiometric setpoti 1 voltage high (>98.5% from 8.3V)
275 Ratiometric setpoti 1 voltage low (<1.5% from 8.3V)
276 Ratiometric setpoti 2 voltage high (>98.5% from 8.3V)
277 Ratiometric setpoti 2 voltage low (<1.5% from 8.3V)
278 Ratiometric setpoti 1 to 2 voltage high (>105% from 8.3V)
279 Ratiometric setpoti 1 to 2 voltage low (< 95% from 8.3V)
280 Ratiometric actpoti 1 voltage high (>98.5% from 8.3V)
281 Ratiometric actpoti 1 voltage low (<1.5% from 8.3V)
282 Ratiometric actpoti 2 voltage high (>98.5% from 8.3V)
283 Ratiometric actpoti 2 voltage low (<1.5% from 8.3V)
284 Ratiometric actpoti 1 to 2 voltage high (>105% from 8.3V)
285 Ratiometric actpoti 1 to 2 voltage low (< 95% from 8.3V)
290 Error by Safety Controller (AD-setpoti 1 uC1 - uC2 difference)
291 Error by Safety Controller (AD-actpoti 1 uC1 - uC2 difference)
292 Error from Safety Controller (powerstages uC1 - uC2 differs)
293 Error from Safety Controller (dig. input uC1 - uC2 differs)
294 Error from Safety Controller (dig. output uC1 - uC2 differs)
295 Error from Safety Controller (srwsangle uC1 - uC2 differs)
296 Error from Safety Controller (Voltage Entraction uC1 - uC2 differs)
299 Common error by Safety Controller

6.6.4 Safety steering error codes:

Information codes

1 Power-Up -Tests not finished (ext. Safetyrelay open but should be closed)
2 Power-Up -Tests not finished (Safetyrelay open but should be closed)
3 Controller set to Passivemode by CAN-Flasher
7 Unteached Potentiometer or corrupped EEProm
8 incorrect EEProm truckidentifer value

Warning codes
No codes implemented

Error codes

220 no Productiontest (--OK--sign missing in EEPROM)
240 Fatal plant behaviour error: Steering angle varies in the opposite direction to the commanded one (PWM). One of those components does not work properly: PWM unit, inverter, motor, gear or angle sensor or the steering axle is externally actively moved (should not occur normally)
242 ext. Safetyrelay open but should be closed
243 Safetyrelay open but should be closed
244 Error from internal communication between controllers (SSC Watchdog)
245 EnableTraction voltage wrong

6.7 ELECTRICAL DIAGRAMS

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6.7.1 T20/24 SP ET AP (LAC)

	POWER:	
1A1	Traction speed control and initial lift	7-22
3A1	Steering speed control	25-35
1F1	Traction / elevation fuse 250A	9
3F1	Steering fuse 100A	26
G1	Battery	1
1K2	Traction/hoist switch	9
3K1	Steering switch	26
1M1	Traction motor	14-17
2M1	Pump motor	20-22
3M1	Steering motor	31-33
9M1	Fan motor	60
9M2	Fan motor	63
	CONTROLS:	
A1	Control interface (moving, lifting, horn)	43-73
1A1	Traction, initial lift speed control (LAC)	48-99
1A8	Stability module	86-89
3A1	Steering speed control (LES)	102-132
7A5	Brake module (LORD)	116-125
1B1	Acceleration potentiometer	65-67
1B2	Traction speed sensor	92-96
1B3	Lower fork detector	77
1B4	High forks detector	75
1B6	Traction motor temperature sensor	80
3B2	Steering potentiometer (set value)	118-123
3B3	Steering potentiometer (wheel position)	125-130
1F3	Control fuse 7.5 A	51
4H1	Horn	45
1K2	Traction contactor	9-76
3K1	Direction contactor	26-113
9M1	Electric plate fan	60
9M2	Electric plate fan	63
6P4	Multifunction indicator	95-100
S1	Ignition key	52
1S3	Rear safety microswitch (belly switch) at tiller (only for T20 AP)	47-50
1S4	Tiller base microswitch	69
1S4A	Tiller base microswitch	70
1S9	Driver presence microswitch	58
1S19	Locking battery microswitch	72
1S21	Forward travel micro switch	51
1S22	Rear micro switch	55
2S6	Fork lowering control	57
2S7	Fork lifting control	60
2S18	Oil level of stabilisers	66
4S1	Horn	44
7S5	Microswitch to open control circuit (controlled mechanically by 7S1)	52

X2	Battery locking controller	72
X13	Brake module connector (LORD)	117-113
1X1	Traction/hoist control connector (LAC)	49-99
1X2	Speed sensor connector	93-96
1X3	Control panel /unit interface connector (A1)	45-73
1X4	Steering programming box connector (LAC)	82-85
1X5	Control module connector	45-73
1X9	Driver presence connector	58
1X20	Platform position connector	53
1x25	Traction motor temperature connector	80
1X26	Stability module connector (inclinometer)	86-88
2X9	Lowering solenoid valve connector LI	84
2X14	High (1B4) and low (1B3) end of course connector of the LI.	77
2X15	Solenoid valve connector (2Y7) for stabiliser block	41
2X16	Stabiliser fluid level connector	65
2X20	Right stabiliser electrovalve connector	53
2X21	Left stabiliser electrovalve connector	89
3X1	Electric steering connector	102-132
3X3	Wheel position potentiometer connector	128-131
6X2	Multi-function indicator connector	94-99
6X7	Diagnostics connector	103-106
7X6	Electromagnetic brake connector (Y1)	80-81
Y1	Electromagnetic brake	78-82
2Y2	Initial lift lowering solenoid valve	84
2Y7	Solenoid valve for stabiliser block (only for trucks with battery with side outlet)	42
2Y8	Solenoid valve for right stabiliser block	86
2Y9	Solenoid valve for left stabiliser block	89
Z1	Interference circuit	45,53, 58,62
Z2	Anti interference diode	47
7Z1	Brake interference	79-81
7Z2	Interference contactors	77,114

Code	Colour	Code	Colour
BK	Black	GN	Green
WH	White	VT	Violet
BU	Blue	RD	Red
OG	Orange	YE	Yellow
BN	Brown	GY	Grey

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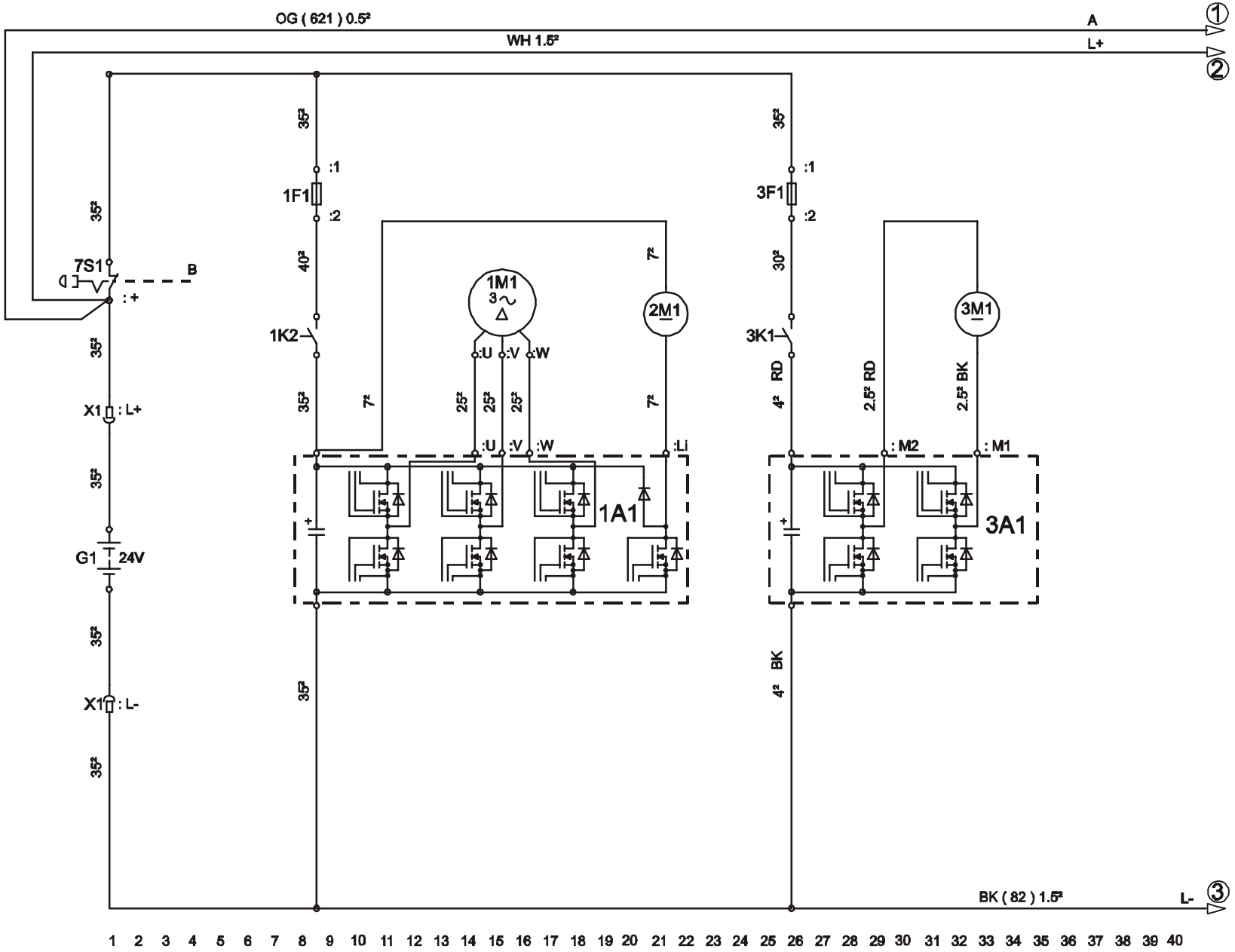
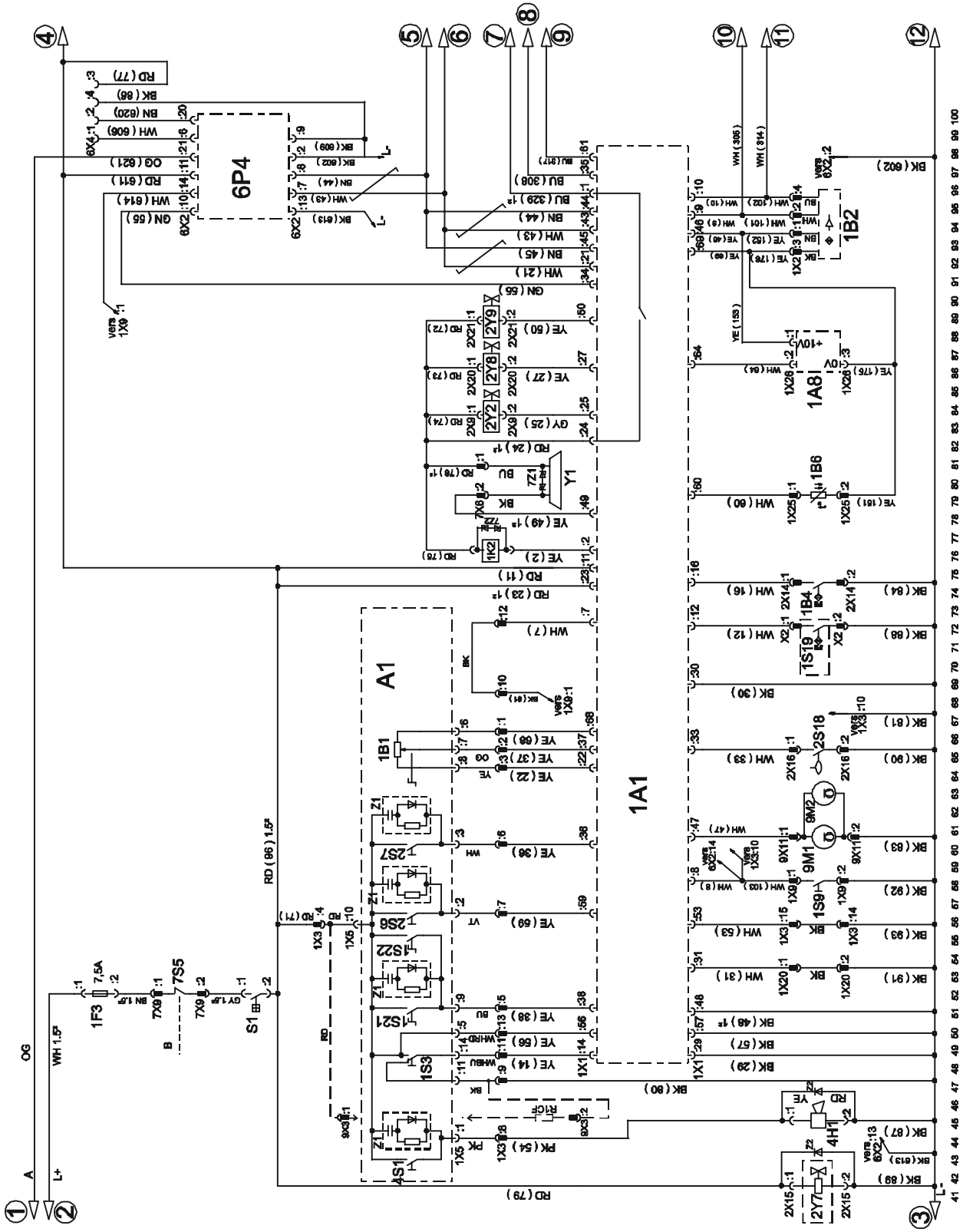
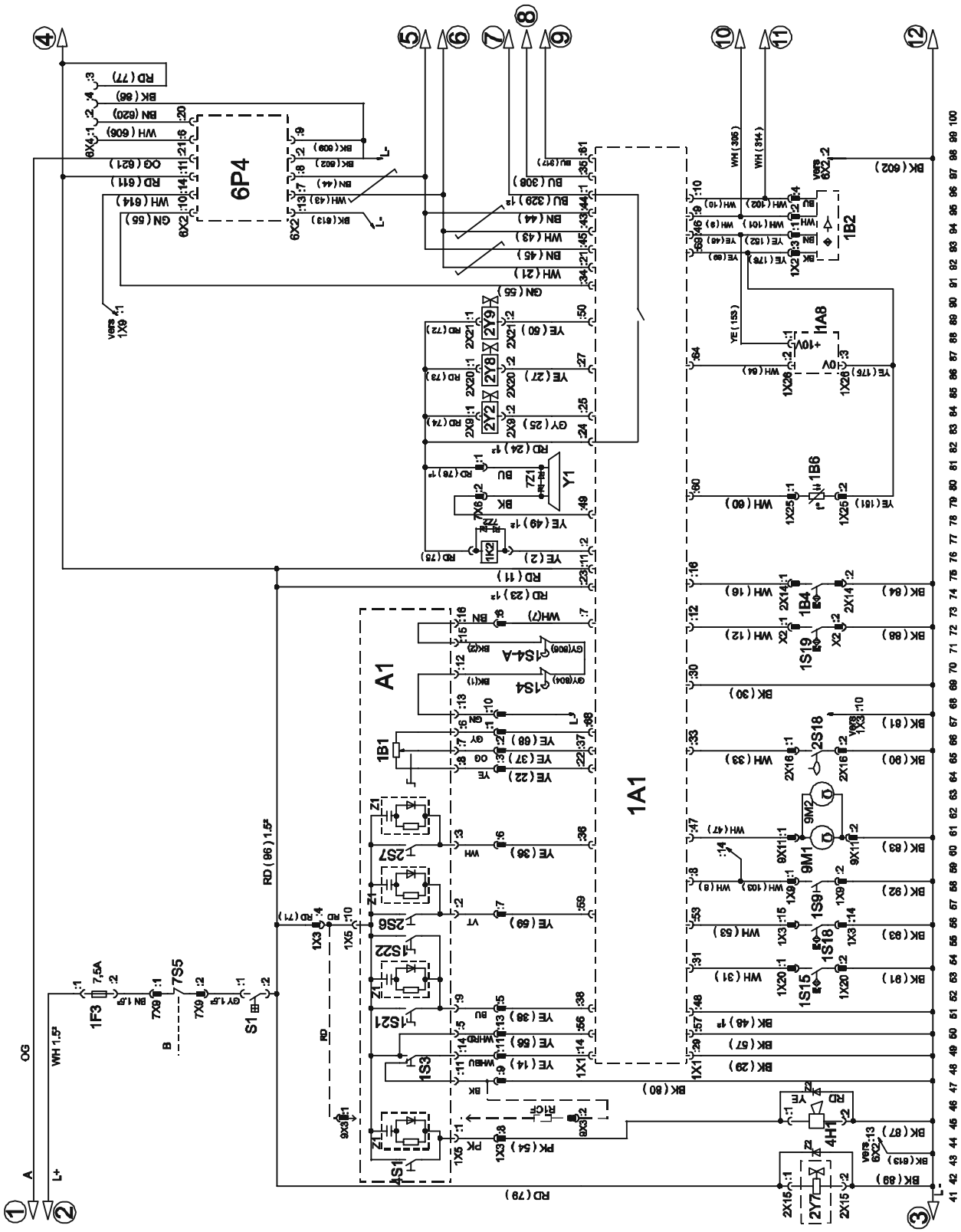
Electrical diagram
power T20/24 SP and AP



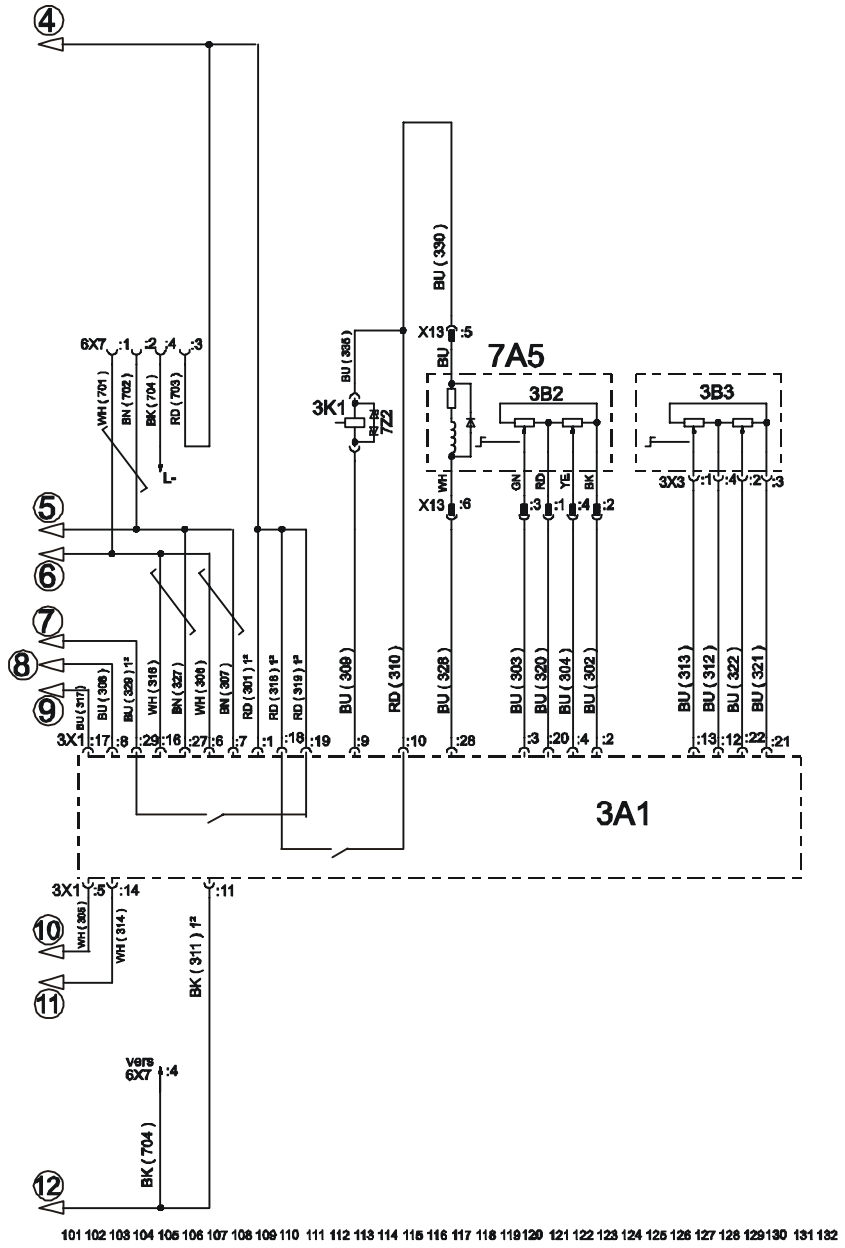
Electrical diagram
Control T20/24 SP (LAC)



Electrical diagram
Control T20/24 AP (LAC)



Electrical diagram
Control T20/24 SP and AP (LES)



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7. HYDRAULIC UNIT

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7.1 HYDRAULIC SYSTEMS

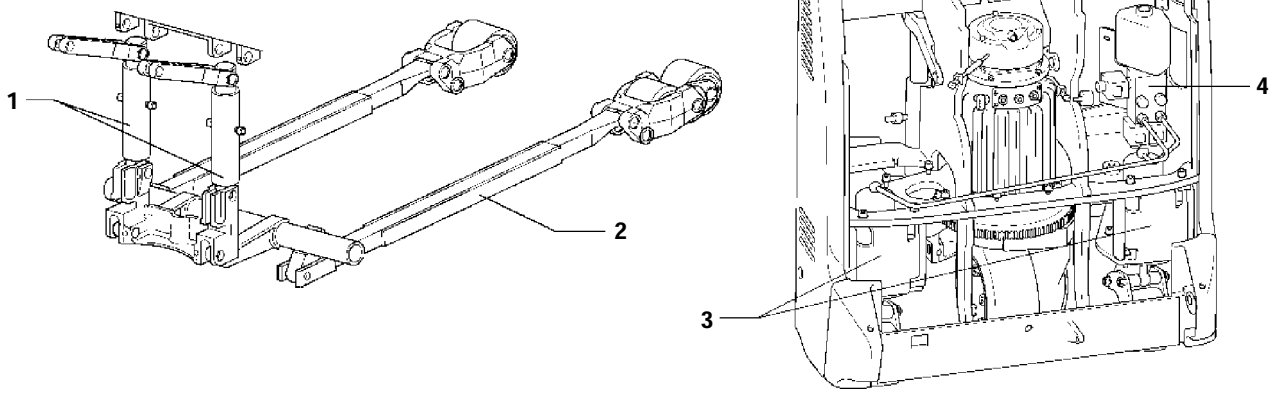

Figure 1

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Two hydraulic systems:

- The controlled stabiliser hydraulic system, compensate the ground unevenness.

- The low lift hydraulic system

Figure 1:

1 Lifting jacks
2 Lifting system push bar
3 Controlled hydraulic stabilisers
4 Stabiliser control hydraulic block

7.1.1 Stabiliser hydraulic system

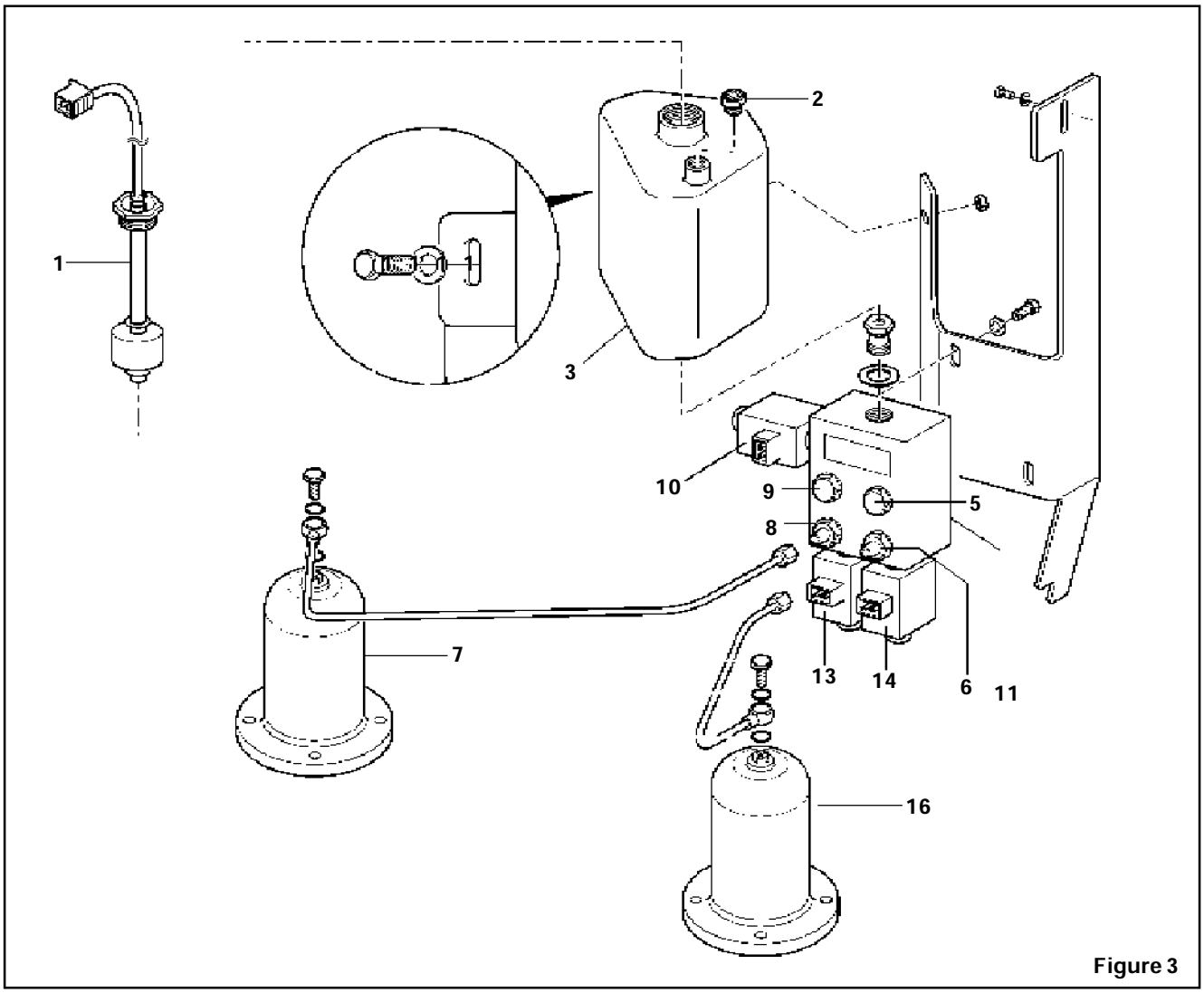


Figure 3

The suspension controlled by a hydraulic system blocks the external speed stabiliser to ensure maximum stability of the appliance.

The solenoid valves that control the hydraulic system are controlled by an electronic circuit, controlled by a tilt sensor (inclinometer).

Note:
In the T20SP model, the solenoid valve of the right stabiliser block (14) (2Y8) is always fed to compensate the weight of the driver.

Figure 2 and 3:

1. Electric gauge
2. Hydraulic tank breather 150µ
3. Hydraulic tank
4. Distribution socket (battery with vertical outlet)
5. Non-return valve
6. 100µ gauze
7. Left stabiliser jack
8. 100µ gauze
9. Non-return valve
10. Solenoid valve for block 2Y7 (only for trucks with battery with side outlet)
11. Stabiliser distribution block
12. Disk filter 160µ
13. Solenoid valve 2Y9 for left stabiliser block
14. Solenoid valve 2Y8 for right stabiliser block
15. Shim calibrated at 0.9 mm
16. Right stabiliser jack

Stabiliser hydraulic system drawing

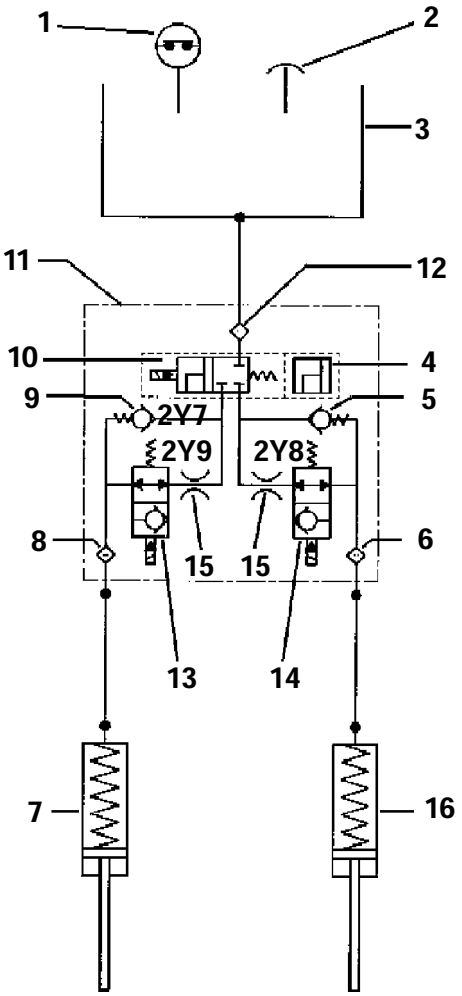


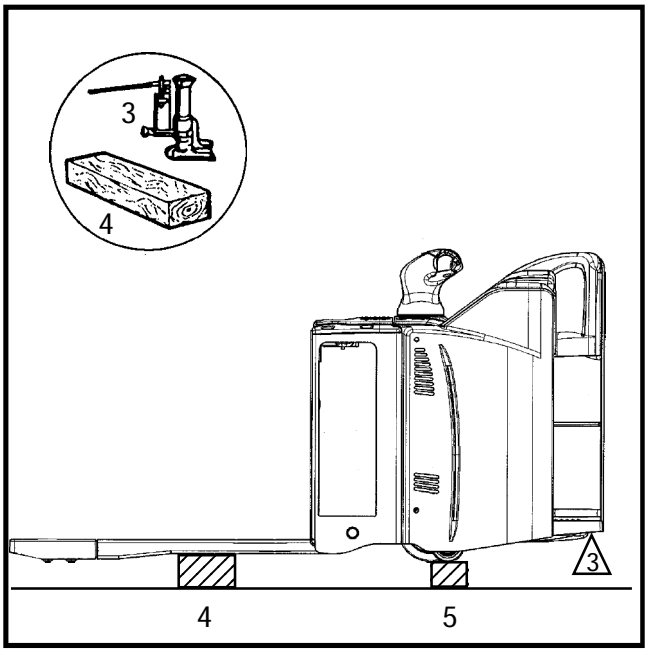
Figure 2

Function	2Y8	2Y9	2Y7	Inclinometer
Truck in line right	0	0	1	
Truck turns to the left	1	0	1	
Truck turns to the right	0	1	1	
Unlocking Battery with side outlet *Option:	1	1	1	
Truck at stop 1S1 at "off"	0	0	0	

0: not powered
1: powered

Stabiliser hydraulic system draining

- Remove the front cover
- Remove the dashboard
- Lift the truck using a jack (3) with sufficient capacity.
- Lift the fork arms, then lock them (4).
- Remove the front part of the truck, then wedge (5) the 2 stabilisers wheels (10) at equal height in the same manner in which they are placed in maximum return position (the driving wheel must not touch the ground) once the jack is lowered.



WARNING
Always wedge and block the truck securely after it has been lifted.

NOTE
In a truck with a platform with side outlet, start the truck and make sure that the battery is locked correctly.

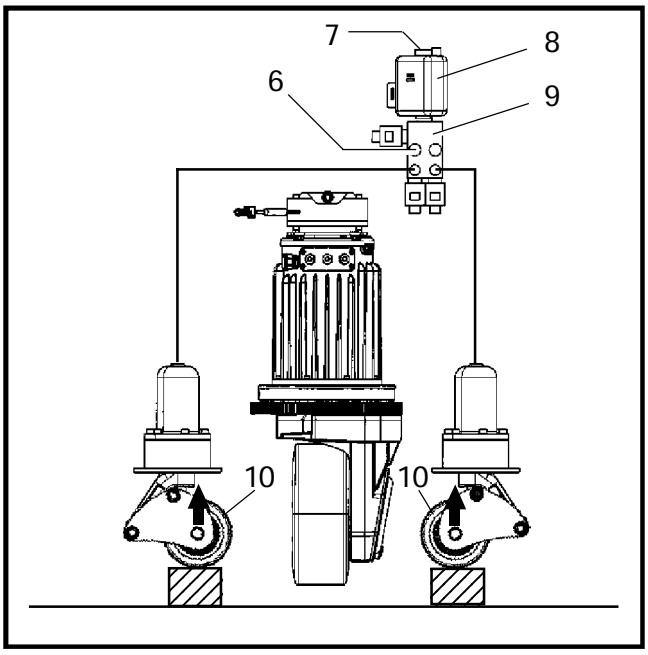
- Place a receptacle (a ½ bottle of water for example) under the distribution block (9)
- Unscrew a non-return flap (6)
- Drain the circuit then rescrew the reverse valve with a new joint.

Filling the hydraulic system

- Disconnect the gauge
- Unscrew the stopper (7)
- Pour 0.6 litres of oil in the tank (8)

Purging the hydraulic system

- Lift the front part of the truck to lower the stabilisers again (the lifting jack chambers are filled)
- Lower the front part of the truck to return the stabilisers to the maximum (the circuit air is chased to the tank)
- Repeat the purging operation twice again by raising and lowering the truck with about 1 minute interval at the end of each movement.
- Rest the truck on the ground.
- After this operation, check the oil level and refill if necessary.
- Retighten the stopper (7)
- Reconnect the gauge.



CAUTION
Only use hydraulic fluid according to the specifications
ISO VG 46 H-L or H-LP (DIN 51524)

Service Training

Lifting hydraulic system drawing

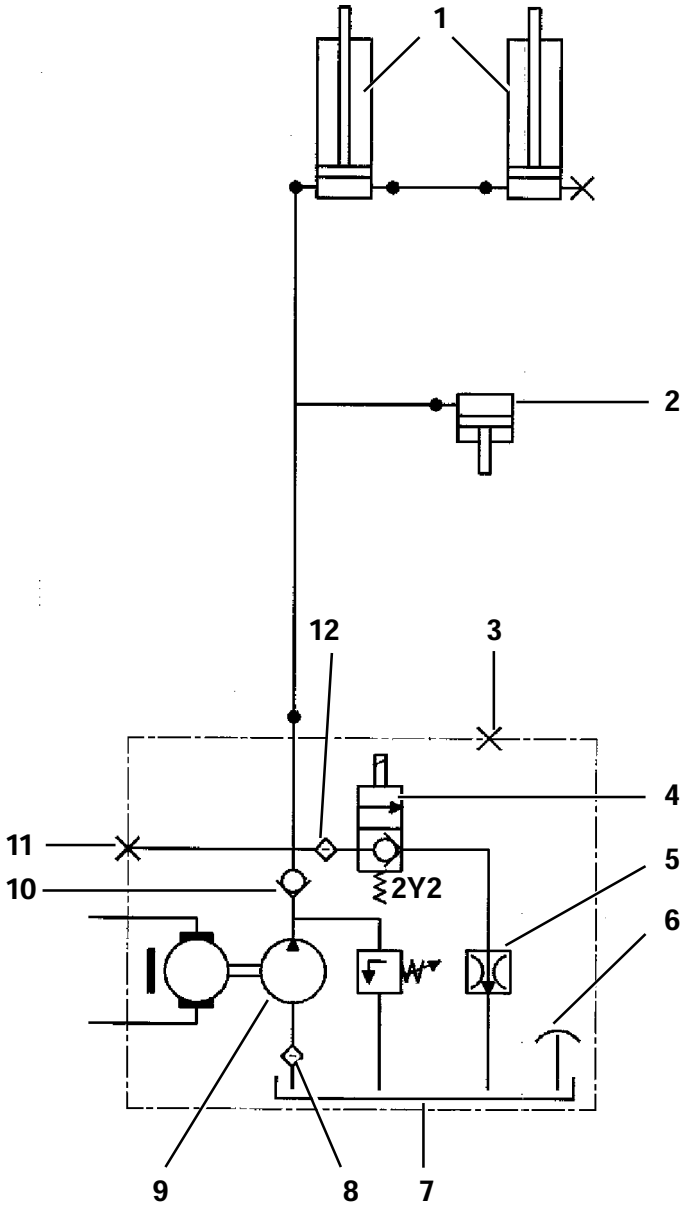


Figure 4

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7.1.2 Lifting jacks hydraulic system

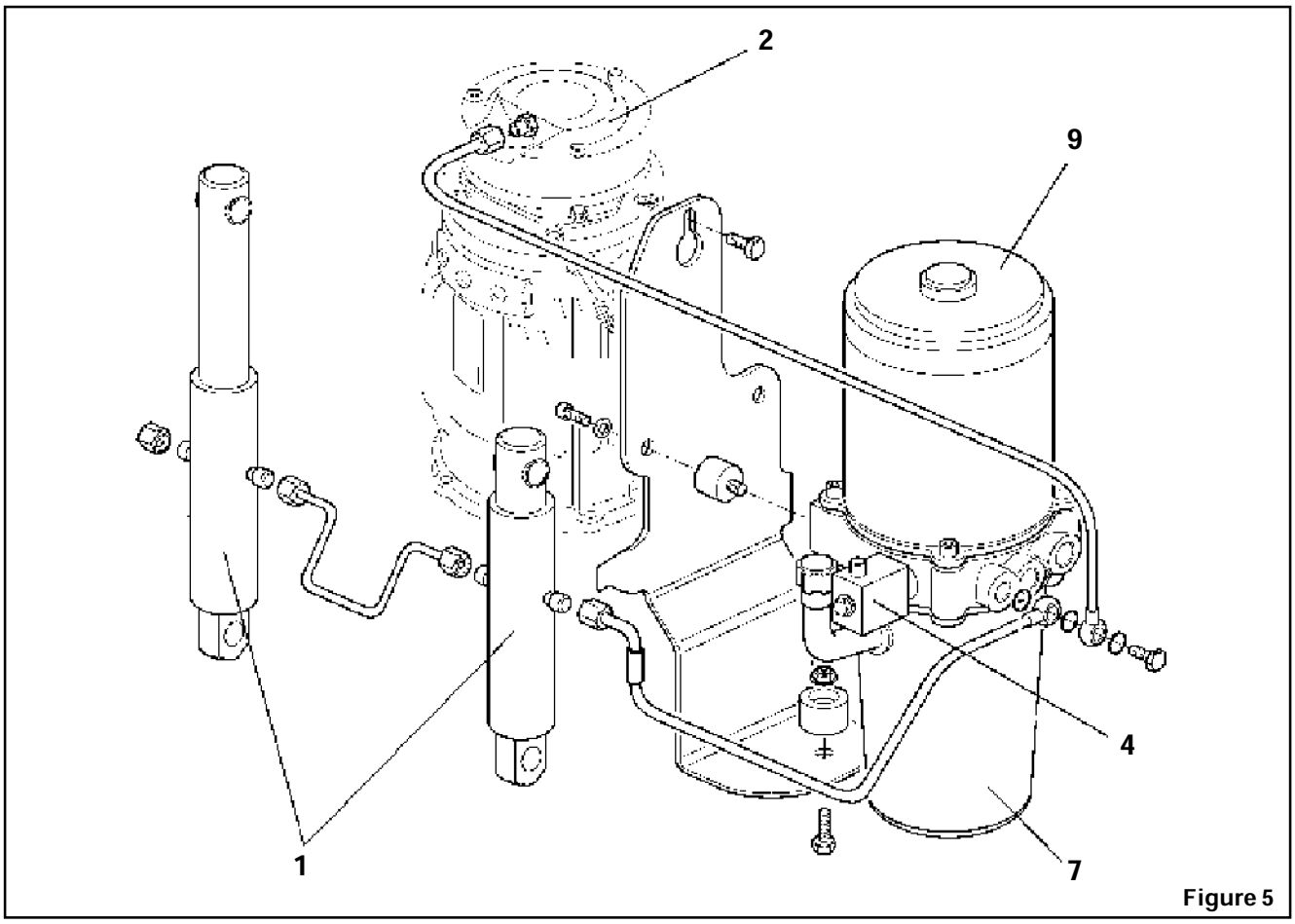

Figure 5

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Two jacks (1) activate the low lift system.

The two jacks are supplied by a motor pump unit:

T20:
- Pump motor group 1.0 KW (S3: 15%). Motor without entertainment

T24 :
- Pump motor group 1.5 KW (S3: 15%).

The pump motor (2M1) is controlled by a power transistor integrated in the L.A.C. control.
(Linde Alternate Control).

Figure 4 and 5:

1. Low lift jacks
2. Electrohydraulic brake
3. Stopper (T24)
4. Descent solenoid 2Y2
5. Lowering retarder:
   Ø 2.2mm (T20), Ø 2.4mm (T24)
6. Filling plug with breather
7. Hydraulic tank
8. Oil pump strainer 450µ
9. Pump 1 cm3/tr
10. Non-return valve
11. Stopper (T20)
12. Filter 300µ.

Service Training

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Business division - Linde Material Handling

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Linde Material Handling Division

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