EN

CAT Lift Trucks

Operation & Maintenance Manual

NPP13M
NPP16M
NPP20M
NPP20MR

MCFE
Hefbrugweg 77,
1332 AM Almere,
The Netherlands

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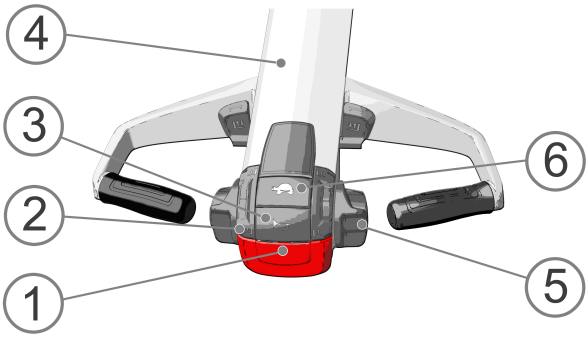
Tiller arm



Safety button (1)

The safety button prevents you from getting squeezed between the truck and an obstacle.

When you push the safety button, the truck reverses its travelling direction and stops when the button is released, if the speed control is also released at the same time.

NOTE *Never use the safety button for normal driving. The safety button is disabled when driving on the platform.*

Check the operation of the safety button daily before you start working with the forklift truck.

Push buttons for lifting and lowering (2)

Horn (3)

Steering (4)

The tiller arm turns ± 100 degrees.

Accelerator (5)

The accelerator is used for controlling the driving speed and for braking. Handle the accelerator gently!

Brake release / slow speed button (6)

- Clean the truck if necessary.
- Check the length of the lifting chains. When the carriages are level with the mast, the chains should be slightly loose. Adjust if necessary. (Does not apply to pallet trucks.)
- Apply a thin layer of lubrication on the mast's guide surfaces.

NOTE *Do not let water onto the electrical devices.*

NOTE

WARNING:
For the installation and use of the inverter this manual and other instructions for additional components must be followed.

WARNING:
To avoid any hazard situation always disconnect the battery before working on the inverter or other additional components.

WARNING:
Work on the traction motors must only be carried out when the power connection between battery and inverter is disconnected.

WARNING:
It is assumed that only trained people who hold the necessary know-how carry out the installation and settings of parameters.

WARNING:
All existing safety regulations both electric and mechanical must be followed.

594200006

List of succeeding displayable parameters:

text	**parameter number**
software version	0
serial number	7
operating hours	9
actual speed	10
speed set value	11
temp. inverter	17
operating state	25
value speed pot.	30
temp. inverter	32
battery voltage	33
connector X1	46
connector X2	47
connector X3	48
connector X4	49
connector X5	50
connector X6	51

Description of the parameters:

Serial number:	Explicit number identifying each individual unit
Operating hours:	Actual counted time in which the motor has been operated.
Actual speed:	The actual measured speed of the controlled motor.
Speed set value:	The actual speed demand of the controlled motor.
Operating state:	0= Fault, 1= Ready, 2= Power stage active (current in motor)
Speed potentiom.:	Displays the analog voltage on input pin X6.6 in the range of 0..1023. This input is the speed reference coming from the tiller head.
Battery voltage:	Displayed in % of the nominal voltage (e.g. 24V, 48V or 80V)

State display for connectors X1 - X6:

Example 1:

Connector X1

connector X1
2

This display shows that the pin 2 on connector X1 is active, meaning that the internal transistor connects pin 2 to battery minus.

Pin 1: Key Switch (Battery voltage)
Pin 2: Digital output 2
Pin 3: Analogue output minus
Pin 4: Analogue output

Example 2:

Connector X3

connector X3
67 A

This display shows that the inputs pin 6, pin 7 and pin 10 (A=10) are activated.

Pin 1: Protected key switch voltag
Pin 2: Protected key switch voltag
Pin 3: Supply voltage for the horn
Pin 4: Supply voltage for the lowering valve
Pin 5: Supply voltage for the contactor that switches on the pump-motor
Pin 6: Input safety socket

No.	Type of fault or state report	Flash code LED	Remarks	Possible cause	Possible action
5	Over voltage, Battery	5 pulses...pause	(Depending on the setting of parameter 174)	1. The battery voltage measured by the inverter has exceed the value set in parameter 174 for more than 3 sec, or the value has been exceeding 150% of the nominal voltage. If the battery is intact and the connections to the inverter are good this fault should not occur. (Assuming that parameter 174 is set correctly) 2. The power stage could be damaged.	Ad 1: Check the settings of parameter 174. Check that the connections from battery to inverter are OK Ad 2: Replace the inverter.
6	Over temperature, Motor	6 pulses...pause	(Depending on the setting of parameters 110 and 111) If the temperature shot down threshold (110) is exceeded the inverter will stay shot down. If the measured value is below the value of parameter 111 the inverter interprets a short circuit sensor.	1. The temperature sensor connected to X4 has detected a too high temperature in the motor. The motor could have been overloaded for a too long time. 2. If the motor is not equipped with a temperature sensor pin 2 and 6 on X4 must be short circuit. 3. Parameter 111 is adjusted >0 and there is a short circuit at the sensor.	Ad 1: Check if the traction system is operating sluggish or is defect. Check eventually the motor current. The continuously motor current must not exceed the motor nominal current. Ad 2: Check the connection on X4. Ad.3: Remove short circuit or set parameter 111 to 0.
7	Over temperature, inverter	7 pulses...pause	(Depending on the setting of parameters 106 and 108) If the temperature shot down threshold (108) is exceeded the inverter will stay shot down.	1. The inverter has been overloaded for a too long time. 2. There is a fault in the temperature measurement of the inverter.	Ad 1: Check that the inverter is mounted according to the directions regarding in order to be able to emit the heat. Check eventually the output current. The continuously current must not exceed the nominal current of the unit. Ad 2: Replace the inverter

1 INTRODUCTION TO THE ZAPI-MOS FAMILY

The ZAPIMOS chopper family represents ZAPI's answer to the needs of the 90's. To ensure that products remain on the market, without running the risk of becoming technically obsolescent, the ZAPIMOS family offers the following features:

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

The design has been derived from:

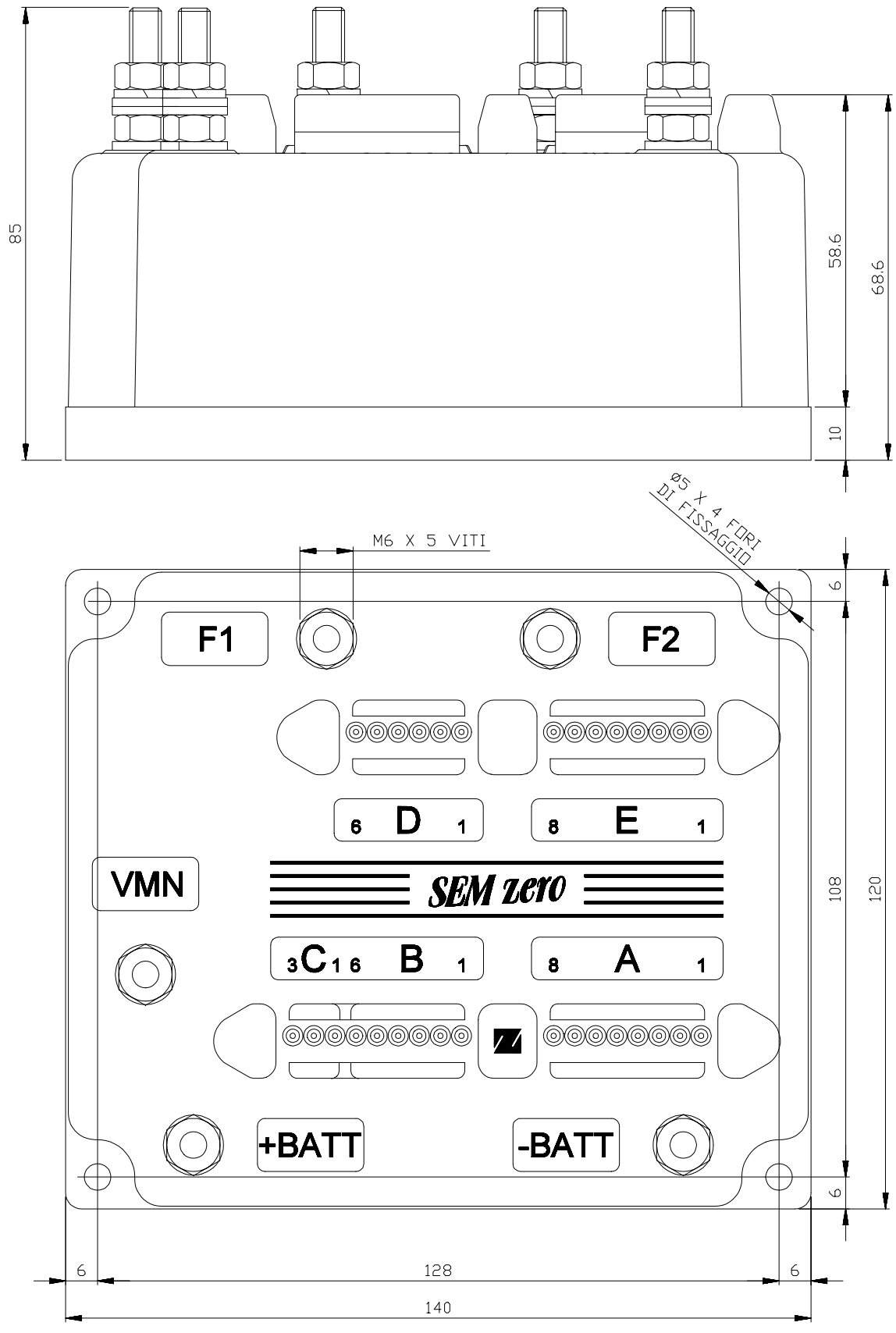
- High Frequency Mos Technology .
- Real time control over the internal and external components that influence the behaviour of the machine, with self diagnosis of the checking circuits themselves.

- Stored Program Machine (SPC), where the hardware is completely separate from the functions to be configured. The programme is parametric and can easily be modified by the end user.
- Various chopper configurations can be selected by the user, without the need for hardware modifications.
- Future technological updates are made easy for the user.

  The communication protocol will continue to evolve, thereby offering increasing possibilities of interaction and expansion. For this reason, the Zapimos family offers a standard dialogue mode with external systems. This allows interfacing with

  commercially available machines. Zapi can offer a range of individually designed Console Software with various features and prices.
- SEM-Zero meets the requirements of (IP54). This provides excellent protection against spray (water, acid.), and against the ingress of dust or small foreign particles. Access to the control logic is very simple, and allows simple substitution or replacement.
- The SEM-Zero family of Choppers are suitable for operating on DC voltages from 24 to 36V inclusive, with maximum armature current up to 200A.
  The choppers may be used to control DC Separately Excited Motors with power ratings up to 2.0kW.

3.6 MECHANICAL DRAWING & DIMENSIONS



Flow Chart showing how to make Programme changes using Digital Console fitted with Eprom CK ULTRA.

1) Opening Zapi Display.

2) Press ENTER to go into the General Menu.

3) The Display will show :

4) Press ENTER to go into the Parameter Change facility.

5) The Display will show the first Parameter.

6) Press either ROLL UP or ROLL DOWN to display the next parameter.

7) The names of the Parameters appear on the Display.

8) When the desired Parameter appears, the Display will show a Level Number that will be between 0 and 9. press either PARAM (Top Right) or SET (Bottom Right) buttons to change the Level value.

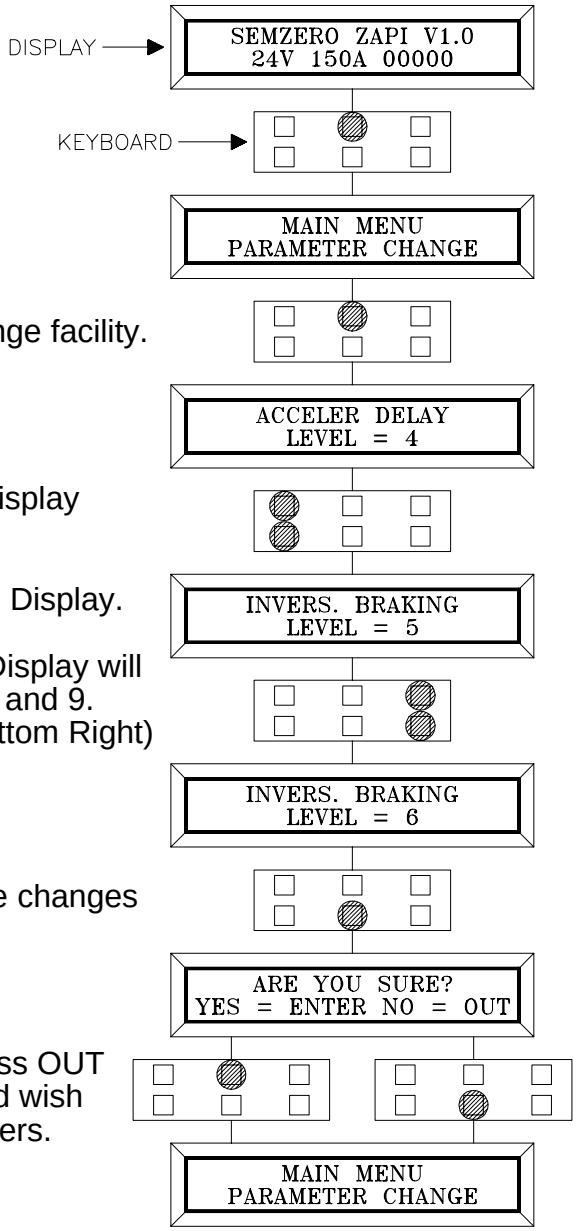
9) The Display will show the New Level.

10) When you are satisfied with the results of the changes you have made, Press OUT.

11) The Display asks " ARE YOU SURE ?

12) Press ENTER to accept the changes, or Press OUT if you do not wish to accept the changes and wish to make further modifications to the parameters.

13) The Display will show :

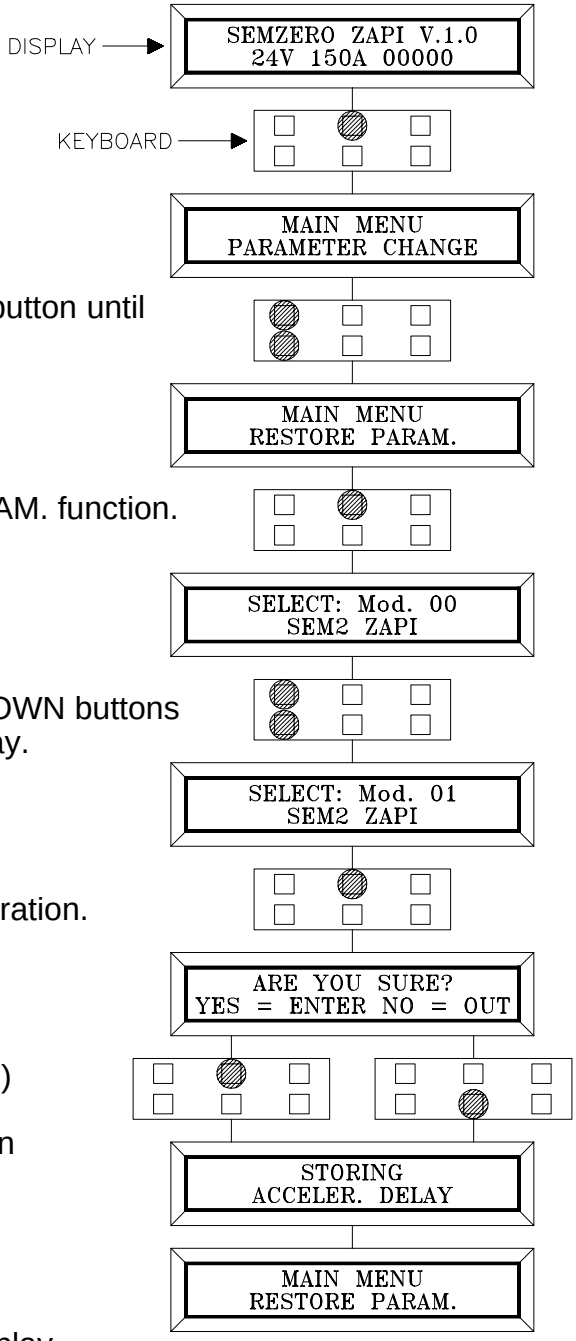


6.4 DESCRIPTION OF CONSOLE RESTORE FUNCTION.

The RESTORE PARAM function allows transfer of the Console's stored data into the memory of the chopper. This is achieved in a fast and easy way using the method previously used with the SAVE PARAM. function.
The data that are available via the RESTORE PARAM. function are as follows :
- All Parameter Values (PARAMETER CHANGE).
- Options (SET OPTIONS)
- The level of the Battery (ADJUST BATTERY)

ATTENTION: When the RESTORE operation is made, all data in the chopper memory will be writtten over and replace with data being restored.
Flow Chart showing how to use the RESTORE function of the Digital Console.

1) Opening Zapi Display.
2) Press ENTER to go into the General menu.
3) The Display will show :
4) Press either ROLL UP or ROLL DOWN button until RESTORE PARAM. appears on the display.
5) The Display will show :
6) Press ENTER to go into the RESTORE PARAM. function.
7) The Display shows the type of Model stored, with a Code Number.
8) Keep pressing either ROLL UP and ROLL DOWN buttons until the desired model appears on the Display.
9) The model is shown
10) Press ENTER to commence the Restore operation.
11) The Display will ask "ARE YOU SURE". Press ENTER for YES, or OUT for No.
12) Press ENTER to confirm (OUT to not confirm)
13) You can see the items that are being stored in the chopper memory whilst the RESTORE routine is happening.
14) When finished the Console displays :
15) Press OUT to return to the Opening Zapi Display .

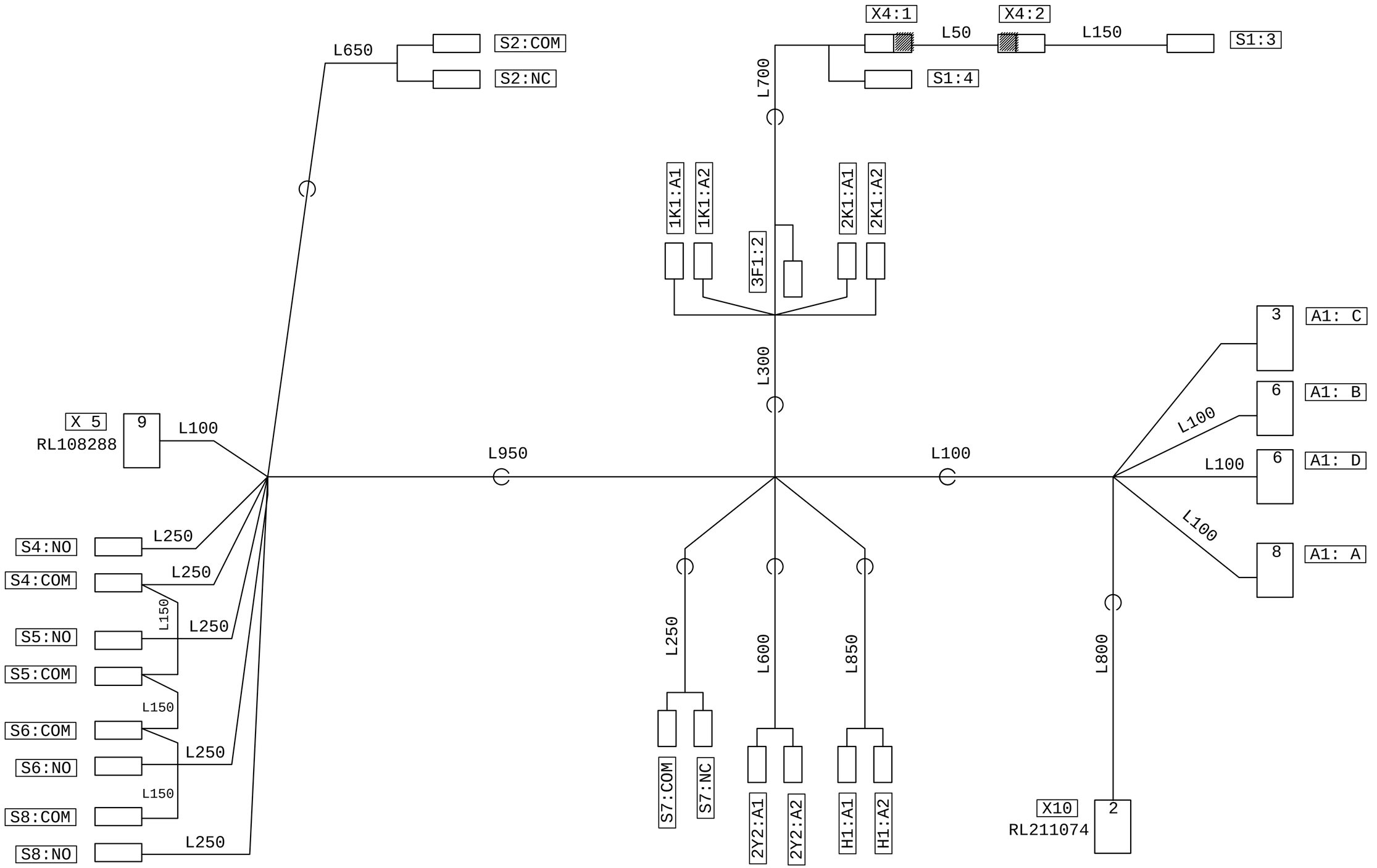


1600 kg

Fork width	**Fork length**
b50 [mm]	**l [mm]**
540 Options min. 480 max. 660	1150 Options 950 1020 1450

Working aisle width (mm)		
Pallet size	**Handling**	**AST 3**
800x1200	Lengthwise	1904
1000x1200	Crosswise	1704
Working aisle width (mm)		
Pallet size	**Handling**	**AST**
800x1200	Lengthwise	2130
1000x1200	Crosswise	2264

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30



CAT Lift Trucks

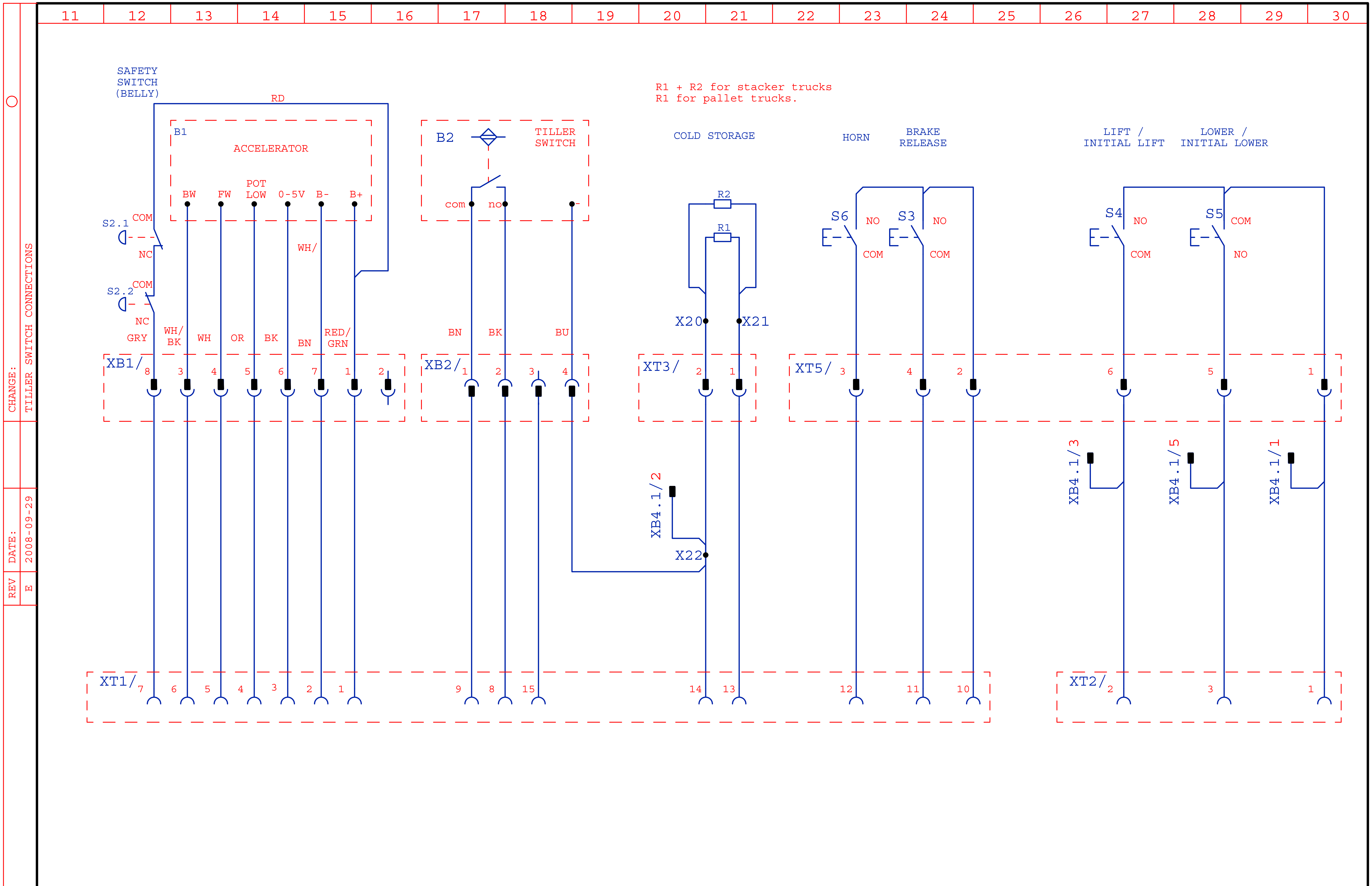
CIRCUIT DIAGRAM TS780699

NPP16K/NPP20K
WIRE HARNESS W5:RL450339

4 / 5

REV

3-6714



CAT Lift Trucks

DATE: 2006-09-14

CIRCUIT DIAGRAM

TS1150908

NEW TILLER

PALLET AND STACKER TRUCKS

1/2

REV E

3-6969

! Never park or stack goods in front of fire doors, fire extinguishers, emergency exits and the like.
! Never park the truck on a slanted surface.

OTHER WORKING INSTRUCTIONS

FREE SPACE

! The operator must make sure that the truck has sufficient moving space with respect to overhead structures. Before driving to aisles or door openings, it must be ensured that there is enough space for the truck, the load and the operator.
! Always drive at a safe distance from the edge of loading platforms or bridges.

BEARING CAPACITY OF THE FLOOR

The operator must make sure that the combined weight of the truck and the load does not exceed the bearing capacity of the floor.

USE IN ELEVATORS

An elevator can only be used to transport the truck between floors by permission of the site supervision. When using an elevator, it must be ensured that the combined weight of the truck, the load and the operator does not exceed the maximum load capacity of the elevator. The truck should always be driven with the load in front to elevators, as well as any other narrow premises.

! Do not let any other people be in an elevator when driving the truck in or out.
! The parking brake of the truck must be on before the elevator starts.

WORKING ON RAMPS

The operator must get permission from the site supervision to drive on a slope or ramp. When the truck is loaded, travel with the load uphill. Without a load, you can also travel with the forks downhill.

! Do not turn the steering wheel abruptly on a ramp. The truck might overturn.

WORKING ON LOADING BRIDGES

Before starting with loading or unloading, always check the bearing capacity and the fastening of the bridge. If the truck is to be driven into another vehicle, it must be ensured that the vehicle cannot move during the work. Do not drive to the edges of a loading bridge, because there is always the risk of overturning.

RECHARGING AND REPLACING THE BATTERY

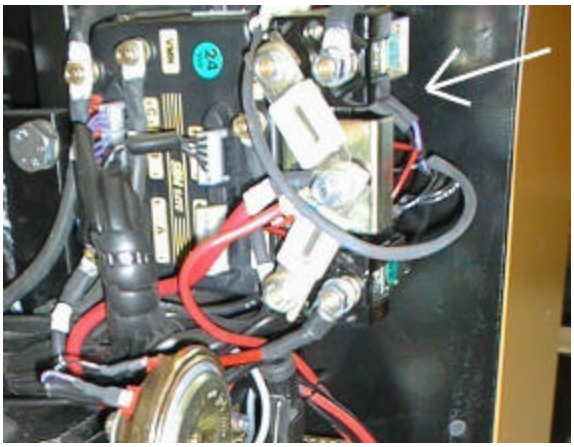
Only appointed and trained personnel may replace and recharge batteries. Individuals maintaining batteries must have sufficient protective clothing.

! Do not handle naked flame in the vicinity of batteries because of a risk of explosion.
! Do not smoke when working with batteries.
! Do not leave tools or other metal implements on top of the battery. Sparking or a short circuit may cause the battery to explode.

SEMIANNUAL SCHEDULED MAINTENANCE (600 H)

In addition to the quarterly and weekly procedures, the following points need to be carried out:
- change the hydraulic oil once a year (1200 h)
- change the gearbox oil once a year (1200 h)
- clean the oil filter
- check the operation of the hydraulics and the pressure-limiting valves
- check the fastening of the gearbox and the amount of gearbox oil (see 17.4)
- check the fastening of the tiller arm
- check the condition of the side castor wheels and load wheels
- check the wear of the drive wheel

LOCATION OF THE FUSES IN THE SPEED CONTROL UNIT



Steering circuit fuses
Drive current fuse
Lift motor fuses

WARNING!

NO ALTERATIONS OR REPAIRS MAY BE MADE TO THE DEVICE THAT MAY WEAKEN ITS STRUCTURE OR ENDANGER SAFETY.

Never use the truck:

- To transport or lift people
- In environments with a fire hazard
- In environments with an explosion hazard
- At premises with insufficient floor load capacity
- If it is damaged
- As a mounting surface
- To tow another truck
- Under the influence of intoxicating substances

2.2.1. Free space

Make sure that the truck has sufficient moving space with respect to overhead structures and other obstructions. Before driving through aisles or door openings, ensure that there is enough space for the truck, the load and yourself. Reduce your driving speed in confined spaces.

NOTE Always drive at a safe distance from the edge of loading platforms or bridges.

2.2.2. Bearing capacity of the floor

Make sure that the combined weight of the truck and the load does not exceed the bearing capacity of the floor or driving surface.

2.2.3. Using elevators

Obtain permission from the site supervisor to use an elevator to transport the truck between floors. Make sure that the combined weight of the truck, the load and any persons present does not exceed the maximum load capacity of the elevator. Always drive the truck into elevators and any other narrow spaces with the load in front.

When the indicator turns to green, the truck's batteries are fully charged and the charger can be unplugged. Even if the charger is not unplugged after charging is completed, it stops charging automatically.

A fault in the internal charger is indicated by the charging indicator as follows:

- Flashing green: Timeout alarm

  The charging duration exceeds the preset maximum value. Verify that the battery has the correct capacity.

- Flashing between red and yellow: Battery current alarm

  Loss of output power control. Indicates a fault in the control logic.

- Flashing between red and green: Battery voltage alarm

  Loss of output power control. Indicates a fault in the control logic.

- Flashing red, yellow and green in sequence: Temperature alarm

  Internal components have overheated. Verify fan operation.

- Flashing between yellow and green: Configuration alarm

  An unavailable configuration has been selected. Verify selector position.

2.7. Transportation and storage

Lift the truck only from a marked lifting point. Make sure that the capacity of the lifting device is sufficient. Only tow the truck with the drive wheel lifted from the surface.

maintenance section in *Chapter 4 Electrical operation and maintenance* for more information.

3.4.3. Checking the truck for external damage

Visually check the truck for any apparent problems or external damage. If damage is apparent, its extent should be checked and any necessary repairs made before continuing with regular maintenance. If the damage in any way affects the use or safety of the truck, the truck must be taken out of use until it is fully operational.

3.4.4. Checking the condition of the wheels

The truck has three wheel types: drive, load and castor. The drive wheel is located immediately under the tiller arm anchoring point and supports a considerable portion of the truck's weight. It is attached to the drive motor via the transmission to propel the truck, and it is turned with the tiller arm to steer the truck.

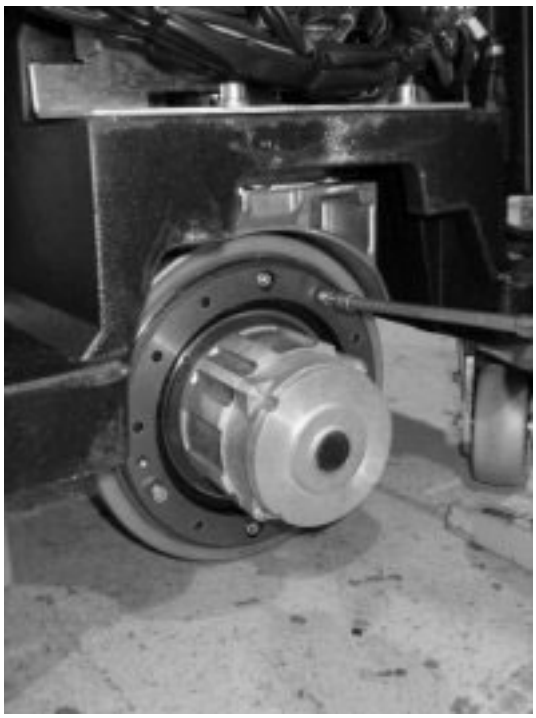


Figure 3.4. Drive wheel

The load wheels are located near the ends of the forks. Their main purpose is to support the weight of the load. Depending on

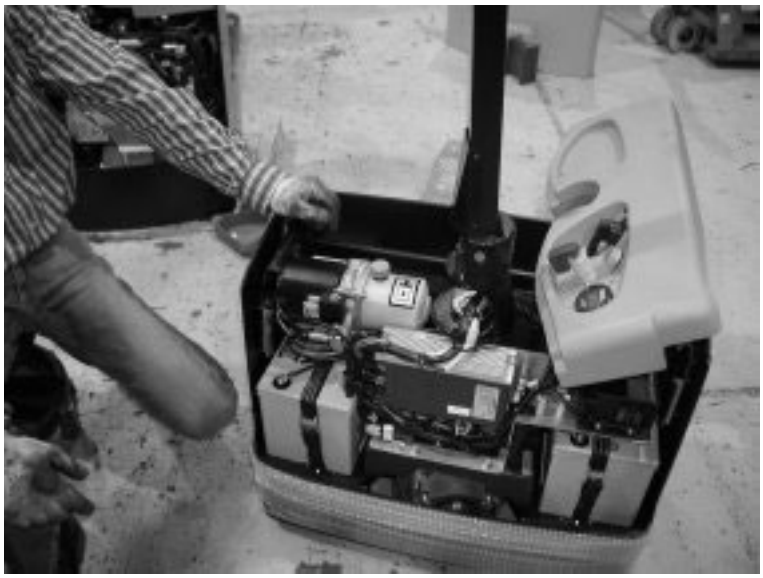


Figure 3.10. Hydraulic tank location (1,300 kg capacity truck model)

On 1,600 kg and 2,000 kg capacity truck models, the tank is installed vertically, and it should be filled to three-quarters (¾) of the capacity when measured from the bottom of the tank to the bottom edge of the filling tube.

Figure 3.21. Checking the forks

3.7.4. Checking, cleaning and adjusting the brake

Check the brake for wear and clean it. The brake on 1,300 and 1,600 kg capacity trucks cannot be adjusted, and the brake pad must be replaced when it has worn. The air gap in the brake of the 2,000 kg capacity truck can be adjusted to compensate for the wear of the brake pad.

Open the main cover to perform these maintenance procedures. Turn the tiller arm so that you can access the brake. Remember to uphold a clean working environment when working with the brake so that you do not inadvertently introduce dirt into the brake mechanism.

3.7.4.1. 1,300 and 1,600 kg capacity trucks

Check the wear of the brake pad and clean the brake. Perform the following procedure to service the brake.

1. Open the three screws that fix the brake to the drive unit. Use a 7 mm wrench.

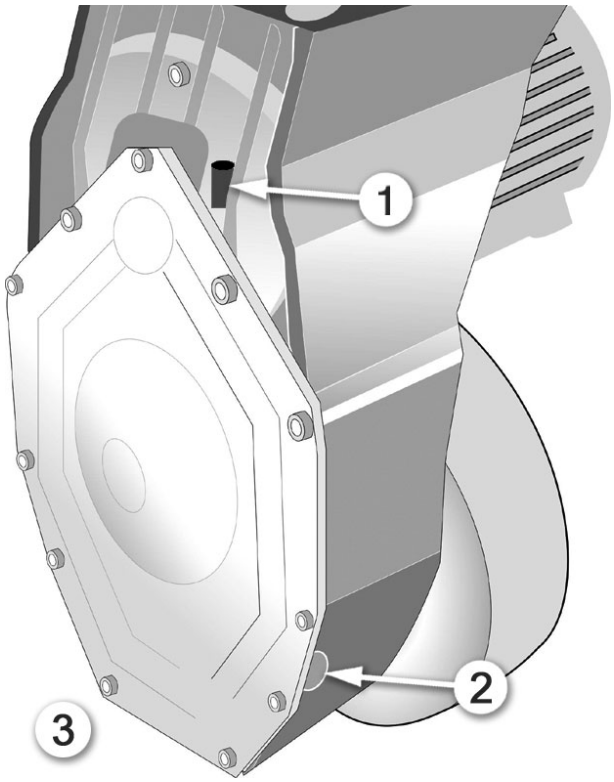


Figure 3.32. Location of filling (1), checking (2) and draining (3) orifices

The filling cap is opened with a 12 mm wrench, while the checking and draining hole caps require a 5 mm Allen key. Take precautions for handling transmission fluid and keep the servicing area clean.

To change the transmission fluid:

1. Lift the truck with a suitable jack or other safe method and secure it to a level position. Always secure the truck so that it is safe to work under.

NOTE Never work under a truck that is supported only by jacks.

2. After the truck has been lifted and levelled, place a suitable container under the transmission draining hole. There is approximately 0.6 litres of fluid in the transmission.

3. Open the draining hole cap using a 5 mm Allen key.

NOTE The operation of the traction speed encoder can be tested using the console. Refer to *Section 4.2 Console* for more information on using the console.

4.1.5. Braking

The truck is normally slowed down with the traction motor. When the truck is being driven in one direction, reducing the deflection of the accelerator control causes the system to reduce the speed reference to the traction motor, which actively reduces the speed. The operator can slow down the truck more rapidly by turning the accelerator in the opposite direction to the movement. This causes the traction controller to instruct the traction motor to reverse its movement and therefore to rapidly reduce its turning speed. If the accelerator is held in this position after the truck has stopped, it begins to move in the given direction at the requested speed.

In practice, when the accelerator is turned opposite to the direction of movement, the traction controller switches the order of the two of the three motor input phases (U, V and W). This action forces the traction motor to reverse its rotating direction. This will initially slow down the motor and then begin to turn it in the opposite direction.

NOTE Braking characteristics can be adjusted with the Reverse braking parameter. Refer to *Section 4.2 Console* and *Section 4.3.2 Parameters* for more information on setting truck parameters with the console.

When the movement of the truck is slowed down with the motor, the motor acts as a generator and produces electrical power. This power is used to recharge the truck’s battery. This is known as regenerative or inverse braking. In this situation, the motor produces AC voltage from each of its phases. This AC voltage is rectified to a direct positive and negative voltage. As long as the resultant DC voltage is higher than the battery voltage, the battery is charged.

The truck is equipped with an electrical brake, but this is normally not used to control the truck’s speed. The Stop mode tiller parameter controls the function of the electrical brake. In the default mode, the electrical brake is engaged only after the truck's movement has stopped. This reduces the wear on the electrical brake. The electrical brake can be used to slow down the truck, but this is not recommended.

4.3.2.2. Parameter 4: Operating hours (diagnostic)

This parameter displays the operating time of the connected controller. The time is displayed in hours and to an accuracy of three decimals.

4.3.2.3. Parameter 7: Serial number (diagnostic)

This parameter displays the serial number of the connected controller.

4.3.2.4. Parameter 10: Actual speed (diagnostic)

This parameter displays the actual current speed of the truck in km/h.

4.3.2.5. Parameter 11: Speed set value (diagnostic)

This parameter displays the speed reference value from the accelerator in km/h.

4.3.2.6. Parameter 17: Temp. controller (diagnostic)

This parameter displays the temperature measured from the traction controller heat sink. The temperature is displayed in degrees Celsius (°C) and to an accuracy of one degree.

4.3.2.7. Parameter 18: Battery level (diagnostic)

This parameter displays the level of the battery charge. The level is displayed as a value between 1 and 10, with 1 indicating a level of 10% and 10 indicating 100%.

4.3.2.8. Parameter 30: Throttle value (diagnostic)

This parameter displays the speed reference value from the accelerator. The value is displayed as a voltage between 0 and 5 V, and to an accuracy of one decimal. When the accelerator is in the neutral position, the value should be close to 0 V. When the accelerator is moved to either extreme, the value should increase linearly close to 5 V.

the battery voltage exceeds 150% of the nominal voltage. This fault should not occur, if the battery and the connections to the controller are intact (assuming that parameter 174 is correctly set). This error could also result from a damaged power stage in the controller.

Check that the connections between the battery and the controller are in good condition. Check the value of parameter 174, if possible. If the cause cannot be found, change the controller.

4.3.3.8. Error 6: Motor overtemperature

This fault has error code number 6. The status LED indicates this fault by repeating the following sequence: six pulses and a pause.

This error should not occur, as a motor temperature sensor is not used in this application.

4.3.3.9. Error 7: Controller overtemperature

This fault has error code number 7. The status LED indicates this fault by repeating the following sequence: seven pulses and a pause.

This error is triggered if the controller has overheated during operation. This may result from the controller being overloaded for a long period. This error can also result from a fault in the controller's temperature measurement function.

Check that the controller is mounted according to the instructions so that it is able to dissipate heat efficiently. Check the controller's output current. It should not exceed the unit's nominal current. If the fault persists, the controller needs to be replaced.

4.3.3.10. Error 8: Drive signal monitoring

This fault has error code number 8. The status LED indicates this fault by repeating the following sequence: eight pulses and a pause.

This error indicates a fault with the accelerator. The error can be due to an incorrect operating sequence. After the controller is powered up, the following conditions must be true:

- Drive signals (X6:2 and X6:3) must not be present.

assembly from its marked lifting points. Never lift the assembly from any other points. When preparing the assembly for lifting, insulate the battery cell contacts to protect against short circuits.

4.4.2. Fuses

The truck's fuses do not require regular checks. They need to be replaced only if they have blown. Never operate a truck with a blown fuse. Replace the fuse before continuing to use the truck. When fuses need to be changed, always replace them with identical components. Never use a fuse of another rating than that recommended by the manufacturer.

The standard truck has two main fuses and an auxiliary fuse in the controller. To access the fuses, open the truck’s main cover.

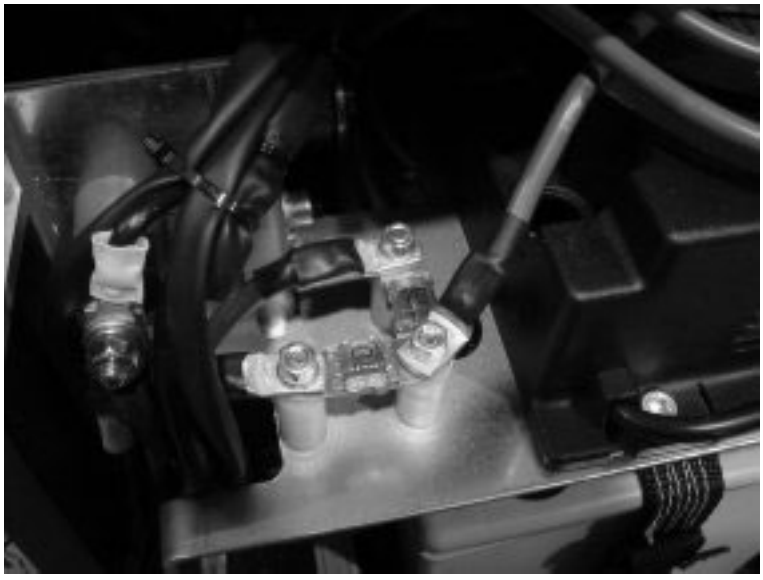


Figure 4.8. Example of the two main fuses

On the electrical schematic diagram, the main fuses are marked as 1F1 and 2F1 (zones 13 and 15 on page 1). Fuse 1F1 supplies the positive battery feed to the traction controller. It is rated at 70 A on the 1,300 and 1,600 kg capacity trucks, and 100 A on 2,000 kg capacity trucks. Fuse 2F1 supplies the positive battery feed to the K1 pump motor contactor. It is rated at 70 A on all truck models.

The auxiliary controller fuse is mounted in the controller, but can be accessed from the outside. The auxiliary fuse is marked as