EN

CAT Lift Trucks

Operation & Maintenance Manual

NSP10N
NSP12N
NSP12NI
NSP16N
NSP16NI

MCFE
Hefbrugweg 77,
1332 AM Almere,
The Netherlands

SWHSU - 00211

Printed in Finland

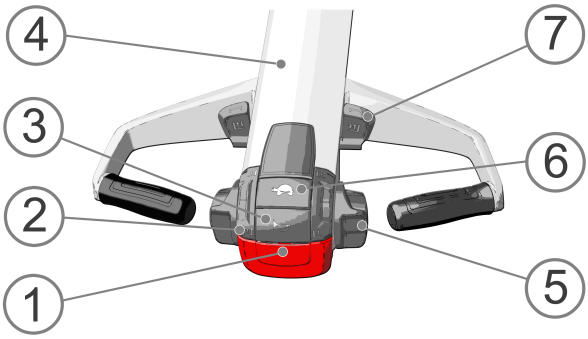
SWHSU - 00211

PIN code entry device (optional)

The PIN code entry device activates the truck. With the entry device you can also activate a **Driver Present** mode, which uses an internal timer. If there is no driver input for a predefined time, the truck will automatically be shut down.

For more information, see section "Using the PIN code entry device" in chapter 5, "Driving instructions".

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 also the speed control is 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 initial lifting and lowering (2)

- Standard for stackers with initial lifting and lowering

Push buttons for single speed lifting and lowering (2)

- Standard for stackers without initial lifting and lowering

3.2.4 X4, Connections for the motor (thermistor and encoder)

X4.1 **Supply voltage for the brake**
Fuse-protected key switch voltage.

X4.2, **Temperature sensor (motor), Not in use. Do not connect!**

X4.3 **Encoder signal A** (open collector or push-pull)

X4.4 **Encoder signal B** (open collector or push-pull)

X4.5 **Digital output for the brake**
Open-drain output; switching to 0V, freewheeling diode to X4.1

X4.6 **Temperature sensor (motor), Not in use. Do not connect!**

X4.7 **+15V Power supply for encoder**

X4.8 **0V connection for encoder**

The speed of the traction motor is when setup as "Speed Control" always be monitored and controlled. An incremental encoder suitable for 15V supply must be connected at the terminals mentioned above. The encoder must deliver two 90° phase shifted signals (A and B).

Phase sequence of encoder signals:
Phase sequence of encoder signals and phase sequence of motor currents have to fit together.
When the shaft of the motor turns right (right sequence U,V,W), the inverter expects signal A before signal B. Signal A before signal B is calculated as positive speed.

3.2.5 X5, tiller and status LED

X5.1,2 **Protected key switch voltage**
On these pins the fuse protected key-switch voltage is available for supply to other components in the system.

X5.3 **Digital input, tiller switch n.o**
In the upright position of the tiller this input has to be low, under working condition it has to be high.

X5.4 **Digital output 1**
Open-drain output; switching to 0V, freewheeling diode to X5.1 (key-switch input), see 'Technical data' for max current. The configuration of the digital output can be set by parameter #70.

X5.5 **Battery minus, internally connected**

X5.6 **Digital input, tiller switch n.c.**
If a tiller switch with complementary signals is used, then the second channel has to be connected here.
Parameter 223 has to be 1 to activate the supervision of the two inputs.
If only X5.3 is used, then parameter 223 has to be 0.

Parameters NPP13/16M	Parameters NPP20M	Format/ Scale	Unit	Factory Default	Description	Remark
Connector X1	Connector X1				Indicates the status of the inputs and outputs of the current connector. See description in manual	
	Connector X2				Indicates the status of the inputs and outputs of the current connector. See description in manual	
Connector X3	-				Indicates the status of the inputs and outputs of the current connector. See description in manual	
Connector X4	Connector X4				Indicates the status of the inputs and outputs of the current connector. See description in manual	
Connector X5	-				Indicates the status of the inputs and outputs of the current connector. See description in manual	
Connector X6	Connector X6				Indicates the status of the inputs and outputs of the current connector. See description in manual	
Stop mode tiller	-		1,2,3	2	Set a stop mode when tiller is activated: 1 = motor current off and brake voltage off 2 = deceleration ramp at first then brake voltage off 3 = deceleration ramp and brake voltage off	
warn.temp.invert	-		AD-units 0…1023	550	Warning level for the high temperature of the controller.	
Rev. speed belly	-	0,25	rpm	-1500	Set's a speed for the truck (backward direction) when belly is activated	1500rpm ~1,8km/h
Max. time belly	-	1.0	s	5.0	Timer setting for belly function. Truck will drive backwards up to "max .time belly" with a speed of "Rev.Speed belly". When time is elapsed, truck stops. If set to 0, truck will drive as long as belly is activated.	

- Green: truck activated.
- Red on for three seconds: wrong code.
- Red flashing slowly: wrong code entered three times.

Driving

- Tilt the tiller arm to the driving position (tiller arm in position 1, see the picture in "Stopping the truck").
- Turn the accelerator lightly in the driving direction.
- To brake, turn the accelerator in the opposite direction to the driving direction.
- Steer the truck smoothly because abrupt movements may cause a dangerous situation, especially when driving at high speed.

NOTE *Due to safety reasons, the truck may be adjusted to travel slower to the direction of the forks.*

General driving instructions

Practice steering and controlling the truck carefully in a safe area.

- Drive slowly at intersections and when turning.
- Handle the truck responsibly and always keep it under control.
- Avoid sudden starts and stops.
- Steer and brake smoothly.
- Decrease the speed if the floor is slippery, for example, because of humidity.
- Take great care when driving on a slanted surface.
- Do not drive over any loose objects on the floor.

When driving, keep the load lowered and, if possible, tilted backwards. Do not lift the load except when stacking. This does not apply to trucks designed to be driven with the load raised.

Be especially careful:

- When there are other people or objects in the working area.
- When the load reduces visibility.
- When driving in narrow aisles, make sure that there is enough space for the truck and the load.

Driving position

When driving a pedestrian truck in the direction of the forks, stand behind the truck and keep both your hands on the tiller arm. When driving in the opposite direction, walk beside the truck and keep one hand on the tiller arm.

Speed

Control the speed according to the situation. Take into consideration the load, visibility, and people in the working area and the working environment. Slow down at cross aisles and whenever the vision is obstructed. If the visibility is inadequate, use an assistant to help guide you.

Uncontrolled acceleration or braking, excessive speed at turning points, and fast and sudden turning may overturn the load and cause an accident. In all conditions, drive the truck at a speed that enables you to stop it safely.

Stopping the truck

Brake the truck smoothly by turning the accelerator against the direction of travel (tiller arm in position 1). You should anticipate a situation when you must brake and decrease the speed well ahead.

10. Transportation and storage

Transportation

Lifting the truck.

The truck can only be lifted from a marked position. Make sure that the capacity of the lifting device is sufficient.

NOTE *If the truck has more than one lifting position, all of the positions must be used during lifting the truck.*

Towing the truck. The truck can only be towed with its drive wheel raised from the floor.

Storage

If the truck is not used for a lengthy period of time, it should be stored in a cool (above 0°C) and dry place on an even surface. Before storage, complete the following:

- Charge the battery well, and recharge it every 2 or 3 months to prevent damage during storage. At the same time, check the fluid level and add more if necessary.
- Change the hydraulic oil if the machine is not used for more than a year.
- If the machine is not used for more than a week, support the truck in such a way that the load exerted on the drive wheel becomes lighter.

Returning the truck to operation. If the truck has been stored for several months, it must undergo maintenance as per 600 operational hours. Otherwise normal daily maintenance and inspection are sufficient.

- Reverse from the unloading location.
- Lower the forks so that they disengage.
- Reverse from the unloading location.

NOTE *Double stackers can be used for moving one or two pallets. Maximum capacity for moving only one pallet is 1600 kg. Maximum capacity for moving two pallets is 1000 kg on forks and 1000 kg on fork arms.*

WARNING! *Do not overload under any circumstances!*

WARNING! *Observe extreme caution when handling two pallets.*

WARNING! *Do not drive fast speed or long distances with a pallet on the raised forks.*

Stacking and unloading (stackers)

To stack:

- Drive towards the shelf or stacking level with the load lowered.
- Lower the side stabilizers (if available).
- Raise the load so that it is clearly above the stacking height or shelf level. Note the height of the upper horizontal beam of the shelf.
- Move forward until the forks and load are on top of the shelf.
- Lower the forks so that they disengage, and then reverse from the stacking location. Make sure that the forks are clear of both the stacking level and the pallet. Lower them to the driving position.
- Raise the side stabilizers (if available).

To unload:

- Drive towards the shelf or stacking level with the forks lowered.
- Lower the side stabilizers (if available).
- Raise the forks high enough so that they can freely go underneath the pallet when you drive forward.
- Move forward until the pallet is completely on top of the forks.
- Raise the load so that it is clearly above the stacking height or shelf level. Note the height of the upper horizontal beam of the shelf.
- Reverse from the stacking location so that the load can be freely lowered. Lower the forks.
- Raise the side stabilizers (if available).

NOTE *The maximum lifting height has been limited to 1800 mm when driving the truck on the platform with the side guards unfolded. To lift above the limit, fold the side guards to the rest position.*

Stacking and unloading (reach trucks)

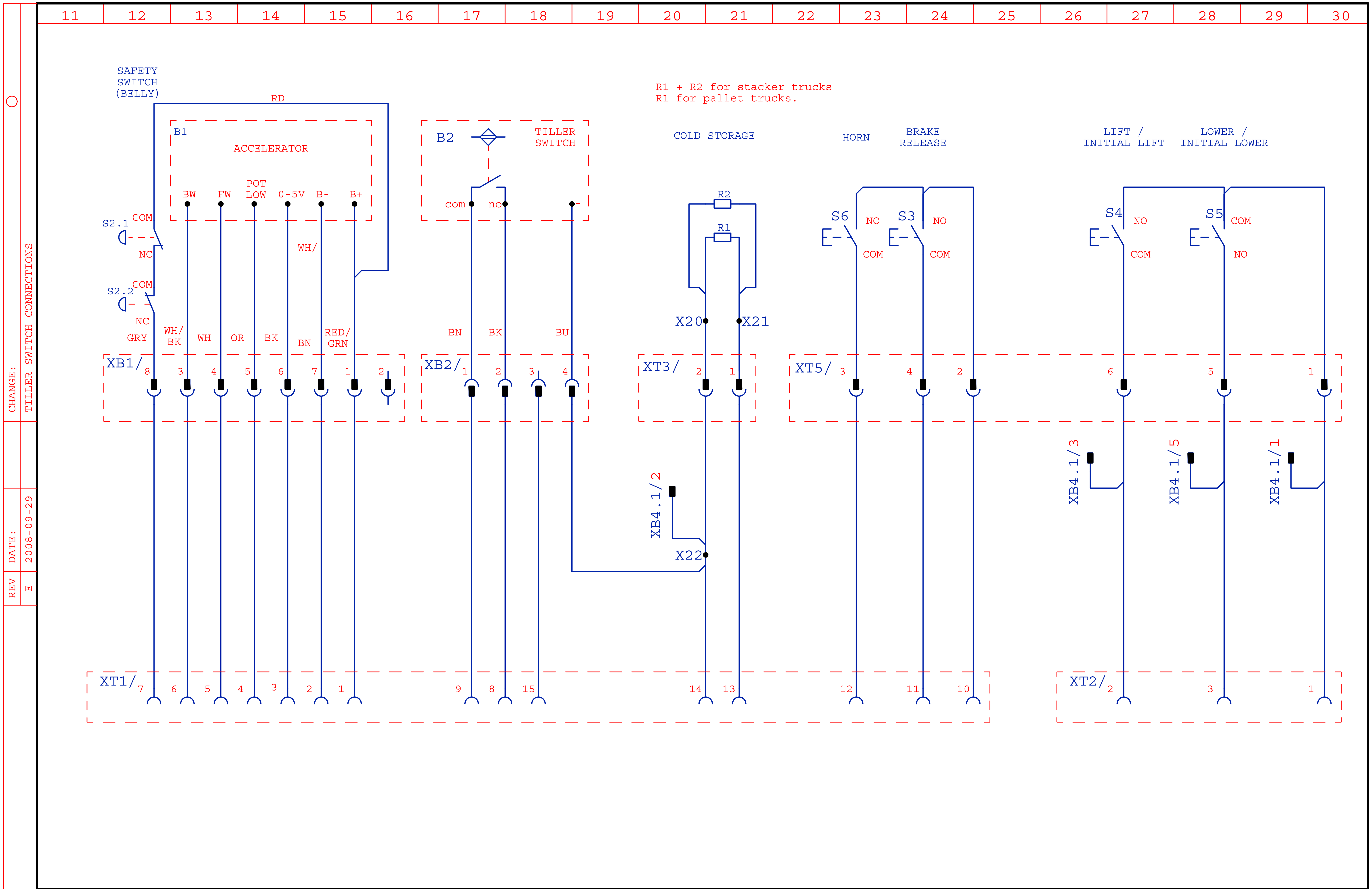
To stack:

- Drive towards the shelf or stacking level with the load lowered and the forks tilted upwards.
- Straighten the forks to a level position.
- Raise the load so that it is clearly above the stacking height or shelf level. Note the height of the upper horizontal beam of the shelf.
- Move the mast forward until the forks and load are on top of the shelf.
- Lower the forks so that they disengage, and then pull in the mast and reverse from the stacking location. Make sure that the forks are clear of both the stacking level and the pallet. Tilt the forks upwards and lower them to the driving position.

To unload:

- Drive towards the shelf or stacking level with the forks lowered and the forks tilted upwards.
- Straighten the forks to a level position.
- Raise the forks high enough so that they can freely go underneath the pallet when you drive forward.
- Move the mast forward until the pallet is completely on top of the forks.

Error code (number of pulses)	Error description
2	New Software version
	Runtime monitoring
4	Low Voltage Battery
	Runtime monitoring
5	Over Voltage Battery
	Runtime monitoring
6	parameters of set value curve lift/lower not realistic
7	parameters of set value curve option not realistic
8	switch or potentiometer active at Power-On
9	more than one functions chosen
	(more than one inputs at the same time switched on)
10	error in sequential program (internal error)
11	Digital output error
	Runtime monitoring
12	Hydraulic pots range
	Lift / Lower potentiometer exceeds its range
14	EEPROM Fault
	Runtime monitoring



CAT Lift Trucks

DATE: 2006-09-14

CIRCUIT DIAGRAM TS1150908

NEW TILLER
PALLET AND STACKER TRUCKS

1/2
REV E
3-6969

1. Introduction

This service manual provides information on maintaining and repairing the 1,000, 1,200 and 1,600 kg capacity models of the AC pedestrian stacker. The manual aims to provide information necessary for keeping the truck fully operational for its entire service life.

1.1. Purpose and target users

This service manual is intended as a reference source for the professionals responsible for maintaining these trucks. The maintenance and repair instructions in this manual are presented with the assumption that the reader is familiar with the operation and maintenance of powered trucks. Do not attempt any procedure described in this manual or elsewhere unless you have the authority, expertise and qualifications for the task. Always adhere to all local regulations that apply to the work being done.

The information in this manual covers the common procedures necessary for keeping a truck in working order. The manual does not cover nor does it attempt to cover every eventuality that may arise when servicing trucks. Every effort has been made to ensure that the information given in this manual is correct and current. The information can, however, be incorrect, outdated or otherwise not suitable to the truck model or task. Make sure that you have all the latest information regarding the truck model and the maintenance task. This includes, but is not limited to, the most up-to-date schematic diagrams and special procedure instructions. Contact your supplier or technical support for information on obtaining the latest documentation.

1.2. Structure

This manual is divided into five main chapters. *Chapter 2 Operating the truck* is based on the user's manual. The chapter is intended as a reference source for the maintenance professional to study the use of the truck model being serviced.

Chapter 3 Regular maintenance presents the regular maintenance procedures of the truck. This chapter also gives the general guidelines for safety and maintenance.

Figure 2.2. Tiller arm controls

2.3.2.1. Safety button (1)

The safety button is located at the far end of the tiller arm. Its purpose is to prevent the operator from being crushed between the truck and an object. The safety button is functional when the truck is being driven in the direction of the tiller arm. It is inactive in the other direction.

When the safety button is pressed while the truck is being driven in the direction of the forks, the truck immediately stops and reverses its movement for a short period. The intensity of this function depends on the speed of the truck.

WARNING! The operation of the safety button is verified as part of the daily maintenance checks, which must be performed each day before using the truck. Never use a truck with a faulty safety button. Never use the safety button to manoeuvre the truck.

2.3.2.2. Lifting and lowering controls (2, 6 & 7)

Use these controls to lift and lower the truck's fork carriage. The available controls depend on the truck model.

If only the lifting and lowering controls (2) on the front face of the tiller arm head are present, use them to lift and lower the fork carriage. Press up to lift the carriage and down to lower the

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.

If the truck is equipped with an hour meter, the meter shows the approximate level of battery charge when the truck's main power is switched on. After charging, this indicator should read full battery charge.

If the battery does not seem to charge properly, does not hold a charge or presents other problems, refer to the battery 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.

When cleaning the truck, take care not to let water or other fluids enter the main chassis or battery compartment. Never use a pressure washer to clean the truck. Use a dry and clean cloth when possible and use solvents only when necessary. If solvents are necessary, make sure that the chemicals will not harm the surface or component that is being cleaned.

3.6. Monthly maintenance

There is only one monthly maintenance procedure.

3.6.1. Lubricating the drive unit bearings

The bearings of the drive unit must be lubricated monthly. Open the main cover of the truck to gain access to the bearing. The bearing assembly to be lubricated sits above the drive motor and transmission assembly. The lubrication nipple should be used to lubricate the bearings.

Figure 3.10. Lubrication nipple location

Use a grease gun to press the lubricant into the bearing assembly. Refer to *Section 3.9 Lubricant and fluid recommendations* for lubricant recommendations. After lubrication, move the tiller arm from side to side to distribute the lubricant evenly in the bearing assembly.

accumulated dust from the brake. Follow work safety procedures when using pressurised air and always use a low pressure.

6. After the above steps, reattach the rubber gasket. Carefully position the gasket so that its skirt falls into the grooves on both sides to seal the enclosure.

3.7.6. Checking the fastening of the transmission and the drive unit

Check that the drive unit fixing bolts and the main transmission bolts are securely fastened.

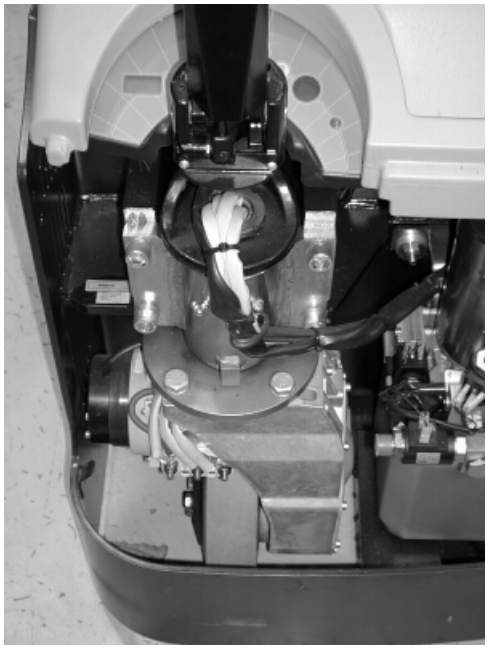


Figure 3.21. Drive unit and main transmission fixing bolts

3.7.7. Checking the amount of transmission fluid (1,600 kg capacity trucks only)

For this check, access the checking hole on the side of the transmission unit. If you need to lift the truck to perform the check, make sure that it remains level while performing this check. Remember cleanliness and follow fluid safety procedures.

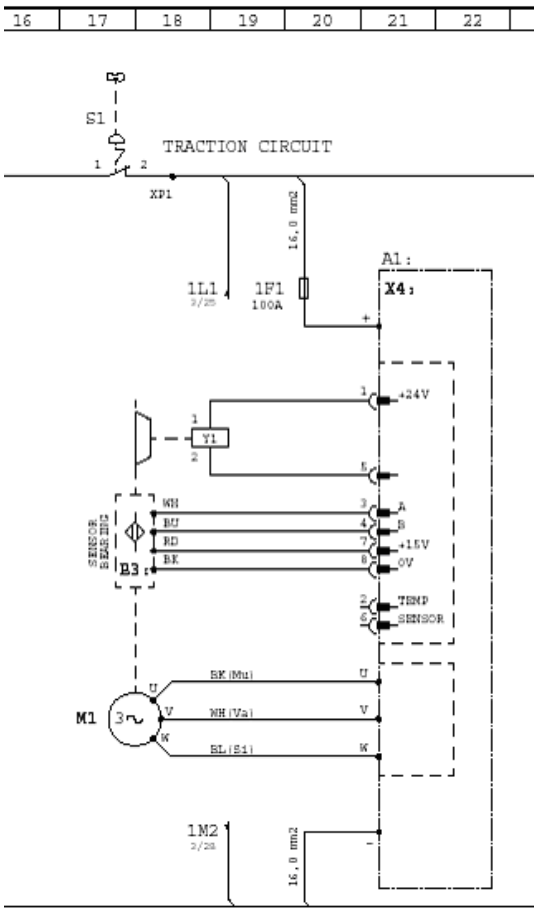
To check the fluid level, open the cap of the checking hole with a 5 mm Allen key. If the fluid level is clearly lower than the edge of the checking hole, you must add transmission fluid. For more

accelerator control. The voltage increases as the accelerator is moved to either extreme.

NOTE

If the accelerator needs to be replaced for any reason, the sensor values should be reread using the console. Refer to *Section 4.3.2.38 Parameter 251: Program throttle* for information on the Program throttle parameter.

When the voltage at pin 6 of connector X6 of the traction controller rises above 0.3 V, the controller first checks the directional inputs (pins 2 and 3 of connector X6) for a direction indication. The controller also checks for any internal errors. Before the controller engages the traction motor, it releases the 1Y1 electrical parking brake.



The brake is controlled through pins 1 and 5 of connector X4. The parking brake is active when it receives no power, that is, also when the truck is powered down. To release the brake, the traction controller applies 24 V to pin 1 of connector X4 for one second and then reduces the voltage to 60% to hold the brake open. Refer to zone 18 on page 1 of the electrical schematic diagram.

valve a predetermined amount by applying a voltage of approximately 5 to 6 V through pins 4 (positive) and 5 (negative) of connector X1 of the HCU. The control voltage depends on HCU parameter settings. Hydraulic fluid is routed at a constant pressure to the initial lifting cylinder.

When the operator requests initial lowering, switch S10 is closed, which sends the 24-volt signal to pin 10 of connector X3 of the HCU. The HCU opens the M3 locking valve by supplying the control voltage through pins 2 (positive) and 8 (negative). The HCU opens the M1 proportional valve a predetermined amount by applying a voltage of approximately 10 V through pins 4 (positive) and 5 (negative) of connector X1 of the HCU. The control voltage depends on HCU parameter settings. The hydraulic fluid from the initial lifting cylinder flows to the tank.

4.2. Console

The handheld console provides a user interface to the controllers used in trucks. The console can be used to verify the operation of the truck, read and modify controller parameter values, monitor the inputs and outputs of a controller, and display the error code when a fault has occurred. The console used in conjunction with these trucks is the BPK part number (RL)469054. Contact your supplier for information on obtaining a handheld console.

Figure 4.2. Handheld console, model BPK ((RL)469054)

4.3.2.13. Parameter 49: Connector X4 (diagnostic)

This parameter displays the active pins of connector X4. The possible displayed pins are 3, 4 and 5. Pin 3 is the channel A input signal from the motor encoder bearing and pin 4 is the channel B signal. Pin 5 is active when the electrical brake is released.

You can test the encoder by driving the truck very slowly to observe the signals from the two encoder channels. When you start driving, pin 5 should appear to indicate that the electrical brake has been released. Pin 5 should not be displayed when the truck is stationary, as the electrical brake should be engaged. The sequence of pins 3 and 4 depends on the direction of travel. They could, for example, indicate the following sequence: first pin 3, then both pin 3 and pin 4, then only pin 4, then neither, then pin 3 again, and so forth.

4.3.2.14. Parameter 50: Connector X5 (diagnostic)

This parameter displays the active pins of connector X5. The possible displayed pins are 3, 4 and 6. Pin 3 indicates that the tiller arm is in the driving position. Pin 4 indicates that the status LED is illuminated. Pin 6 indicates that the tiller arm is either in the upright or in the bottom position.

When the truck is powered on and no faults have occurred, the status LED should be constantly illuminated, that is, pin 4 should be constantly displayed. If a fault has occurred, both the status LED and pin 4 flash in a pulse sequence that indicates the fault type. In other words, the error code can be counted from the sequence.

Move the tiller arm between the upright and bottom positions to check that the tiller switch works correctly. When the tiller arm is in the upright or bottom position, pin 6 should be displayed and the truck should not respond to driving commands, unless the brake release button is pressed.

4.3.2.15. Parameter 51: Connector X6 (diagnostic)

This parameter displays the active pins of connector X6. The possible displayed pins are 2, 3, 4, 5 and 12 (C=12). Pin 2 indicates that the digital input for the forward driving direction is active. Pin 3 indicates that the digital input for the backward

4.3.3.12. Error 10: Safety switch monitoring

This fault has error code number 10. The status LED indicates this fault by repeating the following sequence: ten pulses and a pause.

This error indicates a fault with the safety switch. 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.
- Speed reduction must be active.
- The brake release switch (S3) must be open.
- The tiller switch (B2) must not indicate driving position.
- The safety switch (S2) must be closed (i.e. not depressed).
- The safety socket (S8) must be closed.
- The speed reference signal (X6:6) must be near 0 V.

Use the console to check that there is a signal at pin 4 of connector X6. Refer to *Section 4.3.2.15 Parameter 51: Connector X6 (diagnostic)*.

4.3.3.13. Error 11: Tiller switch monitoring after power-up

This fault has error code number 11. The status LED indicates this fault by repeating the following sequence: eleven pulses and a pause.

This error indicates a fault with the tiller switch. 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.
- Speed reduction must be active.
- The brake release switch (S3) must be open.
- The tiller switch (B2) must not indicate driving position.
- The safety switch (S2) must be closed (i.e. not depressed).

4.4.2.16. Parameter 40: Digital inputs (diagnostic)

This parameter displays the active digital inputs. The possible values:

- 1: Lift
- 2: Lower
- 4: Initial lift
- 8: Initial lower
- 16: 2nd lower
- 32: Option

4.4.2.17. Parameter 42: Check of the digital outputs (diagnostic)

This parameter checks the digital outputs. The possible values:

- 1: Relay
- 2: M3 initial
- 4: M4 lift
- 8: 2nd speed
- 32: M2 lower

4.4.2.18. Parameter 84: Min. current prop. valve 1

This parameter sets the minimum current of proportional valve 1. The value is given in mA and has a range from 0 to 2,000 mA. The default value is 0 mA.

4.4.2.19. Parameter 85: Max. current prop. valve 1

This parameter sets the maximum current of proportional valve 1. The value is given in mA and has a range from 0 to 2,000 mA. The default value is 500 mA.

NOTE The parameters of the replacement controller must be reprogrammed for the application.

4.5.4. Replacing the accelerator module in the tiller arm head

The accelerator module in the tiller arm head may require replacement during the truck's operating life. The tiller arm head assembly contains the main control devices needed by the operator to use the truck. Its main component is the accelerator. It also houses the lifting controls, the brake release button, the horn button and the safety button. Refer to *Chapter 2 Operating the truck* for more information on the truck's control devices.

WARNING! Disconnect the battery connector before beginning.

To replace the accelerator module:

1. Begin by locating the two fixing screws on the underside of the head assembly and the two screws on the topside of the assembly. Open the four screws using a 5 mm Allen key.

Figure 4.8. Main fixing screws at the back of the tiller arm head assembly

5.1.2. Hydraulic system of trucks with initial lift (1,200 kg capacity models)

NOTE Make sure that you have the appropriate maintenance instructions and the schematic diagram for the truck model under maintenance.

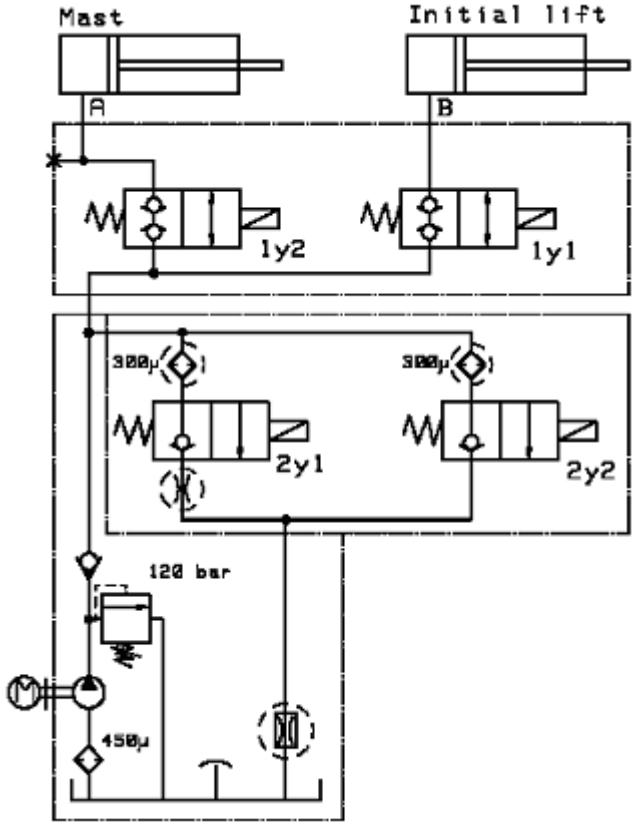


Figure 5.12. Hydraulic system, 1,200 kg capacity trucks with initial lift (TH70 0105)

Figure 5.13. Hydraulic fluid tank with a strainer and filling cap

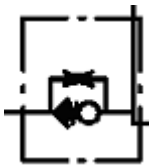


Figure 5.34. Velocity fuses in lift cylinders. The position of the components depends on the mast construction, and is not shown in the hydraulic schematic diagram.

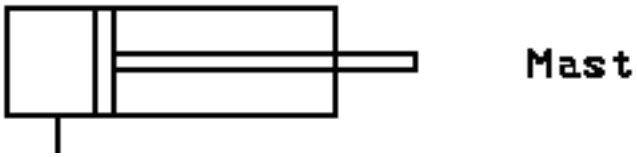


Figure 5.35. Mast. The actual mast may have more than one cylinder.

5.1.3.1. Mast lifting

The hydraulic schematic diagram in this section illustrates the operation of the hydraulic system in 1,600 kg (1,200 kg optional) capacity trucks without the initial lift.