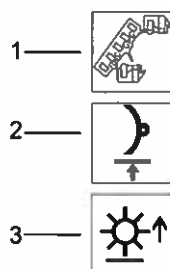


### 3.4.7 Plough Information

#### Position Information

The plough position icons show if the wings are folded and the plough weight distribution.



- |   |  |   |                            |
|---|--|---|----------------------------|
| 1 | Plough wings in transport position or not folded-out completely.<br>Yellow | 2 | Plough weight distribution |
| 3 |  | 3 | Brush lifted               |

*Figure 59: Icons for the plough and brush*

The plough is ready when the folded plough icon is gone.

If any part of the plough is not ready i.e not in full position the icon is yellow.

## Weight Distribution

The plough weight icon shows the plough weight distribution.

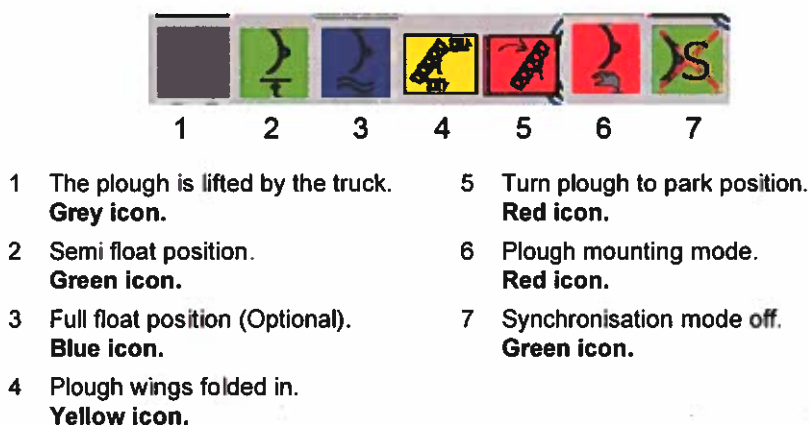


Figure 60: Plough weight distribution

- 1 The plough is lifted by the truck.

---

### NOTE!

The lifted icon does not show if the plough is in top position.

- 2 Semi float position. This is the normal working situation. The truck carries some of the plough's weight. This gives a lighter pressure on the plough to the ground.
- 3 Full float position (Optional). The plough rests to the ground by its own weight.
- 4 Plough mounting mode. The plough lift cylinder can lift and hold the plough parallelogram in the air. This is used when mounting or dismounting the plough to the truck's plough attachment plate.

### 3.4.8 Error Messages

If there is a malfunction and the control system detects it there will be an error message.



Figure 61: Example of an error message

### Runway Sweeper

Error code	English - Cause
Warning01	Alternator not charging!
Warning02	Hydraulic oil temperatur high
Warning03	Blower Pump Pressure Filter blocked!
Warning04	Brush Pump Pressure Filter blocked!
Warning05	LS- Pump work hydr. Pressure Filter blocked!
Warning06	Hydraulik Filter returnline blocked!
Warning07	Hydraulic oil level low!
Warning08	Brush adjusting at maximal diameter
Warning09	Brush adjusting at minimal diameter
Warning10	Low Level Fuel
Warning11	Check your brush Diameter Soon time for a brush change!
Warning12	Warning12
Warning13	Warning13
Warning14	Warning14

Warning15	Warning15
Warning16	Warning16
Error17	Power Supply out of range!
Error18	Sensor Supply out of Range!
Error19	Error CAN- Communication Controller/ IO- module!
Error20	Error CAN- Communication Engine!
Error21	Error CAN- Communication Controller/ IO- module Front Blast!
Error22	Error CAN- Communication Controller/ Display!
Error23	Error CAN- Communication Controller/ Brush angle sensor!
Error24	Error CAN- Communication Controller/ Brush adjusting Sensor!
Error25	Input out of range Pressure filter blower!
Error26	Input out of range Pressure filter brush!
Error27	Input out of range Pressure sensor Brush A!
Error28	Input out of range Pressure sensor Brush B!
Error29	Input out of range Pressure sensor Work funct.!
Error30	Input out of range Fuel level sensor!
Error31	Input out of range Hydr. oil temperatur sensor!
Error32	Input out of range Vehicle speed sensor!
Error33	Brush adjusting out of Range! Proceed the automatic brush calibration.
Error34	Input out of range Pressure sensor Blower!
Error35	Brush Adjusting Sensor not responding! Switch to Manuel Brush Speed
Error36	Blower pump Charge pressure missing!
Error37	Brush pump Charge pressure missing!
Error38	Hydr. oil level very low!
Error39	Hydraulic oil temperatur very high!
Error40	Front Blast Nozzle left



	End position not reached!
Error41	Front Blast Nozzle right End position not reached!
Error42	Front Blast System Up/Down End position not reached!
Error43	Front Blast Transport End position not reached!
Error44	Input out of range Runway Temperatur Sensor!
Error45	No MSG Io Module Dust Box!
Error46	Error46
Error47	Error output Brush adjusting!
Error48	Error output Brush transport!
Error49	Error output Brush turn!
Error50	Error output Supply PVEA!
Error51	Error output Blower lifting!
Error52	Error output Brush lifting!
Error53	Error output Nozzle left!
Error54	Error output Nozzle right!
Error55	Error output vibrator!
Error56	Error output Front Blast On/Off!
Error57	Error output Front Nozzle left!
Error58	Error output Front Nozzle right!
Error59	Error output Blower pump control!
Error60	Error output Brush pump control!
Error61	Error output Front Nozzle right!
Error62	Error62
Error63	Error63
Error64	Error64
Error65	Error CAN- Communication

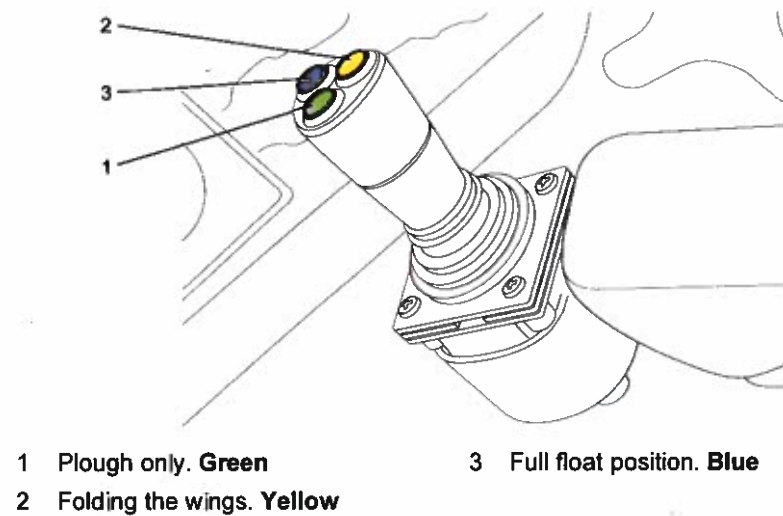
	Plow control/ Joystick!
Error66	Error CAN- Communication Plow control/ Display!
Error67	Error CAN- Communication Plow control/ IO-Module!
Error68	Error68
Error69	Error69
Error70	Error70
Error71	Plow control: Input out of range Pressure Sensor!
Error72	Plow control: Hydraulic oil level low!
Error73	Plow control: Error Output Poppet valve lifting!
Error74	Plow control: Error Output Tank relive valve!
Error75	Plow control: Error Output Supply lifting valve!
Error76	Plow control: Error Output Signal lifting valve!
Error77	Plow control: Error Output Turning valve!
Error78	Plow control: Error Output Wing valve!
Error79	Error79
Error80	Error80
Error81	Error CAN- Communication Display/ Joystick!
Error82	Error CAN- Communication Display/ Plow control!
Error83	Error CAN- Communication Display/ Output Modul OX012 External Plow Control
Error84	Fire alert system activated due to high temperature in engine compartment! Check Carefully for Cause of error!
Error85	Error85
Error86	Error86
Error87	Error87
Error88	Plow control Error Output Plow Up!
Error89	Plow control Error Output Plow Down!
Error90	Plow control

	Error Output Plow Turn Left!
Error91	Plow control Error Output Plow Turn Right!
Error92	Plow control Error Output Wings In!
Error93	Plow control Error Output Wings Out!
Error94	Plow control Error Output Poppet Valve
Error95	Plow control Error Output Bypass Valve
Error96	Plow Control Weight Relief Faulty Proportional Valve!
Error97	Plow Control Oil Level Low!
Error98	Plow Control Oil Temperature Sensor Failure!
Error99	Plow Control Oil Temperature Temp High!
Error100	Plow Control Emergency Stop Active!
Error101	Plow control Error Output Flow Control Valve
Error 102	Plow Control Weight Relief Faulty Pressure Sensor!

### 3.5 Joystick

The joystick is used to manoeuvre the sweeper and the plough simultaneously.

The joystick have three switches on the top.



*Figure 62: Joystick switches*

The plough only switch (1) is used when manoeuvring the plough independent from the sweeper.

The folding wings switch (2) is used when folding out or folding in the wings.

The full float switch (3) is used to engage and disengage the plough's full float position (Optional).



Press and hold one of the joystick buttons to view an illustration of the joystick functions in the display.



- 1 Moving all parts (no buttons). **Grey**
- 2 Move plough only (Synchronisation OFF). **Green** button
- 3 Move (fold) wings only. **Yellow**

Figure 63: Joystick-functions shown in display, standard



- 1 Moving all parts (no buttons). **Grey**
- 2 Move plough only (Synchronisation OFF). **Green** button
- 3 Shock absorbing wings out. **Blue** button
- 4 Cylinder lock EP-lift in/out. **Yellow** button

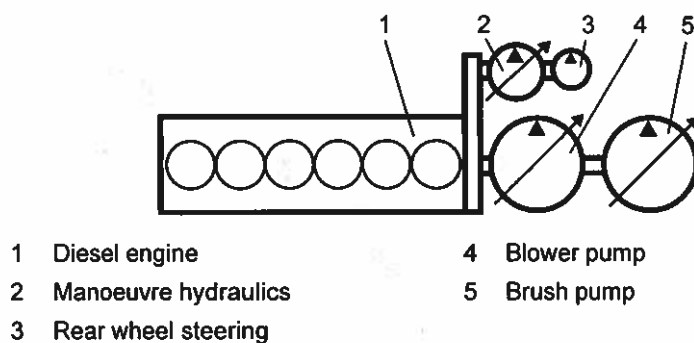
Figure 64: Joystick-functions shown in display, EP-lift and shock absorbing wings (Optional)

### 3.6 Hydraulic System

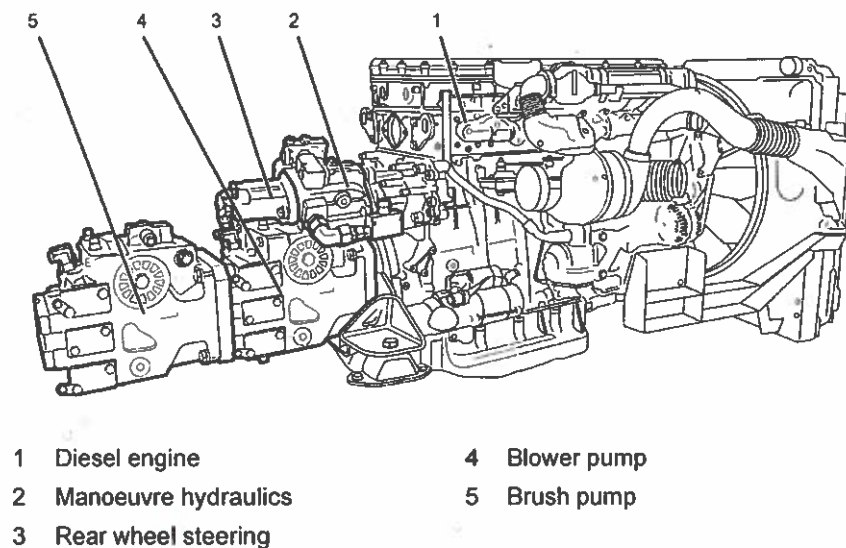
The sweeper's hydraulic system have three sub-systems:

- Manoeuvre hydraulic system.
- Hydrostatic system.
- Rear wheel steering system (optional equipment).

The sweeper has four hydraulic pumps mounted on the diesel engine.



*Figure 65: Hydraulic pumps, principle*



*Figure 66: Hydraulic pumps mounted on engine*

### 3.6.1 Manoeuvre Hydraulic System

#### General

The main components in the manoeuvre hydraulic system are a hydraulic pump, pressure filter, directional valves, hydraulic cylinders and an electrical driven emergency/service pump.

The pump receives fluid directly from the tank through the inlet line. A screen in the inlet line protects the pump from large contaminants. The pump outlet feeds the directional control valves PVG-32

The PVG valve directs and controls pump flow to cylinders and motors. A filter cleans the fluid before it runs to the directional control valves. Flow in the circuit determines the speed of the actuators. The position of the PVG valve spool determines the flow demand. A hydraulic pressure signal (LS signal) communicates demand to the pump control.

The pump control monitors the pressure differential between pump outlet and the LS signal, and regulates servo pressure to control the swashplate angle. Swashplate angle determines pump flow. Actuator load determines system pressure. The pump control monitors system pressure and will decrease the swashplate angle to reduce flow if system pressure reaches the pump control setting.

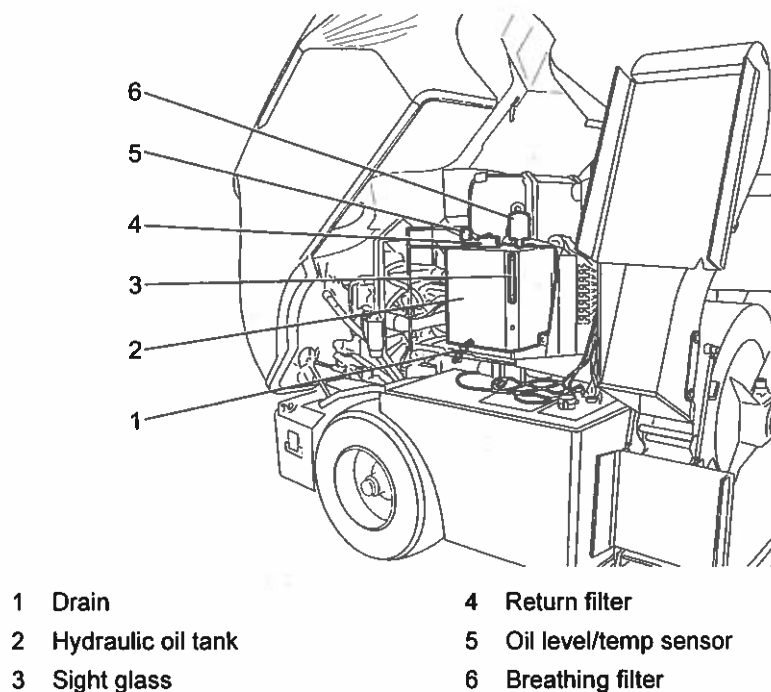
A secondary system relief valve in the PVG valve acts as a back-up to control system pressure.

The following functions on the sweeper are operated by using hydraulics:

- brush, lift/lower
- brush, right/left
- brush, in/out of transport position
- blower housing, lift/lower
- blow nozzle, right side, lift/lower
- blow nozzle, left side, lift/lower
- engine hood, lift/lower
- motor for proportional brush adjustment.
- front air system (optional equipment)

### Hydraulic Oil Tank

The hydraulic oil tank is located on the right-hand side of the sweeper, under the engine cover. The hydraulic oil tank is shared between the manoeuvre hydraulic system, the service pump, the hydrostatic system and the rear wheel steering.



*Figure 67: Hydraulic oil tank*

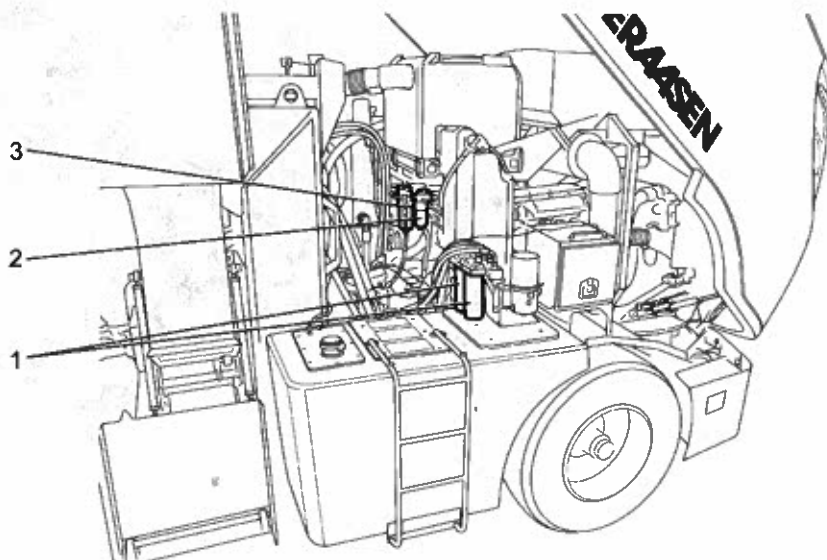
On the side of the tank there is a quick connection for draining hydraulic oil. The sight glass is located on the front of the tank. The oil level, can be checked through the sight glass. There is a level and temperature sensor in top of the tank.

On top of the hydraulic oil tank there is a breathing filter for ventilating the tank.

Inside the tank there are three suction filters that prevent larger particles to enter the pumps.

### Pressure Filter

The pressure filters is located on the left-hand side. On the pressure filters for rear wheel steering and manoeuvre hydraulics there is a filter indicator. That indicates when the filter is clogged up and has to be replaced.

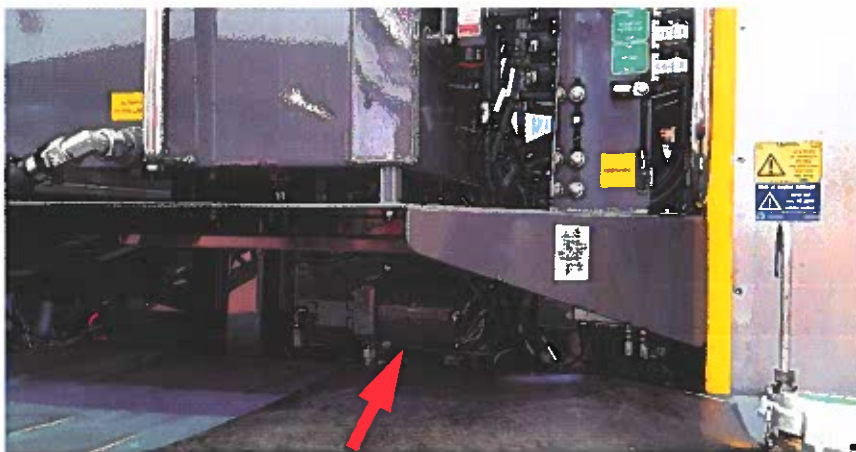


- |  |  |
|--|--|
| 1 Feed pressure filters for brush and blower pumps   | 3 Pressure filter for manoeuvre hydraulics |
| 2 Pressure filter for rear wheel steering hydraulics |  |

*Figure 68: Pressure filters*

### Emergency / Service Pump

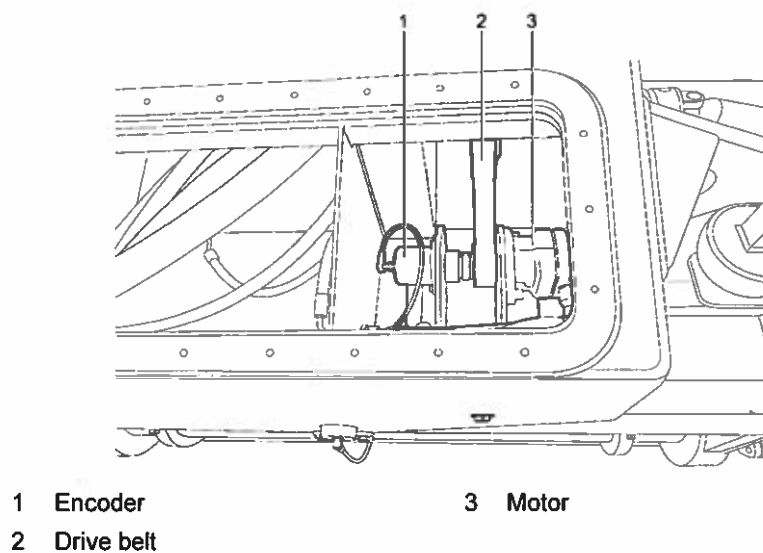
If necessary, the manoeuvre hydraulic system can be powered by an electrical emergency/service pump without starting the diesel engine. Start the pump with the switch below the directional valves.



*Figure 69: Electrical emergency/service pump*

### Brush adjustment motor

The hydraulic motor is fitted inside the brush yoke under a hatch. The motor turns the proportional brush adjustment's shafts. The encoder send information to the control system.



*Figure 70: Brush adjustment drive*

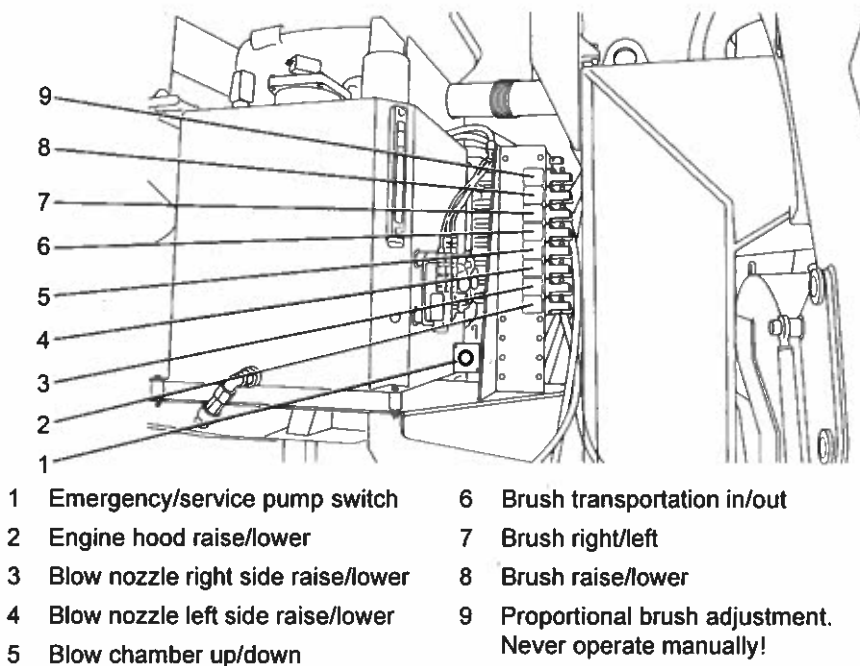
## Directional Valves

### **WARNING!**

**Never operate the proportional valve for brush adjustment manually. Risk of personal injury and damage.**

The manoeuvre hydraulic system's directional valves are grouped on the right side.

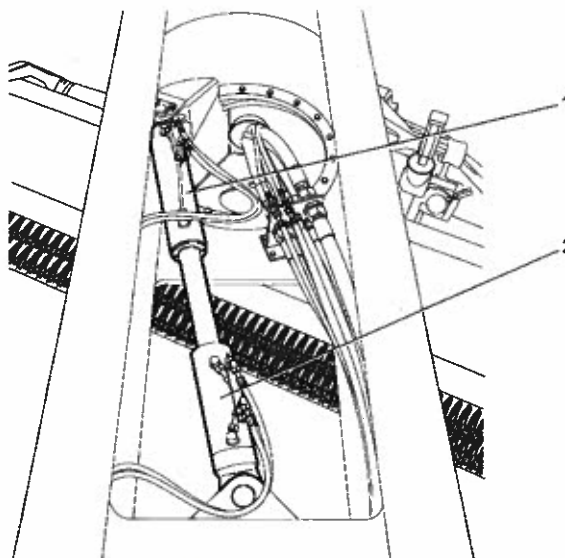
The directional valves are operated electrically by the sweeper's control system, but can also be operated manually with a lever. To use the valve manually, move the lever at the same time and press the emergency/service pump switch.



*Figure 71: Directional valves*

## Cylinders

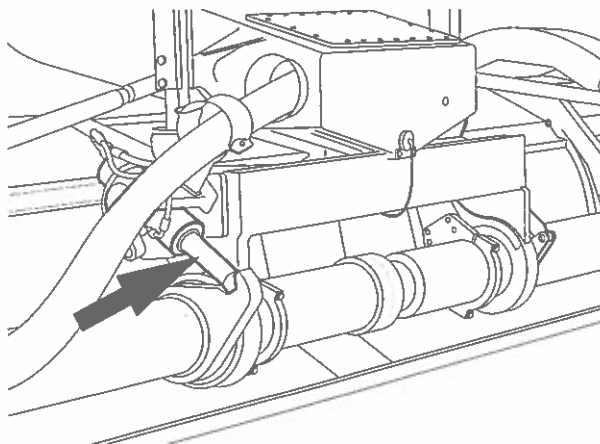
Every cylinder has an over centre valve to control the motion. Therefore, it must be pressure in the system to make a cylinder to move.



1 Cylinder for right/left position      2 Parking cylinder

*Figure 72: Hydraulic cylinder for turning the brush*

The brush's lifting cylinder have a pilot operated check valve that needs pressure to be released and lower the brush.



*Figure 73: Hydraulic cylinder for lift and lower the brush*



### 3.6.2 Hydrostatic System

#### General

The main components in the hydrostatic system are a hydraulic oil cooler, a hydraulic pump, suction and pressure filters, hydraulic motors, adjustable flow valves and measurement outputs.

Hydraulic oil tank and breathing filter are shared with the manoeuvre hydraulic system.

The hydrostatic system can be divided into two main systems, one that drives the brush and one that drives the blower.

#### Hydrostatic Hydraulic Pumps

The hydraulic pumps are axial piston pumps with an integrated feed pump, and is powered by the diesel engine.

With the aid of an electric valve the axial piston pump has a variable delivery volume, which is achieved by means of a servo system in the pump which can vary the stroke of the pistons.

The valves for regulating the delivery volume are integrated in the pump.

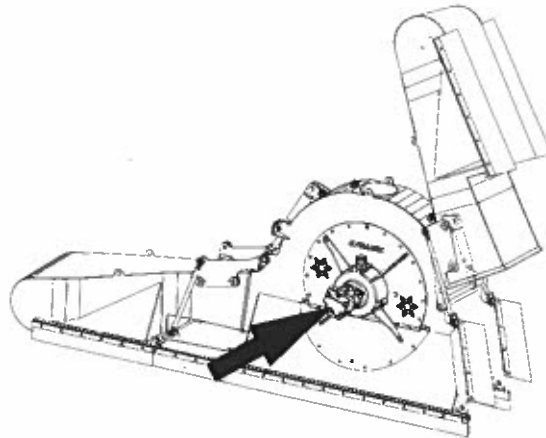
#### Feed Pressure Filter

The hydraulic pumps for the blower and the brush are fed through pressure filters. At each pressure filter there is a pressure sender that reads the feed pressure.

If the pressure drops below a certain level, for example if the filter is clogged an error code will be set and shown in the display.

### **Blower Hydrostatic Motor**

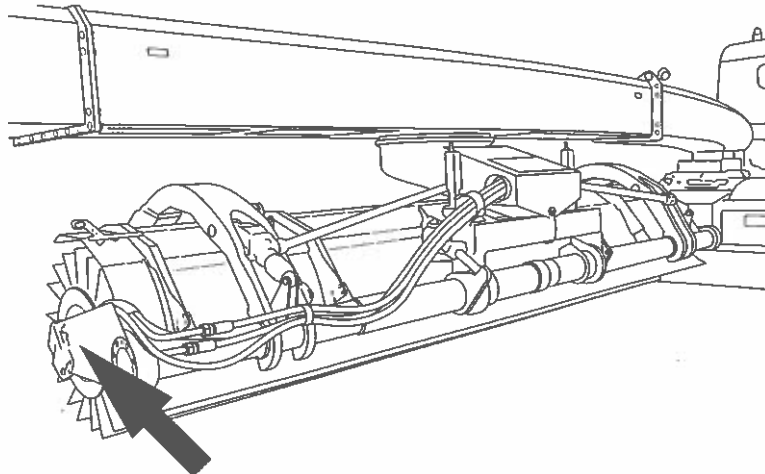
The blower's hydrostatic motor is located in front of the blower housing.  
The speed is determined by the blower pump.



*Figure 74: Blower hydrostatic motor*

### **Brush Hydrostatic Motor**

The brush hydrostatic motor is located inside the right end of the brush.  
The speed is determined by the brush pump.



*Figure 75: Brush hydrostatic motor (hidden)*

### Loop Flush Valve

To control the temperature and clean the oil in a hydrostatic circuit it is necessary to flush the system. This is done with loop flush valves in each hydrostatic circuit.

The feed pressure pump delivers oil via the feed pressure filter to the pump control valves and the hydrostatic low pressure (return flow) side.

The loop flush valve is integrated on the blower motor and mounted externally in the brush hydraulic circuit. The loop flush valve limits the low pressure and circulate the oil through the motor housing.

### Oil Cooler and Thermostat

Leak and flush oil from the pump and motor housings are collected in a manifold and led to a thermostat. The thermostat closes when the oil is warm and leads the oil through the oil cooler and return filter to the tank.

### Return Filter

The return filter cleans the leak and flush oil coming from the blower and brush hydraulic circuits. When the filter starts to be clogged the pressure drop increase and at a certain level the pressure switch sets off an alarm. The bypass valve opens and let unfiltered oil to the tank if the pressure drop over the filter is too high.

## 3.6.3 Rear Wheel Steering Hydraulics

The rear wheel steering pump supplies the steering manifold inside the rear wheel steering control unit called VSE ETS LOCKER.

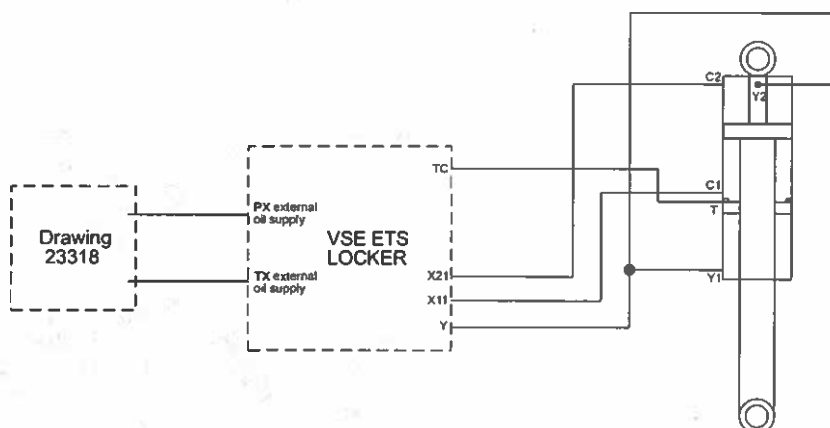


Figure 76: Rear wheel steering hydraulics

The control unit then actuate the steering cylinder mounted in front of the rear axle.

### 3.6.4 Plough Hydraulics

The plough hydraulics sit behind the driver's cab and are protected by a cover. The cover may be easily removed in connection with maintenance.

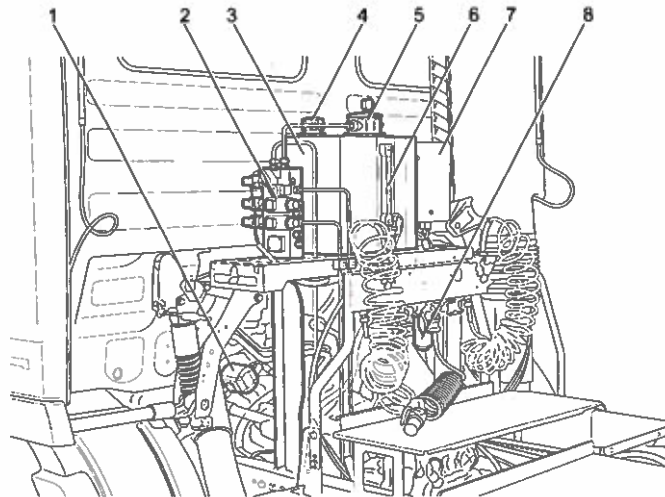


Figure 77: Plough hydraulics, example (Mercedes)

- |                                 |                   |
|---------------------------------|-------------------|
| 1 Hydraulic pump                | 5 Return filter   |
| 2 Valve block                   | 6 Level glass     |
| 3 Hydraulic tank                | 7 Electrics box   |
| 4 Filling up with hydraulic oil | 8 Pressure filter |

The plough fitting and hydraulic connections are in front of the tractor unit, and the connection plate are marked for the hydraulic connections

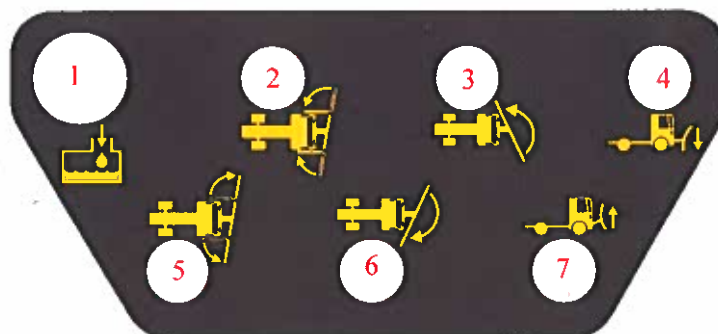


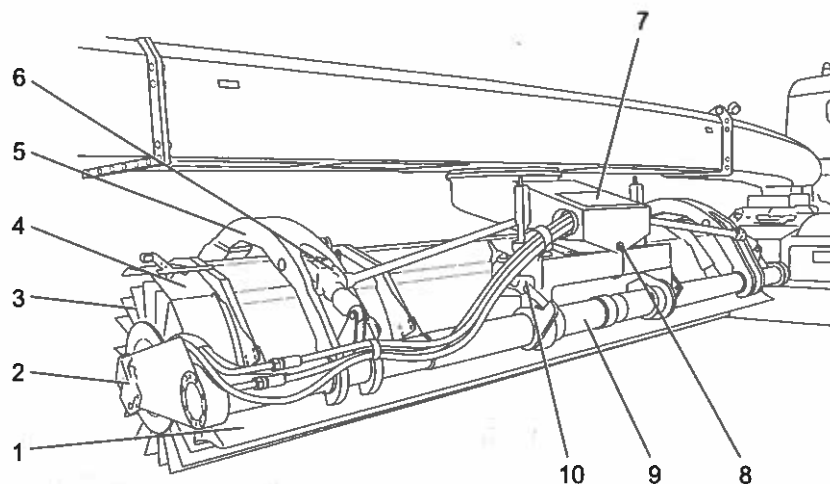
Figure 78: Plough hydraulic connection plate symbols

- |                        |                    |
|------------------------|--------------------|
| 1 Hydraulic oil return | 5 Plough wings out |
| 2 Plough wings in      | 6 Plough right     |
| 3 Plough left          | 7 Plough up        |
| 4 Plough down          |                    |

### 3.7 Brush

#### 3.7.1 General

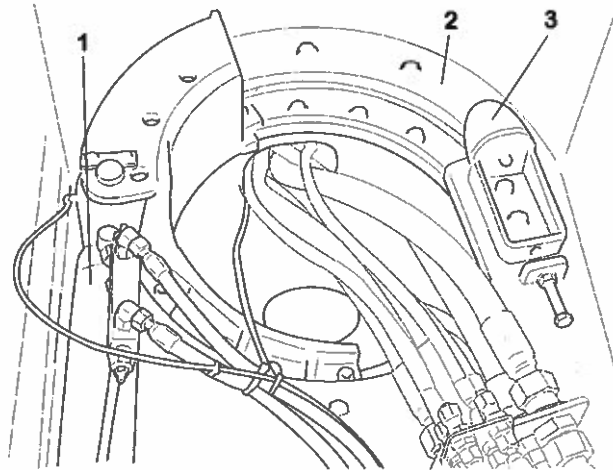
The brush principally comprises a brush with a hydraulic motor, support wheel, deflector and a deflector cover. The deflector cover follows the wear of the brush.



- |                     |   |
|---------------------|---|
| 1 Deflector cover   | 6 Brush adjustment jack                         |
| 2 Hydraulic motor   | 7 Hydraulic motor for brush adjustment (hidden) |
| 3 Brush             | 8 Pendulum bolt                                 |
| 4 Deflector         | 9 Brush bearing axle                            |
| 5 Support wheel arm | 10 Brush lifting cylinder                       |

*Figure 79: Brush*

The brush is mounted in a ball bearing-type turntable. The turning cylinder consists of two cylinders connected in series. The first cylinder takes the brush between right and left working position. The second cylinder takes the brush in and out from parking position.



1 Turning cylinder

2 Turn table

*Figure 80: The brush's slewing system*

The brush shaft is located directly below the turning centre. The brush experiences no sideways movement when turning, and the brush width is symmetrical in relation to the frame. The working angle is  $32^\circ$  in both directions. In parking position the brush is parallel with the frame.

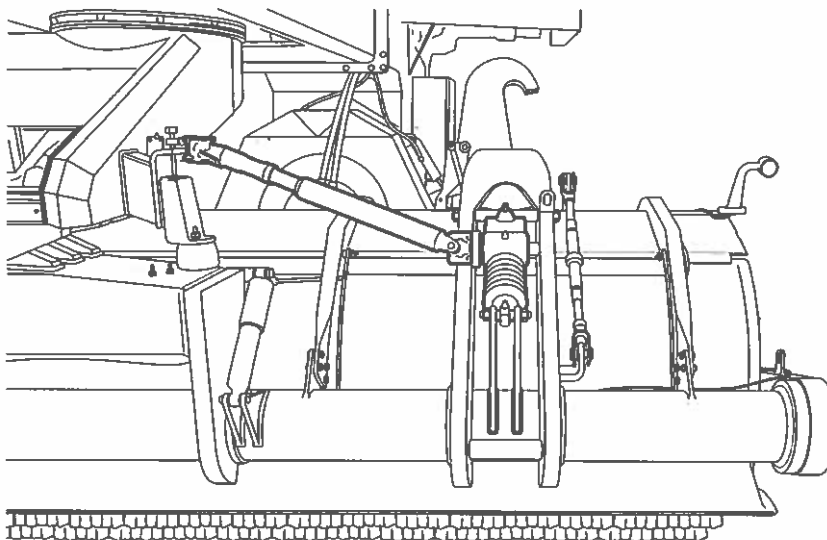
When the brush is lowered to working position it is floating on the runway by the support wheels. The lifting cylinder is fully retracted and any bumps or unevenness are absorbed by a shock absorber.

The support wheels are inflated with air and are fitted with roller bearings.

The brush shaft is made of aluminium with profiles for cassette brushes.

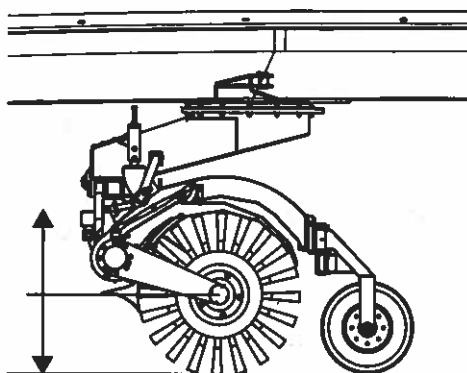
### 3.7.2 Screw Jack for Proportional Brush Adjustment

The two screw jacks are operated via the shafts.



*Figure 81: Screw jack for proportional brush adjustment*

The screw jack holds the brush bearing arm in position when the brush is lowered in to working position. Then the brush rests on the support wheels.



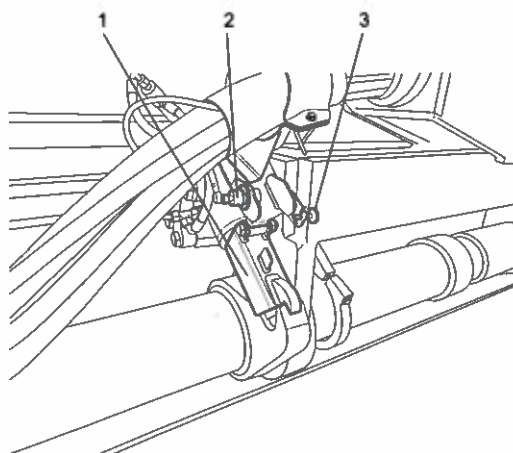
*Figure 82: Brush height*

The brush axle is raised or lowered when the proportional brush adjustment operates.

### 3.7.3 Brush Parking Lock

(Optional Equipment)

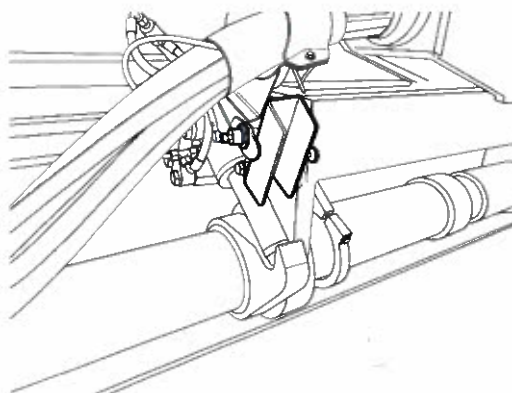
The parking lock is a mechanical device to hold the brush in raised position. The parking lock is manual operated.



- 1 Parking lock
- 2 Position sensor
- 3 Catch

*Figure 83: Parking lock engaged*

The position sensor senses if the lock is disengaged and in upraised position.



*Figure 84: Parking lock disengaged*



When the parking lock is in disengaged position it shall be secured with the spring tensioned catch. The brush icon in the display gets crossed-over when the parking lock is not fully disengaged.

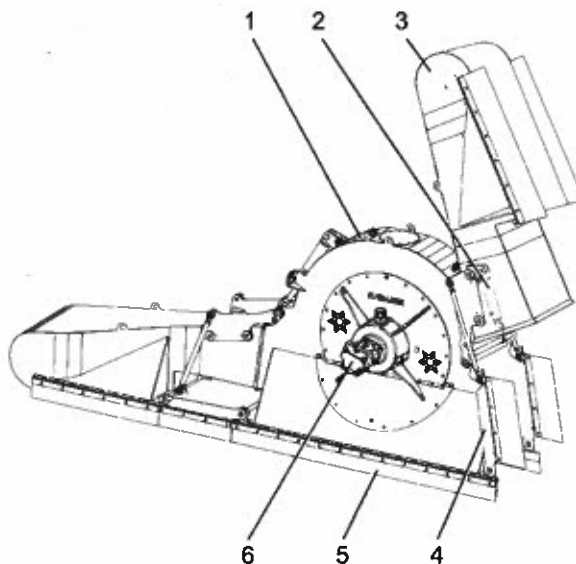


*Figure 85: Crossed-over brush icon*

### 3.8 Blower Housing

The blower housing hold the fan and the nozzles and air tunnels.

When the blower is in transport position the blower housing is lifted and both nozzles are folded.



- |                                  |                                    |
|----------------------------------|------------------------------------|
| 1 Blower housing                 | 4 Air tunnel and flap              |
| 2 Hydraulic cylinder, air nozzle | 5 Blower tunnel with rubber skirts |
| 3 Air nozzle                     | 6 Hydraulic blower motor           |

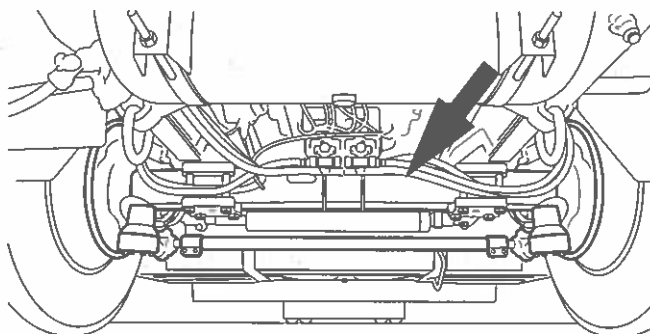
*Figure 86: Blower housing, left working position*

When the blower is activated, the blower housing is lowered and the blower starts. When the sweeper is in left working position, the right-hand air nozzle is lowered and the left-hand air nozzle is lifted. The left air tunnel is lifted and acts as a flap over the left side blower housing opening.

The air blows through the right-hand air nozzle, through the blower tunnel and out on the left-hand side.

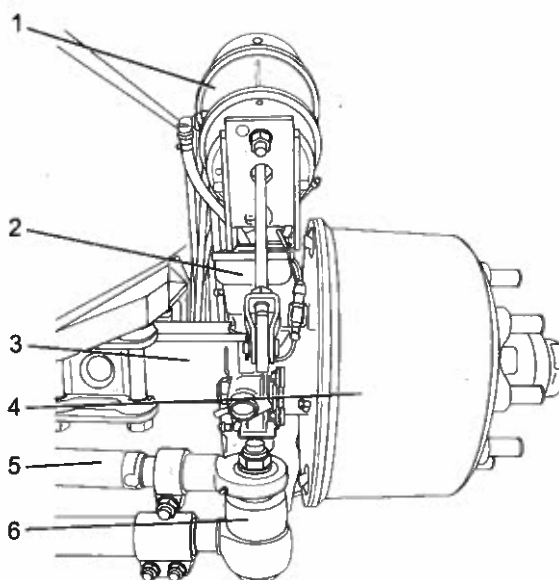
### 3.9 Rear Axle

The rear axle is attached directly to the frame.



*Figure 87: Rear axle*

The steering cylinder operate the left steering arm. The parallel track rod is fitted to left and right steering arm. The drum brake is operated by the brake cylinder.



- |                    |                     |
|--------------------|---------------------|
| 1 Brake cylinder   | 4 Drum brake        |
| 2 Steering knuckle | 5 Steering cylinder |
| 3 Rear axle        | 6 Steering arm      |

*Figure 88: Rear axle components*

### 3.10 Rear Wheel Steering

**— WARNING! —**

The rear wheel steering is powered by hydraulics.

The Runway Sweeper's engine must always be running when driving the truck. That is to ensure that the rear wheel steering is active.

**— WARNING! —**

The wheels may move during calibration and operation of the rear wheel steering system. Make sure the immediate vicinity of the vehicle is clear of people and objects and that the wheels on the steered axle can move freely.

**— WARNING! —**

The hydraulic system of the rear wheel steering system is pressurized after commissioning: the centring (or Y-) circuit is always under pressure, the steering (or X-) circuit only during steering.

De-pressurize the hydraulic system of the rear wheel system before carrying out any work on the system. To do so, follow the instructions in the manual for diagnostic display

**— NOTE! —**

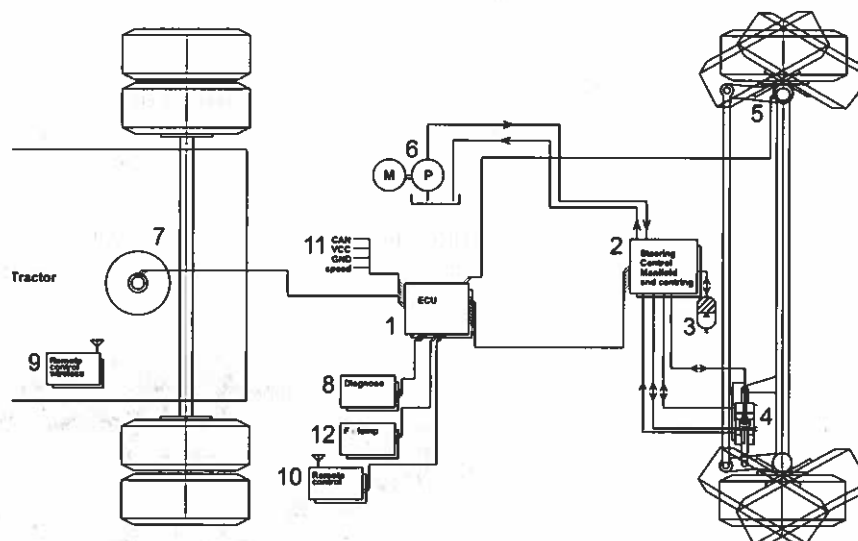
The rear wheel steering system contains electronic components. Ensure that all electrical connections are disconnected before performing any welding on the vehicle.

**— NOTE! —**

Always start the truck's engine before starting the sweeper engine. When starting to drive, make a small turn to allow the angle sensor to pass the center flag.

### 3.10.1 Technical Description

The rear wheel steering system consists of the following main components:



- |                                  |                            |
|----------------------------------|----------------------------|
| 1 Electronic control unit, ECU   | 7 Kingpin sensor           |
| 2 Steering control manifold      | 8 Diagnose display         |
| 3 Accumulator                    | 9 Wireless remote control  |
| 4 Steering cylinder              | 10 Remote control receiver |
| 5 Rear angle sensor              | 11 Input signals           |
| 6 Hydraulic pump (engine driven) | 12 Function lamp           |

Figure 89: Rear wheel steering system

The rear wheel steering system is an electronically controlled hydraulic steering system. The flag on the kingpin sensor is clamped in the wedge of the fifth wheel. When the truck-sweeper combination drives around a bend the angle between the truck and sweeper changes. This angle is measured by the kingpin sensor as the flag moves with the fifth wheel.

The value of the angle is transmitted to the ECU. The ECU is located in the system cabinet. Software in the ECU uses the data representing the angle between the truck and sweeper to calculate the required steering angle for the wheels. The steering angles are then measured by sensor mounted on the steering knuckle. The ECU then signals the steering manifold in the system locker to activate the steering cylinder on the axle until the axle sensor indicate that the correct wheel angle has been reached.

Through a signal from the EBS unit, the ECU also receives information about the vehicle speed. To increase the stability of the vehicle at higher speeds, the steering angle is gradually reduced between 25 and 55 km/h. Above 55 km/h the axles are completely rigid (i.e. they are no longer steered).

#### EBS/ABS

The EBS/ABS connection between the truck and sweeper is used to get a speed signal and the ignition-on power supply to the steering system.

#### Function Lamp

The function lamp is present as a rear wheel steering icon in the display. The icon indicates the status of the steering system.



Figure 90: Rear wheel steering icon

- Normal steering mode: function lamp is off.  
The steering system is operational.
- Start-up mode: function lamp flashes, 1/8 second on and 3 seconds off (continuous cycle).  
This mode is activated when the vehicle ignition is switched on (or the engine is started) after the sweeper has been coupled at a different angle than the last time it was uncoupled. The steering system 'waits' for a steering movement. When the ignition is switched on (or the engine is started) after the sweeper has just been coupled to the truck, the function lamp will go on briefly 1 or 2 times and then go off.
- Alarm mode: function lamp is on.  
This mode indicates a malfunction has been detected in the steering system.

- Manual operation mode: function lamp flashes, 2/3 second on and 1/3 second off (continuous cycle).

### 3.10.2 Wireless Remote Control

A wireless manual control, the Electronic Truck and Trailer Steering (ETS), is available for the rear wheel steering system as an option. This manual control is used to manually operate the rear wheel steering system during manoeuvring at speeds below 12 km/h.

The wireless manual control consists of four components (listed below).

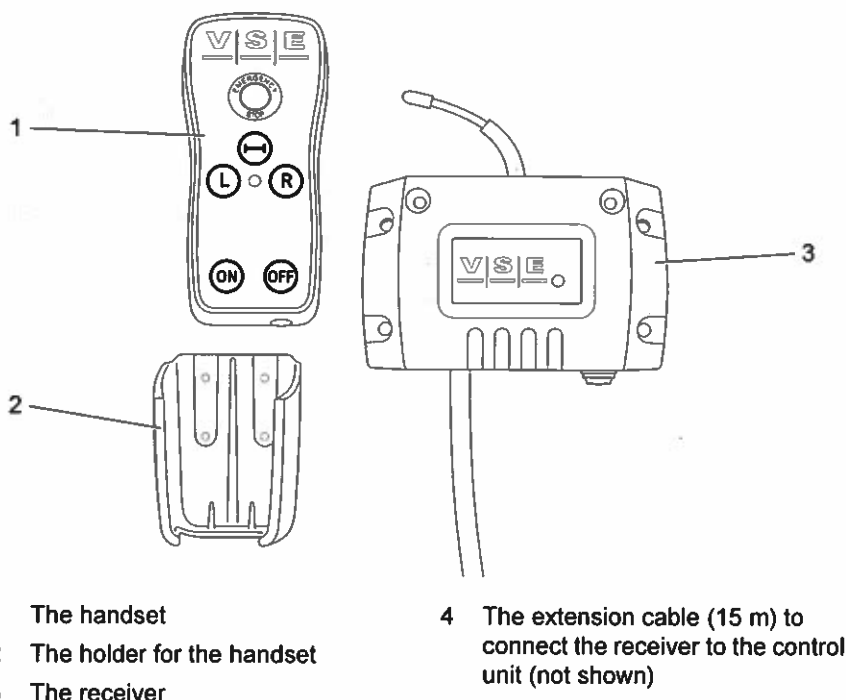


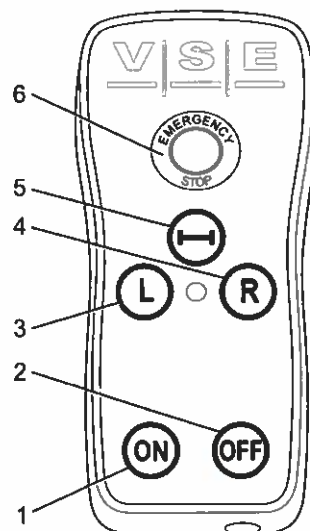
Figure 91: Wireless remote control

Functions and operation of the handset.

#### Operation

#### — NOTE! —

**When a vehicle with a heavy load is stationary, the axles may not be able to steer to the desired position. In this case, allow the vehicle to roll slowly while operating the control.**



- |                                 |                     |
|---------------------------------|---------------------|
| 1 ON Switch on manual control   | 4 Steer right       |
| 2 OFF Switch off manual control | 5 Centring function |
| 3 Steer left                    | 6 Emergency stop    |

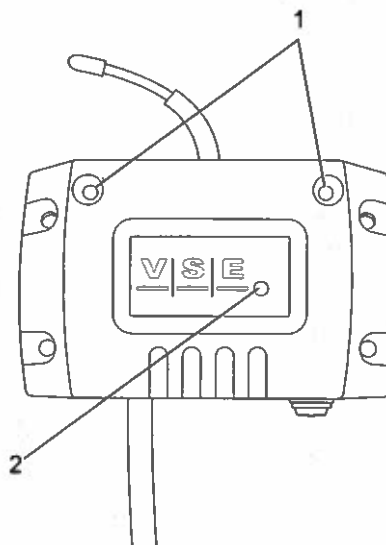
*Figure 92: Remote control*

#### *Switching on Manual Control*

The controller switches to manual control mode when the 'ON' button on the handset is pressed briefly.

- The rear wheel steering function lamp begins flashing quickly.
- The two LEDs at the top of the receiver begin flashing.





1 Top LED

2 Status LED

*Figure 93: Receiver*

When manual control is activated, no other buttons may be depressed on the handset and the vehicle speed may not be faster than 12 km/h. In addition, there must not be any active manual control alarm.

#### *Manual Steering*

When manual control is switched on, the 'L' and 'R' buttons on the handset can be used to steer the axle(s) through a left or right bend. The buttons may only be operated one at a time. If both buttons are pressed at the same time, the steering system will not respond.

#### *Centring*

When the centring button is pressed during manual operation, the axle will be steered to the straight-ahead position.

- The two LEDs at the top of the handset will be lit continuously.

Pressing the centring button again will cancel the centring function, and the 'L' and 'R' buttons can then be used again to steer through a left or right bend respectively.

- The two LEDs at the top of the handset will begin flashing again.

#### *Switching off Manual Control*

The controller switches to normal control mode when the 'OFF' button on the handset is pressed briefly.

- The rear wheel steering function lamp goes out.
- The LEDs at the top of the manual control receiver go out.

When the manual operating mode is active and the vehicle speed exceeds 12 km/h, the steering system automatically switches to normal operating mode.

If the vehicle speed does not exceed 25 km/h, the manual operating mode will become active again when the vehicle speed drops below 12 km/h.

- The function lamp will continue to flash quickly.

If the vehicle speed exceeds 25 km/h with the manual control mode still active, a 'silent' manual control alarm will be generated. During this alarm, the steering continues to function normally.

- The function lamp will begin flashing slowly: short on (1 second) and long off (2 seconds).

To reset this alarm, manual control must be switched off by briefly pressing the 'OFF' button on the handset.

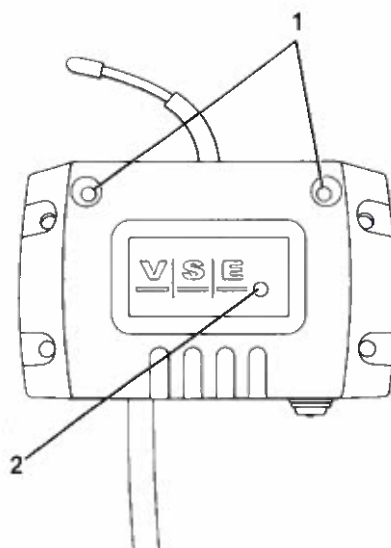
#### LEDs on the Receiver

The two LEDs at the top:

- Flashing = system switched on
- Lit continuously = centring function active
- Flashing slowly = emergency stop activated
- Off = manual control mode off

Status LED:

- Flashing = a button is pressed



1 Top LED

2 Status LED

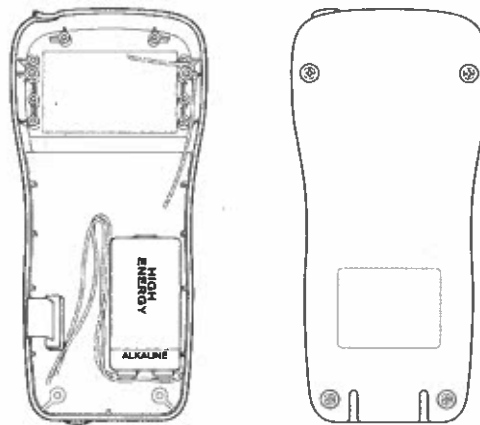
*Figure 94: Receiver*

### Programming the Receiver for a New or Additional Handset

When a handset becomes defective or you want to use an additional handset with the receiver, send the receiver and the handset to manufacture.

### Replacing the Battery in the Handset

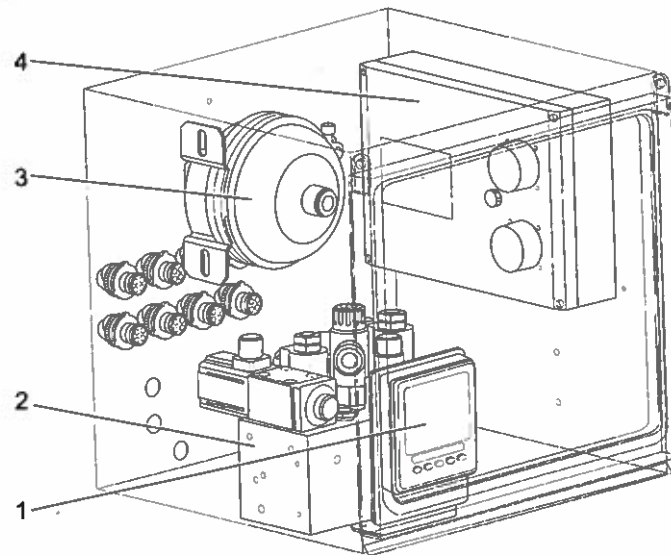
The handset has a battery replacement indicator. When the LED on the handset flashes slowly while a function is activated this means that the battery is nearly discharged and is due for replacement. The battery is located in the handset. To replace it, the back cover of the handset must be opened by removing the four screws. Then replace the battery (9 V 600 mAh) and reinstall the back cover.



*Figure 95: Replacing the battery*

### 3.10.3 Control Cabinet

The control cabinet is located on the sweeper's left rear side under the engine cover.



- |                     |                           |
|---------------------|---------------------------|
| 1 Display           | 3 Accumulator             |
| 2 Steering manifold | 4 Electronic control unit |

*Figure 96: Rear wheel steering control cabinet*

### 3.10.4 Display



*Figure 97: Display*

#### General

The display is located in the rear wheel steering control cabinet.

In the control software, procedures are present to examine the statuses of all inputs and outputs and to calibrate the rear wheel steering system. This display will be easy controllable and the information given to the user shall be simple and clear so a diagnosis can be made easily.

The communication between ECU and display occurs by CAN. If no CAN communication is available, the display shows a big black sign with the text: "No CAN communication available". In this case check the CAN-connection between ECU and display or the fuses of the ECU.

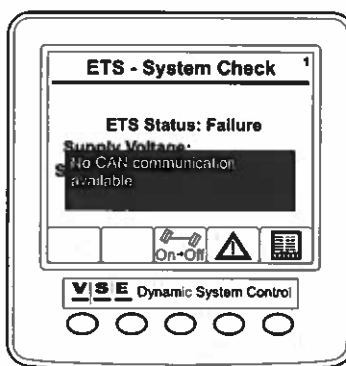


Figure 98: CAN error

The ECU decides whether a diagnosis routine can be carried out (dependent on speed and other data that is security critical).

The display is actual divided into two sections:

- User section. This section is accessible for everybody and will show useful information about the system such as Vehicle Data and possible alarms.
- Specialists section. This section is accessible with an entry code and gives access to the diagnose routines and calibration routines.

Every page has a unique number, it is placed in the right upper corner, see Figure 99. The display buttons in this manual are designated with Btn x, where x is a number from 1 to 5. The numbering is from left to right, beginning with Btn 1 to Btn 5, see Figure 99.



Figure 99: Display page

When the ESC button is pushed and released the display will go back one page, when the button is pushed for about three seconds the display goes back to its main page, see section Main Page, page 105. The ESC button is always Btn 1.

Underneath every display picture is pinpointed in which authorization levels the screen is accessible (more details about the authorization levels, see section Main Menu, page 115).

### Comments

When the display is used for the first time, a choice must be made in what language the display must function. Select the language with the Up/Down buttons and press "OK". The selected language is stored in the display memory so every time the display is started the same language is active. See also section Display Options, page 129 for display options.

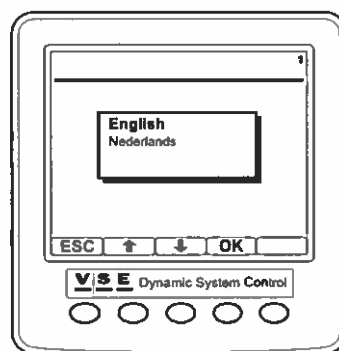


Figure 100: Language

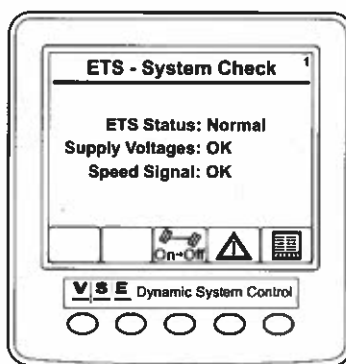
## Main Page

This is the page that is showed when the display is started, the main page is also the default page and will be displayed when no button is pushed for about 30 minutes or when the “ESC” button is pushed for longer than 3 seconds.

There is a possibility to choose between two pages. To switch between the two pages, hold Btn 5 pressed for about 5 seconds. The settings are stored so the next time the display starts up, the selected page will appear

### *Main Page - System Check (1)*

This page simply shows the system status and if the vehicle signals are correct, see Figure 101. In the table, the different items of the screen with there possible status are shown.



*Figure 101: System check*

**ETS - System Check (1)**

<b>Item</b>	<b>Possible status</b>	<b>Remarks</b>
ETS Status: (The mode of the rear wheel steering system)	Checking...	Each time when the ignition is switched on, the system is checked before it is operational.
	Normal	The system is in normal operation mode.
	Failure	The system has an active alarm.
	Centring	The system is centered. (Centring Switch).
	Manual	Manual steering mode is activated.
	Diagnostic	System is in diagnostic mode (authorisation level 1, 2 of 3).
Supply Voltages: (The vehicle supply voltages)	Checking...	When the E-pump is running, the battery voltage will drop. At this moment "Checking..." is displayed because the system can not determine if the voltage is correct or incorrect.
	OK	Supply voltages are correct.
	Failure	One of the voltages (KL15 of KL30) or both voltages are incorrect.
Speed Signal: (Signal from the vehicle)	OK	Speed signal is correct. Failure Signal is incorrect, check the source of the signal



## Main Page (2)

On this page the most important status of the system is displayed, see Figure 102. Depending of the configuration of the system, it is possible the page looks a bit different than shown. In table, the different items of the page are described.

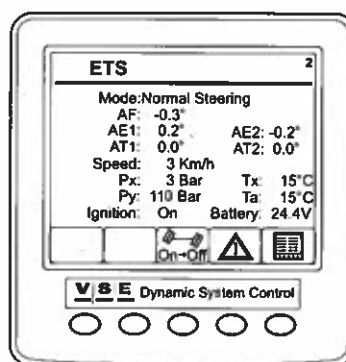


Figure 102: Main page

## ETS (2)

Item	Description
Mode	See next table
AF	Angle Front (Kingpin or front axle angle)
AE1	Angle of the first ETS axle
AE2	Angle of the second ETS axle
AT1	Target Angle of the first ETS axle
AT2	Target Angle of the second ETS axle
Speed	Speed of the vehicle (in Km/h or mph)
Px	Pressure in the X (steer) circuit of the ETS system (in Bar or Psi)
Py	Pressure in the Y (centre) circuit of the ETS system (in Bar or Psi)
Tx	Oil temperature in X circuit
Ta	Ambient temperature
Ignition	Whether the ignition is on or off (motor runs)
Battery	The voltage of the (ETS) battery

## **ETS (2)**

<b>Item</b>	<b>Possible status</b>	<b>Remarks</b>
Mode: (Mode where the system is in)	Diagnostic Mode	System is in diagnostic mode (authorisation level 1, 2 or 3).
	Alarm Mode	The system has an active alarm.
	Waiting for movement	The system waits for vehicle movement.
	Centring	The ETS axle(s) are centred (for example: due to a lift axle signal).
	Normal Steering	rear wheel steering system is functioning normal
	Manual Centring	When manual control is active and the centring switch on the remote is pushed
	Manual Steering	Manual control is active (remote control)

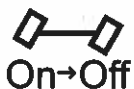
## Buttons Main Page

### Centering Btn 3

No symbol

Centring is not available

Button for centring the ETS axle(s), system will switch to "centring mode"



When the ETS axle(s) are centred, the symbol changes to "Off->On". The "centring mode" can now be stopped. After actuating, the symbol changes back to "On->Off"

### NOTE!

When the centring button is actuated the icon will flicker until the request is accepted by the ECU.

### Alarm Btn 4

Button to enter the Alarm Pages DM1 en DM2 (see section Alarm Pages (DMx), page 111).



### Test/Diagnose Btn 5

Button to enter the test and diagnostic section (see section Main Menu, page 115).



### System Alarm Main Page

When the system generates an alarm a traffic sign pops up (only in the main page) with a warning to attend the driver or user that something is wrong, see Figure 103. There are three priorities.

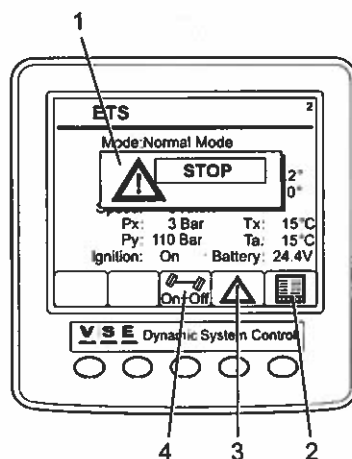


Figure 103: Alarm main page

### Warning signs



When a “STOP” alarm is generated it is necessary to stop immediately because something serious can happen or has happened. Driving is only prohibited in consultation with the workshop



With a “WORKSHOP” alarm it’s not necessary to stop immediately. It is advised to go to a workshop as soon as possible



With a “WARNING” nothing serious has happened, it’s not necessary to stop or go directly to a workshop

### Alarm Pages (DMx)

The alarm structure of the rear wheel steering system is based on the SAE J1939 diagnostic error code handling (DMx). The used DMx messages are:

- DM1: Active error codes
- DM2: Stored error codes
- DM3: Clear all stored error codes

Figure 104 shows the set up of a DMx message.

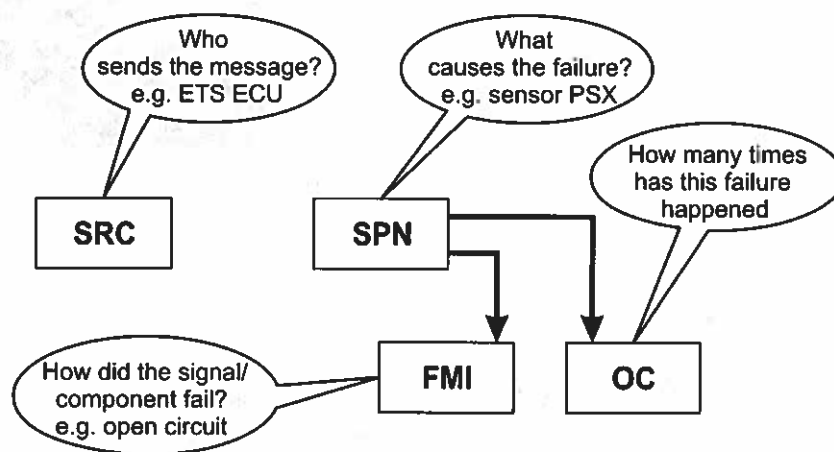


Figure 104: DMx message

### DM1, active error codes

This page displays the active error codes of the rear wheel steering system, see Figure 105. On top of the page, the total number of alarms is displayed that are currently active. The error codes are displayed in order of occurrence with the last occurred alarm at the top. To scroll through the error codes, use the up/down arrow buttons (Btn 2 and Btn 3).

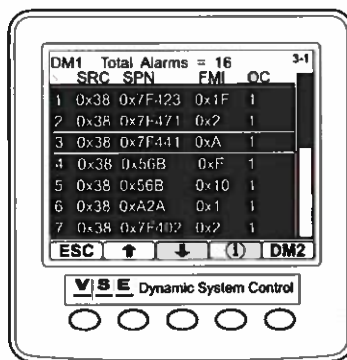


Figure 105: Active error codes

With the information button (i) extra information about the selected error code is displayed, see Figure 106. It is also possible to scroll through the error codes with the alarm information on.

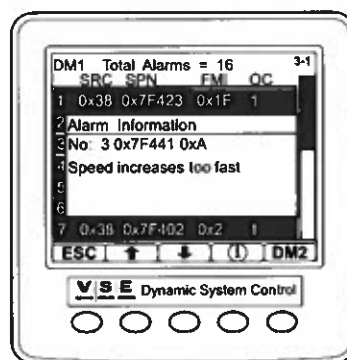


Figure 106: Alarm information

With the DM2 button the DM2 (stored error codes) page is opened.

### DM2, stored error codes

When the system generates an alarm, the error code is stored in the system memory at the moment that the vehicle ignition is switched off. Just like the DM1 page, the stored error codes on the DM2 page are displayed in order of occurrence with the last occurred alarm at the top, see Figure 107. To scroll through the error codes, use the up and down arrow keys (Btn 2 and Btn 3).

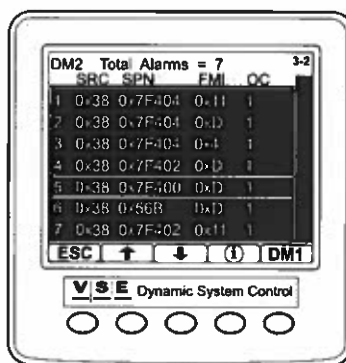


Figure 107: Stored error codes

With the information button (i) extra information about the selected error code is displayed (This is the same as the DM1 page, see Figure 106). It is also possible to scroll through the error codes with the alarm information on.

With the DM1 button the DM1 (active error codes) page is opened again.

### DM3, clear stored error codes

When the user is logged on in authorisation level 1, 2 or 3, it is possible to clear all the stored error codes from the system memory. In authorisation level 1, 2 and 3, Btn 5 has an extra function in the DM2 page.

To clear messages: push and hold button DM1/3 (Btn 5) for about three seconds. A pop-up will appear with the question: "Are you sure to clear all the DM2 messages (Yes/No)", see Figure 108.

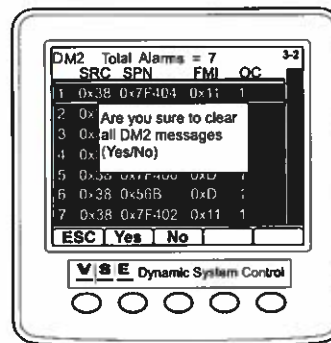


Figure 108: Clear stored error codes

When the question is answered with No the display returns to the DM2 page, see Figure 107. If the question for clearing is confirmed with Yes all codes will be cleared from the memory and a pop-up appears with the message that the display and ECU must be reset by switching the ignition off and on, see Figure 109.

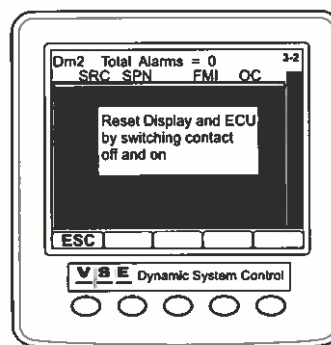


Figure 109: ECU reset message

### Comments

Wait at least 5 seconds between switching the ignition off and on.  
After reset, the authorisation level is set to level 0.



## Main Menu

When in the main page the “Test\Diagnose” button (Btn 5) is pushed, the main menu page appears, see Figure 110.

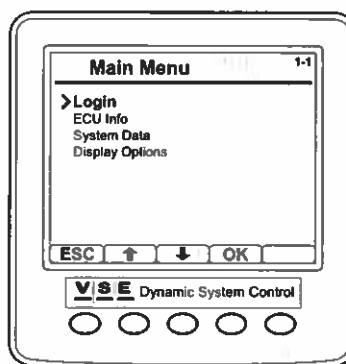


Figure 110: Main menu, basic

A menu item can be selected with the up/down arrow buttons and confirmed with the OK button. Depending of the authorisation level, the menu will be enlarged with more menu items, Figure 111.

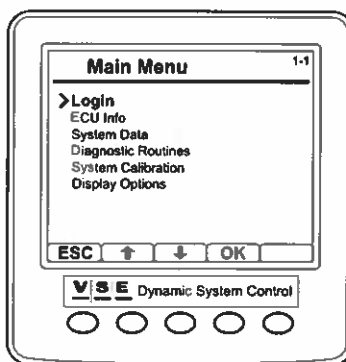


Figure 111: Main menu, higher authorisation level

This table shows which menu item is displayed in which authorisation level:

#### Main Menu

Menu item	Authorisation level
Login (Log on)	0, 1, 2, 3
ECU Info	0, 1, 2, 3
System Data	0, 1, 2, 3 (in level 0 and 1 read only)
Diagnostic Routines	1, 2, 3 (in level 1 only Manual Steering)
System Calibration	1, 2, 3 (in level 1 only Calibration Data)
Display Options	0, 1, 2, 3

#### Login

The display is divided in four authorization levels. Three user levels and one “VSE” level.

#### Authorisation level

Level	Description
0	For everybody. When the display starts up, it's in level 0.
1	User level 1 (Driver).
2	User level 2 (Workshop).
3	Only for experts/developers. “VSE” level

#### Select authorisation level

When from the main menu “Login” is chosen, the “Authorization Lvl (x)” screen appears, see Figure 112. The number between the brackets indicates the actual level. Select the authorization level with the + button and confirm with the OK button.



Figure 112: Authorisation level

### Fill in code

When the level is chosen and confirmed, the screen will be enlarged with a fill in field for the “Login Code”, see Figure 113.

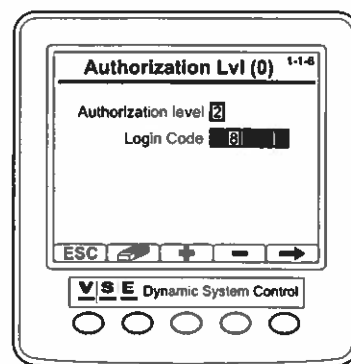


Figure 113: Code

The code consists of 5 numbers between 0 and 9. With the + and - button the numbers can be separately increased or decreased. With the arrow button (Btn 5) the cursor jumps one position to the right. Use button 2 to erase the complete field when a wrong code is filled in.

After finishing the fifth number of the code, the arrow button (Btn 5) must be pressed one more time. The screen of the display changes and the chosen level must be confirmed, see Figure 114.

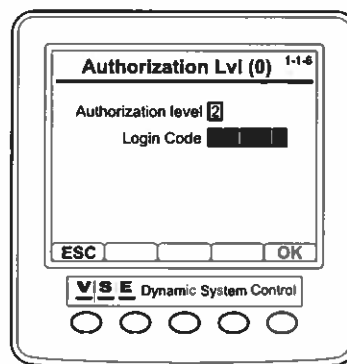
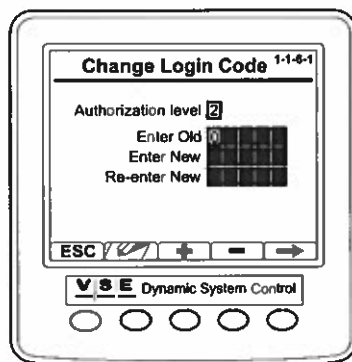


Figure 114: Confirm chosen level

Press the OK button and when the code is accepted, the display will confirm that. Press one more time the OK button and the display returns to the main menu, see Figure 111.

### *Change Code*

The login codes for authorization level 1 and 2 can be changed. First select a level (see section *Select authorisation level*, page 116) and press Btn 2. The “Change Login Code” screen appears, see Figure 115.



*Figure 115: Change login code*

Filling in the codes works the same way as described in section *Fill in code*, page 117. First fill in the old code and after that the new code. To verify the new code, re-enter it again.

When the codes are entered, “Code changed. Level x” pops up. If a wrong old code is entered then a pop-up will appear with the message: “Wrong code. attempt x/3”. After three wrong attempts the display is reset to the main page.

When the first and second new codes are not corresponding, a pop-up appears with the message: “New codes not corresponding”.

## ECU Info

### General Info

When from the main menu “ECU Info” is chosen, a new menu appears, see Figure 116.

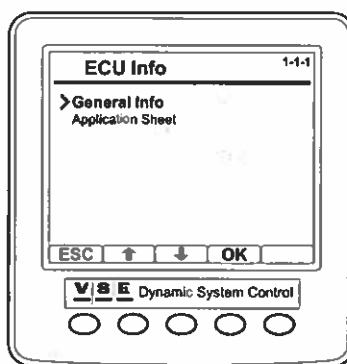


Figure 116: ECU information

In the “General Info” page, information is available to identify the connected ECU and the version of the software in the ECU and display, see Figure 117.



Figure 117: General information

The table describes different items of the screen.

#### General Info

Item	Description
Prod. Date	Production date of the ECU. When the ECU is tested and the software is downloaded
S/N	Serial number, unique number of the ECU
P/N without software.	Part number. VSE Article number of the ECU
ECU SW	Part number of the software in the ECU
Display SW	Part number of the software in the Display
(Bottom line)	ETS application code

#### Application Sheet

In the application sheets the configuration of the connected vehicle can be read out, see Figure 118. The items on these two pages correspond to the Customer/VSE application sheets on which the software is build.

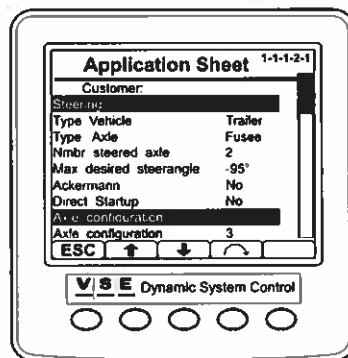


Figure 118: Application sheet

With the up/down arrow buttons it's possible to scroll through the items. Use Btn 4 to switch between the customer and VSE sections.

## System Data

### General

These pages are only accessible in authorisation level 0, 1, 2 and 3, with exception of the “Read/Write Memory” screen. This screen is not accessible in level 0 and 1.

In the “System Data” screen, several data can be watched. For example: inputs, outputs and supply voltages of the ECU. Select with the up/down arrow buttons an item in the list and press the “OK” button to confirm.

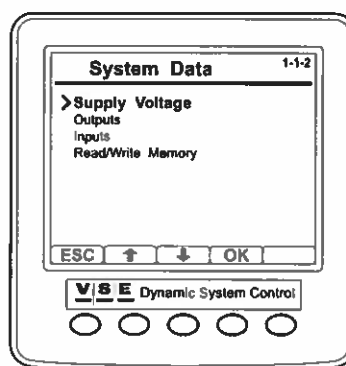


Figure 119: System data

### Supply Voltage

The “Supply Voltage” page contains all power supply voltages and sensor power supply voltages, used in the ECU, see Figure 120.

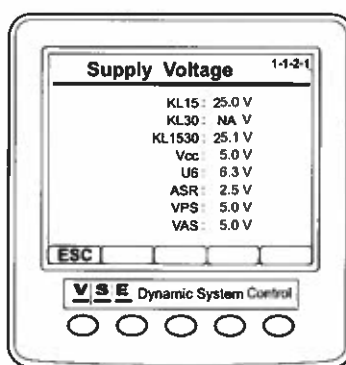


Figure 120: Supply voltage

The next table describes the different items of this page.

### Supply Voltage

Item	Description
KL15	Switched power supply voltage (ignition).
KL30	Constant power supply voltage
KL15/30	Combined power supply, used as power supply for the outputs
VCC	Internal (PCB board) power supply
U6	Pre-voltage for internal power supply
ASR	Angle Sensor signal adoption reference supply voltage
VPS	Pressure sensors power supply
VAS	Angle sensors power supply

### Comments

In this example, behind KL30 the value is NA V. This doesn't mean that the KL30 is not connected. It means that the value is Not Available for displaying.

### Outputs

When "Outputs" is chosen from the "System Data" menu, a new menu appears with two items, see Figure 121.

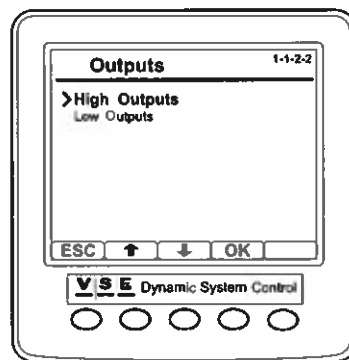


Figure 121: Outputs

- High Outputs: These outputs can be switched to power supply by the ECU.
- Low Outputs: These outputs can be connected to ground by the ECU.

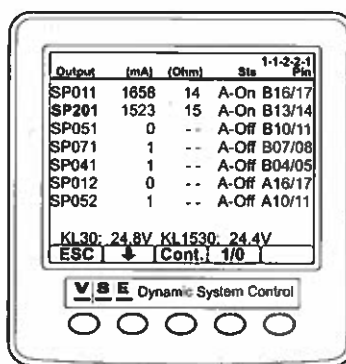


On these pages all outputs are displayed and can be switched on or off (switching outputs on and off is only possible in authorisation level 2 and 3).

### High Outputs

In the “High Output” page the different values and statuses of the used outputs are represented, see Figure 122.

In the first column, the names of the outputs are displayed. The second column displays the current through the coil and third column the ohmic value of the coil. The pin connection on the ECU is displayed in the last column.



Output	(mA)	(Ohm)	Sta	1-1-2-2-1 Pin
SP011	1658	14	A-On	B16/17
SP201	1523	15	A-On	B13/14
SP051	0	--	A-Off	B10/11
SP071	1	--	A-Off	B07/08
SP041	1	--	A-Off	B04/05
SP012	0	--	A-Off	A16/17
SP052	1	--	A-Off	A10/11

K130: 24.8V K11530: 24.4V  
ESC ↓ Cont. 1/0

VSE Dynamic System Control

Figure 122: High outputs

With the down arrow button the desired output can be selected. The outputs can be switched in two different ways. With the Cont. button the selected output will constant turned ‘ON’. If the button is pushed again the output is turned “OFF”. When the 1/0 button is pushed the output is turned ‘ON’, when the button is released the output will turn ‘OFF’.

### Comments

It's possible the number of outputs and the names are different from Figure 122, these are application dependent.

### Low Outputs

In the “Low Outputs” page the statuses of the low outputs are represented, see Figure 123. In the first column, the names of the outputs are displayed. The pin connection on the ECU is displayed in the last column.

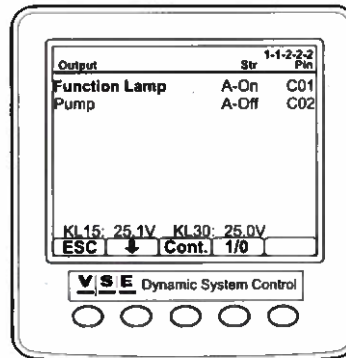


Figure 123: Low outputs

With the down arrow button the desired output can be selected. The outputs can be switched in two different ways. With the Cont. button the selected output will constant turned “ON”. If the button is pushed again the output is turned “OFF”.

---

#### NOTE!

**When testing the pump, Don't leave it on too long (max. 30 seconds).**

When the 1/0 button is pushed the output is turned “ON”. When the button is released the output will turn “OFF”.

### Comments

It's possible the number of outputs and the names are different from Figure 123, these are application dependent.

## Inputs

When “Inputs” is chosen from the “System Data” menu, a new menu appears with three items, see Figure 124.

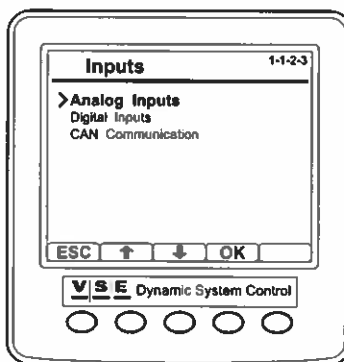
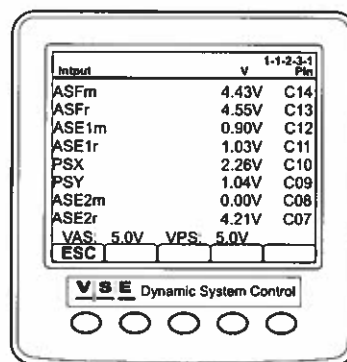


Figure 124: Inputs

- **Analog Inputs:** These are the inputs from the angle sensors and pressure sensors.
- **Digital Inputs:** These are inputs from (on/off) switches.
- **CAN Communication:** On this page, the CAN data of the CANbus is displayed.

## Analogue Inputs

On the “Analogue Inputs” page, see Figure 125, the values of the analogue inputs are showed. The Analogue Input values are given in volts. The pin connection on the ECU is displayed in the last column.



Input	v	Pin
ASFm	4.43V	C14
ASFr	4.55V	C13
ASE1m	0.90V	C12
ASE1r	1.03V	C11
PSX	2.26V	C10
PSY	1.04V	C09
ASE2m	0.00V	C08
ASE2r	4.21V	C07
VAS	5.0V	
VPS	5.0V	

Figure 125: Analogue inputs

The next table describes all existing analogue inputs.

### **Analog Inputs**

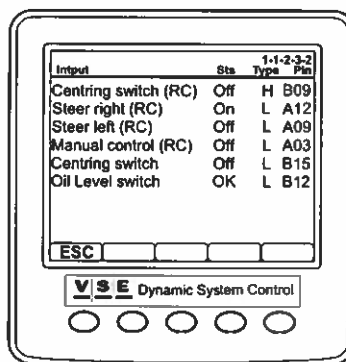
<b>Item</b>	<b>Description</b>
ASFm	Main Front angle signal or king pin sensor signal.
ASFr	Redundant Front angle signal or king pin sensor signal
ASE1m	Main Rear angle signal on the first ETS axle
ASE1r	Redundant Rear angle signal on the first ETS axle.
PSX	Steering pressure sensor signal
	PSY Centring pressure sensor signal
ASE2m	Main Rear angle signal on the second ETS axle
	ASE2r Redundant Rear angle signal on the second ETS axle
VAS	Angle sensors power supply
VPS	Pressure sensors power supply

### **Comments**

The page with analogue inputs is application dependent, therefore it is possible that the number of inputs and there names can differ from the example of Figure 125.

## Digital Inputs

On this page, see Figure 126, the status of the digital inputs are showed, whether they are “On” or “Off”. For the oil level switch the status will be displayed with “Low” or “Ok”.



Input	Sta	Type	1-1-2-3-2 Pin
Centring switch (RC)	Off	H	B09
Steer right (RC)	On	L	A12
Steer left (RC)	Off	L	A09
Manual control (RC)	Off	L	A03
Centring switch	Off	L	B15
Oil Level switch	OK	L	B12

ESC

VSE Dynamic System Control

Figure 126: Digital inputs

The type of input is displayed with “L” or “H”, this are Low inputs (switched to ground) or high inputs (switched to power supply). The pin connection on the ECU is displayed in the last column.

## Comments

The page with digital inputs is application dependent, therefore it is possible that the number of inputs and there names can differ from the example of Figure 126.

### CAN Communication

On the CAN communication page the status of the CAN bus is displayed and it shows all the received CAN messages on the CAN-bus, see Figure 127.

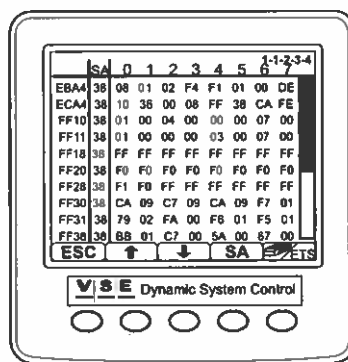


Figure 127: CAN messages

- Column 1      Displays the PGN: Parameter Group Number
- Column 2      Displays the SA: Source Address
- Column 0-7    Displays the CAN data

With the up/down arrow buttons it is possible to scroll trough the messages.

The SA button (Btn 4) will sort the data by Source Adres. The symbol of this button will change to [PGN] when the data is sorted by "SA", Pushing the button again the data will sort by Parameter Group Number.

By pushing Btn 5 for 5 seconds, only the CAN messages send by the rear wheel steering system are shown. Pushing Btn 5 for 5 seconds again, all messages will be displayed. With a short push on Btn 5, the page will refresh.

## Display Options

### General

These pages are accessible in all authorisation levels. With the “Display Options” page the Language, Units, Contrast and Lighting can be changed. To change one of the items, select the item with the up/down arrow keys and press the OK button to confirm.

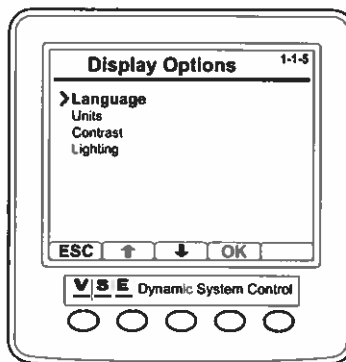


Figure 128: Display options

### Language

To set all the display texts in the desired language select the language with the up/down arrow keys and press OK to confirm, see Figure 129.

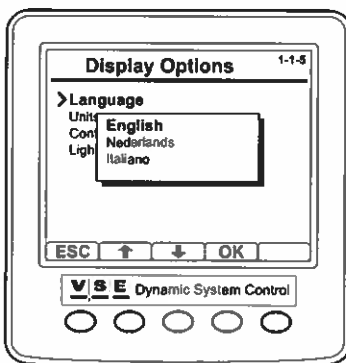


Figure 129: Language

The selected language is stored in the display memory, so every time the display is started the same language is active.

## Units

With this menu the units of some variables can be set in American or European standards, see Figure 130. Select with the down arrow key the unit. Change the selected unit by pressing the + button. When done, press the OK button to store the changes.

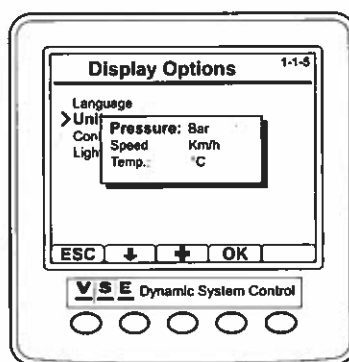


Figure 130: Units

## Units

Item	Option
Pressure	1. Bar
	2. psi
Speed	1. Km/h
	2. mph
Temp	1. °C
	2. °F



### Contrast

Adjusting the contrast of the LCD to an optimum level ensures that the display is clearly readable and that grey-scales are appropriately displayed, see Figure 131. The contrast is reduced by pressing the - button, which will tend to lighten the display and increase by pressing the + button, which will tend to darken the display. With the OK button the contrast level will be stored.

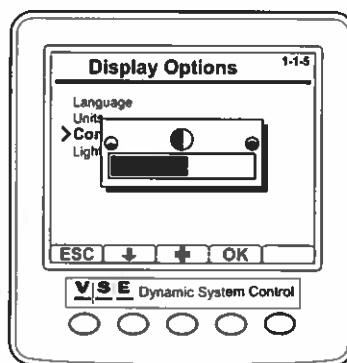


Figure 131: Contrast

### Lighting

The LCD has ten back-light levels that allow the display to be read in the dark, see Figure 132. The appropriate level is selected by the - button to decrease the illumination or the + button to increase it. With the OK button the illumination setting will be stored.

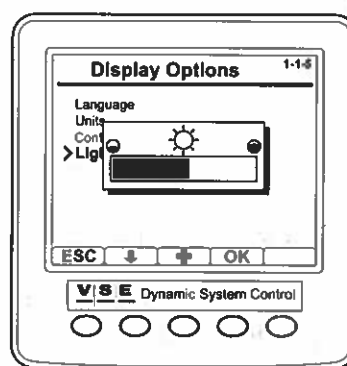


Figure 132: RS400P-136

### 3.11 Brake System

The sweeper has compressed air-driven drum brakes on all wheels. There is also mechanical actuated parking brakes. An electronic EBS system prevents the wheels from locking in the event of heavy braking.

#### 3.11.1 Air supply

The tractor vehicle supplies compressed air to the brake system through the supply line (red), and regulates the brake pressure through the service line (yellow).

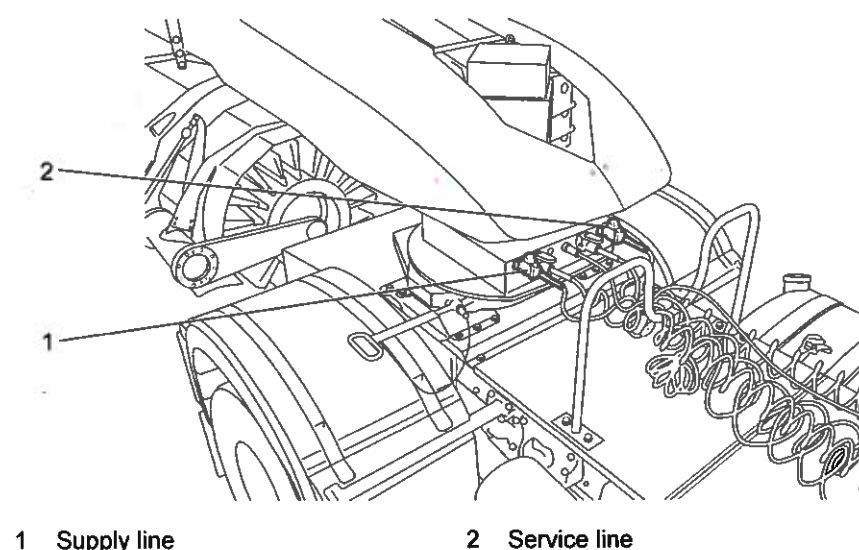


Figure 133: Trailer brake couplers (gladhands)

#### 3.11.2 Parking and Emergency Brake Valve

There are two different versions of the parking and emergency brake valve for valve:

1. TEM - Trailer Emergency Module.
2. TrCM - Trailer Control Module.

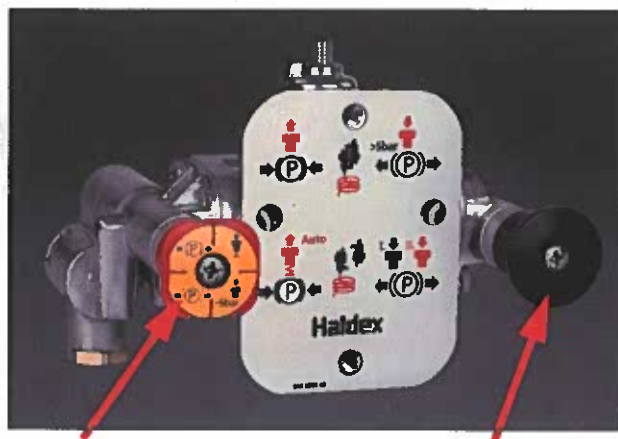
#### **WARNING!**

**Always check that the manual parking brake on the trailer is disengaged before driving**

**Always check that the trailer is rolling freely without resistance during the first meters of driving**

**Driving with activated parking brake will after short time result in overheated brakes.**

## TEM - Trailer Emergency Module



- 1 Parking valve. Red                      2 Shunt valve. Black

Figure 134: TEM Parking and emergency brake valve

### NOTE!

#### Before driving:

**Make sure that the red and yellow connectors are connected to the towing vehicle.**

**The towing vehicle must supply pressure >5 bar**

**Push the red button to release the parking (spring) brakes on the trailer.**

#### Disconnected trailer

- When the supply line (red) is disconnected or the supply pressure < 5 bar, the red button will pull out automatically and activate the emergency brake.
- Secure the trailer wheels with blocks.

#### Shunting

- For shunting uncoupled trailer, push the black button first and then the red button to release the brakes.
- NOTE! Now the trailer will roll without brakes.
- After shunting, pull out the black button to apply the parking brake.

## TrCM - Trailer Control Module



1 Shunt valve. Black

2 Parking valve. Red

*Figure 135: TrCM Parking and emergency brake valve*

---

### NOTE!

#### **Before driving:**

**Make sure that the red and yellow connectors are connected to the towing vehicle.**

**The towing vehicle must supply pressure >5 bar**

**Push the red button to release the parking (spring) brakes on the trailer.**

#### *Disconnected trailer*

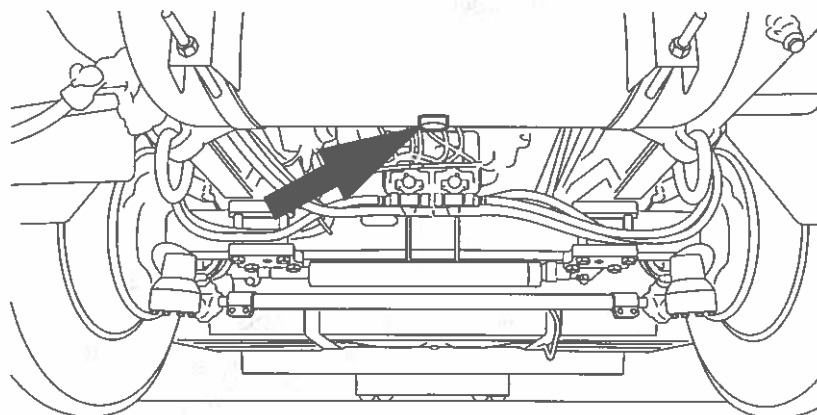
- When the supply line (red) is disconnected or the supply pressure < 5 bar, the emergency brakes will be activated.
- Pull the red button to manually activate the spring parking brakes.
- Secure the trailer wheels with blocks.

#### *Shunting*

- For shunting uncoupled trailer, push the black button first and then the red button to release the brakes.
- NOTE! Now the trailer will roll without brakes.
- After shunting, pull out the black button to apply the parking brake.

### 3.11.3 Drain Valve

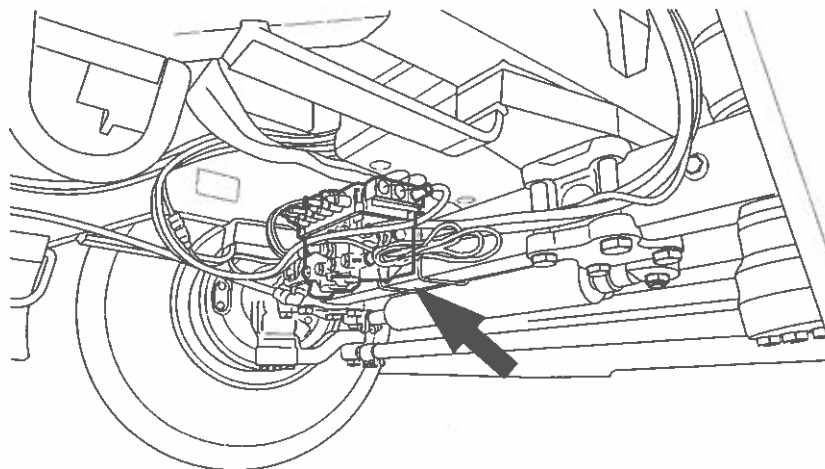
There is a drain valve fitted under the supply air tank. The valve is manually operated.



*Figure 136: Drain valve*

#### 3.11.4 Electronic Brake System, EBS

The EB+ Gen3 system provides electro-pneumatic control of the sweeper brakes with built in electronic load sensing and anti-lock functions. It provides the necessary components to enable compatibility with either an electronically and pneumatically signalled or a pneumatically only signalled towing vehicle.



*Figure 137: Brake valve EB+ Gen3*

The main system package consists of a brake valve / modulator assembly, containing a brake apply solenoid, twin solenoid operated relay valves and pressure sensors for monitoring the pneumatic control line, brake delivery, tank and air suspension pressure. Externally the system comprises two wheel speed sensors.

Trailers fitted with the system may only be towed behind vehicles fitted with an ISO 7638 connector (either 7 or 5-pin). When connected with a 7-pin connector the system receives brake demand data via the CAN data line. When connected with a 5-pin connector the system determines brake demand by sensing the pneumatic control transmission.

### 3.12 Frame and Bodywork

#### 3.12.1 Frame

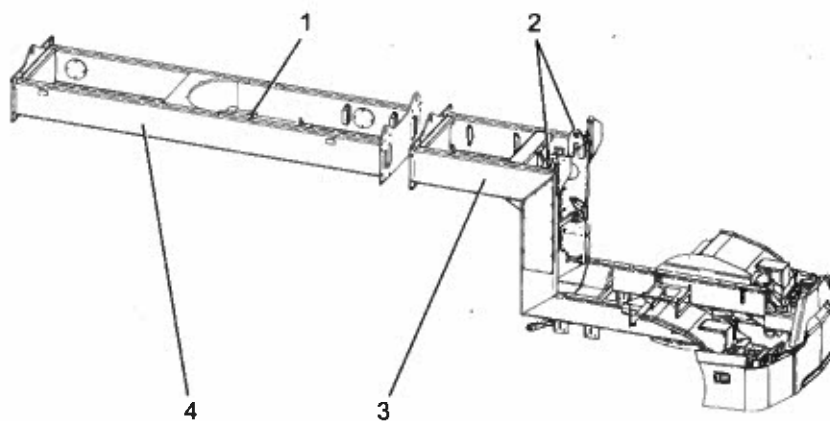
The rear frame and the middle frame are welded structures made of rectangular steel tubes.

For information regarding the front frame section, please refer to section 3.13 Front Section, page 141.

The frames are connected with screw joints.

The mounting for the brush is welded onto the middle frame.

The blower housing, engine, fuel and hydraulic oil tanks, electrical cabinet and the rear axle, as well as two lifting lugs, are located on the rear frame.



- |                      |                |
|----------------------|----------------|
| 1 Mounting for brush | 3 Rear frame   |
| 2 Lifting lugs       | 4 Middle frame |

*Figure 138: Middle frame and rear frame*

### 3.12.2 Support legs

#### Standard

There are two telescopic jack stands that to support the frame when it is not coupled to a tractor vehicle. The jack stands are mounted in front of the brush in the middle frame.

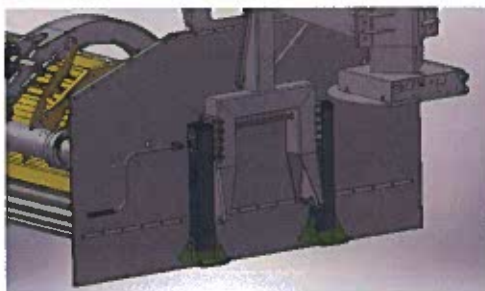


*Figure 139: Telescopic jack stand*

#### Optional Telescopic support leg

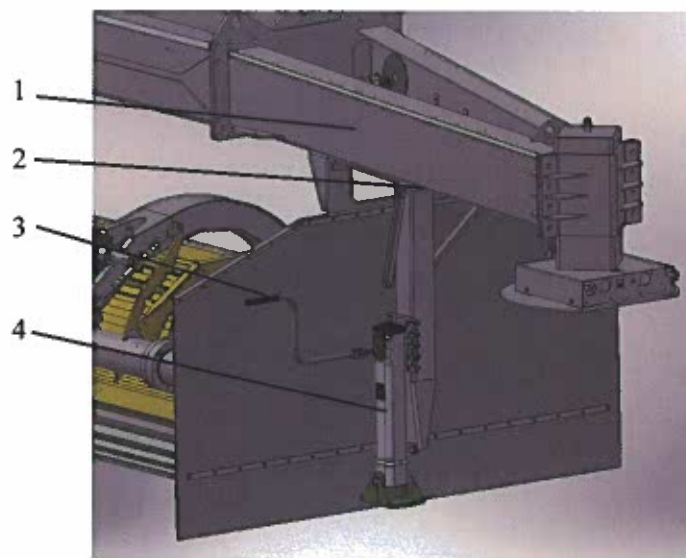
There are two alternatives of the support legs for parking the standard sweeper when disconnected from the tractor vehicle. This can be used when a longer brush axle is mounted, and the space in front is reduced.

A bracket is mounted on the front frame, and the support leg is mounted in the bracket. The single leg is used as standard for normal parking. If the sweeper is to be parked in a workshop, there is a double support leg, which can be used to parking above the drain.



*Figure 140: Frame with single support leg*



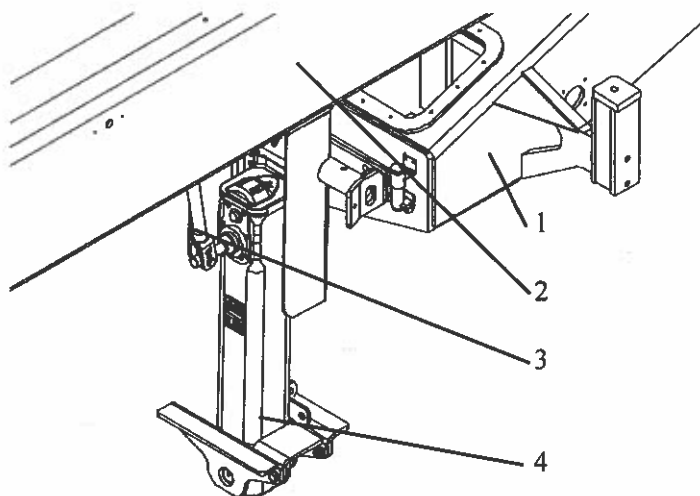


- |                    |                     |
|--------------------|---------------------|
| 1 Front frame      | 3 Adjustment handle |
| 2 Mounting bracket | 4 Support leg       |

*Figure 141: Frame with single support leg*

#### Option Hydraulic Support leg

The hydraulic support leg is fixed on the middle frame, and can be lowered and raised by operating the .

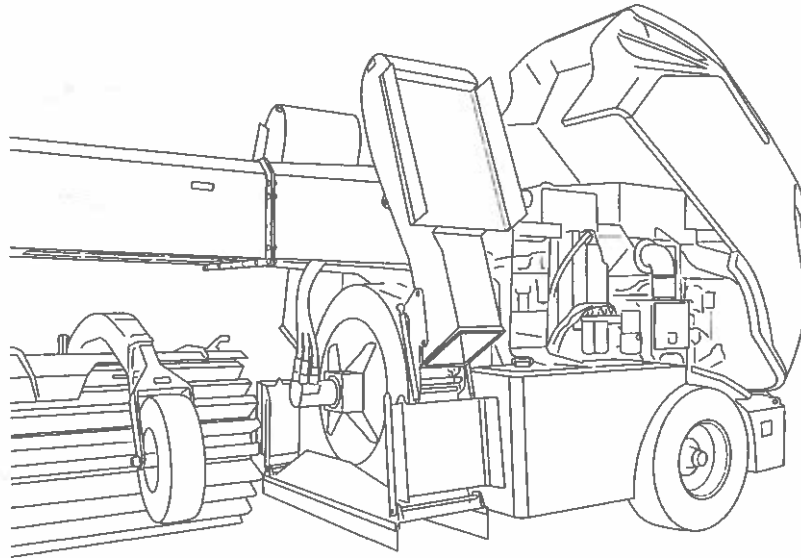


- |                   |                     |
|-------------------|---------------------|
| 1 Support leg arm | 3 Adjustment handle |
| 2 Middle frame    | 4 Support leg       |

*Figure 142: Frame with single support leg*

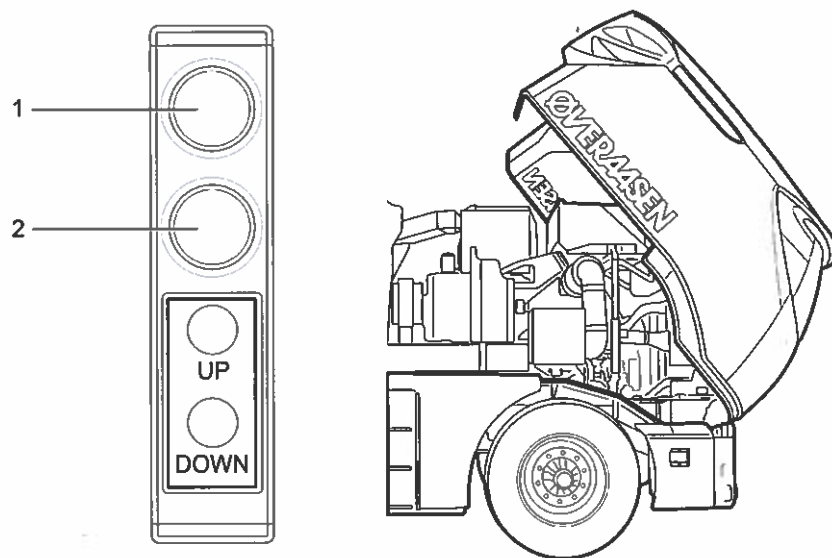
### 3.12.3 Engine Cover

The engine cover is made of fibreglass and protects engine, hydraulics and electronics.



*Figure 143: Engine Cover*

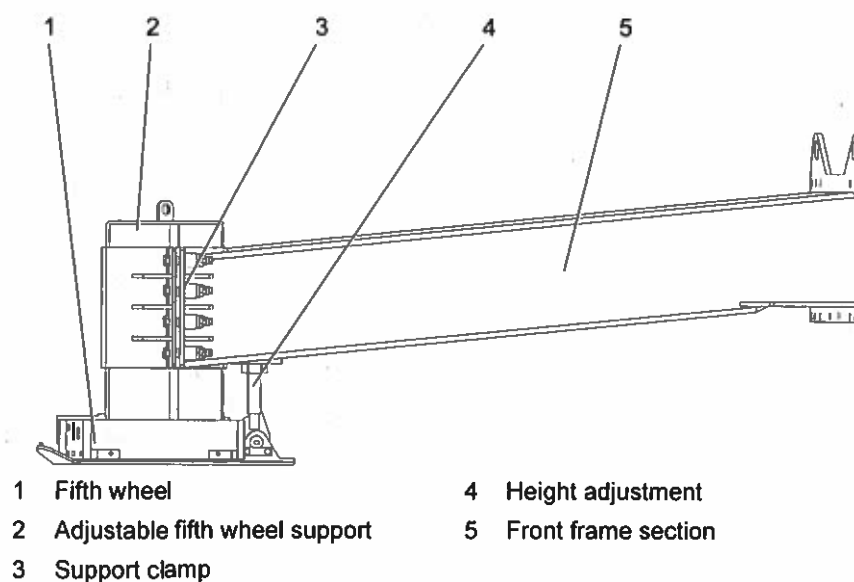
The engine cover is manoeuvred by two hydraulic cylinders, and operated by the engine cover switch placed in the rear hatch on the left side.



*Figure 144: Engine cover switch*

### 3.13 Front Section

#### 3.13.1 Adjustable Semi-Adapter for Fifth Wheel



*Figure 145: Adjustable semi-adapter for fifth wheel*

The riding height is set to fit the truck that the sweeper is coupled to.

**— NOTE! —**

**The riding height is very important to the sweeper result.  
Consult workshop manual before adjusting the riding height.**

### 3.13.2 Front axle

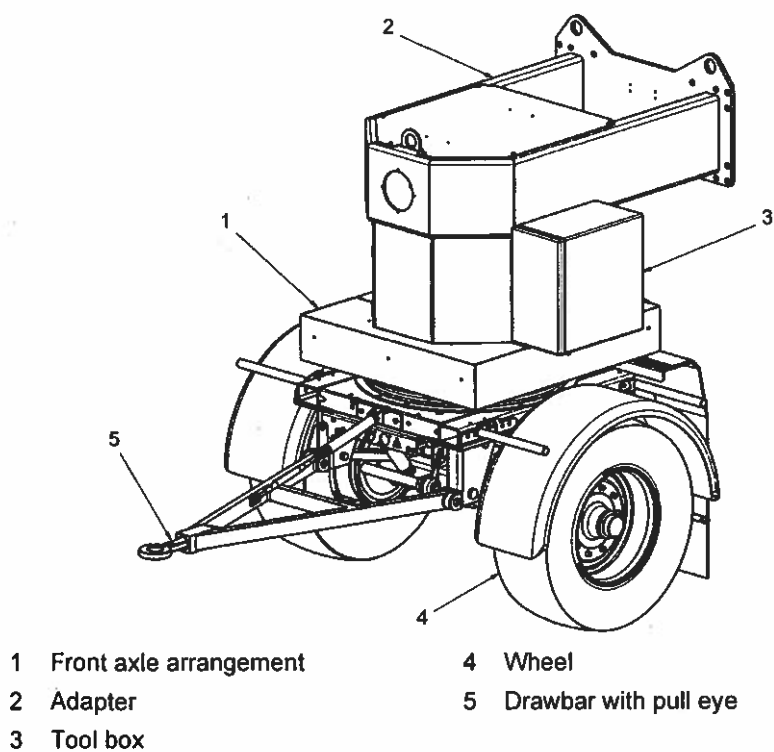


Figure 146: Front axle assembly

The front axle comprises a front frame section with two wheels and a trailer drawbar to be connected to the towing vehicle. The front axle has air suspension, two 40 l air tanks.

Total length of RS400 with front axle is 12870 mm.

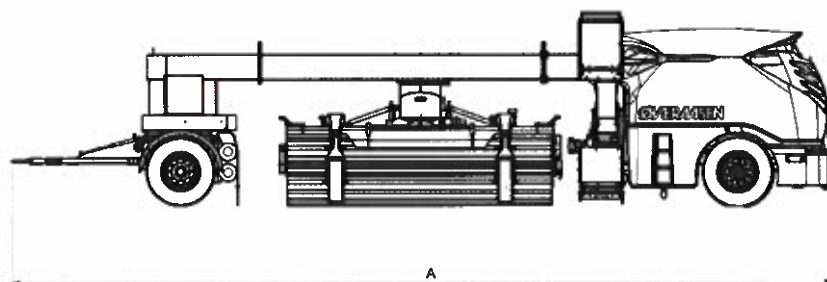
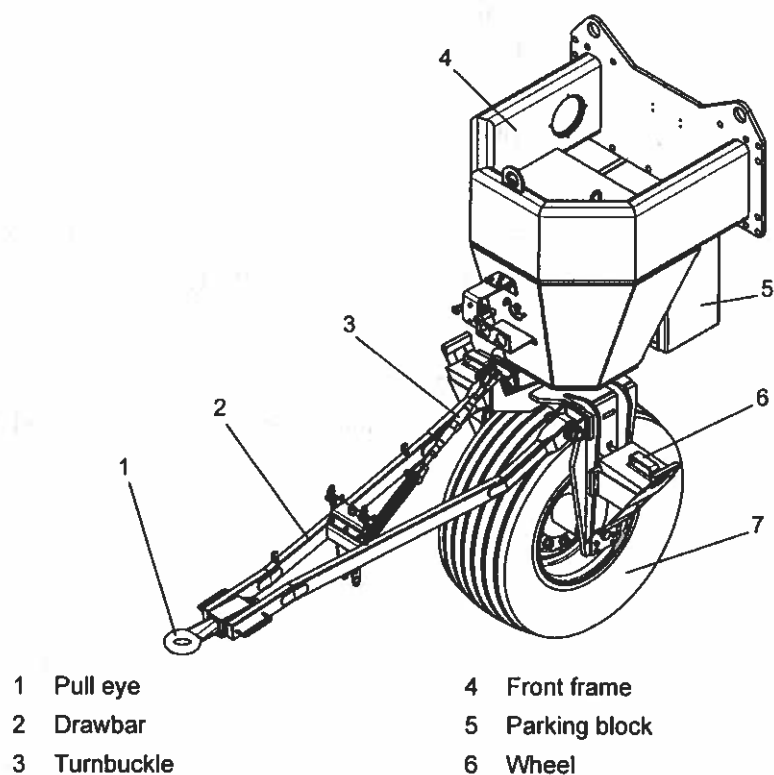


Figure 147: Front axle assembly

### 3.13.3 Front wheel



*Figure 148: Front wheel adapter*

The front wheel comprises a front frame section with a drawbar and a pull eye to be connected to the towing vehicle.

### 3.14 Central Lubrication

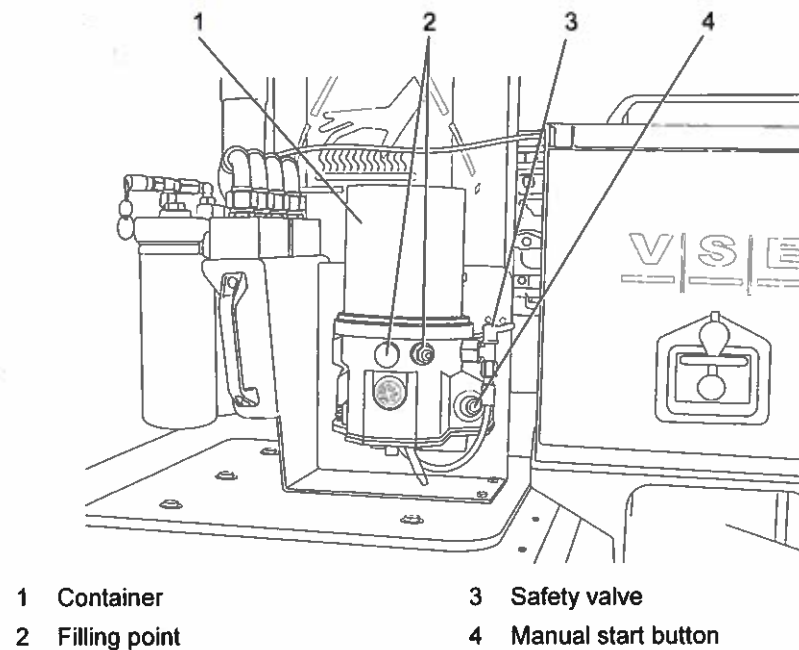
(Optional Equipment)

The central lubrication pump is located on the left side under the engine cover.

When the sweeper is in operation, the central lubrication automatically lubricates the following parts:

- all cylinders and mountings on the blower housing
- all bearings and hydraulic cylinders on the brush
- all lubrication points on the rear wheel steering
- all lubrication points in the brake system
- bearings on the frame and coupling to the tractor vehicle.

The system does not lubricate the support wheel hub.



*Figure 149: Central lubrication unit*

If one of the lubricating points is clogged, the overpressure is indicated by grease on the safety valve.

### 3.15 Front Air System

(Optional Equipment)

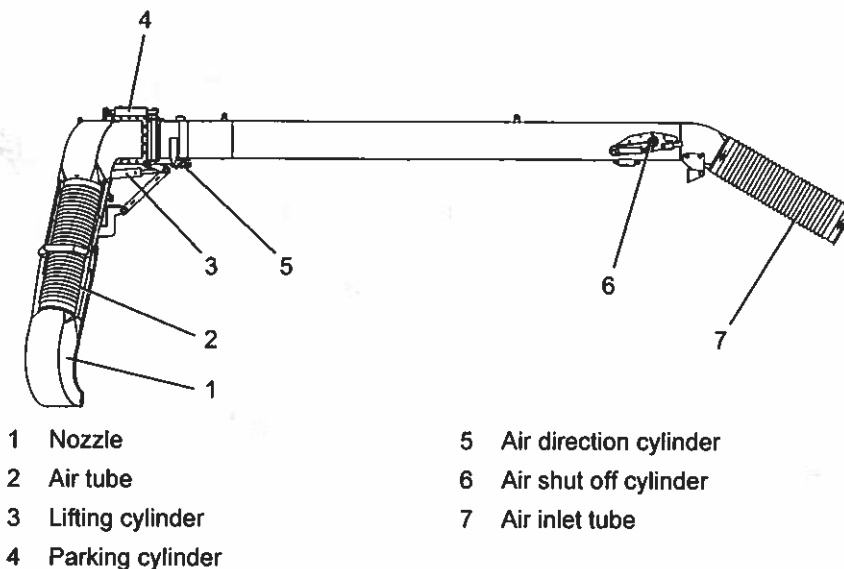


Figure 150: Front air system

The front air system is designed to let a part of the air flow in front of the brush. There is an air tube on top of the blower housing that lead-off air to the air shut off throttle. The throttle opens when air shall be lead in front of the brush.

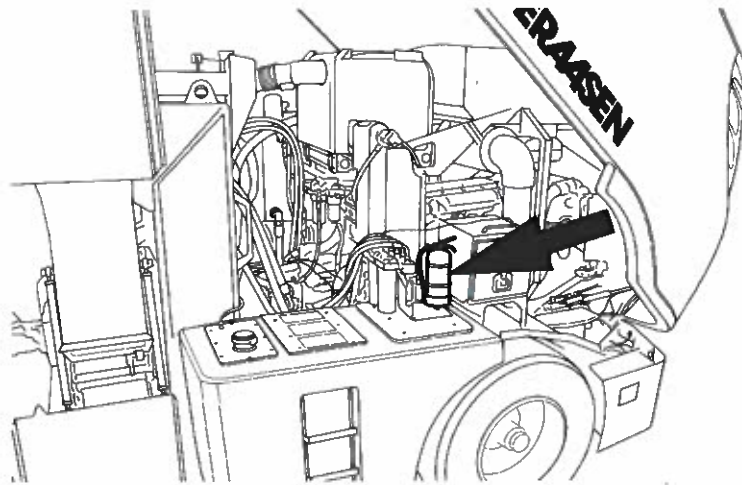
There is an air direction throttle that directs the air to the left or right air nozzle depending on the working position.

When the sweeper is in transport position or the front air function is de-selected the front air system is lifted and the nozzles are lifted and in parking position.

### 3.16 Fire Extinguisher

(Optional Equipment)

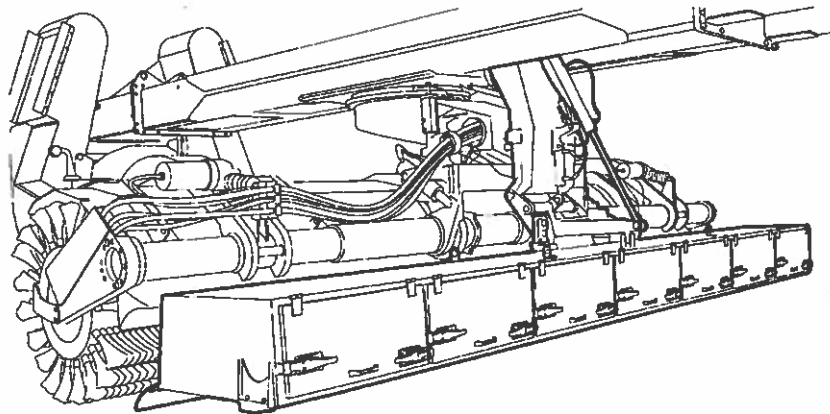
There is a fire extinguisher placed on the left side of the engine. Follow instructions on the label of the fire extinguisher for use.



*Figure 151: Fire extinguisher*

### 3.17 Dust box (extra equipment)

The dust box is mounted in front of the brush and is open towards the brush.



*Figure 152: Dust box*

When in use, the dust box is lowered towards the ground and the brush sweeps dirt into the dust box's containers. The containers are emptied by opening the hatches at the front. The hatches are hydraulically operated.



### 3.18 Magnetic sweeper (extra equipment)

#### **WARNING!**

**This equipment includes one or more extremely powerful magnetic circuits. The magnetic field may be much stronger than the Earth's background field at a distance several times the largest dimension of the equipment. Danger of injury. Read the attached manual before use!**

The magnetic sweeper is mounted on the sweeper.



*Figure 153: Magnet sweeper*

When in use, the magnetic sweeper is lowered towards the ground. Please see attached manual for detailed description and operation.

## 4 Operation

**— WARNING! —**

Check that no unauthorized personnel are in the vicinity of the sweeper when starting and during operation. Risk of personal injury.

**— WARNING! —**

Always use ear protection when the sweeper is in operation. Risk of damage to hearing.

**— WARNING! —**

It is dangerous to remain in the vicinity of the brush and air nozzles during operation. Stones, gravel and other particles are ejected from the machine with great force. The jets of air are very powerful. Risk of personal injury.

**— WARNING! —**

The rear wheel steering is powered by hydraulics.  
The Runway Sweeper's engine must always be running when driving the truck. That is to ensure that the rear wheel steering is active.

**— WARNING! —**

Always check that the manual parking brake on the trailer is disengaged before driving  
Always check that the trailer is rolling freely without resistance during the first meters of driving  
Driving with activated parking brake will after short time result in overheated brakes.

**— NOTE! —**

Check if any maintenance tasks is due before and after using the equipment.  
Perform daily maintenance every day.

## 4.1 Start the Engine

### WARNING!

Always start the truck's engine before starting the sweeper engine. The Runway Sweeper's engine must always be running when driving the truck. That is to ensure that the rear wheel steering is active.

### NOTE!

Before moving the sweeper, start the truck's engine and fill the air brake system. Then push the red parking valve on the Runway Sweeper to release the parking brake.

### NOTE!

When starting to drive, make a small turn to allow the angle sensor to pass the center.

### 4.1.1 Start

Prerequisites: The sweeper is in any position and the engine is stopped.

- 1 Check that no emergency stop switch is pressed in.

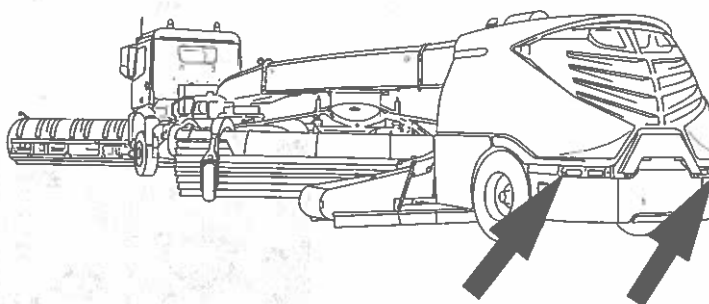


Figure 154: Emergency stop switch



Figure 155: Emergency stop switch in the cab, Scania

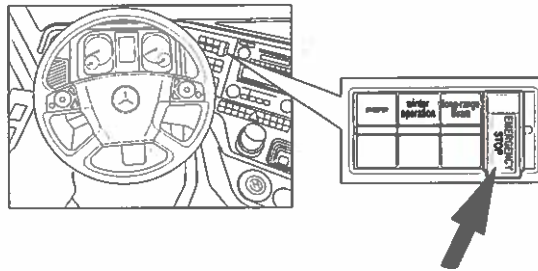


Figure 156: Emergency stop switch in the cab, Mercedes

- 2 Open the service hatch and turn on the main switch.



Figure 157: Main switch

- 3 Switch on the sweeper switch in the cabin and wait until system is ready.



Figure 158: Sweeper switch in the cab, Scania

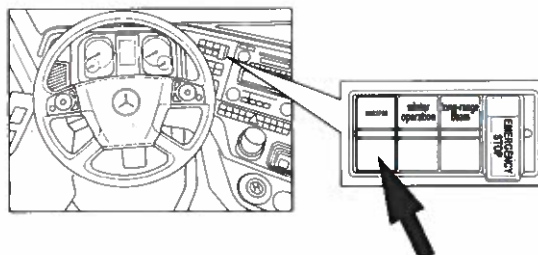


Figure 159: Sweeper switch, Mercedes

If there is no engine symbol and no sweeper icon picture on the display you must:

- a Switch off the sweeper switch
  - b Check that the main switch is on
  - c Check that the emergency stop switches are released
  - d Check that the manoeuvre cable is connected between the truck and the sweeper
  - e Switch on sweeper switch again
- 4 Press and hold the engine start button and release when the engine is running.

#### NOTE!

If the engine does not start immediately, do not let the starter motor to run for more than 20 seconds at a time. Wait 60 seconds before next starting attempt to let the starter motor to cool down.



Figure 160: Engine start

#### WARNING!

Check that nobody is in the vicinity of the brush or blower before selecting reset and preheat. Risk of personal injury.

#### NOTE!

If the engine's coolant temperature is lower than +0°C, the sweeper must be preheated before work may begin.

- 5 Select OK to reset position and start the preheat sequence. The brush and blower moves into transport position and the preheat sequence starts.

#### Comments

It is possible to abort the reset position and preheat sequence. Only the engine will run and the rear wheel steering will be active. No manoeuvre hydraulics, brush or the blower will be active.



*Figure 161: Reset position and preheat*

During the reset position and preheat sequence, the brush and blower rotate and the engine speed increases from idle. The display shows the coolant and hydraulic oil temperatures and a green brush/blower symbol.

- 6 The sweeper is now in transport position.