Technical Manual

Z 15/20

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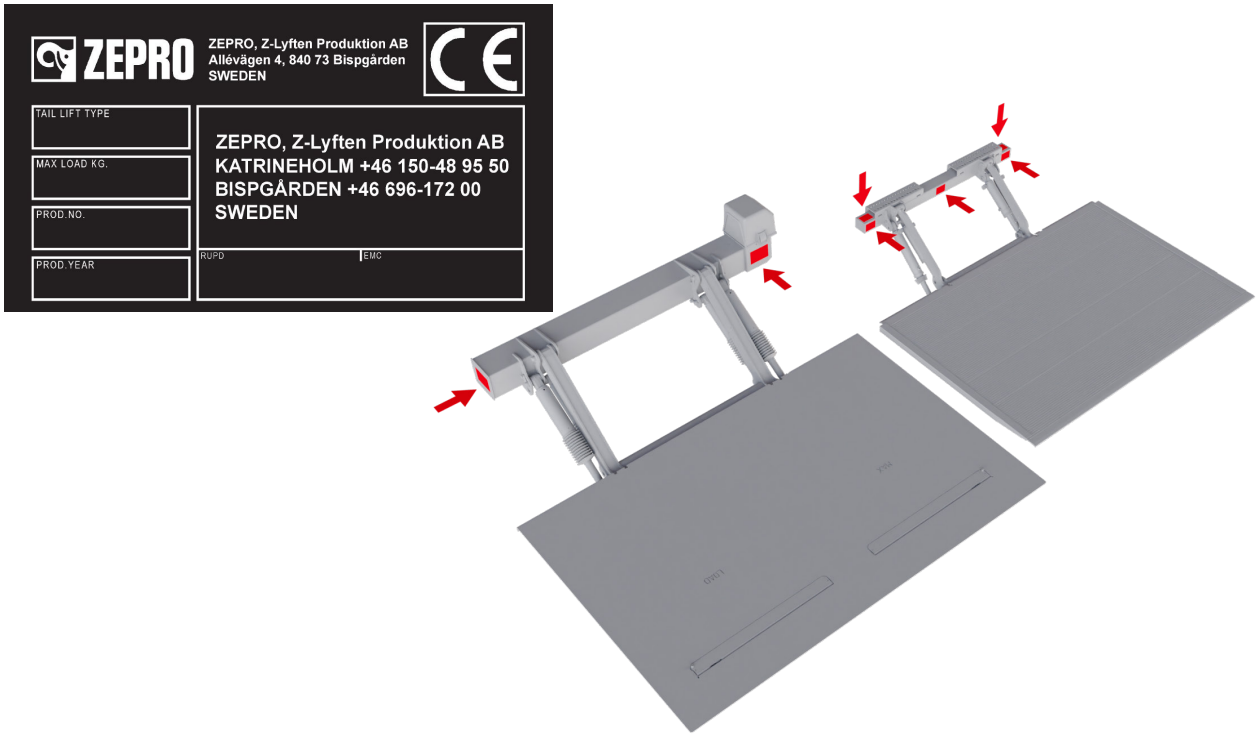
Contents

1 Product overview

1.1 Product variants and identification

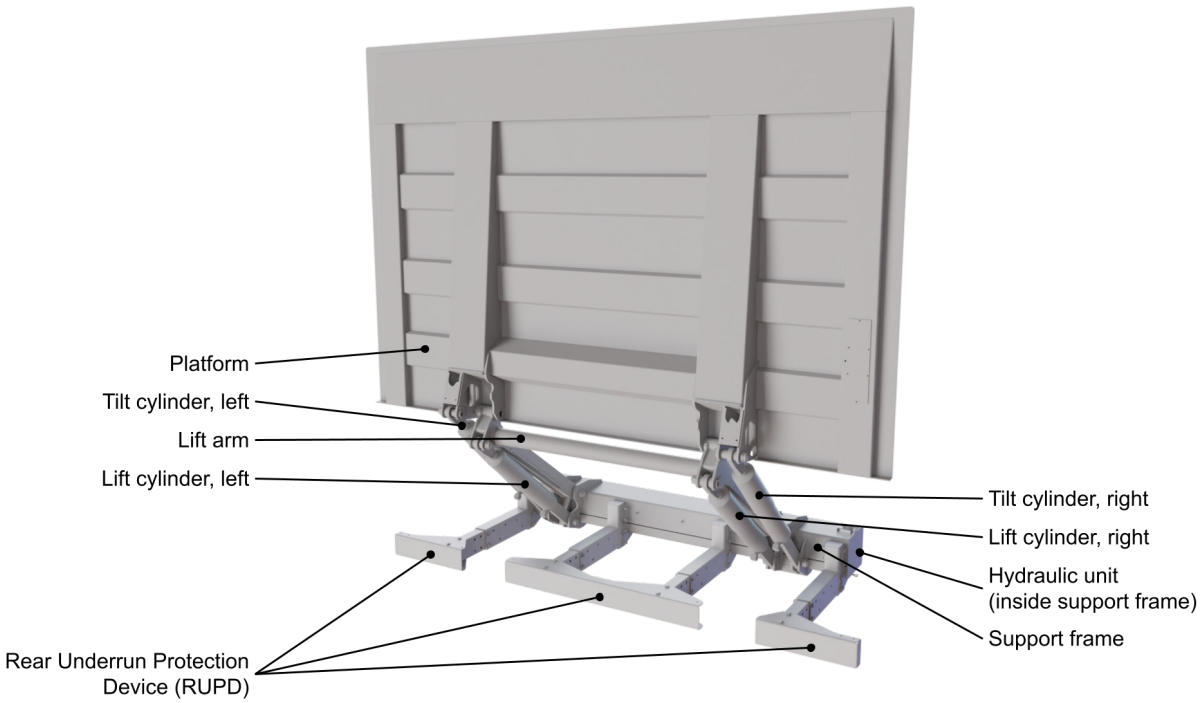
1.1.1 The type sign

The Z 15/20 product family is available in a number of different variants with varying levels of functionality. The control systems, cylinder configurations, available control units and sensors can vary between the variants. It is therefore crucial to first identify the variant at hand to be able to find the correct technical information for it.
The first step in the process of identifying the variant is locating the type sign and reading the information in the tail lift type-field.
The location of the typesign varies between different tail lift models but it is always riveted onto the support beam of the lift with the most common location being shown on the figure below.
There should also be a sticker showing the same information in the user manual and on the door sill on the drivers side of the vehicle. The information contained in this document is only valid for the Zepro Z 15/20 family of tail lifts.



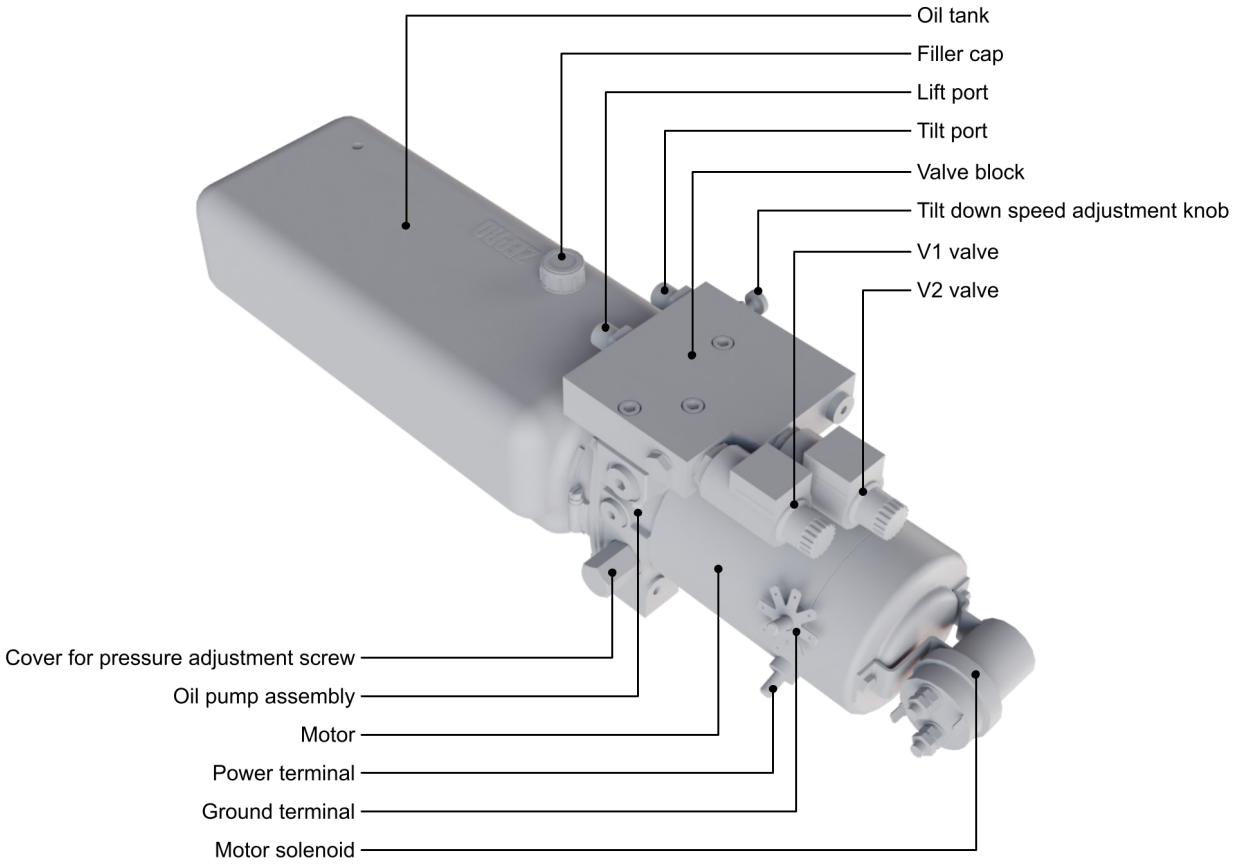
1.1.2 Main components

All variants of the Z 15/20 model family consist of the main components shown in the figure below. Most of these components are self-explanatory and will not be explained in-depth in this document. The Rear Underrun Protection Device is not required in some markets.



1.1.3 Hydraulic unit overview

The hydraulic unit consists of the major components shown in the picture below.
Explanations follow in the upcoming subchapters.



Motor solenoid

A motor solenoid is a type of electromagnetic device that uses a current flow through a helical wire (coil or magnet) inside it to create a magnetic field which moves an armature at the centre of the coil. The magnetic field is created when there is a current passing through the minor (smaller) terminals of the device, one of which is connected to an output pin on the control card, in this case to the Relay Card, and the other to a ground point on the motor. The movement of the armature is used to create a connection between the two major (larger) terminals on the device, one of which is connected to the battery (+) and the other to the power terminal on the motor. This connection effectively connects the motor to the battery.

Motor

An electric motor is a device that converts electrical power into mechanical power. It works by the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. It receives power through the power terminal, which is connected to the solenoid. The ground terminal on the motor serves as a ground point for parts of the lift that require one, such as the magnets on the V1 and V2 valves. The ground terminal is connected to the ground cable, which in turn is connected to a ground point on the vehicle.

Pump

A hydraulic pump is a mechanical device that converts mechanical power into hydraulic power that can be used to move a load. When the pump operates, it creates a vacuum at the pump inlet, which sucks liquid from the oil tank into the pump where, by mechanical action, it is forced through the outlet at a certain pressure and flow rate. The pressure varies depending on the load but the pump only creates enough pressure to create movement of the platform. The oil is then directed through the valve block and to the cylinders where it is used to create the desired motion. The pump is located inside the oil tank with its housing attached to the valve block and its shaft attached to the motor.

Valve block

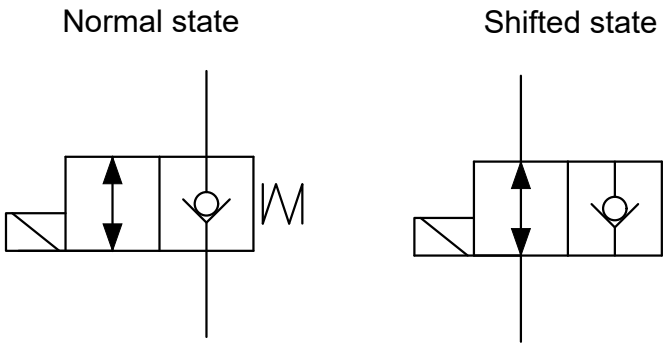
The valve block is located between the motor and the oil tank and consists of two separate aluminium blocks that are bolted together. The valve block houses the V1 and V2 solenoid valves used to control the oil flow through the system. A check valve is used to prevent damage to the pump by preventing reverse flow. An adjustable relief valve used to control the operating pressure and an adjustable constant flow valve used to control the speed of the tilt down motion. All the above are enclosed in the valve block.

Solenoid valve (Consists of valve and coil)

A solenoid valve is an electromechanical device used to control the oil flow in a hydraulic system. The valve consists of a solenoid which acts as a magnet when electrical current flows through it and pulls a plunger against a spring. In the normal position the solenoid is inactive and the plunger is pushed in the normal position by the spring. When the control system powers the solenoid, it overcomes the spring and moves the plunger in the active position.

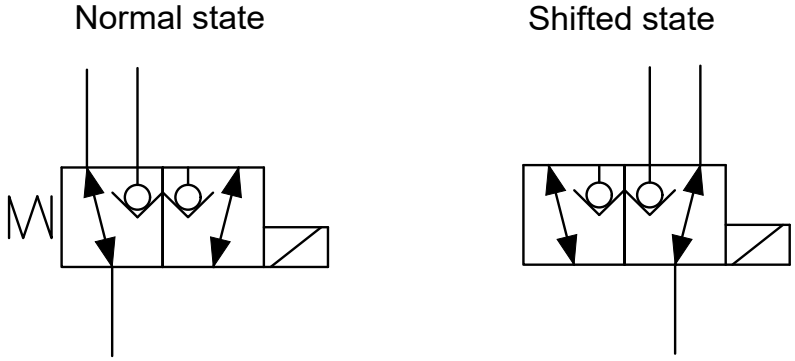
V1 valve

The V1 is a 2-position, 2-way, solenoid valve located inside the valve block on the hydraulic unit. The valve is normally closed and only opens when oil needs to flow back into the tank i.e. during lowering or tilting down. No oil can flow from the cylinders and into the tank while the valve is closed.



V2 valve

The V2 valve is a 2-position, 3-way, solenoid valve located inside the valve block on the hydraulic unit. It is used to direct flow to or from either the lift- or the tilt circuit. In its normal resting state the valve allows oil flow to and from the lift circuit but blocks oil flow to and from the tilt circuit. When shifted, it does the opposite, i.e. it allows oil flow to and from the tilt circuit and blocks flow to and from the lift circuit. The valve doesn't allow simultaneous oil flow to or from both circuits.



Oil tank

The oil tank is the main oil reservoir of the system. It is where stored oil is sucked into the pump from and returned to during operation. It is refilled by the filling cap on the top. There are markings on the outside of the tank showing the minimum and maximum levels for the oil which may not be exceeded. Refer to the users manual on how to check oil level.

1.1.4 Safety valves

The lift and tilt cylinders are equipped with safety valves which limit unwanted motion of the tail lift in the event of a hose failure by locking the oil into the cylinders. The valves are located on the cylinder ports and can be mechanical or electrical depending on the market requirements where the tail lift is being used.

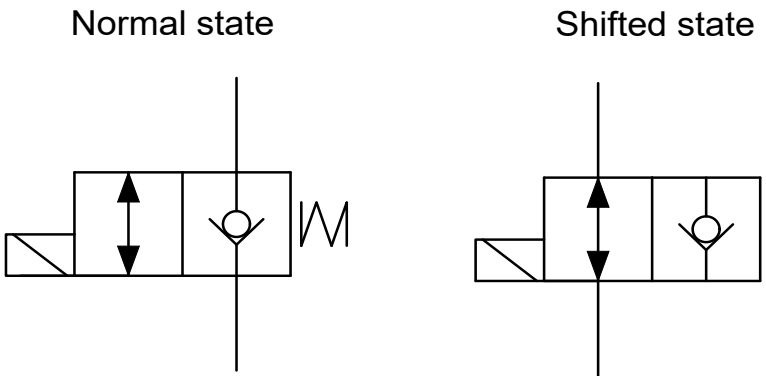
The most basic variant of the tail lift is equipped with mechanical safety valves at each cylinder. Other variants are equipped with two electrical safety valves, usually located on the right lift and the right tilt cylinders, and mechanical safety valves on the remaining two cylinders.

Mechanical Safety Valves

Mechanical safety valves are devices used to limit the flow of oil when a certain flow rate limit is exceeded, for example due to a hose failure. They are screwed into the cylinder port, between the cylinder and hose on each of the four cylinders. Since they are purely mechanical, they are not controlled by the Relay Card which means that there are no cables running through to them.

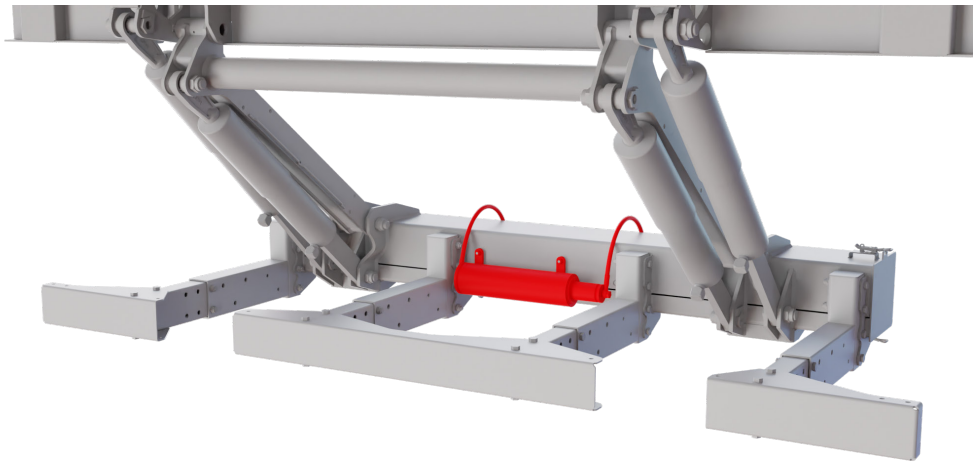
Electrical Safety Valves

Electrical safety valves are solenoid valves that are normally closed and don't allow oil to flow out from the cylinder but does allow free flow into the cylinder. For oil to flow out of the cylinder, the safety valve must be shifted, by sending voltage to the coil. During lowering of the platform, the safety valve on the lift cylinder, also known as the V4, is shifted to allow oil to flow out of the cylinder. During tilt down, the safety valve on the tilt cylinder, also known as V5, is shifted to allow oil to flow out of the tilt cylinder. Oil flow into the cylinders is always possible without the safety valve being shifted. This means that the valves are not shifted during the raise or tilt down motions. The easiest way to identify these valves is by the cable running through to them and by the fact that they're installed inside a valve block attached to the cylinder instead of sitting inside the cylinder port.



1.1.5 Auto tilt

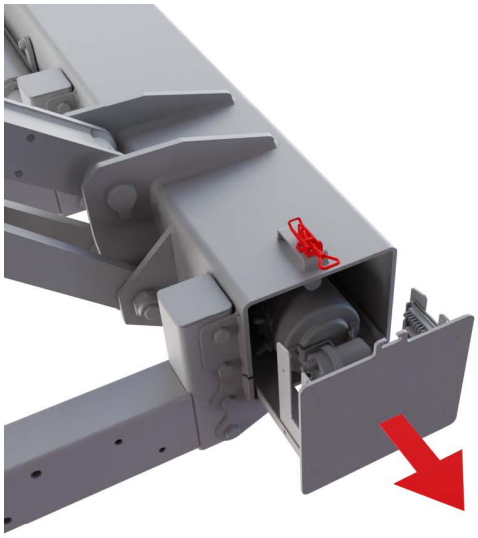
A tail lift equipped with auto tilt functionality automatically tilts the platform down, so the tip contacts the ground for easy transition of loads. This happens when the platform reaches the ground. It tilts back up to horizontal, to its original position, when you press the up button without any additional input from the operator. The Z 15/20 can be equipped with hydraulic auto tilt which is based on an additional, 5th, hydraulic cylinder usually located on the rear facing side of the support frame. The cylinder interconnects the lift and tilt paths of the hydraulic system and shifts oil between them to achieve the desired auto tilt functionality.

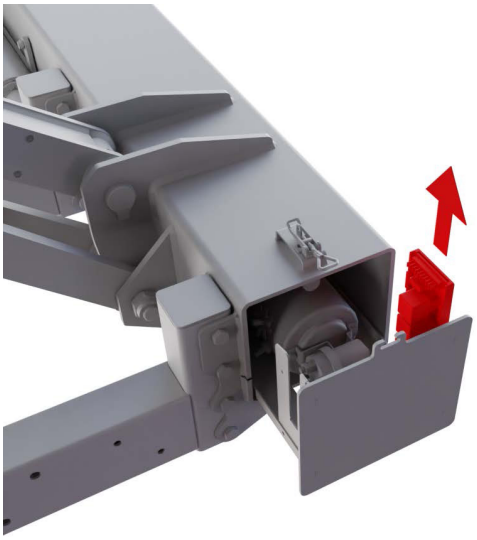


For more details on the Auto Tilt Functionality, a separate document titled “Technical manual - Hydraulic auto-tilt”. Please contact zeprotech@hiab.com for assistance.

1.2 Accessing the card and the haydralic unit

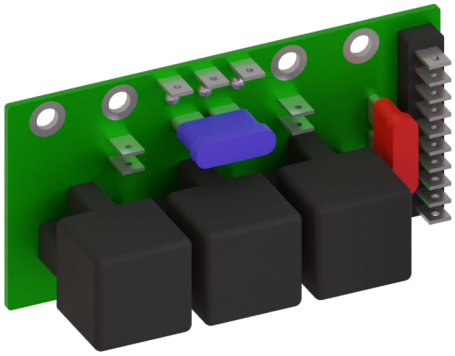
The Relay Card and the Hydraulic Unit are housed inside the main support frame of the tail lift right side when facing the Tail lift standing at the rear. They are accessed by unlocking the lock on the top and bottom of the support frame and pulling the tray out from the support frame. Once the tray is pulled out, the relay card is accessed by pulling it up and out of its slot. The Connection Card, when installed, is housed outside the main support frame inside a white sealed box. The box is usually secured to the chassis of the vehicle.



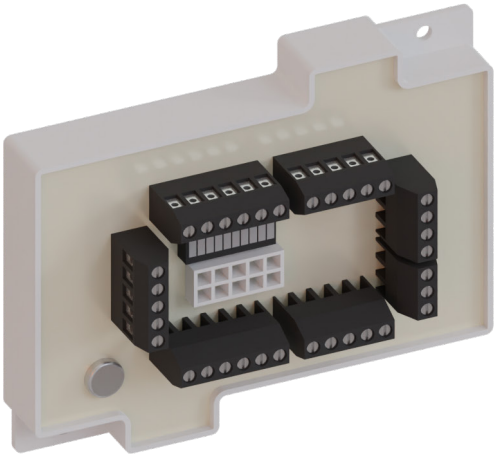


1.2.1 Control cards

The control card converts the inputs from the user and the sensors into outputs to the motor solenoid and the valves which accomplish the desired motion. The Z 15/20 is equipped with a relay card with three relays that acts as the primary control card. This card is used for the most basic models with simple functionality. The relay card can be extended with an additional Connection Card for additional functionality described below



Relay card



Connection Card

The Connection Card is used in the following scenarios:

1 The tail lift is used in a market that requires safety functionality such as:
   a. two hand operation while opening and closing against the box body.
   b. signal separation between control devices.

2. More than two control devices are required on the tail lift.

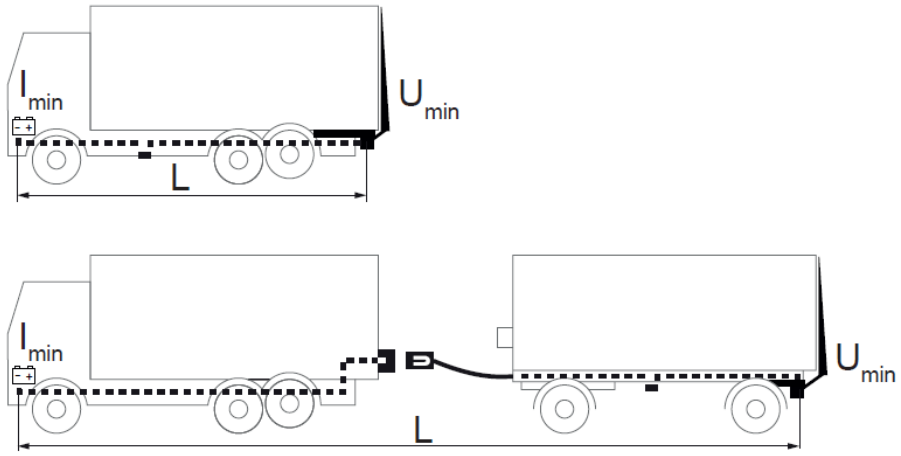
3. Radio control is required on the tail lift.

1.3 Battery and cable requirements

For proper function of the tail lift the electrical system needs to be sized per the following:

Item	12V	24V
Minimum battery capacity (I_{min})	180Ah	170Ah
Minimum voltage during operation (U_{min})	9V	18V
Cross sectional area of power cable, length up to 8m	35mm^2	35mm^2
Cross sectional area of power cable, length 8-15m	50mm^2	35mm^2
Cross sectional area of power cable, length over 15m	Not possible	50mm^2

The given cross sectional areas are valid for copper cables. If other conductor material is used proper conversion needs to be made in order to properly size the connection. The total length of the cable is measured according to the following figure.



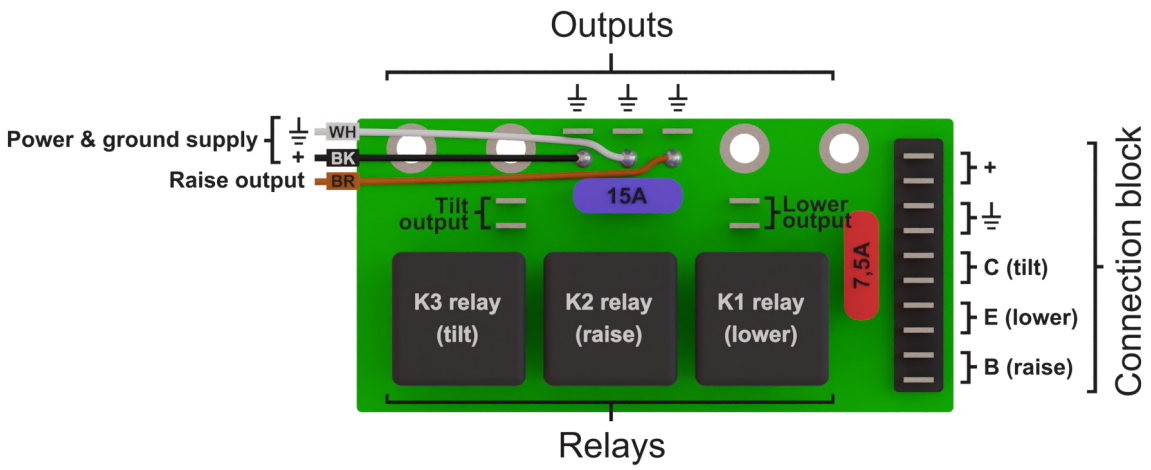
Some vehicle models have restrictions regarding the amount of current the lift can access from the existing battery and some vehicle models do not fully charge the battery. It may therefore be necessary to switch to a battery and sometimes also to a charger with a larger capacity. Manufacturer's instructions for connection to the vehicle's electrical system must be followed at all times.

2 Control card

2.1 Relay card

2.1.1 Overview

An overview of the relay card is shown below. The following chapters contain in-depth information on the different sections of the card.

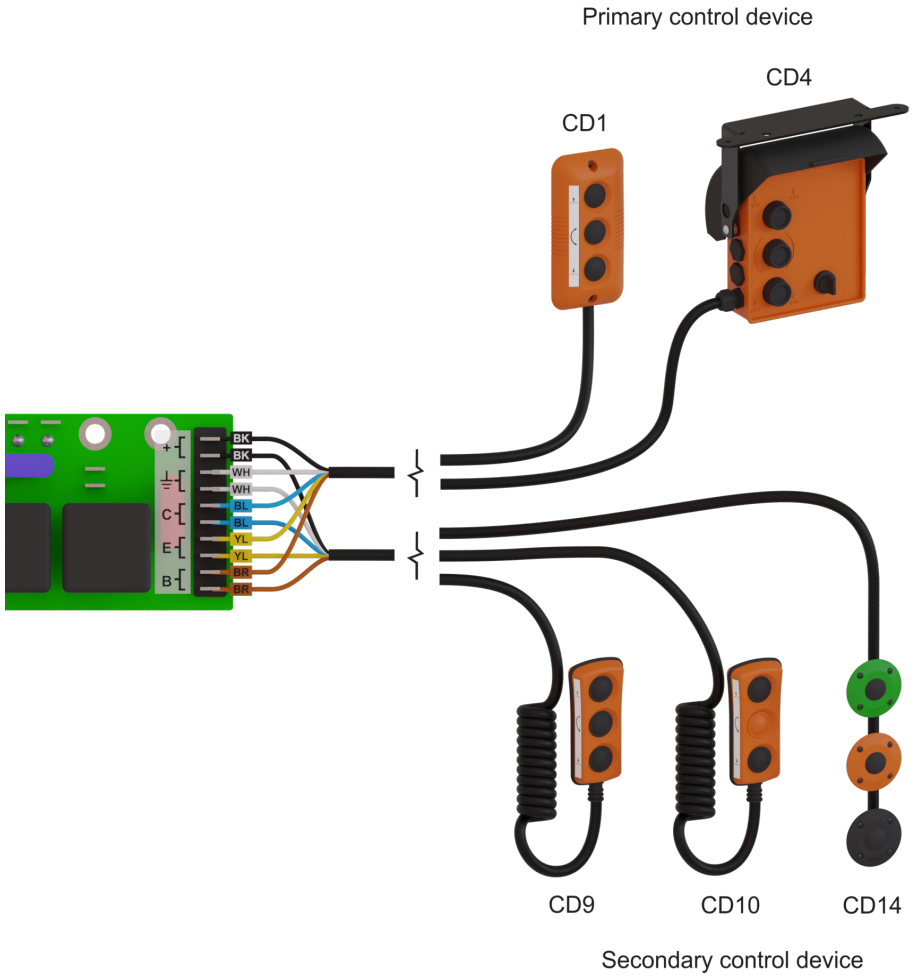


2.1.2 Connection block

The connection block on the right side of the card is used for control device input to the relay card. It consists of ten spade pins which are interconnected in couples to provide:

- 2 x power supply spade pins used to send voltage into the control device.
- 2 x ground spade pins used as ground points for the control device.
- 2 x C (tilt) output spade pins that send voltage to the card from the control device.
- 2 x E (lower) output spade pins send voltage to the card from the control device.
- 2 x B (raise) output spade pins send voltage to the card from the control device.

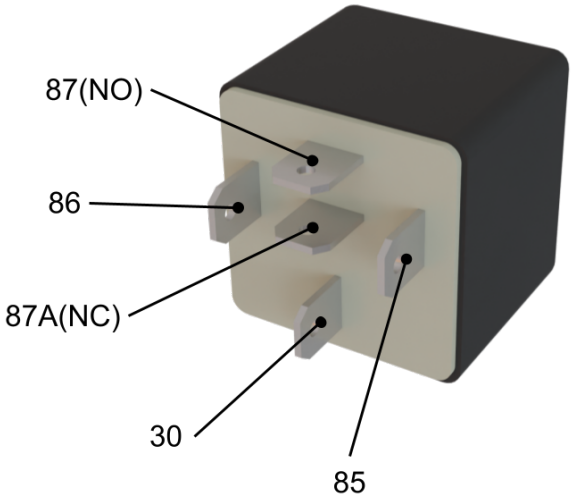
The Relay Card can accommodate up to two control devices, for example, one fixed and one spiral cable device which are connected directly to the terminals. Diagram below shows options for connecting either CD1 or CD4 in the primary inputs, not both. In the second input you have the option of using CD9 or CD10 or CD14. Connecting more than one wire to each terminal is not allowed. For cases where more than two control devices and/or advanced safety functions are required, a Connection Card must be added, see chapter 2 for more information. The output block is protected by the 7,5A fuse located next to it.

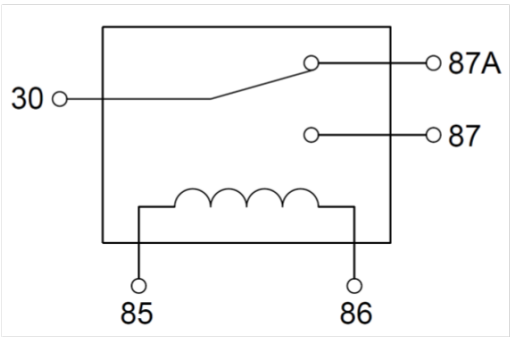


2.1.3 Relays

The relay card has 3 electric mechanical relays, sometimes defined as K1, K2 and K3 in the documentation, used to control the lower, raise and tilt functions respectively. The relays have basic terminals identified as 30, 85, 86, 87 and 87a. Note that 87a is not used on this card. In its normal state, terminal 30 is connected to 87a. Black relays are 24vdc and Brown relays are 12vdc.
Each relay has a coil between 85 and 86. 85 is always grounded. Terminal 30 is what we call common because it connects to either 87a or 87 terminal. Normally 30 is connected to 87a.
When voltage is applied to terminal 86, a magnetic field is created which moves the connection so, 30 connects to 87. The connections to the relays on the card are as follows:

- 85 is the ground point on all three relays for the coil.
- 30 is the main input and has 24vdc or 12vdc.
- 86 is the coil input from the switch. When voltage is applied to 86, the relay shifts so 30 connects to 87.
  •86 Lower (K1)relay or E terminal
  •86 Raise (K2) relay or B terminal
  •86 Tilt (K3) relay or C terminal





2.1.4 Outputs

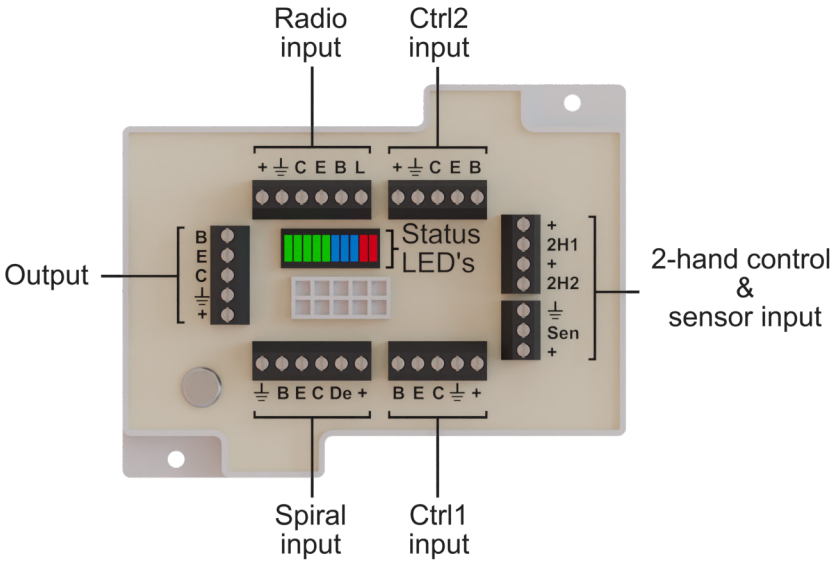
The card has 5 output terminals that go to operate the hydraulic power unit.

- 3 x ground spade pins usually for the magnets on the electrical safety valves.
- 1 brown wire for the raise function, usually used to activate the motor solenoid.
- 2 x spade terminals for the tilt function.
- 2 x spade terminals for the lower function.
- 1 black wire + (positive input power to the card and power to 30 on relays)
- 1 white wire which serves as a ground point for the relay card and the device(s) connected to it via the connection block. The wire is connected to the ground point on the motor.
  The outputs are protected by the 15A fuse located in the middle of the relay card.

2.2 Connection card

2.2.1 Overview

The Connection Card consists of seven discrete blocks containing 3-6 connection points each and a LED strip with ten LED's used to indicate active functions. The card is located in a separate white plastic box which is mounted on the vehicle close to the tail lift. An overview of the card is shown below.



The connection card is used to extend the functionality of the main relay card and must be used in the following scenarios:

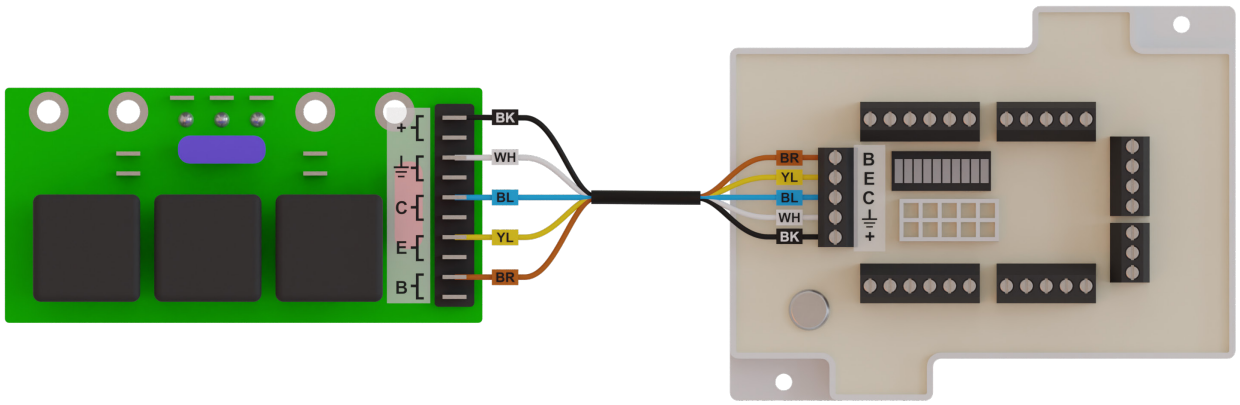
1 The tail lift is used in a market that requires safety functionality such as
   a. two hand operation while opening and closing against the box body.
   b. signal separation between control devices.
2 More than two control devices are required on the tail lift.
3 Radio Control is required on the tail lift.

2.2.2 Output block

The output block is located on the far left of the card and consists of the following five connection points:

- B: Outputs a raise-signal.
- E: Outputs a lower-signal.
- C: Outputs a tilt-signal.
- Ground: Ground source for the card.
- Power: Power source for the card.

The output block is used to connect the Connection Card to the Relay Card. The connection is done using a five-conductor cable as shown below.



2.2.3 Ctrl1 and Ctrl2 inputs

The Ctrl1 and Ctrl2 input blocks located horizontally on the top and bottom on the right side of the card are used to connect the primary control device(s) which are fixed on the outside of the vehicle. Ctrl1 is used for the primary control device on the curb-side and Ctrl2 is used for the device on the road-side or any other location, if required.

Each block consists of five connection points:

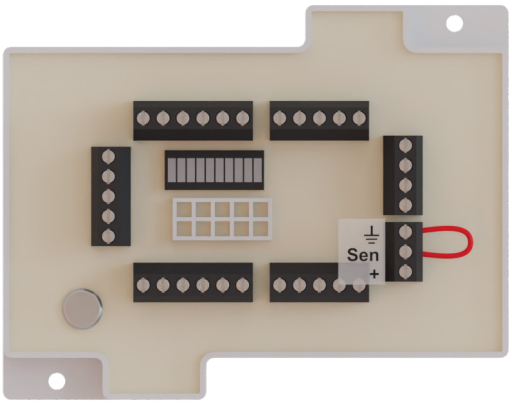
- B: Raise-signal input.
- E: Lower-signal input.
- C: Tilt-signal input.
- Ground: Ground source for the control device.
- Power: Voltage source for the control device.

2.2.4 2-hand control and angle sensor inputs

Usage of the 2-hand control and sensor input blocks located on the right side of the card varies depending on the legal requirements of your local market.

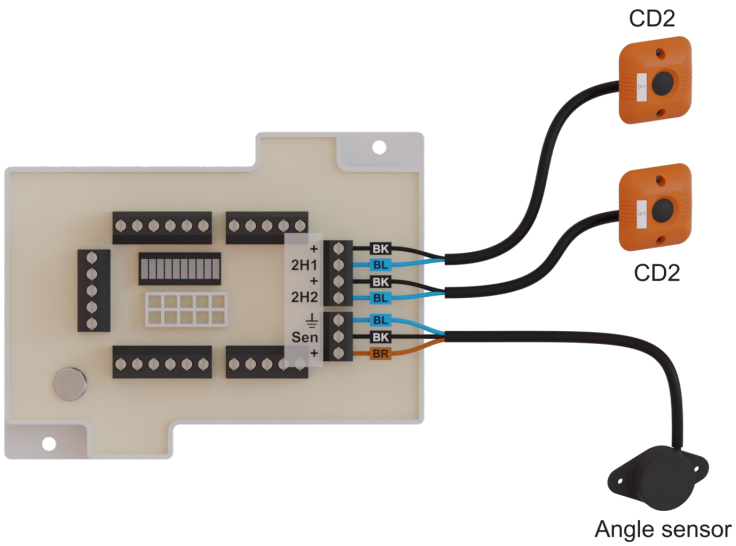
Without 2-hand control functionality

In the most basic configuration, the 2H input is not used and the sensor-input is bridged as shown below. This configuration means that opening and closing of the platform can be accomplished using one hand by pressing two buttons on the controller. It is not legal in all markets, check your local laws.



With 2-hand control functionality

In markets where opening and closing of the platform must be performed using both hands, an angle sensor and additional one-button control device(s) are installed as shown below. The one-button control device is sometimes referred to as CD2, Safety Button or 2H-button.



The angle sensor is active when the angle of the platform is within 45 degrees of horizontal and platform tilting is allowed with all connected control devices. Basically the first 45 degrees of opening or the last 45 degrees when closing. i.e. when the platform angle exceeds 45 degrees from horizontal, the sensor is inactive and tilting is only allowed with a primary control device in combination with a one-button device

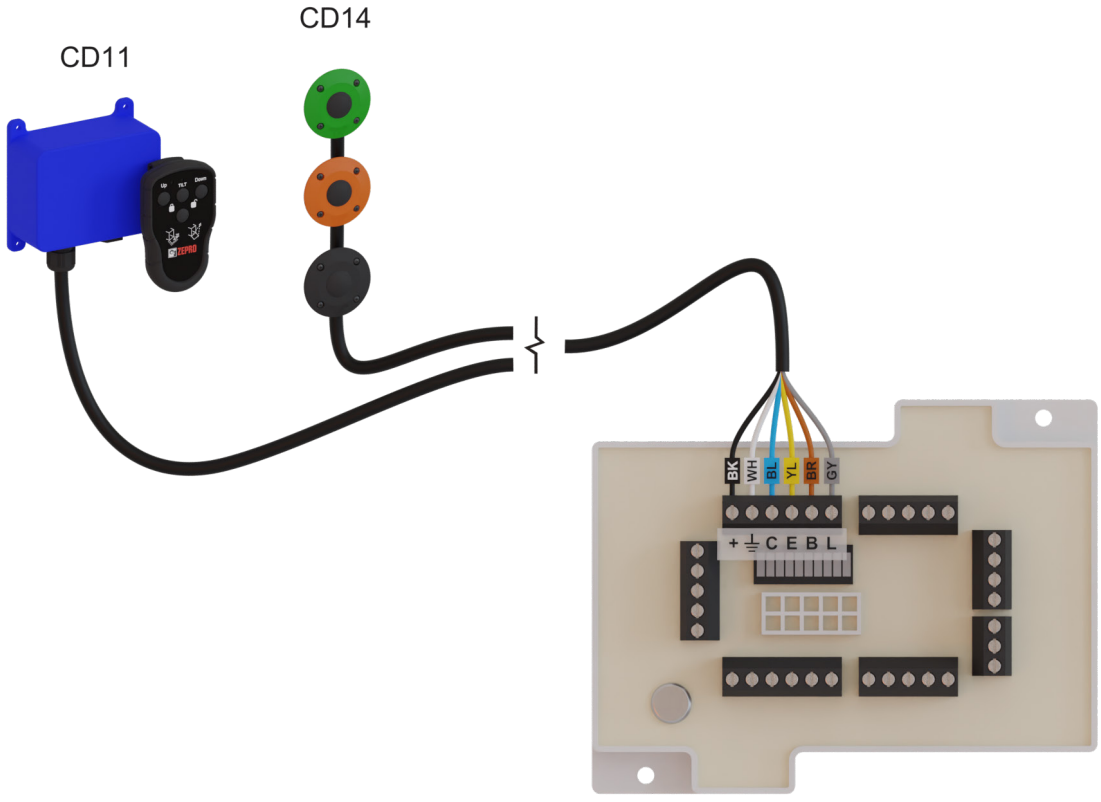
Note that each of the two primary control devices have their own one-button device. The button connected to 2H1 is used in combination with and installed on the same side as the control device connected to Ctrl1. The button connected to 2H2 is used in combination with and installed on the same side as the control device connected to Ctrl2.

2.2.5 Radio input

The radio input block is used for the external radio receiver sometimes referred to as CD11. It can also be used for foot controls, CD14. The devices are connected as shown below. Note that some devices have fewer wires than shown.

The block consists of six terminals:

- B: Raise-signal input.
- E: Lower-signal input.
- C: Tilt-signal input.
- L: Lock-signal input.
- Ground: Ground source for the control device.
- Power: Power source for the control device.

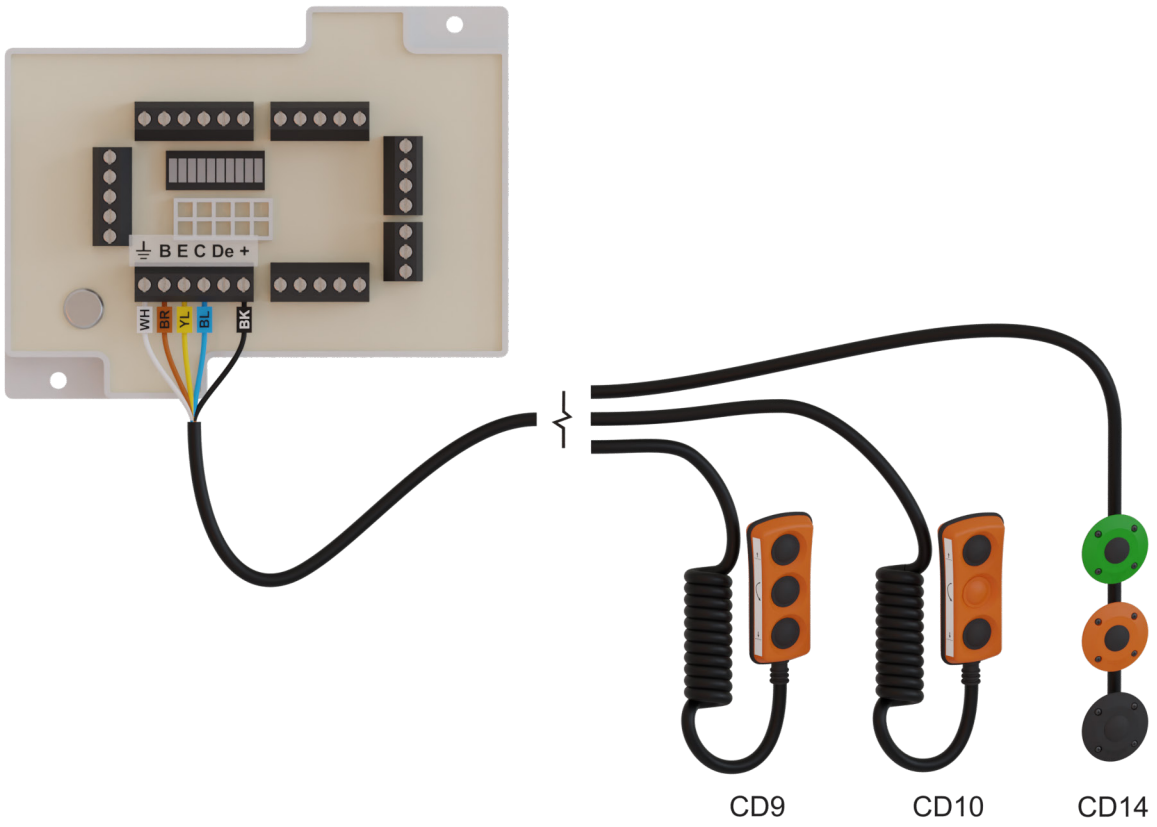


2.2.6 Spiral input

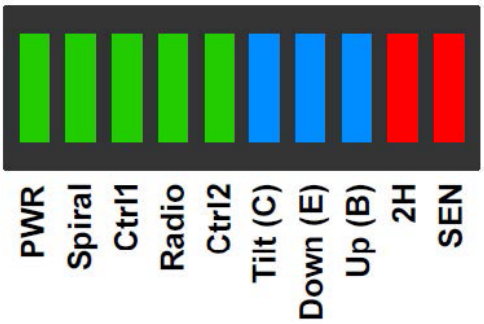
The spiral input block is used for the spiral cable control device sometimes referred to as CD9 (3 button) or CD10 (2 button) or remote hand held control. It can also be used for foot controls, CD14. The devices are connected as shown below. Note that some devices have fewer wires than shown.

The block consists of six terminals:

- B: Input for a Raise-signal.
- E: Input for a Lower-signal.
- C: Input for a Tilt-signal.
- De: Not used for anything.
- Ground: Ground source for the control device.
- Power: Power source for the control device.



2.2.7 Status LED's



Green LED's

PWR

Active LED indicates that the card has power and is active. This LED should never be OFF in normal circumstances.

Ctrl1, 2, Radio and Spiral Remote controllers

These green LED's indicate the status of the inputs from the two primary control devices, the radio and the spiral cable device. Each LED has three states:

- On: A button on the device is being pressed.
- Off: No button is pressed on the device.
- Flashing: There is an error, most likely a short circuit, in the control device.

Blue LED's

C, E and B

These blue LED's indicate the status of the C, E and B outputs. Each LED has three states:

- On: The output is active.
- Off: The output is inactive.
- Flashing: There is an error, most likely a short circuit, in the control device.

Red LED's

2H

This red LED indicates the status of the 2-hand control inputs. It has three states:

- On: A 2-hand button is being pressed.
- Off: No 2-hand buttons are pressed.
- Flashing: There is an error, most likely a short circuit, in the control device.

SEN

This red LED indicates the status of the sensor input. It has three states:

- On: Sensor is inactive.
- Off: Sensor is bridged to ground.
- Flashing: Sensor is active.

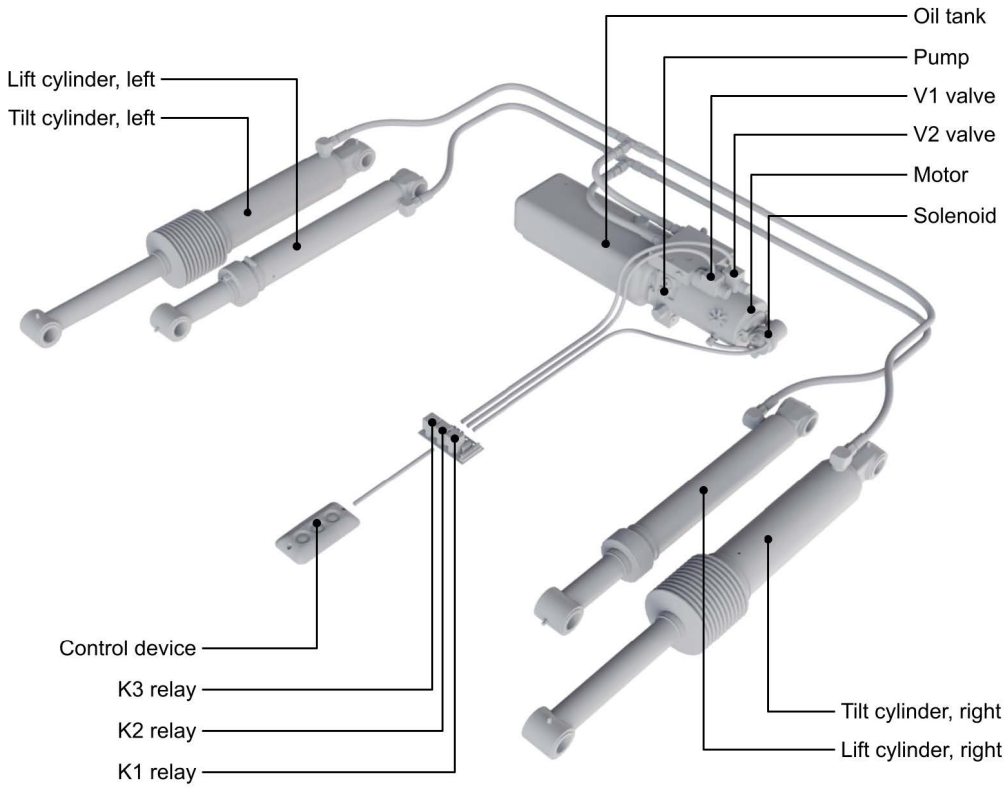
3 Functional descriptions and schematics

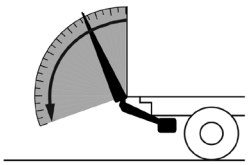
3.1 Mechanical safety valves

3.1.1 Relay card only (Most basic variant)

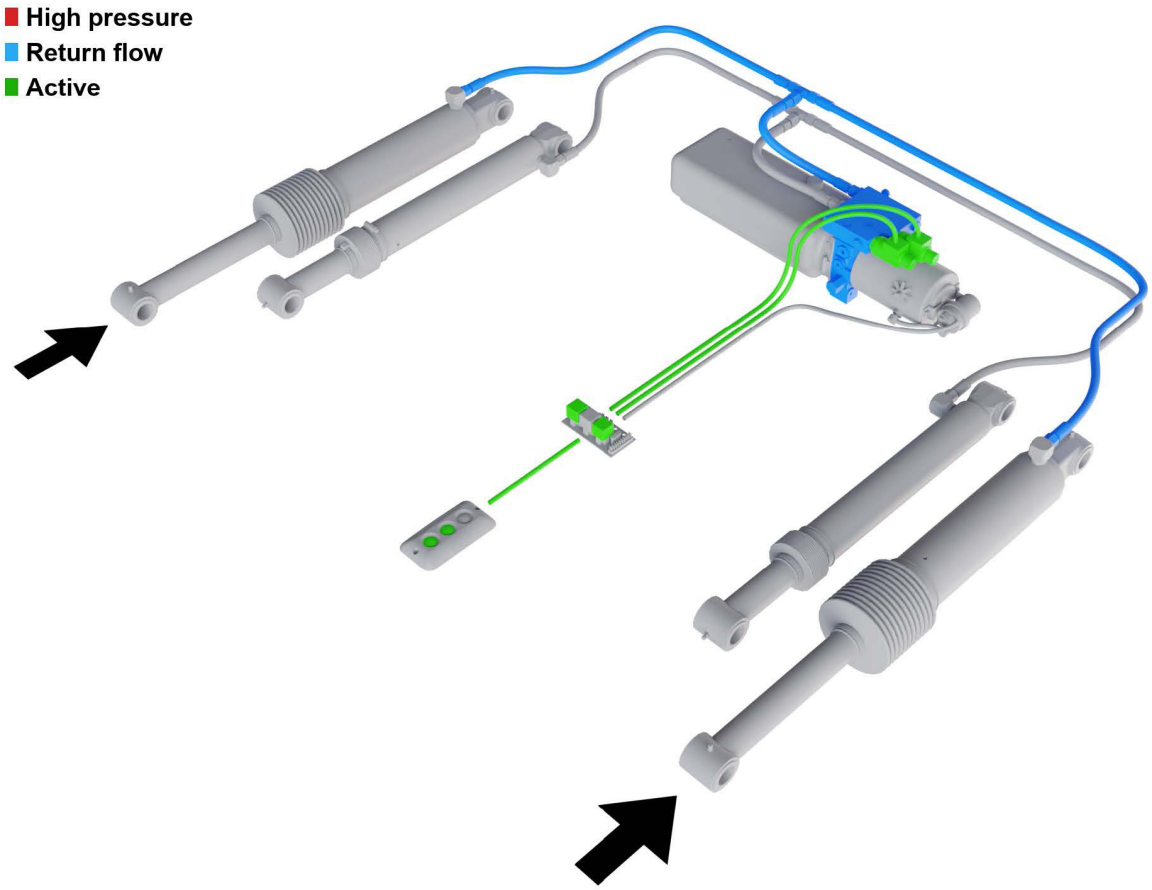
Overview

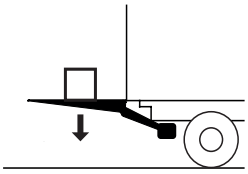
The Z 15/20 with mechanical safety valves and no Connection Card is a variant which uses a simple hydraulic system based on two electrically operated valves located at the valve block above the pump/motor-assembly and four mechanical safety valves, one on each cylinder. The electrically operated valves are controlled by the relay card and direct flow to or from the tilt or lift cylinders, depending on which function is active. The mechanical safety valves are used to lock the cylinders when a hose is ruptured, thus preventing unwanted motion of the tail lift. This variant can accommodate up to two control devices, both of which are connected directly to the terminal on the relay card. No sensors are used on this variant which makes it unsuitable for markets where two-hand safety functionality is required and is limited to 2 control devices only.



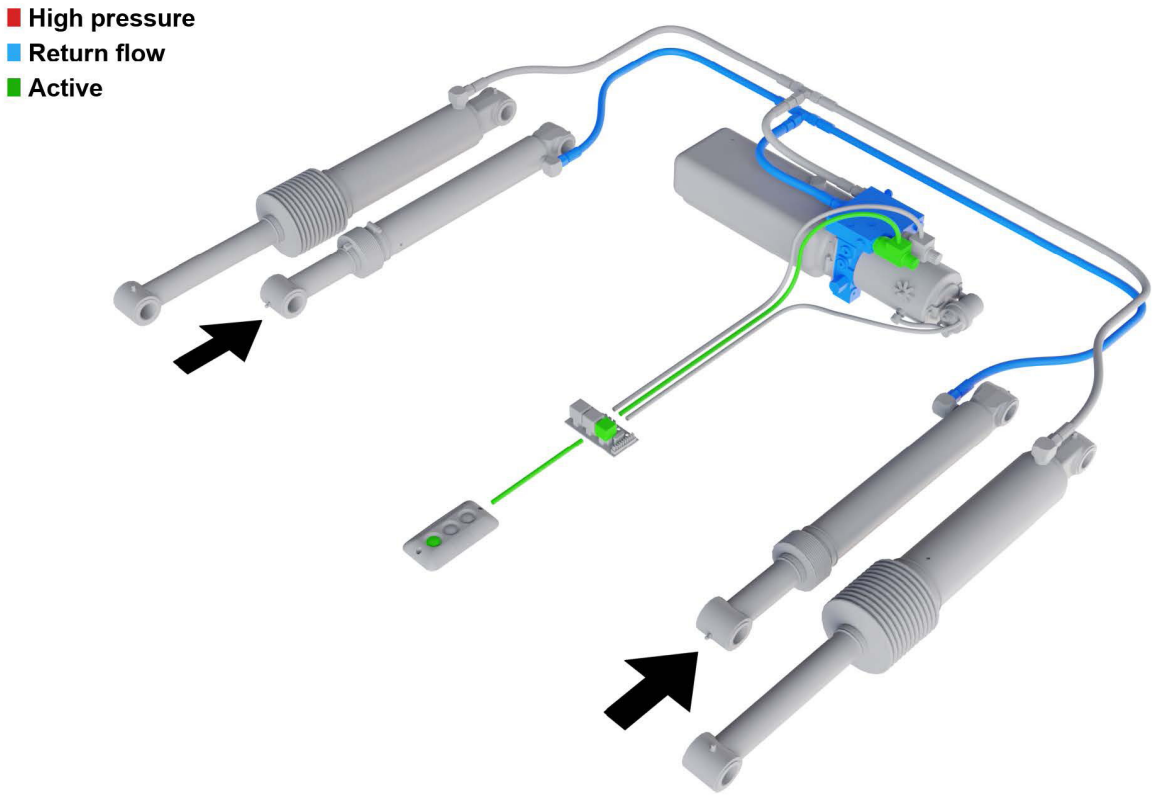


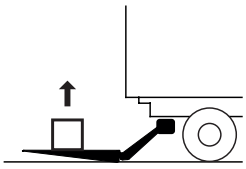
Z15/20
Function: Open/ tilt down
Description: Platform tilt down including opening from fully closed against body
Control input: Down (E) + Tilt (C)
Sensor input: None required for function.





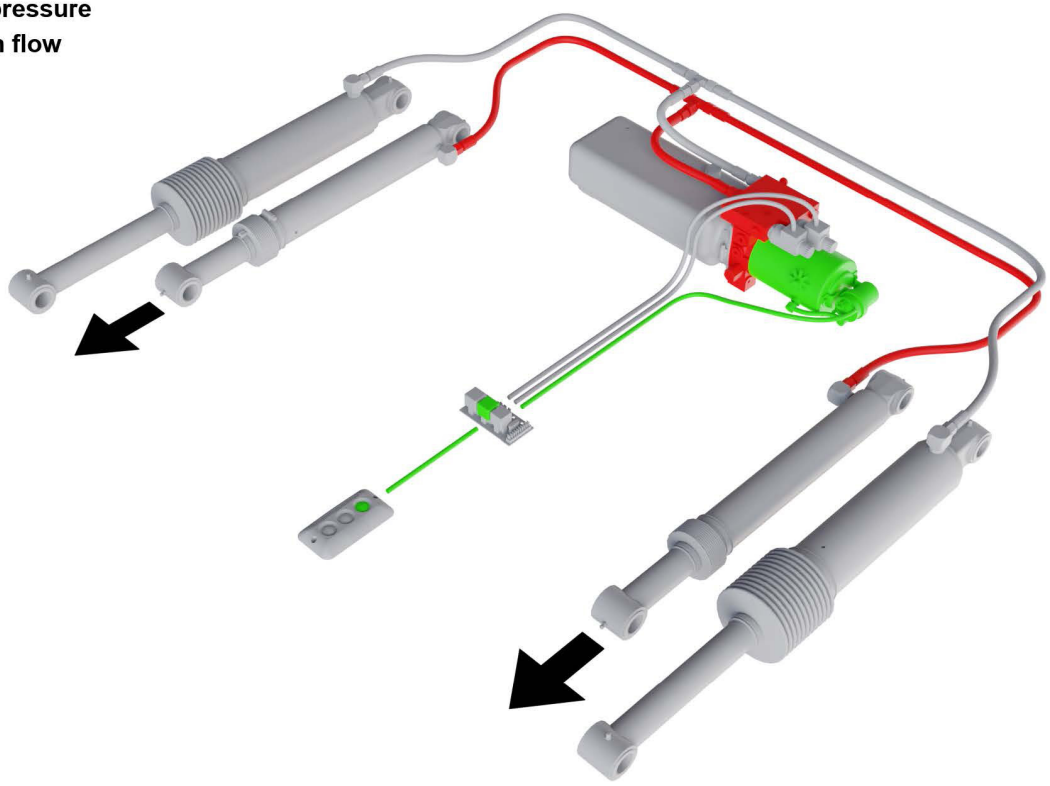
Z15/20
Function: lower
Description: Vertical platform lowering.
Control input: Down (E)
Sensor input: K1 (V1)

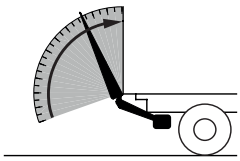




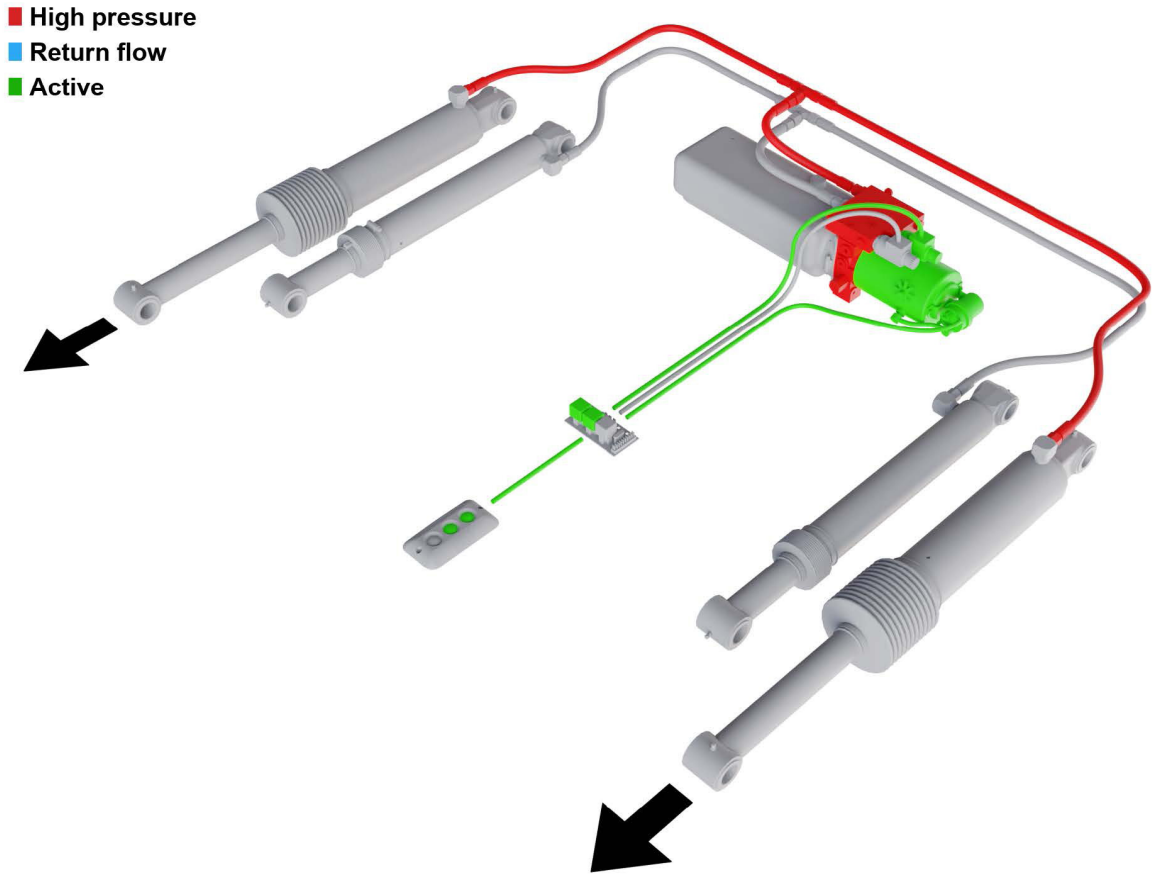
Z15/20
Function: raise
Description: Vertical platform raising.
Control input: Up B
Sensor input: K2 (Motor solenoid)

High pressure
Return flow
Active





Z15/20
Function: tilt up, close
Description: Platform tilt up including against the box body
Control input: Up (B) + Tilt (C)
Sensor input: K2 (Motor solenoid) + K3 (V2)

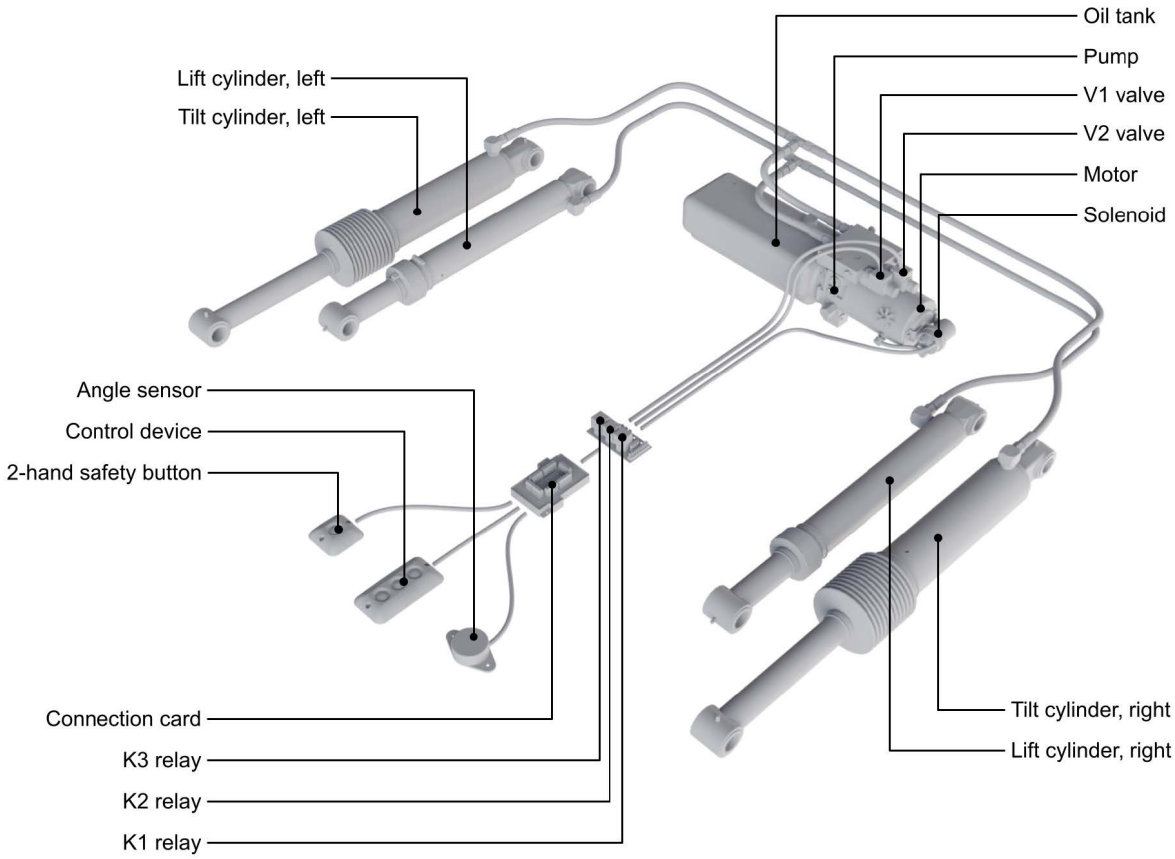


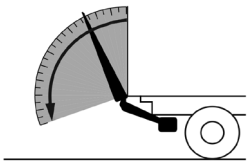
3.1.2 Relay Card with Connection card (mechanical safety valves)

Overview

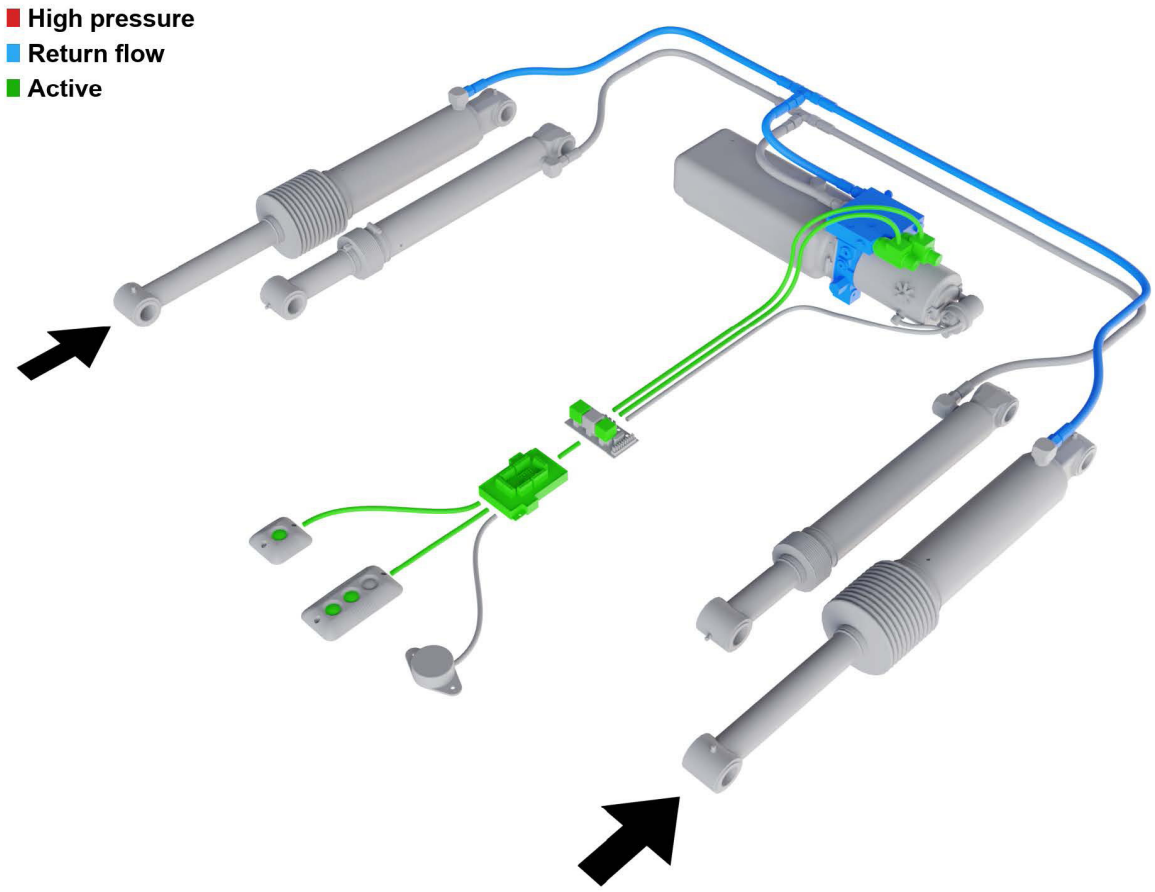
The Z 15/20 with mechanical safety valves and a connection card is a variant which uses a simple hydraulic system based on two electrically operated valves located at the valve block above the pump/motor-assembly and four mechanical safety valves, one at each cylinder. The electrically operated valves are controlled by the relay card and direct flow to or from the tilt or lift cylinders, depending on which function is active.

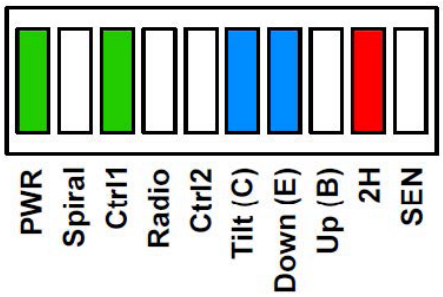
The mechanical safety valves are used to lock the cylinders when a hose is ruptured, thus preventing unwanted motion of the tail lift. The connection card extends the functionality of the relay card, allowing this variant to be equipped with up to four control devices and an angle sensor-based safety functionality which prohibits opening and closing using only one hand thus preventing operator injuries.



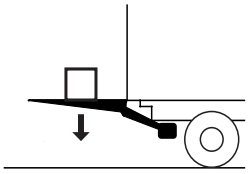


Z15/20
Function: open
Description: Platform opening from fully closed against box body to horizontal.
Control input: Safety button (2H) + Down (E) + Tilt (C)
Sensor input: Inactive angle sensor (doesn't send voltage to card) enables the safety button requirement in the initial 45° of opening
Active output: K1 (V1) + K3 (V2)

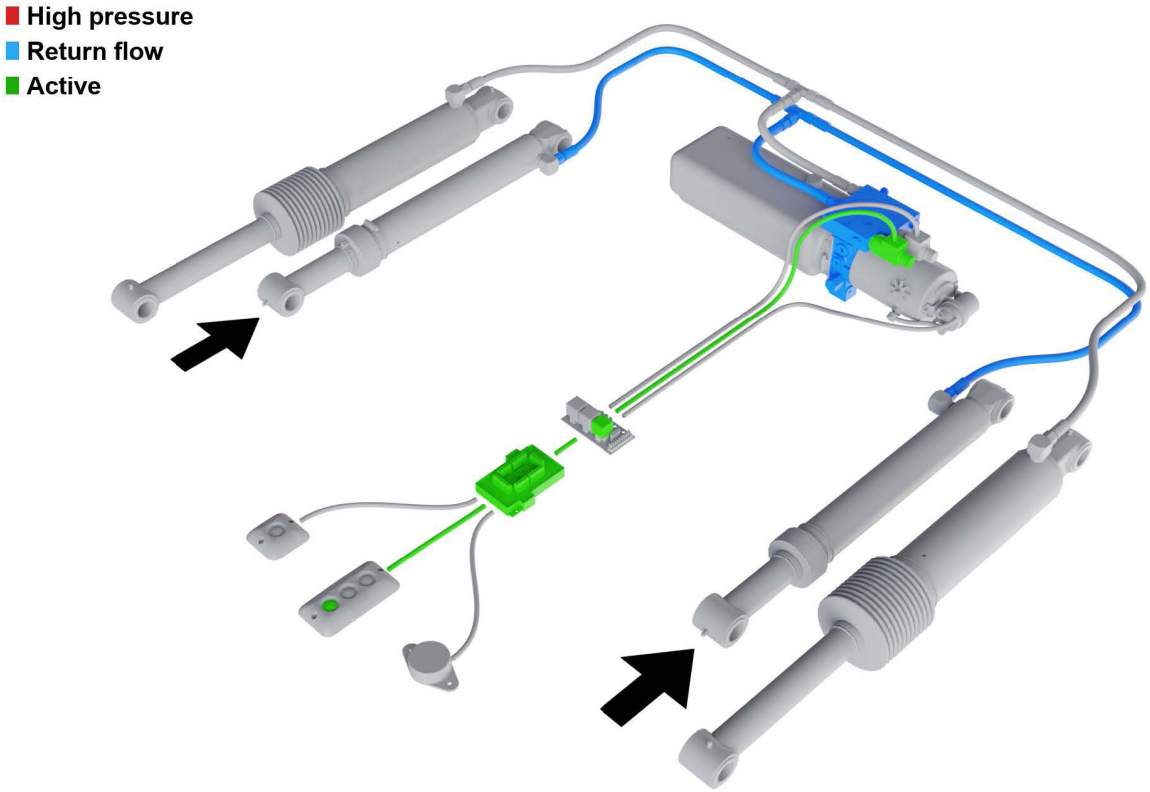




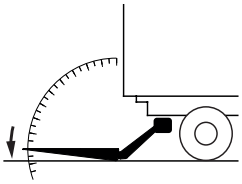
Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.



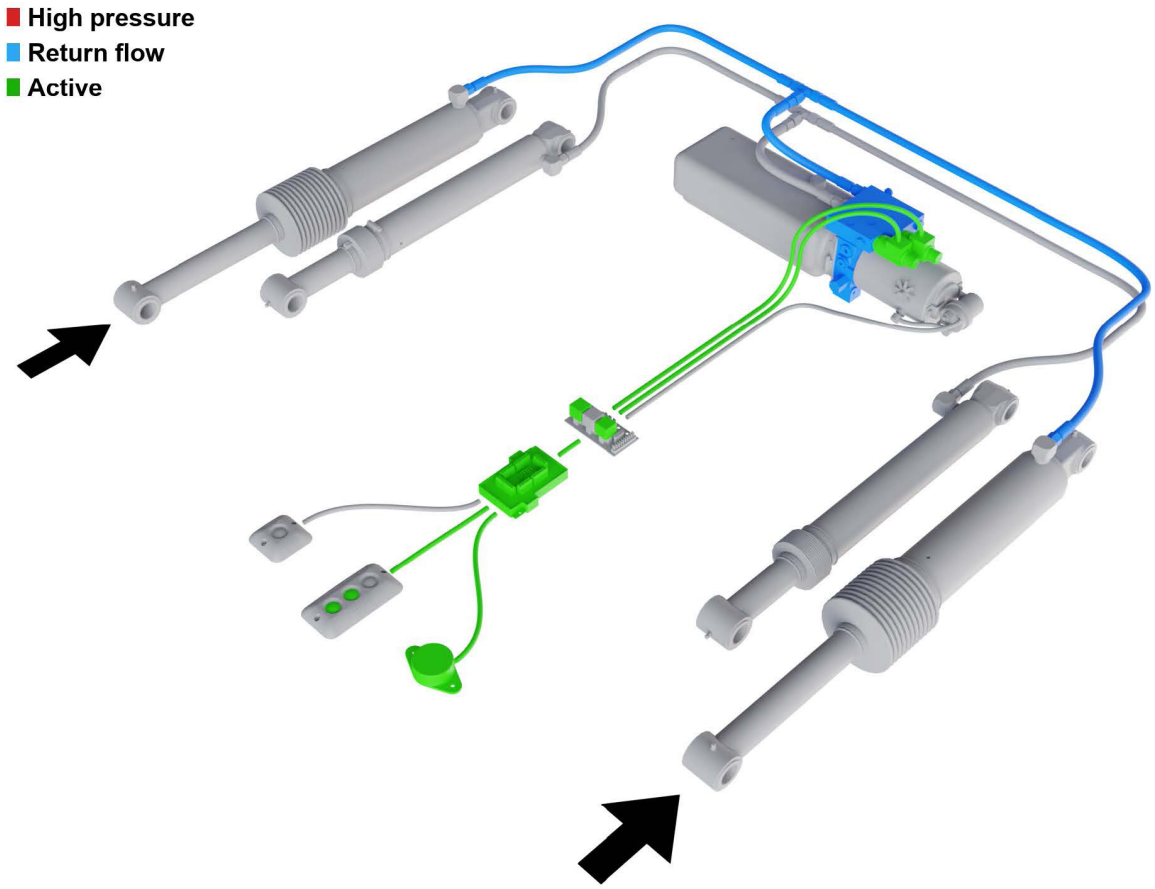
Z15/20
Function: lower
Description: Vertical platform lowering.
Control input: Down (E)
Sensor input: Function not affected by sensor
Active output: K1 (V1)

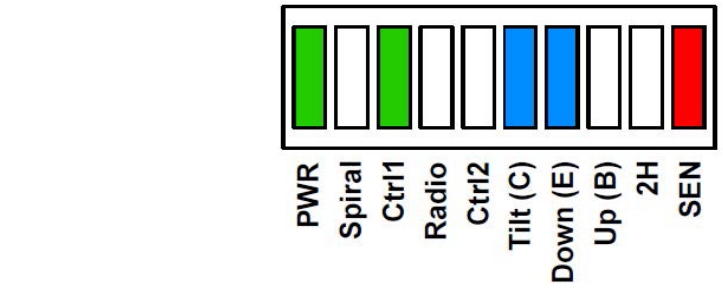


Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

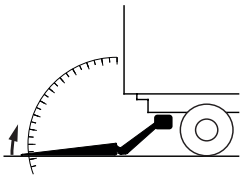


Z15/20
Function: tilt down
Description: Tilting down within +45/-10 degrees from horizontal.
Control input: Down (E) + Tilt (C)
Sensor input: Active angle sensor (sensor is sending voltage to card) disables safety button requirement when the platform is within 45° from horizontal
Active output: K1 (V1) + K3 (V2)

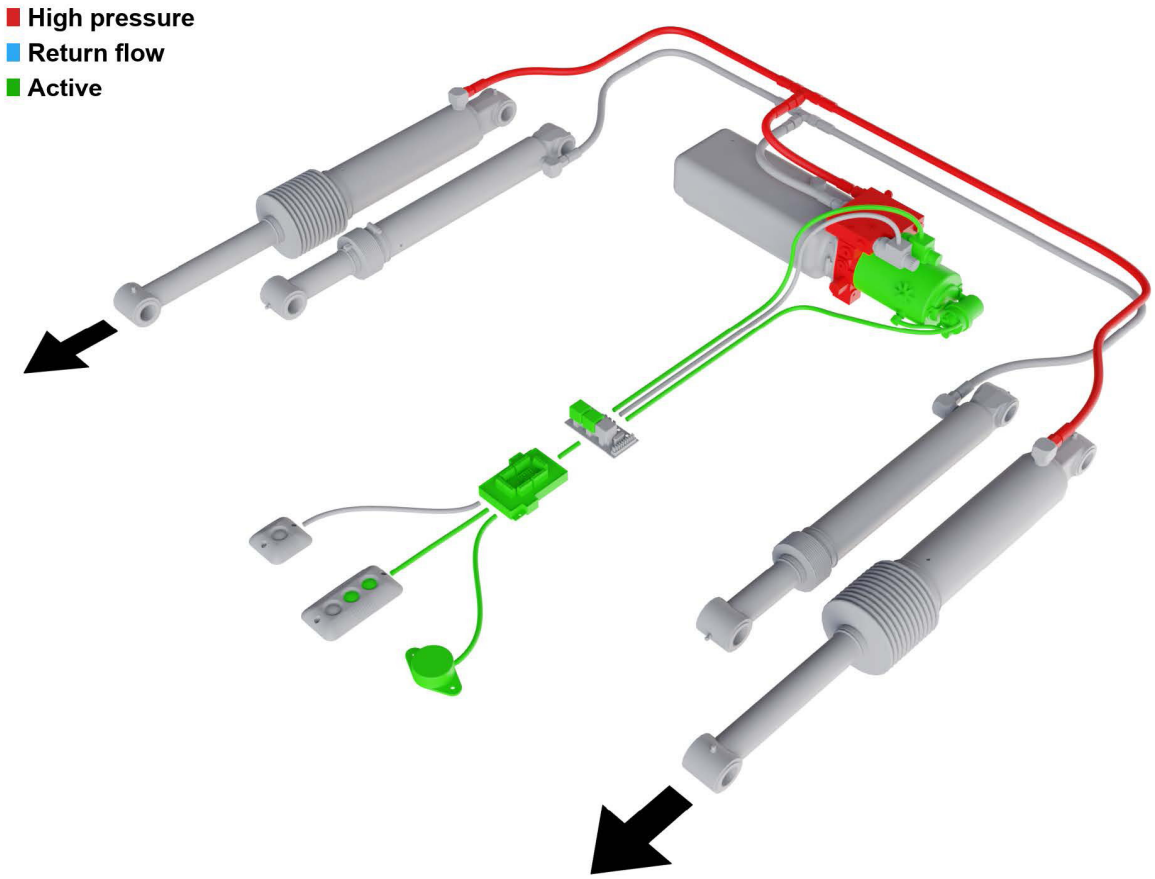


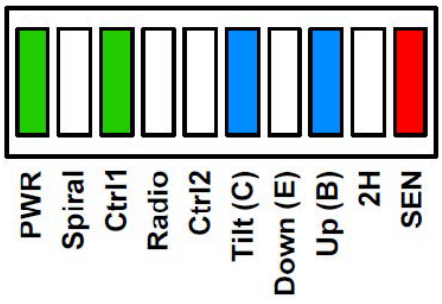


Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

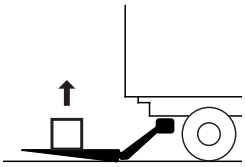


Z15/20
Function: tilt up
Description: Platform tilt up or closing
Control input: Up (B) + Tilt (C)
Sensor input: Active angle sensor (sensor is sending voltage to card) disables safety button requirement when the platform is within 45° from horizontal
Active output: K2 (Motor solenoid) + K3 (V2)

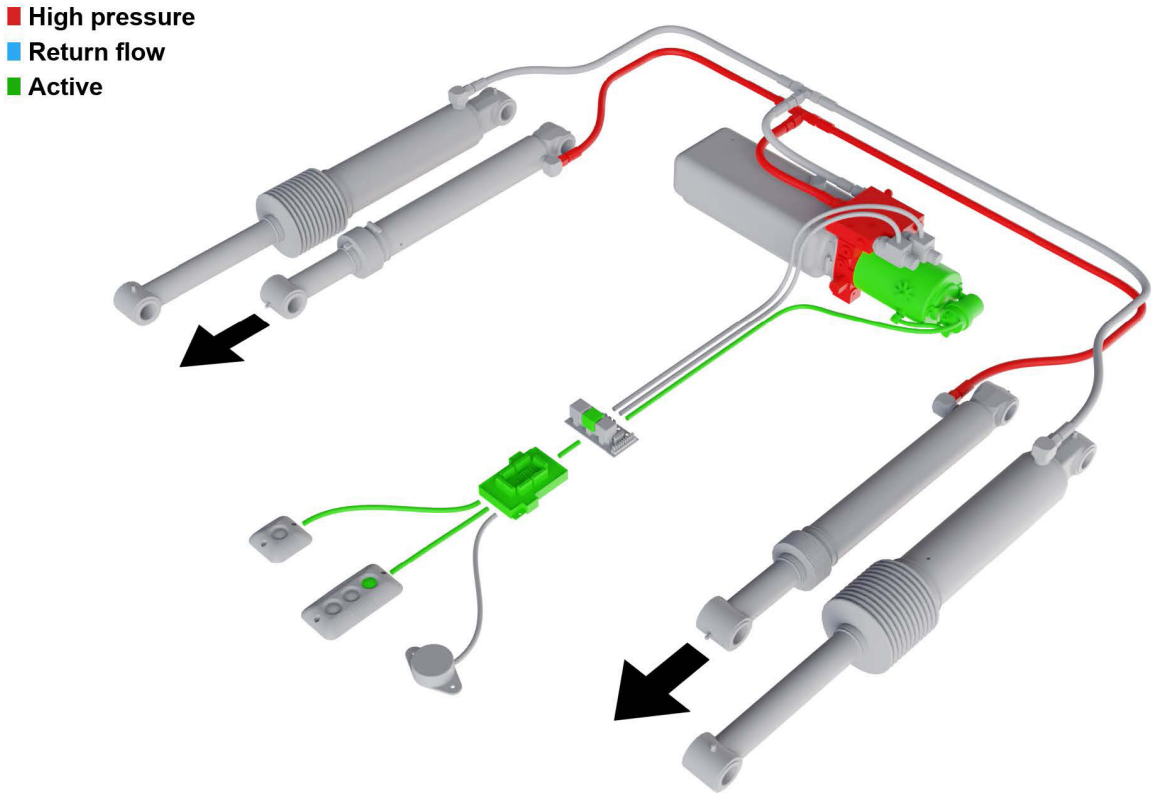


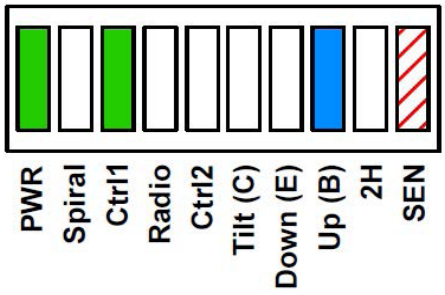


Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

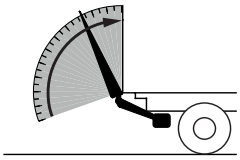


Z15/20
Function: raise
Description: Vertical platform raising.
Control input: Up (B)
Sensor input: Function not affected by sensor
Active output: K2 (Motor solenoid)

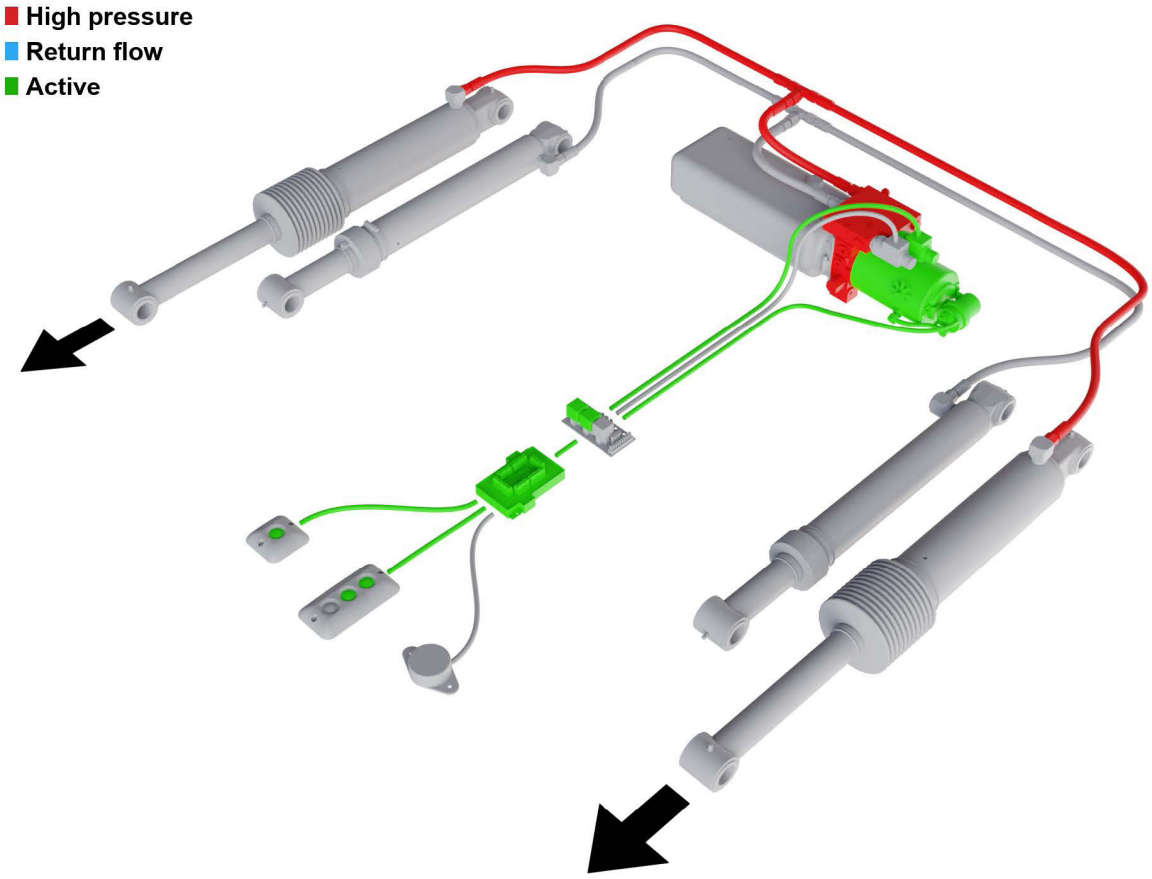




Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

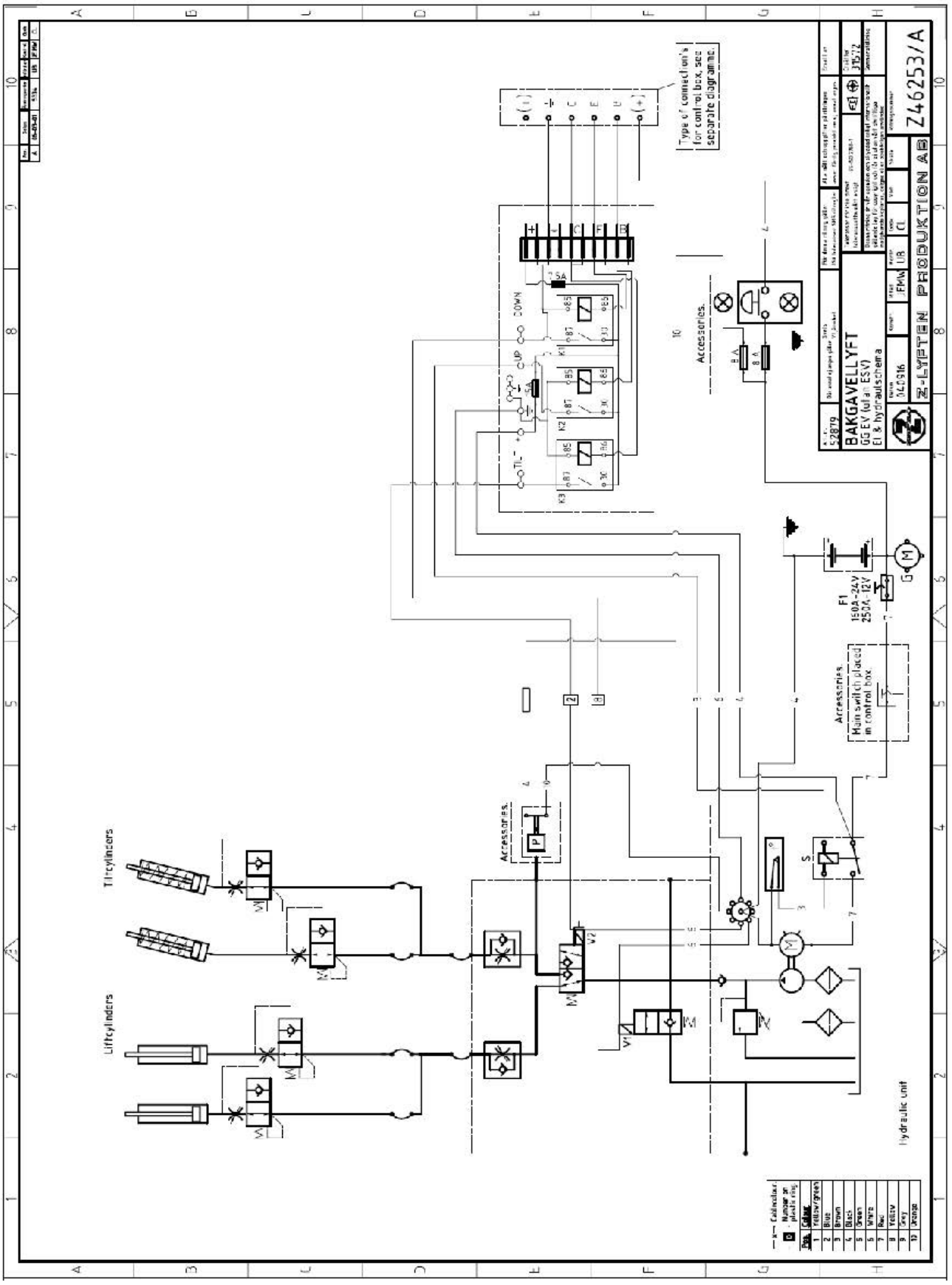


Z15/20
Function: close
Description: Closing fully against the box body.
Control input: Safety button (2H) + Up (B) + Tilt (C)
Sensor input: Inactive angle sensor (doesn't send voltage to card) enables the safety button requirement in the last 45° of closing
Active output: K2 (Motor solenoid) + K3 (V2)



Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

3.1.3 Schematic

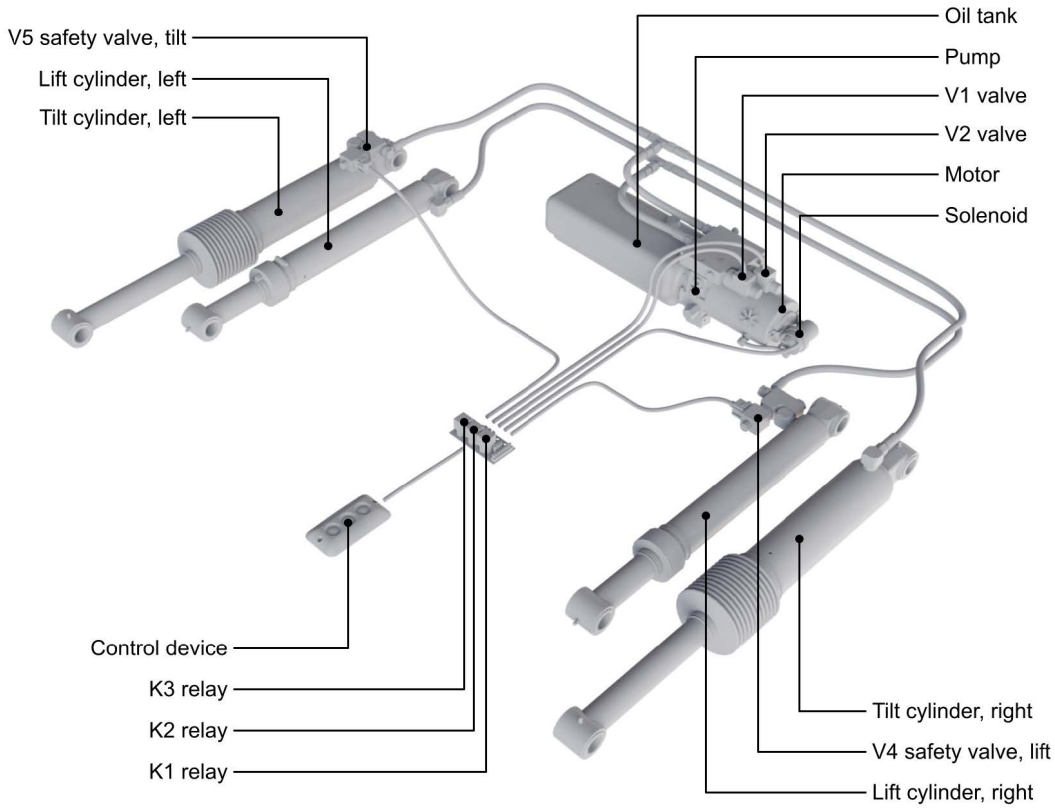


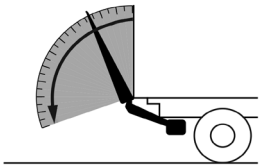
3.2 Electrical safety valves

3.2.1 Relay card only

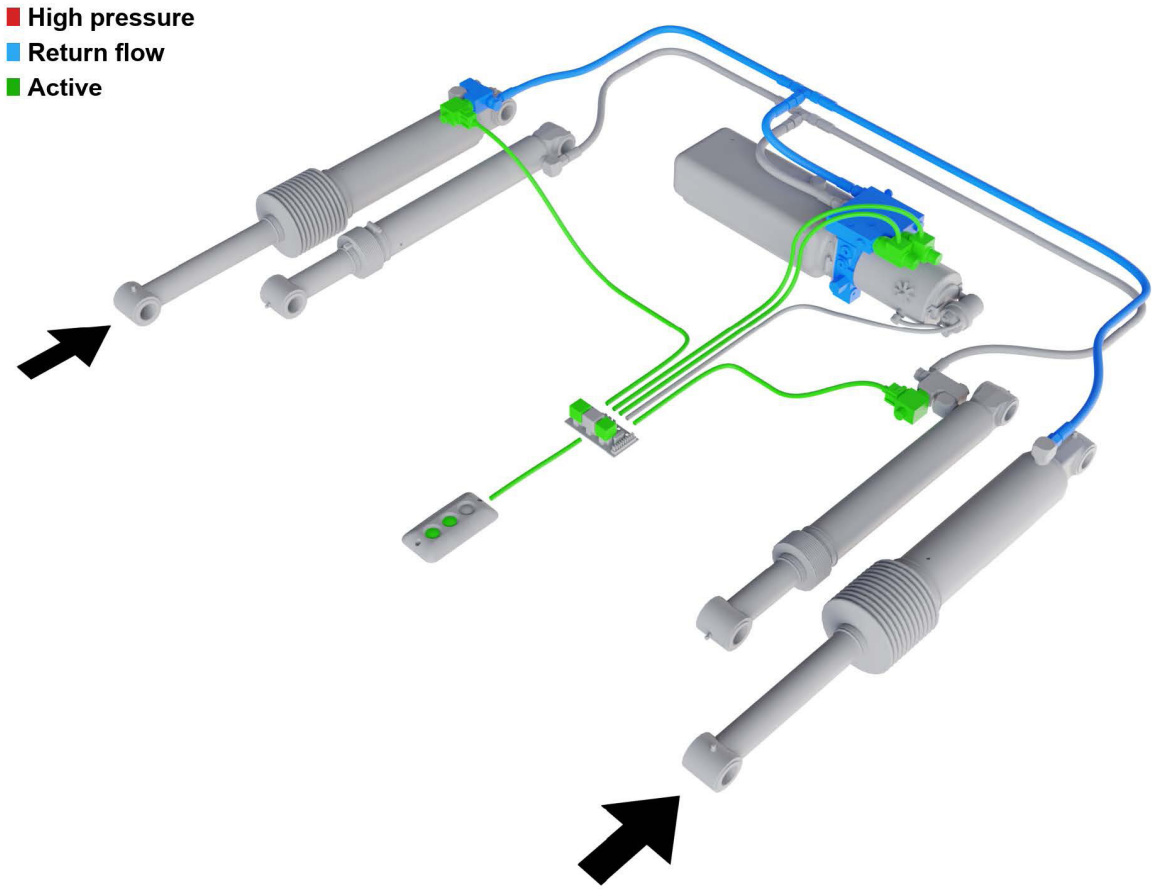
Overview

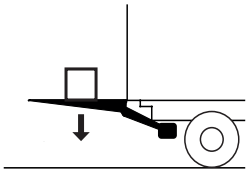
The Z 15/20 with electrical safety valves and no connection card is a variant which uses a hydraulic system based on four electrically operated valves and two mechanical safety valves. Two electrically operated valves, V1 and V2, located at the valve block above the pump/motor-assembly are used to direct flow to or from the tilt or lift cylinders, depending on which function is active. Two electrically operated safety valves, V4 and V5, located on the lift and tilt cylinders respectively are used to lock the oil inside the cylinders and prevent unwanted motion of the tail lift. The other two cylinders are equipped with mechanical safety valves that lock the cylinders if a hose is ruptured. This variant can accommodate up to two control devices, both of which are connected directly to the terminal on the relay card. No sensors are used on this variant which makes it unsuitable for markets where two-hand safety functionality is required.



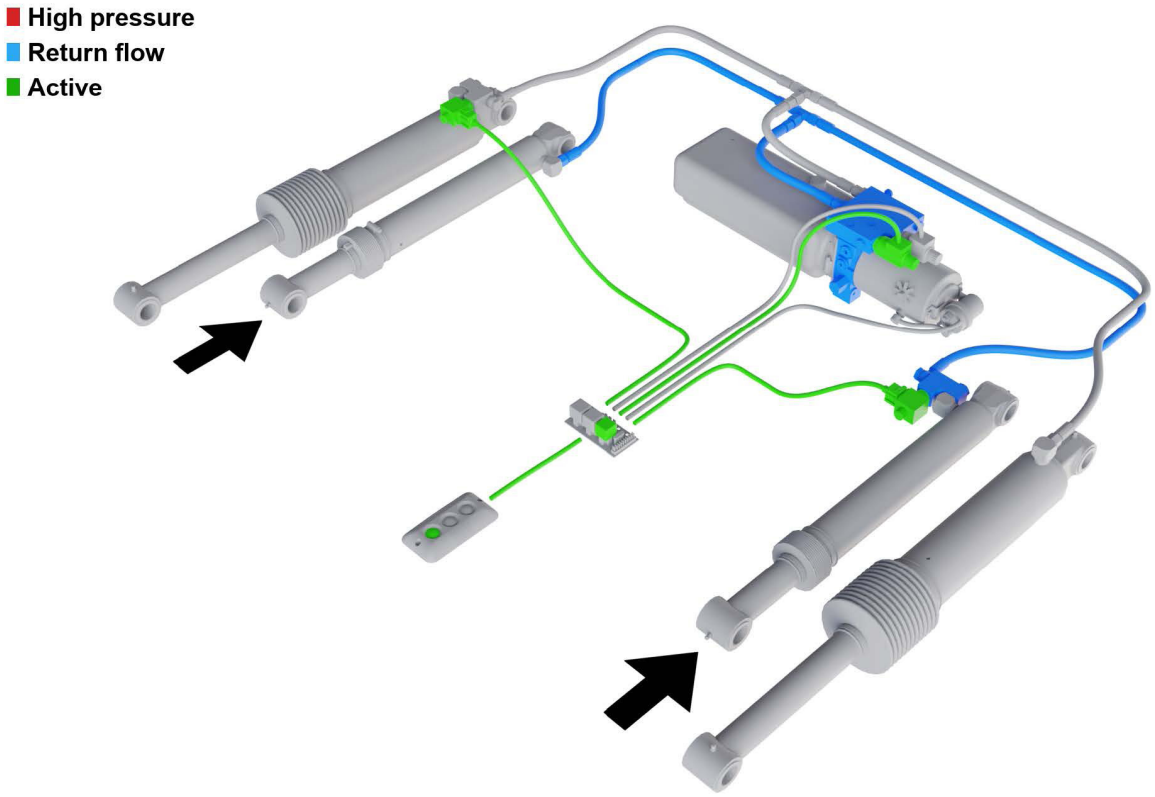


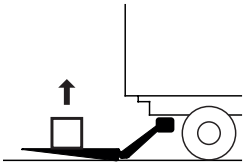
Z15/20
Function: open, tilt down
Description: Platform tilt down including opening from fully closed against body
Control input: Down (E) + Tilt (C)
Active output: K1 (V1, V4, V5) + K3 (V2). Note: no flow through V4 due to shifted V2



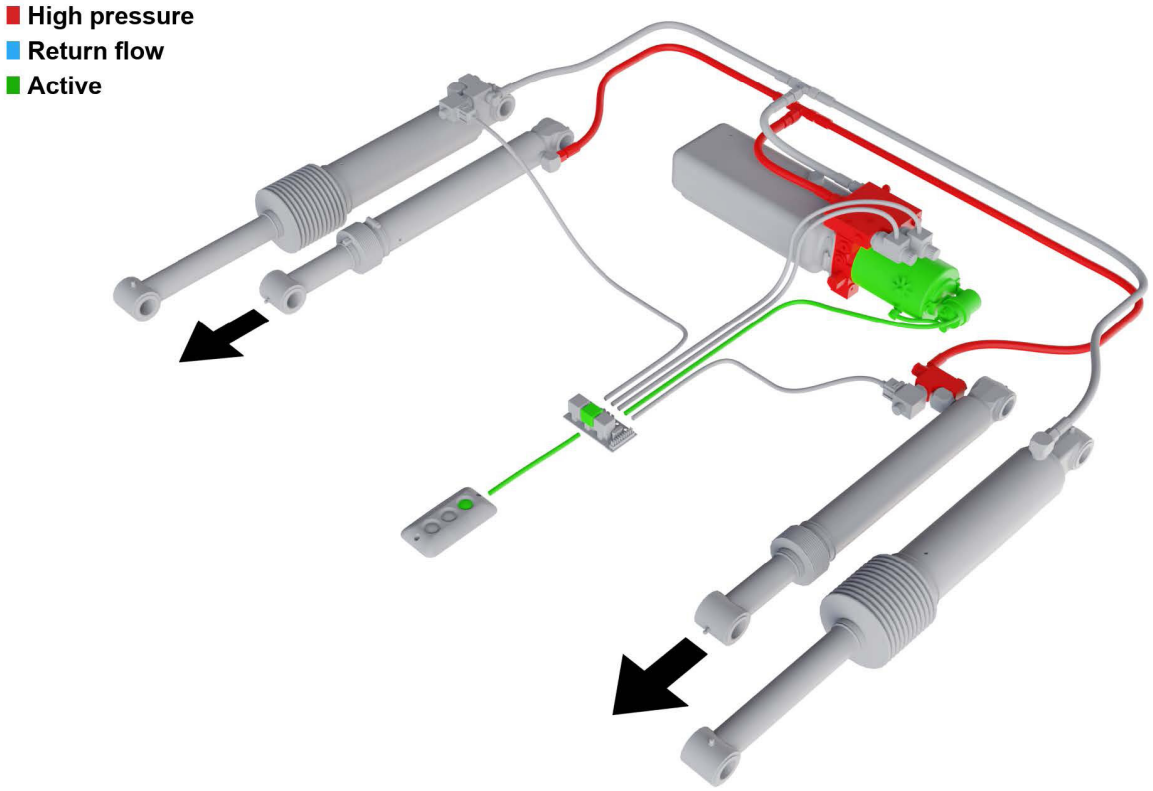


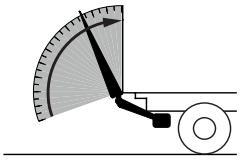
Z15/20
Function: lower
Description: Vertical platform lowering.
Control input: Down (E)
Active output: K1 (V1, V4, V5). Note: no flow through V5 due to unshifted V2



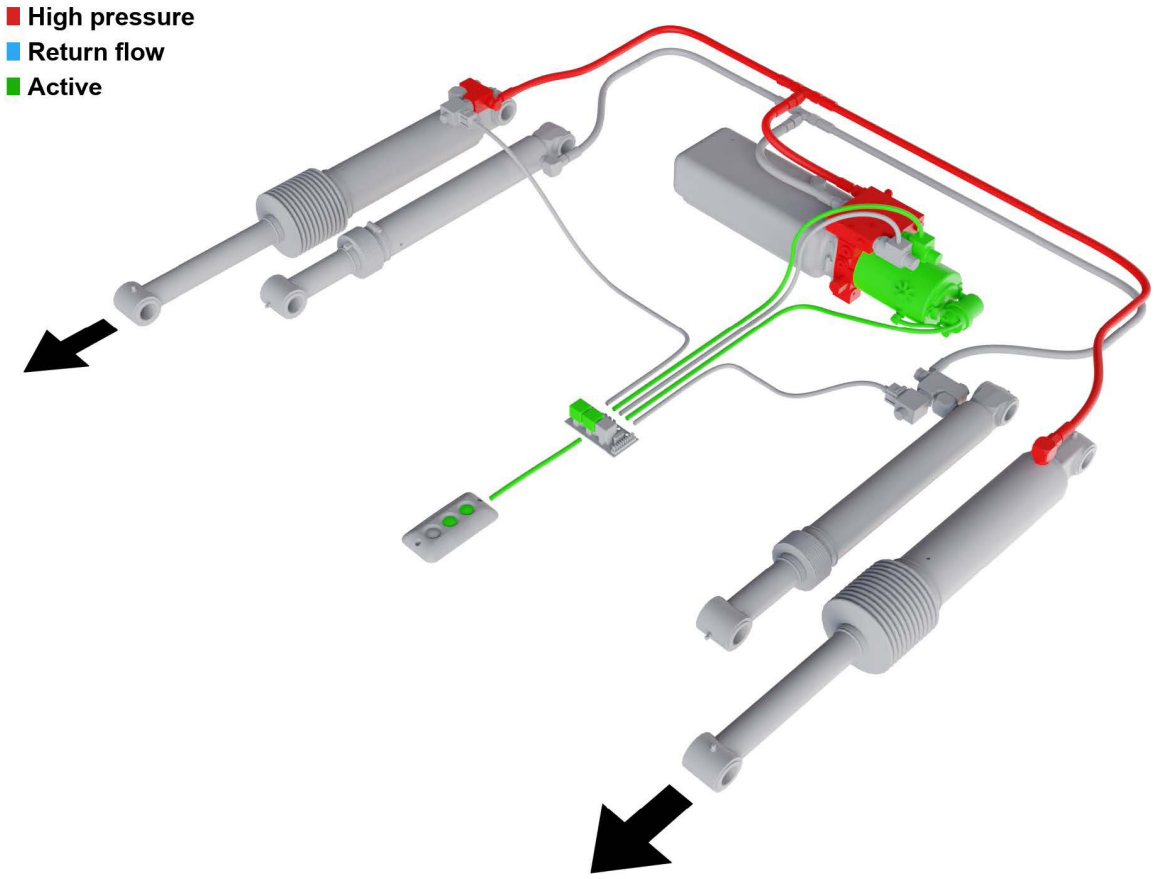


Z15/20
Function: raise
Description: Vertical platform raising.
Control input: Up (B)
Active output: K2 (Motor solenoid)





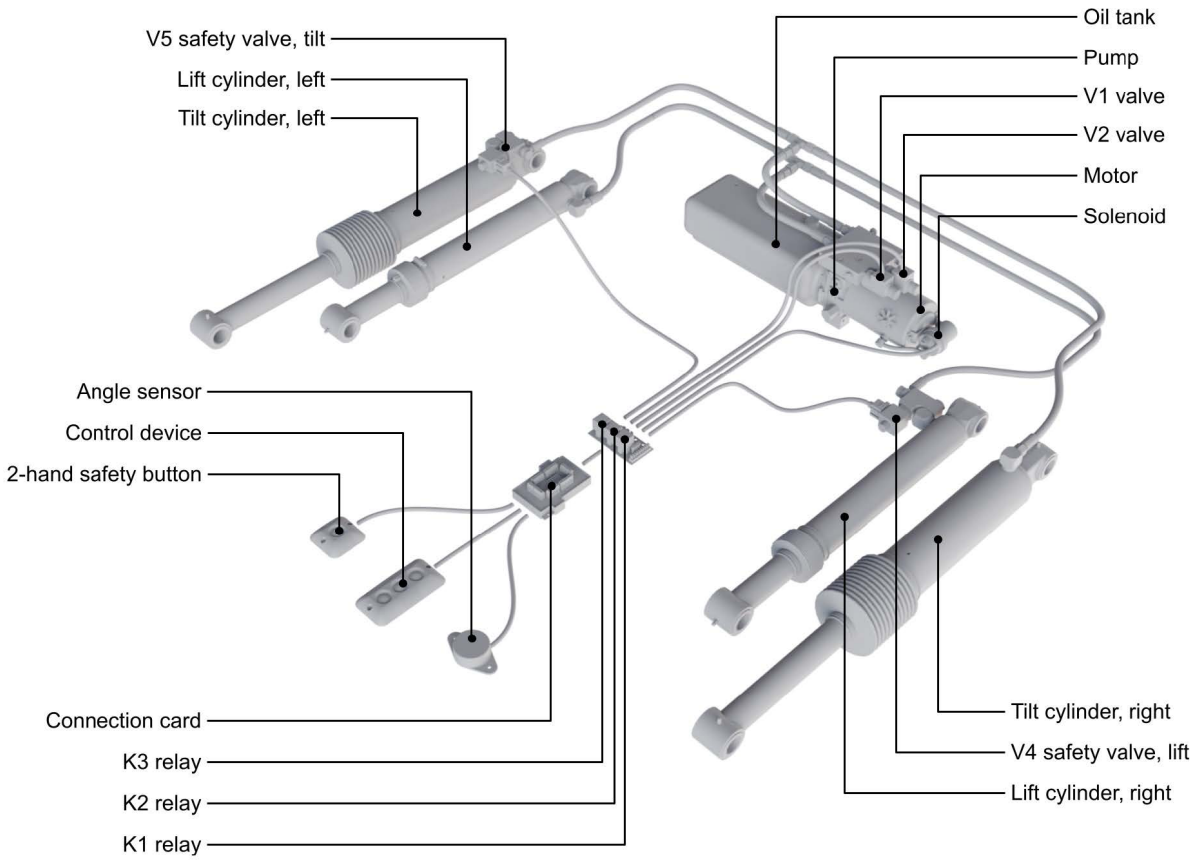
Z15/20
Function: Tilt up, close
Description: Platform tilt up including closing against the box body
Control input: Down (E) + Tilt (C)
Active output: K2 (Motor solenoid) + K3 (V2)

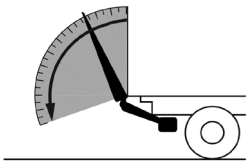


3.2.2 Relay car with Connection card

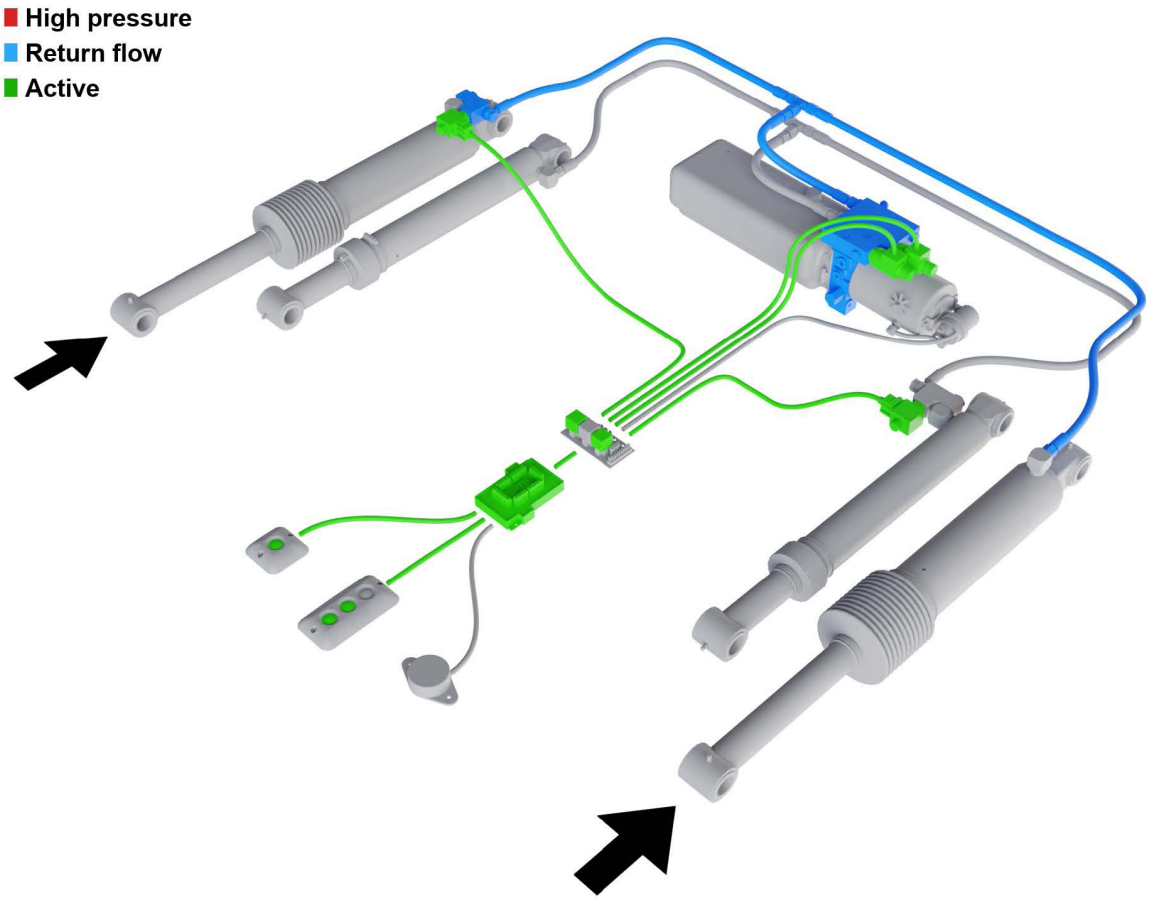
Overview

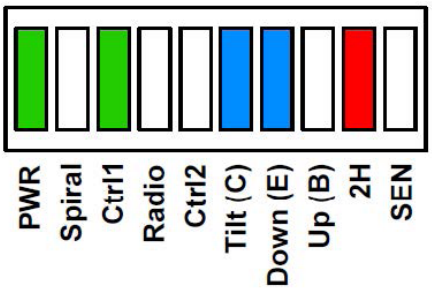
The Z 15/20 with electrical safety valves and no connection card is a variant which uses a hydraulic system based on four electrically operated valves and two mechanical safety valves. Two electrically operated valves, V1 and V2, located at the valve block above the pump/motor-assembly are used to direct flow to or from the tilt or lift cylinders, depending on which function is active. Two electrically operated safety valves, V4 and V5, located on the lift and tilt cylinders respectively are used to lock the oil inside the cylinders and prevent unwanted motion of the tail lift. The other two cylinders are equipped with mechanical safety valves that lock the cylinders if a hose is ruptured. The connection card extends the functionality of the relay card, allowing this variant to be equipped with up to four control devices and an angle sensor-based safety functionality which prohibits opening and closing using only one hand thus preventing operator injuries.



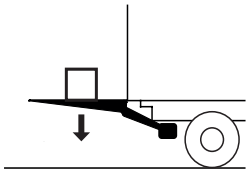


Z15/20
Function: open
Description: Platform opening from fully closed against box body to horizontal.
Control input: Safety button (2H) + Down (E) + Tilt (C)
Sensor input: Inactive angle sensor (doesn't send voltage to card) enables the safety button requirement in the initial 45° of opening
Active output: K1 (V1, V4, V5) + K3 (V2). Note: no flow through V4 due to shifted V2

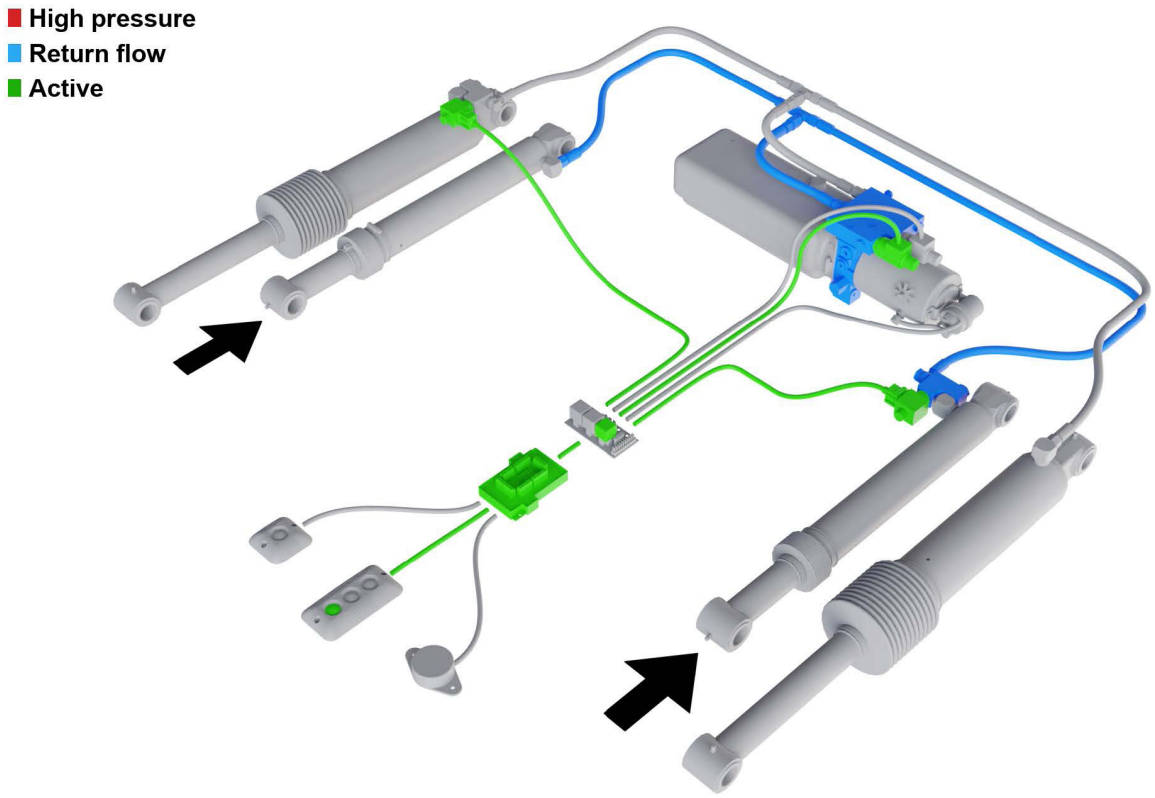


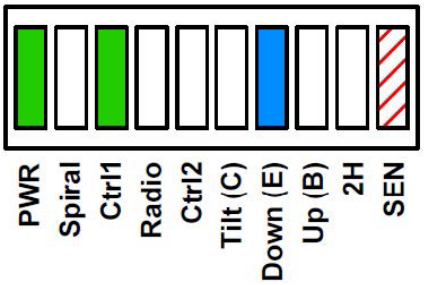


Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

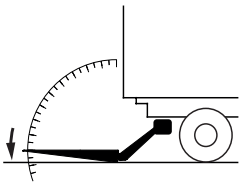


Z15/20
Function: lower
Description: Vertical platform lowering.
Control input: Down (E)
Sensor input: Function not affected by sensor
Active output: K1 (V1, V4, V5). Note: no flow through V5 due to unshifted V2

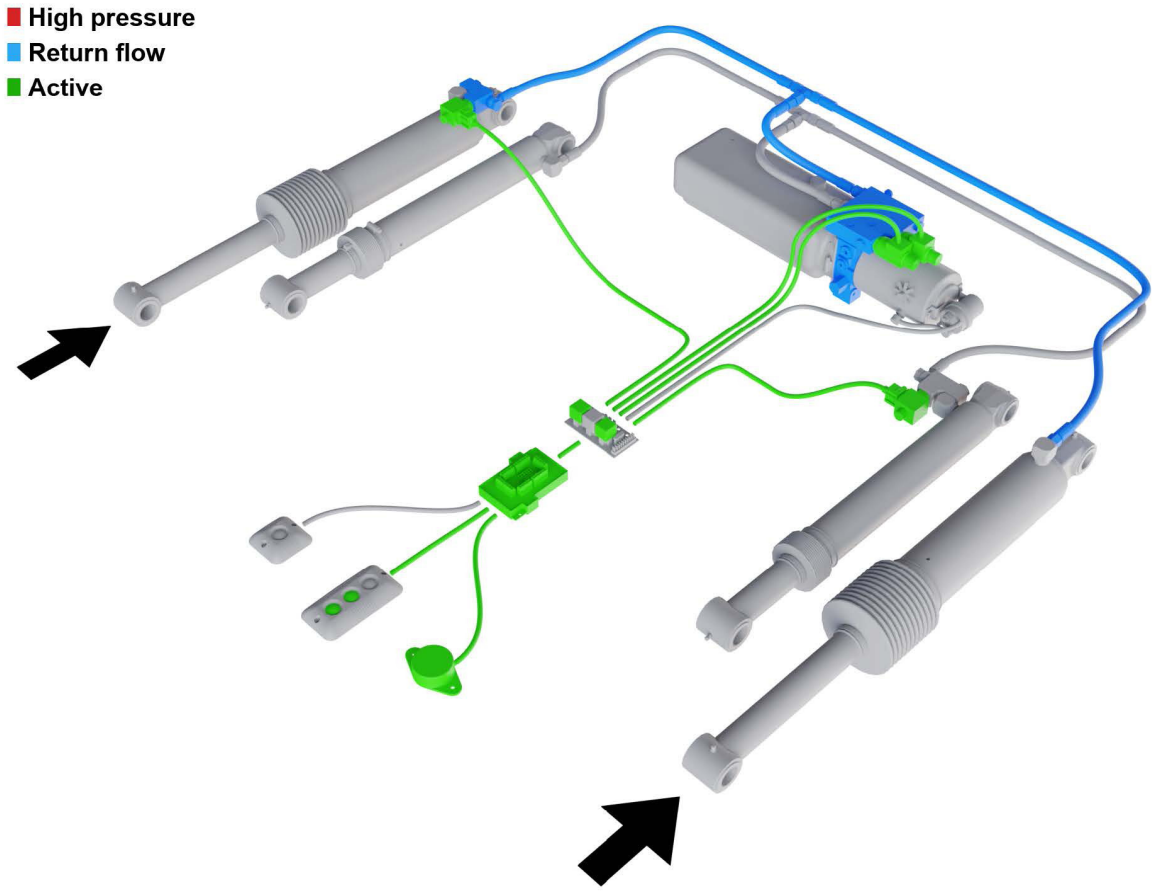


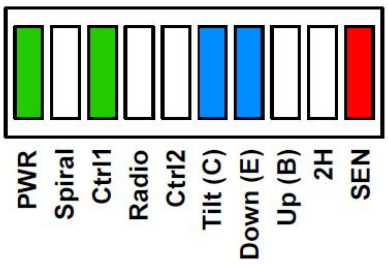


Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

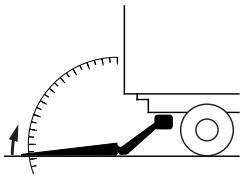


Z5/20
Function: tilt down
Description: Tilting down within +45/-10 degrees from horizontal.
Control input: Down (E) + Tilt (C)
Sensor input: Active angle sensor (sensor is sending voltage to card) disables safety button requirement when the platform is within 45° from horizontal
Active output: K1 (V1, V4, V5) + K3 (V2). Note: no flow through V4 due to shifted V2

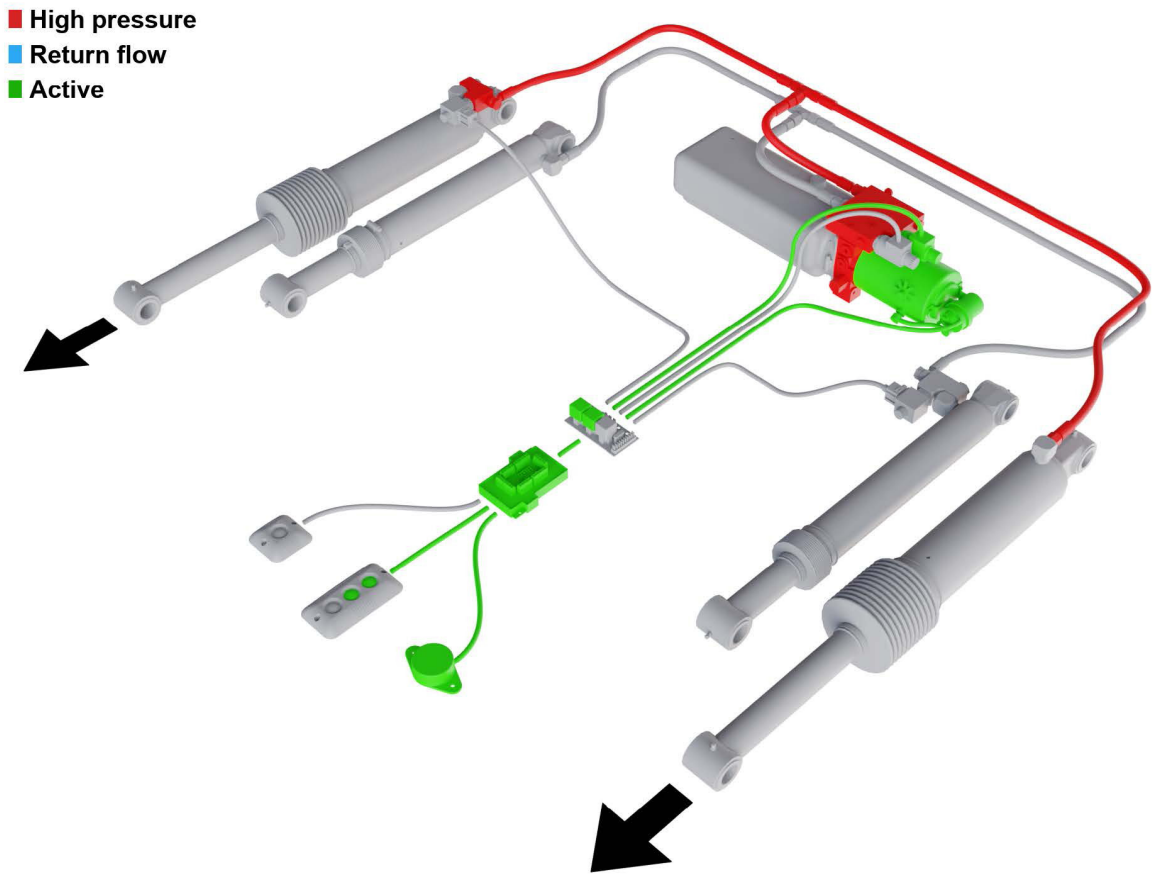


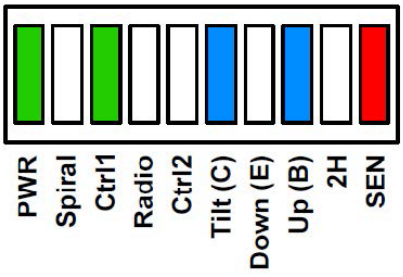


Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

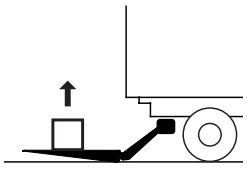


Z15/20
Function: tilt up
Description: Tilting up within +45/-10 degrees from horizontal.
Control input: Up (B) + Tilt (C)
Sensor input: Active angle sensor (sensor is sending voltage to card) disables safety button requirement when the platform is within 45° from horizontal
Active output: K2 (Motor solenoid) + K3 (V2)

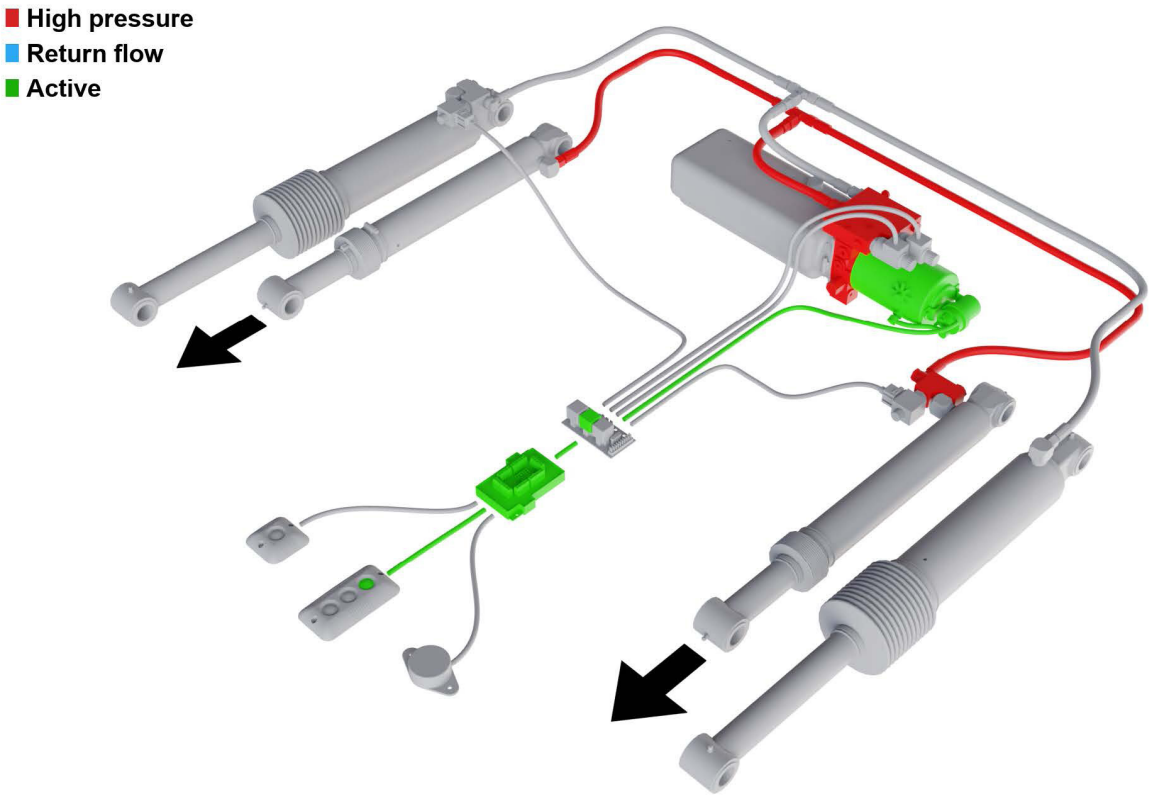


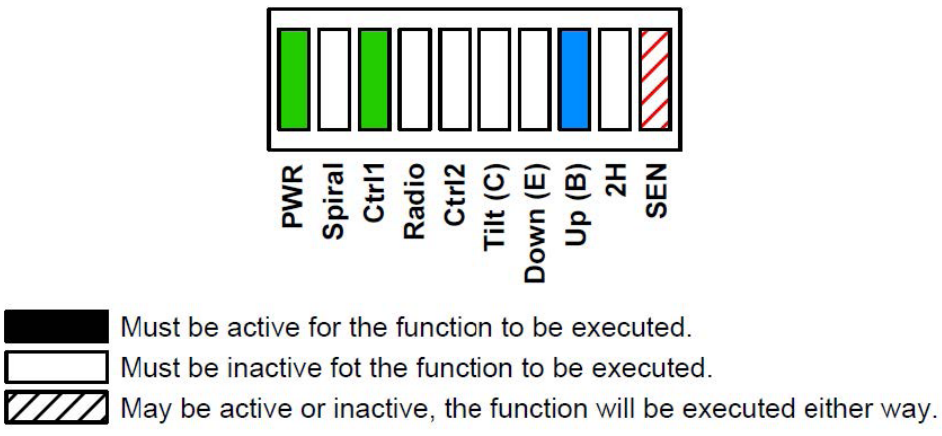


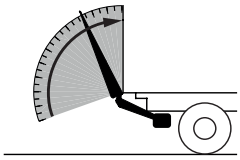
Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.



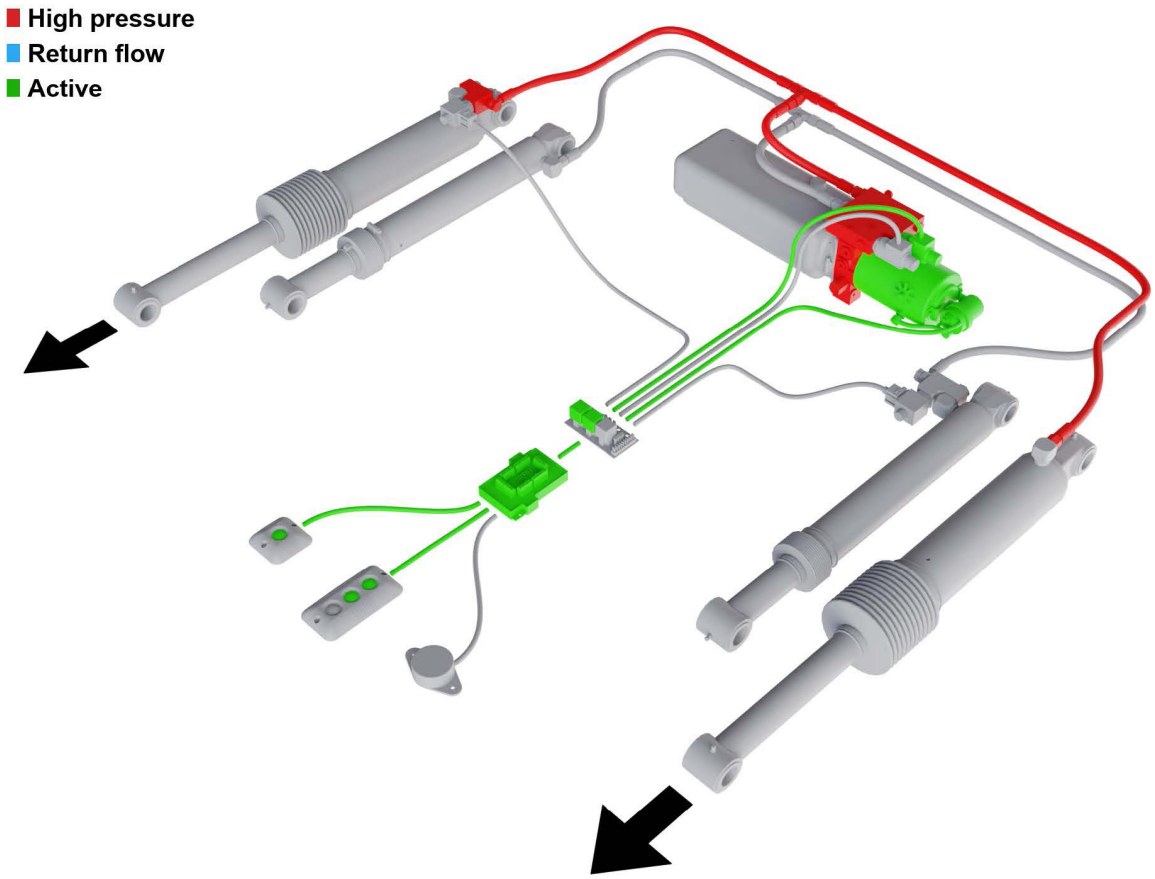
Z15/20
Function: raise
Description: Vertical platform raising.
Control input: Up (B)
Sensor input: Function not affected by sensor
Active output: K2 (Motor solenoid)

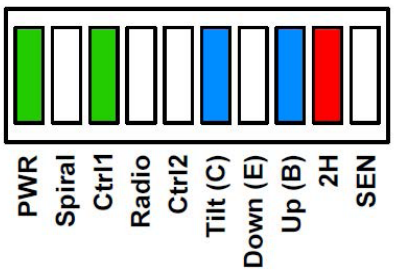






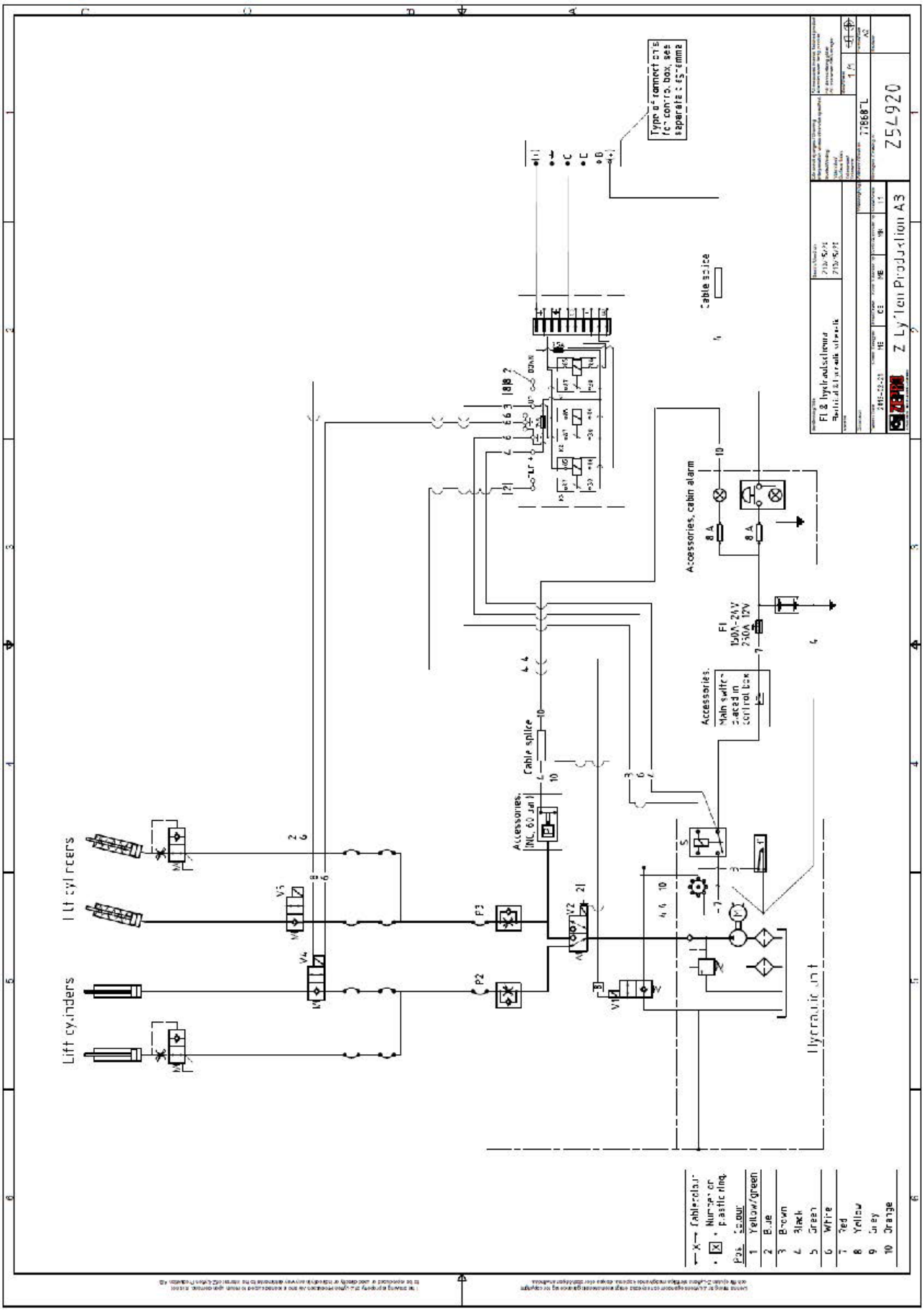
Z15/20
Function: close
Description: Closing fully against the box body.
Control input: Safety button (2H) + Up (B) + Tilt (C)
Sensor input: Inactive angle sensor (doesn't send voltage to card) enables the safety button requirement in the last 45° of closing
Active output: K2 (Motor solenoid) + K3 (V2)





Must be active for the function to be executed.
Must be inactive fot the function to be executed.
May be active or inactive, the function will be executed either way.

3.2.3 Schematic



4 Troubleshooting

4.1 Causes of malfunction

There are three categories of issues that can lead to a malfunctioning tail lift: electrical, hydraulic and mechanical. Electrical issues are fairly common and include but are not limited to damaged wiring, sensors, magnets and solenoids. Control card failures also fall in this category but are very rare in normal circumstances. Hydraulic issues include stuck or damaged valves and other oil flow obstructions or leaks within the hydraulic system. Mechanical issues include bent, seized or damaged structural components and are the least common of the three and also the most easily detectable.

4.2 Relay card

The Relay Card is a central part of the system and is responsible for turning the input signals into usable output signals which drive the desired function of the tail lift. This makes the card the ideal starting point for the troubleshooting process. Do not start treating the symptoms in chapter 4.3 without first making sure the card is fully functional.

Step 1: Power

Is there voltage on the power supply wire to the Relay Card?

- No: Is there voltage on the power supply terminal on the motor solenoid?
  - No: check the battery and the battery cables.
  - Yes: check the connection between the terminal and the Relay Card.
- Yes: the relay card has power, proceed to the next step.

Step 2: Inputs

Press and hold the Up, Down and the Tilt button one after the other while checking for voltage on the B (up), E (down) and C (tilt) terminals respectively. Is there voltage on all three terminals when the respective button is pressed?

- No: there is an issue with the control device or the Connection Card if one the tail lift is equipped with it.
- Yes: the card is receiving the correct inputs, proceed to the next step.

Step 3: Outputs

Press and hold the button(s) required to activate the function being troubleshooted. Check for voltage on the output terminals which should be active. Is there voltage on all relevant outputs?

- No: there's an issue with one or more of the relays.
- Yes: the relays are functioning properly.

If the card has power, is receiving the correct inputs and activates the correct outputs then it is fully functional and troubleshooting should proceed by treating the symptoms as explained in the following chapter.

4.3 Symptoms and causes

Tail lift is unable to raise and lower

If the tail lift is unable to raise or lower the platform but is able to tilt it up and down then the V2 valve is most likely stuck in its shifted position and doesn't allow oil to flow into or out of the lift cylinders. Disconnect the magnet from the Relay Card to make sure it isn't constantly pulling the valve. If the tail lift is able to raise and lower after that, the magnet is malfunctioning and needs replacing. If the problem remains even after the magnet is disconnected, the valve is malfunctioning and needs to be replaced. If the problem remains even after the magnet is checked and the valve is replaced, there may be a flow obstruction somewhere in the system. Check and replace the constant flow valve in the lift port on the valve block as well as all the hoses and connections the oil must flow through to reach the lift cylinders.

Tail lift is unable to lower

If the tail lift is unable to lower the platform but can perform all other functions then a safety valve on the lift cylinder is most likely stuck in its closed position and doesn't allow oil flow out of the cylinder. If the tail lift is equipped with electronic safety valves, it is most likely the electronic safety valve on the lift cylinder that is stuck

in its closed position. Make sure the magnet on the valve is properly connected to the down-output on the Relay Card and to the earth point on the card. If the magnet is properly connected and the problem remains, use a multimeter to measure the resistance within the magnet. If the resistance is above or below the normal values of 2-8 Ohm for 12 Volt systems and 8-32 Ohm for 24 Volt systems, replace the magnet. If the resistance is within the normal range, replace the valve. If the problem remains even after the magnet is checked and the valve is replaced, there may be a flow obstruction somewhere in the system. Check the mechanical safety valve on the other lift cylinder and the constant flow valve located on the lift port on the valve block. Replace as necessary.

Tail lift is unable to tilt down

If the tail lift is unable to tilt the platform down but can perform all other functions then a safety valve on the tilt cylinder is most likely stuck in its closed position and doesn't allow oil flow out of the cylinder. If the tail lift is equipped with electronic safety valves, it is most likely the electronic safety valve on the tilt cylinder that is stuck in its closed position. Make sure the magnet on the valve is properly connected to the down-output on the Relay Card and to the earth point on the card. If the magnet is properly connected and the problem remains, use a multimeter to measure the resistance within the magnet. If the resistance is above or below the normal values of 2-8 Ohm for 12 Volt systems and 8-32 Ohm for 24 Volt systems, replace the magnet. If the resistance is within the normal range, replace the valve. If the problem remains even after the magnet is checked and the valve is replaced, there may be a flow obstruction somewhere in the system. Check the mechanical safety valve on the other tilt cylinder and the constant flow valve located on the tilt port on the valve block. Replace as necessary.

Tail lift is unable to lower and tilt down

If the tail lift is unable to lower and tilt the platform down but is able to raise it and tilt it up then the V1 is most likely stuck in its normally closed position and doesn't allow oil to flow back into the tank. Make sure the magnet on the V1 valve is properly connected to the down-output on the Relay Card and to the earth point on the motor. Run the function again. If the problem remains, use a multimeter to measure the resistance within the magnet. If the resistance is above or below the normal values of 2-8 Ohm for 12 Volt systems and 8-32 Ohm for 24 Volt systems, replace the magnet. If the resistance is within the normal range, replace the valve.

Tail lift is unable to tilt in either direction

If the tail lift is unable to tilt the platform in either direction but is able to raise and lower it then the V2 valve is most likely stuck in its normal position and doesn't allow oil flow into or out of the tilt cylinders. Make sure the magnet on the V2 valve is properly connected to the tilt-output on the Relay Card and to the earth point on the motor. Run the function again. If the problem remains, use a multimeter to measure the resistance within the magnet. If the resistance is above or below the normal values of 2-8 Ohm for 12 Volt systems and 8-32 Ohm for 24 Volt systems, replace the magnet. If the resistance is within the normal range, replace the valve. If the problem remains even after the magnet is checked and the valve is replaced, there may be a flow obstruction somewhere in the system. Check and replace the constant flow valve in the tilt port on the valve block as well as all the hoses and connections the oil must flow through to reach the lift cylinders.

Tail lift is unable to raise and tilt up

If the tail lift is unable to raise or tilt the platform up but is able to lower it and tilt it down then the pump is not supplying the oil flow required. This can be due to an issue with the motor solenoid, the motor or the pump itself. Bypass the solenoid by connecting the power cable directly to the power terminal on the motor. This will result in one of the following:

1. The motor doesn't run. In this case the motor is most likely malfunctioning and needs to be replaced.
2. The motor runs and the tail lift is able to raise and tilt up. In this case the solenoid is most likely malfunctioning and needs to be replaced.
3. The motor runs but the problem remains. In this case the pump is most likely malfunctioning and needs to be replaced.

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Zepro, Del and Waltco are Hiab trade marks for tail lifts. Hiab is a world-leading supplier of equipment, intelligent services and digital solutions for on-road load handling. As an industry pioneer, our company commitment is to increase the efficiency of our customers' operations and to shape the future of intelligent load handling.