



# Technical Manual

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## Before starting work

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### Persons for whom the operating manual is intended

This operating manual is intended for those persons who work with or on the shields.

#### This includes persons who:

- are in charge of transport
- prepare the rise heading
- perform assembly/disassembly work
- operate the shields
- correct malfunctions
- perform daily routine work on the face
- monitor/look after for the hydraulic system
- perform maintenance work
- perform repair work
- supervisory personnel who
  - initiate and/or
  - supervise the activities just indicated.

Everybody working on the shield support must have read this operating manual beforehand.  
Any persons visiting or inspecting the face must have received adequate instructions.

### Purpose of this operating manual

#### operating manual

This operating manual contains general information on the safe and economical handling of shield supports and provides you with important instructions on the work performed directly on or with the shield support.

Therefore, read this operating manual completely and at leisure. Pay special attention to the safety instructions. Try to memorize the appearance and meaning of the safety and instruction symbols.

#### questions?

Should you have any questions, please contact our service department. Contact details are given in chapter 7 of this operating manual.

#### safety

Read chapter 2 (“Your safety”) closely. This chapter contains important information indicating potential hazards.

Observe this information and follow the procedural instructions.



## Safety instructions

### Installation

Use appropriate loading equipment for safe transfer of the transport units.

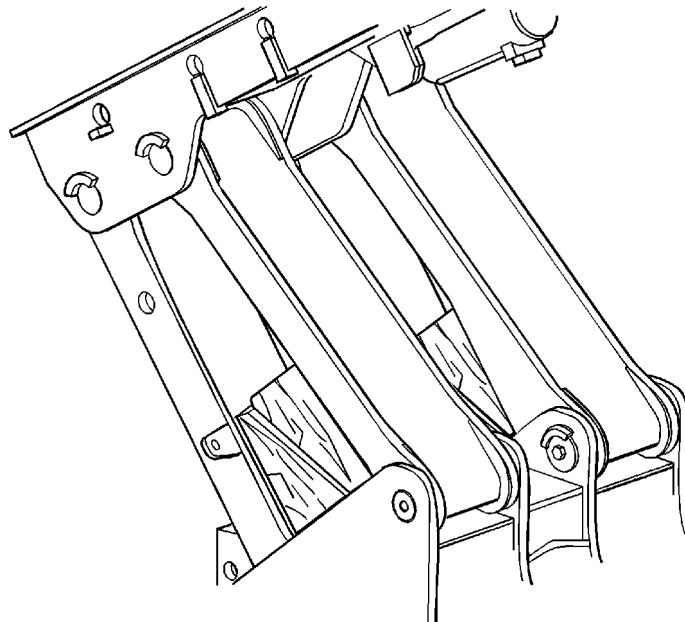
Prior to commencing any work on the shield make sure that the shield is secured to prevent it from retracting automatically

Mechanically secure the caving shield against lowering during:

- installation of the props and cylinders,
- installation of the canopy,
- work on the open hydraulic system.

For securing the shield, hardwood wedges, for instance, can be placed between the pairs of lemniscatic links.

**Fig. 1: Securing by means of hardwood wedges**



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#### transport securing devices

If the shield is provided with movable side seals these are pre-tensioned by spring force. Therefore do not use force to remove the transport safety device of the side seals. Use the hydraulic control system to adjust the seal cylinders such that the locking pins either drop down or can be pulled out without the use of physical force.

When removing the transport securing device of the flipper ensure that nobody is present in the swiveling area of the latter as the flipper may swing downward.

#### travel way

Make sure that the minimum dimensions specified for the travel way with the shield are maintained at all times. The minimum dimensions are:

- Width: 600 mm,
- Height: 400 mm.

Any devices added to the shield later such as for example steering devices are not allowed to reduce the minimum travel way. It may be necessary to install additional devices limiting the lowering height in order to ensure that the minimum travel way is maintained.



## Overview of the safety instructions

During normal operation, the support may only be moved by means of the control unit of the electrohydraulic neighboring control. Always observe the instructions in the control unit's separate operating manual.

Do not put the filter into operation before making sure that all connections have been made properly.

Never put both levers into backflush position simultaneously, because the emulsion flow will be completely shut off and backflushing will be impossible.

The actuators on the control valve block should only be used in an emergency and for repair work and only in compliance with the special operating instructions of the mine. During normal operation they should not be used. Otherwise, dangerous situations could arise which could result in very serious injury.

The shield support is operated in normal operation exclusively by means of the electronic control. It is imperative that you observe the instructions in the control unit's separate operating manual. If the control unit is included in the DBT scope of delivery, the respective operating manual will be included in the DBT documentation provided for the installation.

You are only allowed to operate the controls of the control valve block when you know exactly which effects the functions have with respect to the shield support. You must have attended a special training course to this purpose. Otherwise, there is a risk of incorrect operation. This could result in serious injury and even fatal accidents.

Manual actuation of a button on one of the pilot valves initiates direct execution of the corresponding function. Dependencies between the individual functions are not taken into account. Dangerous situations could arise if functional sequences are initiated in an incorrect order. For example, the function "*advance shield*" can be activated without previously activating the functions "*retract side seal*" and "*actively lower support*". This can cause dangerous situations which can result in very serious injury.

If the operational safety is endangered, damaged components must be replaced immediately. If this is not possible, you must immediately shut down the shield and secure it. Immediately notify the entire face crew and your superiors.

There is a heightened risk of accidents when performing troubleshooting work on hydraulic systems. In particular malfunctions in the hydraulic system and hydraulic medium escaping at high pressure can cause serious injury.

Therefore take special care and always wear the specified protective clothing.

Failure to comply with these instructions can result in serious injury.

### Caution!

Never exceed the permissible angle of inclination of the canopy. Exceeding the permissible angle of inclination of the canopy specified in chapter 6 of the section "Technical data" can lead to the support becoming damaged. This especially applies for stabilizing cylinders, their fastening elements and fulcrum points to the shield canopy and caving shield.

Never extend or retract the stabilizing cylinders of the shield completely!

Stabilizing cylinders must always have sufficient residual stroke.

Guide value: at least 20 mm!

The same applies to the adjusting cylinder of the front cantilever.



## Transport



### Warning!

**Use only load handling devices complying with the technical and legal regulations for transporting loads.**

**You could be seriously injured or even killed by falling loads. Use only suitable load handling devices.**

#### transport units

In agreement with the customer, the transport units were defined taking the special local circumstances into account as follows:

- The shield units are transported as a complete unit.

#### points of attachment

Where technically possible, the load units have suitable, fixed attachment points for transport and installation. Otherwise, corresponding thread bores or other fastening options are to be provided for temporarily fixing the points of attachment.

More detailed information about the arrangement and capacity of the points of attachment can be found in the figures of the replacement part catalog or the special drawings for transport subassemblies which, if applicable, can be found in the appendix of this manual.

#### temperatures below freezing

Before transporting the equipment at temperatures below freezing, all hydraulic parts which were previously operated with a frost-sensitive medium, such as an oil-in-water emulsion (HFAE), must be completely emptied and then filled with a frost-proof corrosion inhibitor, for example HYDROCOR® CV 50. If the fluids could not be completely exchanged due to technical reasons, a corrosion inhibitor is to be selected which can be mixed with the originally used medium and it is to be made sure that the media are sufficiently mixed.

Transport of equipment at temperatures in the range of -21 °C to -40 °C is only permissible when certain measures have been taken to meet these conditions at the design and manufacturing stages. Nevertheless, the individual parts and devices of this equipment must not be subjected to sudden impact loads at such low temperatures and may only be loaded statically or quasi-statically. Here, the external forces are only to be applied to the attachment points and retainer surfaces as specified in special drawings, if available.

The equipment may not be transported at temperatures below -40 °C.

During transport of this equipment with floor conveying devices at such low temperatures, measures must also be taken to ensure that the parts and devices are not subjected to sudden impact loads.

At very low temperatures and on poor roads, the transport vehicle speed must therefore be limited to max. 25 km/h for truck transport.

#### electrical and electronic components

Electrical and electronic components must be removed for overseas transport or prolonged storage outdoors or outdoor storage of the equipment during winter.

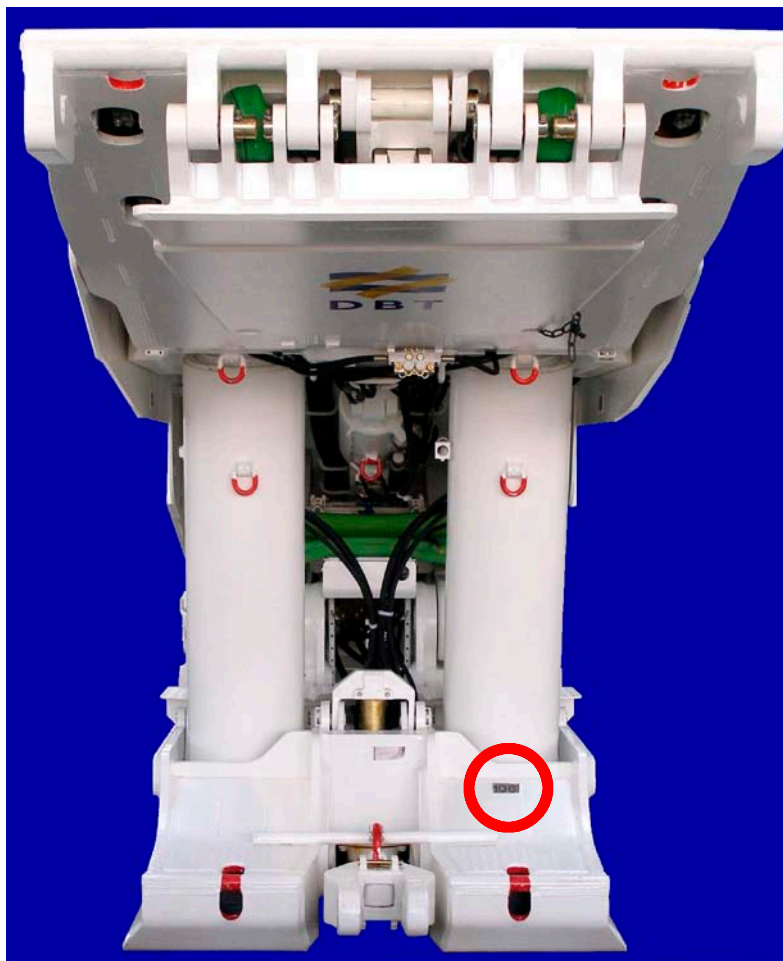
Unless these components or the complete equipment is protected against harmful environmental influences by suitable packaging. The electrical cables remain in the equipment. They must be carefully protected against transport damage and soiling of the connections.



## Installation of the shield units

**shield number** The shield number serves as an identification feature. All shields are numbered sequentially. Firmly attached tags with the respective shield number are on the left base of the shield.

**Fig. 15: Shield number on the base, example**



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**Tab. 5: Allocation of the shield numbers**

Shield number	Device no.	Use
2 to 181	7420 182 000 00 01	Face shield
1 and 182	7420 182 000 00 02	Transition shield
1G	7420 183 000 00 01	Endshield, with right-hand side flap and protective wall
2G to 3G	7420 183 000 00 02	Endshield without side flap and protective wall
4G to 5G	7420 183 000 00 03	Endshield without side flap and protective wall
6G	7420 183 000 00 04	Endshield with left-hand side flap and protective wall



## Requirements

- travel way** The minimum dimensions for the travel way specified must be maintained.
- In the Federal Republic of Germany, the following values apply with respect to the minimum dimensions of the travel way:
- Width: 600 mm,  
Height: 400 mm.
- If the support is used in countries other than the Federal Republic of Germany the respective regulations applicable in those countries must be observed.
- Debris or objects lying in the travel way must be removed immediately. This applies particularly for low seam heights.
- If crawl pans are used whose length is adjustable, care has to be taken that a safe travel way of adequate width remains.
- If the height of the travel way is restricted by the use of additional equipment, e.g. for conveyor alignment, care has to be taken that a safe travel way of adequate height remains.
- If the area behind the front props is to be used as travel way, e.g. in case of thick seams, steeply inclined faces, or if the shield support can be advanced up to the conveyor, the travel way must be marked at the face ends by a sign.
- roof supporting work** Roof supporting work must be carried out so that the filling section of the face conveyor remains unobstructed. This means that the canopies of the shields must be set against the roof immediately after the shields have been lowered and advanced.
- work in the mining area** Work in the mining area may only be carried out from a safe position. The face conveyor and the mining machine must be at a standstill and locked-out to prevent restarting.
- The conveyor and the space above the conveyor may only be entered if the roof has been secured against falling rock. In thick seams the coal face must also be protected against slabbing in these places. On faces equipped with shield supports this is the best done by using flippers.
- Care must be taken that the flippers are always extended towards the coal face far enough to achieve the desired protection. This does not apply during shield unit advance.
- If flippers are not used, some other kind of protection must be applied to shield the mining area from the rest of the face, e.g. extra-high spill plates, wire mesh, nets, etc. or the like.
- Work which has to be performed in the immediate vicinity of the face conveyor at or above the spill plates may also only be carried out after the place of work has been secured against fall of rock and falling coal layers.
- In longwalls of the inclined face, additional barricades, such as air cushions, must be set up above the work area in the conveyor to protect against the following material. The design and amount of required safety equipment depends on the local conditions.



## Safe working

For the purpose of safe operation, the supports are equipped with a neighboring control. This means that the support functions are operated using the control unit on the right or left neighboring support or with the automatic sequential phase control.



### Warning!

**Never be on a support which is currently being moved. Circumstances which are not always obvious may lead to unexpected movements in the shield units. This could result in serious injury or even death.**

**For example, the shield canopy may jerk free during lowering if it was stuck between the canopies of the neighboring shield.**



### Caution!

**Take care not to damage the pilot valve buttons. Sticking buttons might lead to malfunctions and cause an accident.**

### Observe the following safety regulations:

Make sure that your body is completely under a set shield. Keep away from shields which are in the process of being moved or which are to be moved soon.

If groups of shields are automatically advanced, no person may be in the area between the operator and the moved shield.

### Follow these steps if a shield has failed to advance:

1. Determine the cause. Check the following possibilities:

- Malfunction of the electronic controls
- External obstructions:
  - shield is wedged in between the neighboring shields.
  - tip of the canopy is stuck in the roof.
  - floor step or debris is blocking the base.

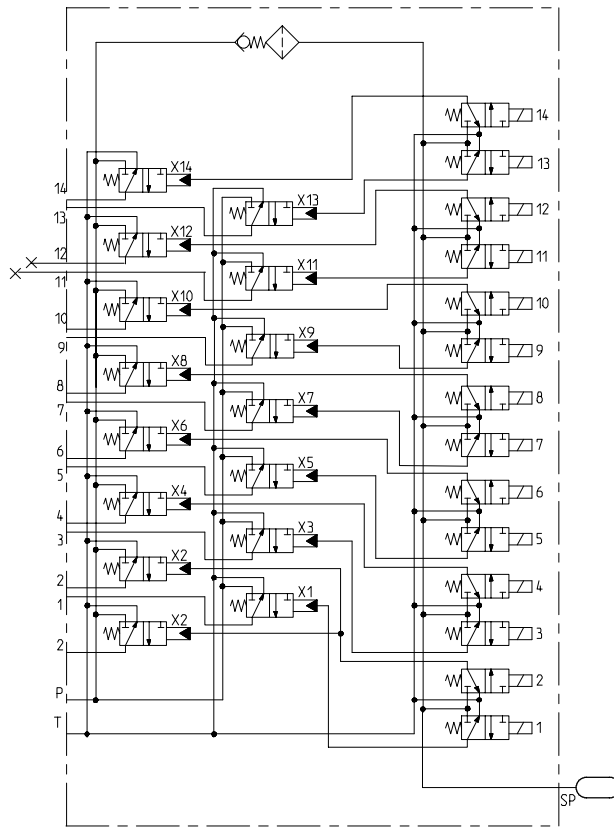
2. If the automatic function of the electronic control is not working properly, the support can be manually controlled using the individual control of the control unit of a neighboring shield. See the separate operating manual for the electronic control.

3. If the cause is an external obstruction, try to get the shield free by manually moving the neighboring shields.



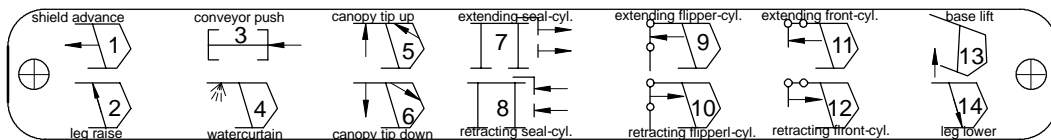
# Operation of the shield hydraulics

Fig. 31: Electrohydraulic control unit functions, instruction plates for endshield variants 01 to 04

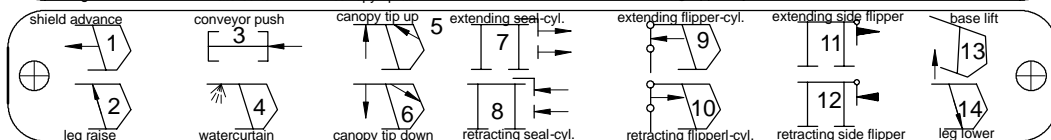


14 Functions

For endshield variants 02, 03



For endshield variants 01, 04



Tab. 9: Electrohydraulic control units with 14 functions, assignment of functions for endshield variants 01 and 04

Function, designation	Function no. for
Advance shield	1
Prop setting	2
Advance conveyor	3
Water spraying system, face side	4
Stabilizing cylinder, extend	5
Stabilizing cylinder, retract	6
Seal cylinder, extend	7
Seal cylinder, retract	8
Flipper cylinder, extend	9
Flipper cylinder, retract	10
Not assigned (02, 03) / side flap, extend (01, 04)	11
Not assigned (02, 03) / side flap, retract (01, 04)	12
Extend baselift cylinder	13
Props lowering	14

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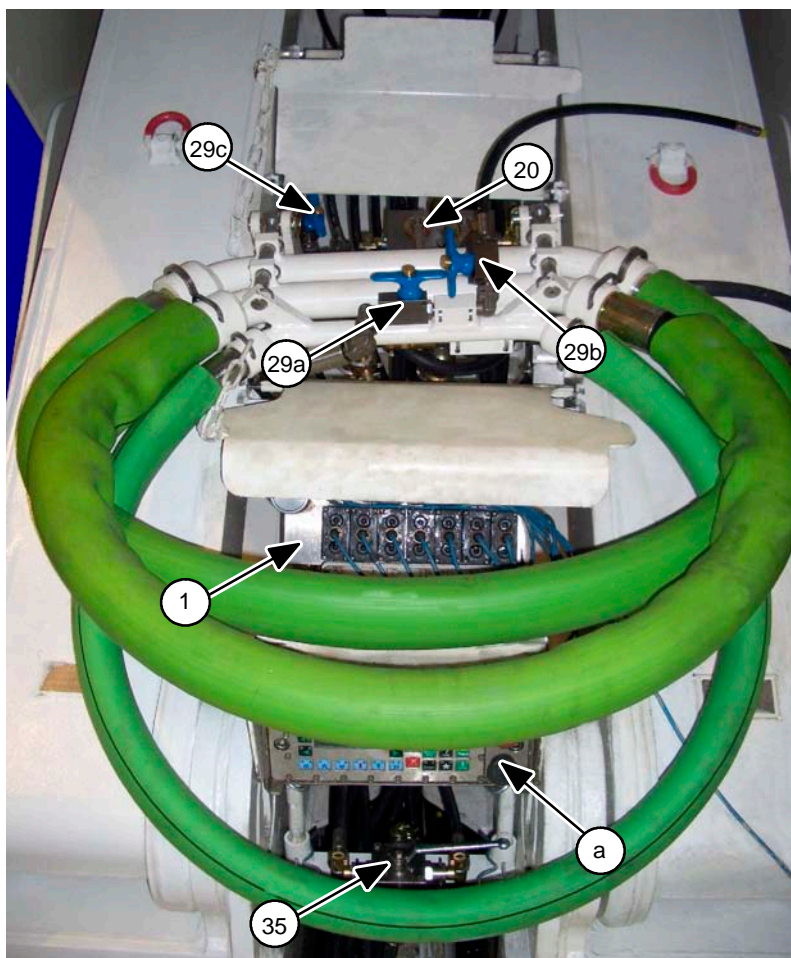
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## Operation of the shield hydraulics

### Control unit

Fig. 43: View of the control units (the supply lines are bypassed for transport)



- |   |  |
|---|--|
| 1 Electrohydraulic control unit               | 29c HP ball valve DN 10, for blocking the lemniscatic spraying system's water supply           |
| 20 Dual filter                                | 35 Block ball valve, cross shaped, for pusher cylinders (only for endshield variants 01 to 04) |
| 29a HP ball valve, shuts off the water supply | a PMC <sup>®</sup> -R control unit   |
| 29b HP ball valve for spray line              |  |



## Operation of the shield hydraulics

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### Repair and emergency operation

This section contains information on the functions and operation of the hydraulic control, which may only be used in exceptional cases such as for repair and emergencies.

In the following, it is assumed that the shield has already been correctly installed. It is also assumed that all shut-off valves are open as during normal operation.

Operation of the control unit of the electronic control is **not** described here, but in a separate operating manual. If the control unit is included in the DBT scope of delivery, you will find the corresponding operating manual in the DBT documentation of the system.

The fundamental design of the shield unit and the shield control is shown in the chapter "Technical description", chapter 6 of this manual.

It has also been assumed that the reader is familiar with the fundamental principles of the hydraulic shield support and the operation of the control unit.



#### Warning!

**The actuators on the control valve block should only be used in an emergency and for repair work and only in compliance with the special operating instructions of the mine. During normal operation they should not be used. Otherwise, dangerous situations could arise which could result in very serious injury. The shield support is operated in normal operation exclusively by means of the electronic control. It is imperative that you observe the instructions in the control unit's separate operating manual. If the control unit is included in the DBT scope of delivery, the respective operating manual will be included in the DBT documentation provided for the installation.**

The drawings Fig. 59 and 60 show the position of the PMC<sup>®</sup>-R control unit and the electrohydraulic control unit on the support.

Operation of the PMC<sup>®</sup>-R control unit is not described in this operating manual. For information on this, please refer to the separate operating manual for the PMC<sup>®</sup>-R control unit.



## Remedying faults

### Troubleshooting on shield hydraulic system

The shield hydraulics of a shield unit consist of a multitude of individual components. The linking of the components with each other is shown in the circuit and hose diagrams for the shield hydraulics. Also refer to the section "Operating the shield hydraulics" in this chapter or the spare parts catalog.

Functional errors can in principle occur in all components. The majority of faults on hydraulic valves is, however, caused by hydraulic bypass flows. These are normally audible to the operator.

The following information is provided to assist you in the detection and elimination of faults.



#### Warning!

**There is a heightened risk of accidents when performing troubleshooting work on hydraulic systems. In particular malfunctions in the hydraulic system and hydraulic medium escaping at high pressure can cause serious injury. Therefore take special care and always wear the specified protective clothing. Failure to comply with these instructions can result in serious injury.**

### Fault localization

#### failure to advance the shield

Possible cause	Check/measure required
The shut-off valve for the shield supply on the supply block is closed.	Open the shut-off valve. Valves can only be switched when the supply line is open.
The shut-off valve in the supply line to the prop piston chamber is closed.	Open the shut-off valve. Lines to the piston and annular space of the prop must be open.
The shield canopy is stuck between the neighboring supports.	Find the cause. If required, lower neighboring supports and align them in order to free the canopy.
Control piston on the prop control valve isn't working.	Check whether the pressure is sufficient to control the valve. Minimum approx. 80 bar. The prop control valve may be defective.
Damaged or trapped hoses.	Check for damaged or kinked prop hose pipes. Replace the hoses, if necessary. Make sure hoses are laid properly.
Prop is defective.	Check the prop for damage and leakage. Replace the prop, if necessary.



## Description

End-shield variants	Application	Device number	Dimensions, LxWxH max. / min. in mm	Approximate weight in kg
01	Right-hand end-shield with side flap and protective wall	7420 183 000 00 01	7580 x 2570 <sup>3)</sup> x 4500 8382 x <sup>4)</sup> 1650 <sup>2)</sup> x 2250 <sup>2)</sup>	31500
02	Endshield, without side flap and without protective wall	7420 183 000 00 02	7580 x 1850 <sup>1)</sup> x 4500 8382 x 1650 <sup>4)</sup> x 2250 x	30500
03	Endshield without left-hand side flap and without protective wall	7420 183 000 00 03	7580 x 1850 <sup>1)</sup> x 4500 8382 x 1650 <sup>4)</sup> x 2250 x	30500
04	Endshield with left-hand side flap and protective wall	7420 183 000 00 04	7580 x 2570 <sup>3)</sup> x 4500 8382 x 1650 <sup>2)</sup> x 2250	31500

- 1) Side seal fully extended
- 2) Side flap completely folded in
- 3) Side flap fully folded out
- 4) Side seal fully retracted

The variants of the bases differ in regard to whether they are equipped with a protective wall and its position, as well as whether they are equipped with a push cylinder and its position, see table (Tab. 11).

Tab. 11: Shield variants (2)

Shield variants	Application	Shield no.	Special equipment
01	Face shield	2 to 181	Shorter canopy 4175 mm <sup>1)</sup> , without pusher cylinder
02	Transition shield	1 and 182	Longer canopy 4675 mm <sup>1)</sup> , without pusher cylinder
Endshield variants	Application	Shield no.	Special equipment
01	Right-hand end-shield with side flap and protective wall	G1	Canopy length 5175 mm <sup>1)</sup> Right-hand side flap/protective wall, left-hand pusher cylinder
02	Right-hand end-shield	G2 and G3	Canopy length 5175 mm <sup>1)</sup> left-hand pusher cylinder
03	Left-hand end-shield	G4 and G5	Canopy length 5175 mm <sup>1)</sup> right-hand pusher cylinder
04	Endshield with left-hand side flap and protective wall	G6	Canopy length 5175 mm <sup>1)</sup> Left-hand side flap/protective wall Right-hand pusher cylinder

The shield is equipped with a one-piece base. This consists of two bases which are tightly connected to each other, in the middle of which is the channel for the shifting unit.

The variants of the bases differ in the design of the shifting rams, differing length shifting beams length and whether the shield variants are equipped with a side flap and protective wall or not, see table (Tab. 11).

- 1) Flipper completely folded in



# Description



## Shifting unit

The shield variants are equipped with differing shifting units, see Tab. 14.

The shifting unit is located in the middle of the base. It mainly consists of the relay bar, shifting ram, baselift cylinder and the required fastening elements. It serves to advance the conveyor and shield.

The shifting ram is reverse mounted with the force of the cylinder is transmitted to the relay bar. Here, the force on the piston surface side is used to advance the shield, while the smaller force of the ring surface is used to advance the conveyor.

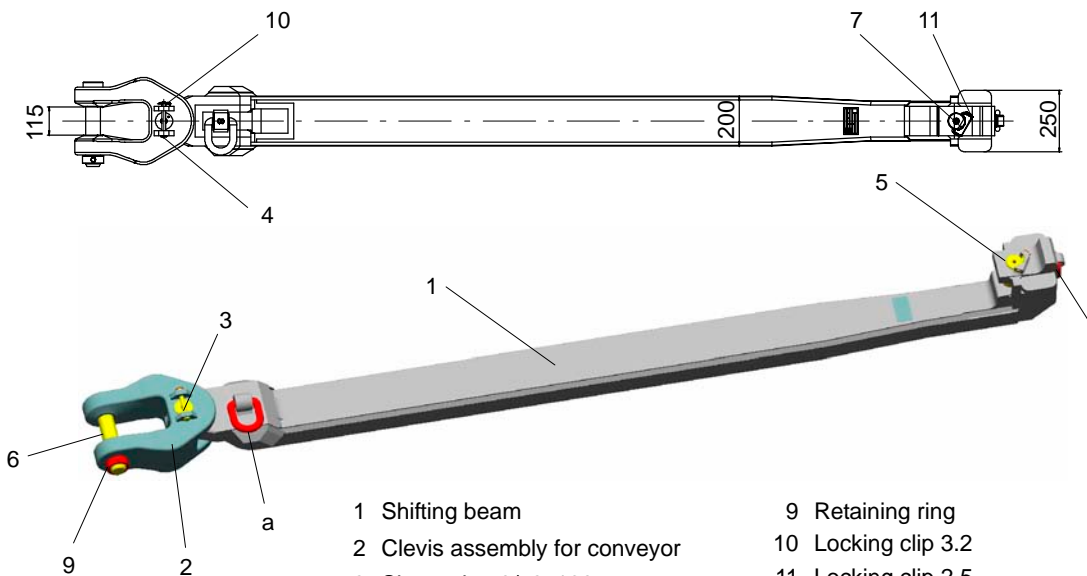
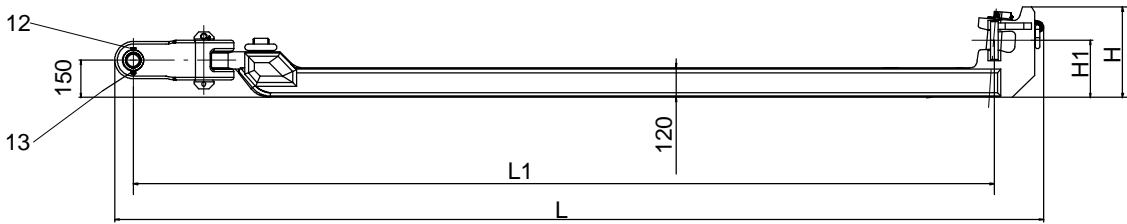
With the help of the lifting equipment, the base can be lifted from the floor during pulling up.

The baselift cylinder is located in the middle of the base. The force of the baselift cylinder acts on the floor via the relay bar.

Tab. 14: Shifting unit, differences

Shield	Shifting unit, Device no.	Dimensions			
		L	L1	H	H1
7420 182 000 00 01/02	7420 182 330 00 01	3749	3475	365	230
7420 183 000 00 01-04	7420 183 330 00 01	3854	3580	380	250

Fig. 70: Shifting unit



- 1 Shifting beam
- 2 Clevis assembly for conveyor
- 3 Shear pin 70/53x160
- 4 Pin 25/16x138
- 5 Pin 65/58x193
- 6 Pin 80/60x320
- 7 Pin 15/12x95
- 9 Retaining ring
- 10 Locking clip 3.2
- 11 Locking clip 2.5
- 12 Hex. head screw M 12x100-A 4-80
- 13 Hex. nut M 12-A 4-80
- a Load ring 8000 kg
- b Load ring 3000 kg

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# Description

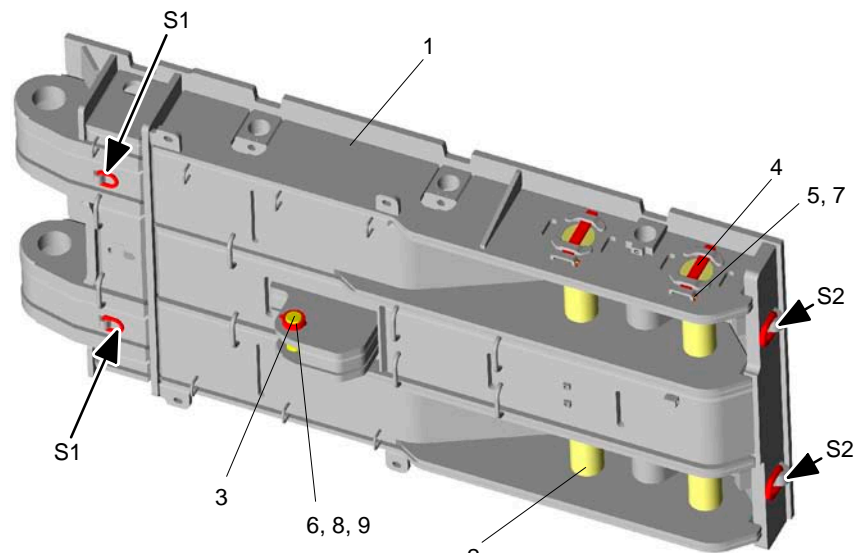
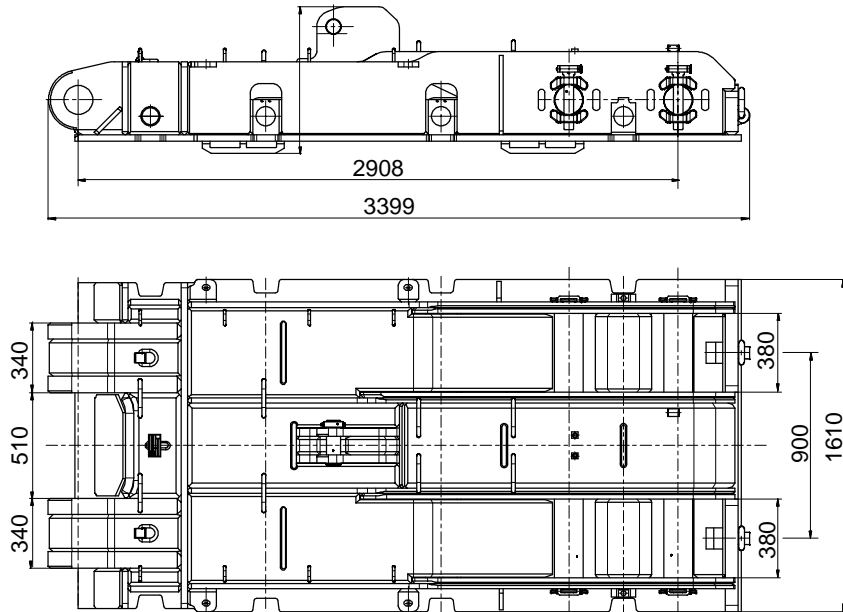


## Caving shield

The caving shield protects the face area toward the gob. It is connected to the shield canopy and with the base via the front and rear lemniscatic links. A stabilizing cylinder is arranged between the caving shield and the shield canopy to provide stability for the articulation.

The caving shield has retainers for the cylinders and guiding pins of the side seal.

**Fig. 80: Caving shield for all shield variants**



- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1 Caving shield, subassembly      | 7 Locking clip 2.5                |
| 2 Lemniscatic link pin Ø139,3x525 | 8 Hex. head screw M 10x110-A 2-70 |
| 3 Pin 75/69x218                   | 9 Hex. nut M 10-A 2-70            |
| 4 Securing device                 | S1 Lifting eye, capacity: 3000 kg |
| 5 Pin 15/12x120                   | S2 Lifting eye, capacity: 8000 kg |
| 6 Retaining ring                  |                                   |



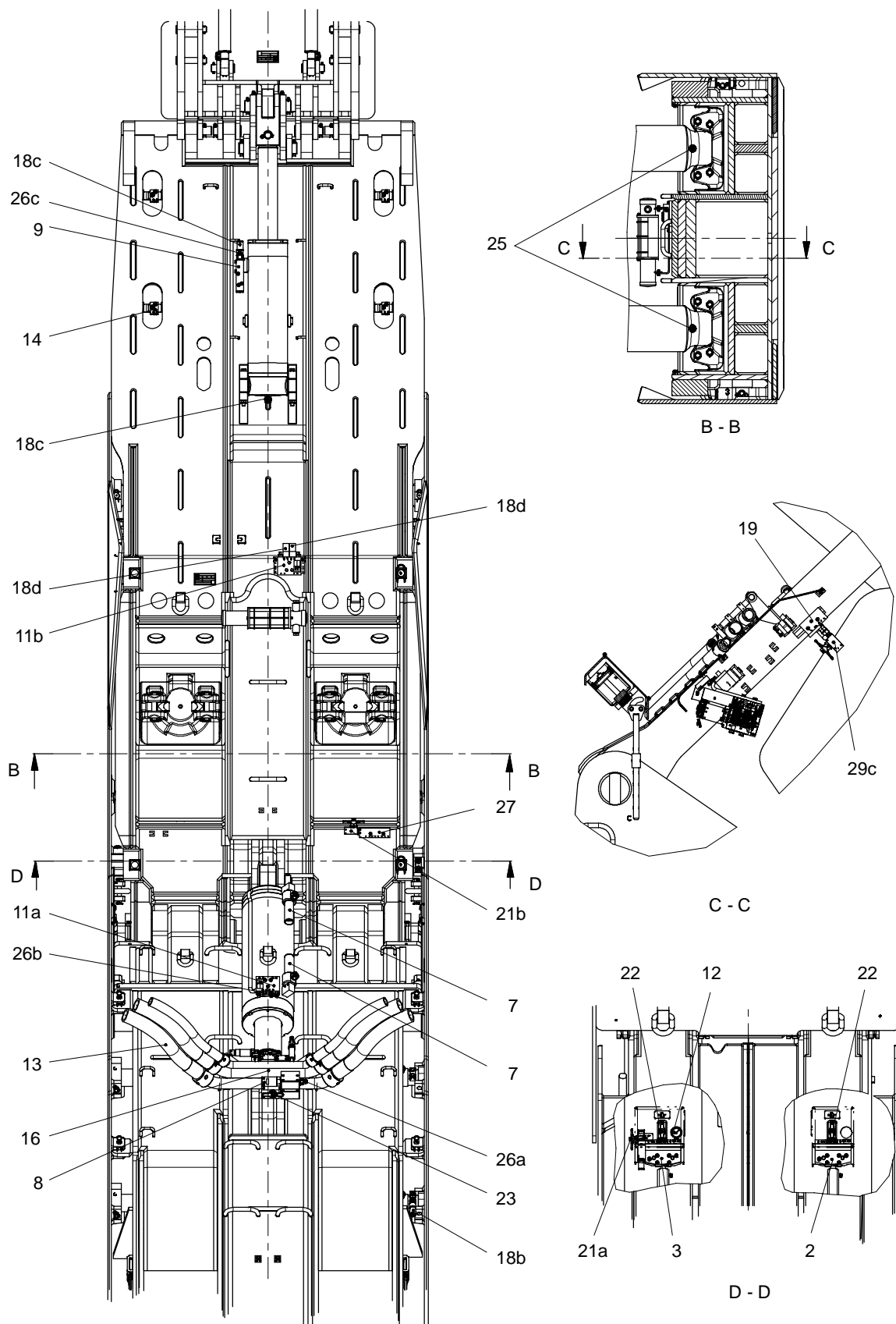
**Notice!**  
Apply lubricant B6 EWN 7068 to all connecting points and slide surfaces.

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# Hydraulic system

**Fig. 84: Shield hydraulics, arrangement (2) shield variants 01 and 02**  
Image caption: see Table 18



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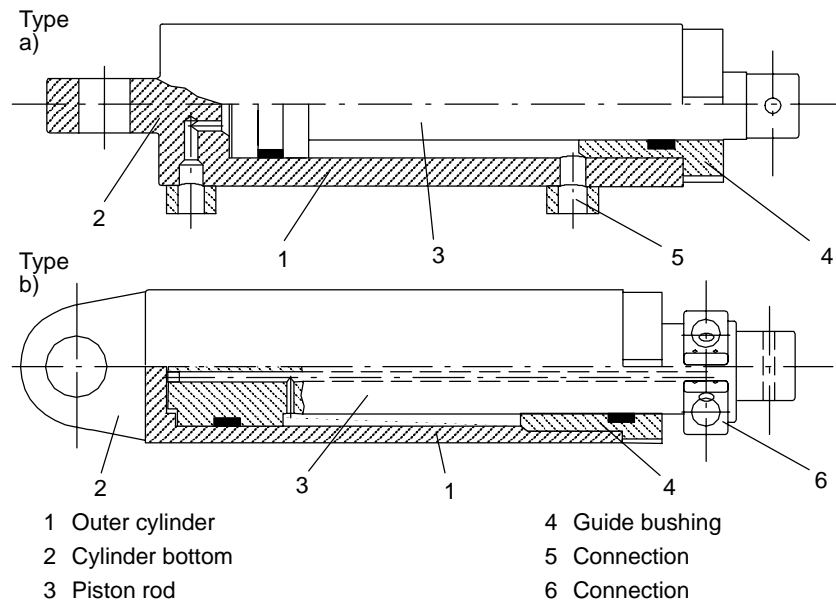


## Hydraulic cylinder

### Design

The hydraulic cylinders used mainly differ in the arrangement of their connections. They can be roughly divided into two groups:  
 Type a) Connections arranged on the outer cylinder  
 Type b) Connections arranged at the end of the piston rod.

Fig. 93: Hydraulic cylinder, typical example



#### Notice!

The technical data for the cylinders can be found in section “Technical data, hydraulic cylinders” of the used shield unit.



#### Warning!

Risk of serious bodily injuries due to pressure fluid suddenly escaping at high pressure and bursting hydraulic lines caused by dangerous overpressure.

Never close the lowering ports of double-acting props pressure-tight.

Otherwise, when extending the prop, a pressure can build up in the annular space which is several times more than the set pressure.

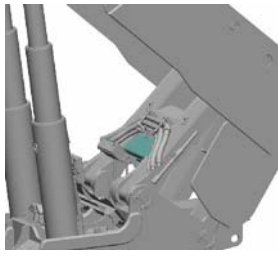
The end of the piston rod either has its own fastening option or is made so that a fastening option, e.g. rod head or fork head, can be screwed on and can be secured against working loose using clamping screws or a clamping sleeve connection.

The pressure fluid is either fed through the connections at the outer cylinder (type a) or on the piston rod (type b).

If a double-acting cylinder is to be operated as a single-acting cylinder the annular space connection must be protected using filter screw to prevent the penetration of dirt. If the cylinder is used without the annular space seals, the seal grooves are to be filled with grease.



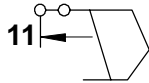
# Electrohydraulic control system



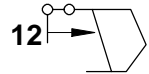
## Electrohydraulic control system

### Electrohydraulic control unit

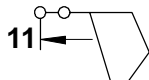
The electrohydraulic control unit has 14 functions and is the same for all shield variants. The assignment of function keys 11 and 12 differs between shield variants:



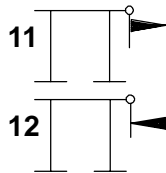
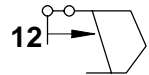
■ Face and transitions shield -  
Front cylinder, extend



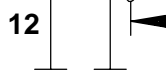
Front cylinder, retract



■ Endshield variants 02 and 03  
neither of both functions is assigned

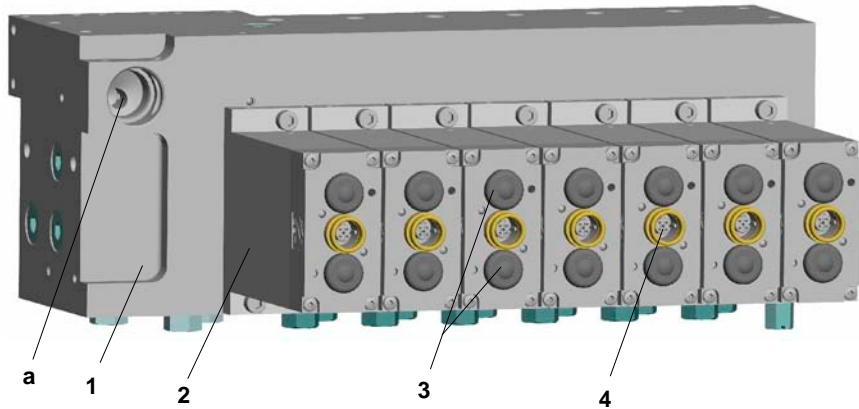


■ Endshield variants 01 and 04  
Side flap, extend



Side flap, retract

Fig. 103: Electrohydraulic control unit, 14 functions



- a Connection (DN 20) for storage cartridge
- 1 Distribution block
- 2 Pilot valves with electromagnetic operation
- 3 Button for manual operation
- 4 Contact for electrical connection to the valve control strip

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## Permissible media

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### Hydraulic fluid maintenance

The consistent good quality of the hydraulic fluid is essential for the operational reliability of hydraulic systems. Therefore, maintenance of the hydraulic fluid must not be neglected but should be performed with special care. The most important properties of the hydraulic fluid should ideally be monitored automatically and recorded in order to be able to directly counter any harmful effects. These properties include: temperature, foaming, pH-value, concentrate ratio, and microbial load.

The operator of the equipment has to prepare a hydraulic fluid maintenance concept for any individual application. The maintenance concept should be prepared in close co-operation with the manufacturer of the concentrate and has to be applied consistently.

If it is not possible to monitor the hydraulic fluid continuously, the properties listed in the following should be checked at least once every week:

- pH - value
  - Target value: 7.5 to 9.5
- Concentrate ratio
  - Target value: see certificate
- Microbial load
  - Target value:  $\leq 10^5$  col/ml.

In addition, the electrical conductivity, foaming and the operating temperature of the hydraulic fluid should be monitored regularly.

The permissible max. temperature of the hydraulic fluid is 55 °C. During normal operation, however, an operating temperature of 45 °C should not be exceeded. A higher operating temperature will reduce the stability of the emulsion and shorten the life of the sealing material.

### Quality of the process water

The quality of the water used for the preparation of the hydraulic fluid has an enormous influence on the properties of the hydraulic fluid. Accordingly, the requirements for monitoring the water quality are very high.

The following (table 27) lists limits for the essential properties and components of the water.

If the limits shown are maintained, it can be assumed that the water is basically suitable.

If one or several of the limits mentioned are not met this should be taken into consideration when selecting a concentrate. Additional water treatment may also be required.

The customer shall in any case, however, provide a sample of the original water to permit performing the tests required for the issue of the certificate.

Changes in the composition of the water will also lead to the loss of the certificate, even if they are within the limit values mentioned.

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