



Technical Manual

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Before starting 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 shields.

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

question

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

safety

Read the chapter 2 "For your safety" with special attention. This chapter contains important information indicating possible hazards.

Observe the information given and follow the procedural instructions.

Characters and symbols used

The following characters and symbols are used for safety instructions and important information in the operating manual.

Try to memorize the symbols and their meanings.



DANGER!

Points in the text marked with this symbol draw your attention to immediately impending danger. Possible consequences are: very serious injury or even death.



WARNING!

These points contain information on dangerous situations. Possible consequences are: very serious injury or even death.



CAUTION!

This symbol draws attention to dangerous situations. Possible consequences are: light to moderately serious injuries and machine damage.



NOTICE!

Points in the text marked with this symbol draw attention to harmful situations. Possible consequences are: damage to the shield or damage in the immediate vicinity.



IMPORTANT!

Points in the text marked with this symbol contain useful tips and information intended to facilitate work for you. They do not warn about harmful or dangerous situations.



Safety instructions

Installation

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

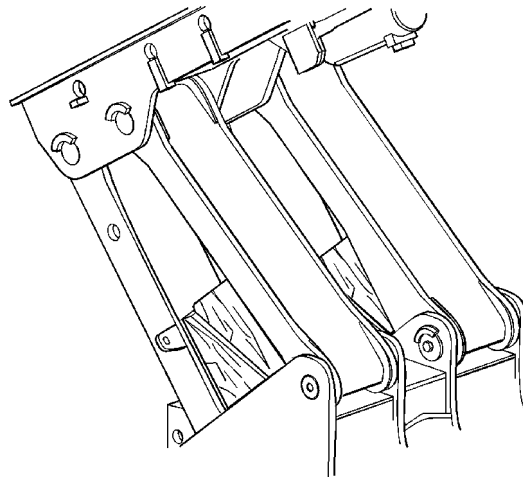
Prior to commencing any work on the shield make sure that the shield has been secured to prevent it retracting automatically.

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 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 securing device of the side seals. Use the hydraulic control system to adjust the side 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 swivelling area of the latter as the flipper may swing downward.

travelway

Make sure that the minimum dimensions specified for the travelway within the shield are maintained under any circumstances. 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 travelway. It may be necessary to install additional devices limiting the lowering height in order to ensure that the minimum travelway is maintained.



Overview of the safety instructions



CAUTION!

Prior to assembly, sockets and nipples of the plug-type connectors must be treated with lubricating paste B3 to EWN 7068 which does not contain molybdenum disulfide. See chapter 6, section "Recommended lubricating greases and pastes".

Prior to assembly, the sliding surfaces of the transport units of the steel structure must be coated with lubricating paste B6 to EWN 7068 which does not contain molybdenum disulfide. See chapter 6, section "Recommended lubricating greases and pastes".

For transport underground only the attachment points detailed in chapter 3 "Transport" are allowed to be used. Further information is given in chapter 3 "Transport". Failure to comply may lead to injury to persons and damage to property.

Face hydraulic systems which are unstable or not amply dimensioned could cause temporary pressure drops during operation. A pressure drop down to 180 bar or less entails the danger of malfunctions of the electrohydraulic control system. Possibly, valve functions will not be executed. It may even result in valves starting to vibrate which could lead to valve damage.

Under unfortunate conditions this could result in hazardous situations with accidents entailing injury to persons and damage to property.

Therefore, take all measures required to ensure that the system pressure cannot drop to less than 180 bar anywhere in the face hydraulic system.



NOTICE!

Take care to ensure that all transport safety devices required for transport have been removed. See chapter 3, section "Transport".



IMPORTANT!

When installing the shields in the face, be sure to observe the shield numbers. Since the individual shields might be provided with different functions they must be arranged in the specified order.

For details, please refer to the respective separate operating manual of the manufacturer.

Chapter 5: Operation



DANGER!

You are only allowed to operate the shield control if you have a profound knowledge of the control elements and of the way the control system works. You must have been task-trained on the present control system and should have practiced to deepen your knowledge. Should this not be the case you are not allowed to operate the control. Inform your superior immediately and ask for the required training.

Push buttons that are jammed or fixed could lead to uncontrolled movements of the shield. These may cause severe injuries or death to the operator.

Therefore, never fix the push buttons and take care to ensure that damaged pilot valves are always replaced without delay.



WARNING!

Ignoring the safety regulations will cause accidents and may result in serious bodily injuries or death.

The regulations about safe working of your mine must be followed strictly. Apply the following instructions analogously in addition and in accordance with the individual safety regulations of the mine.



Storage

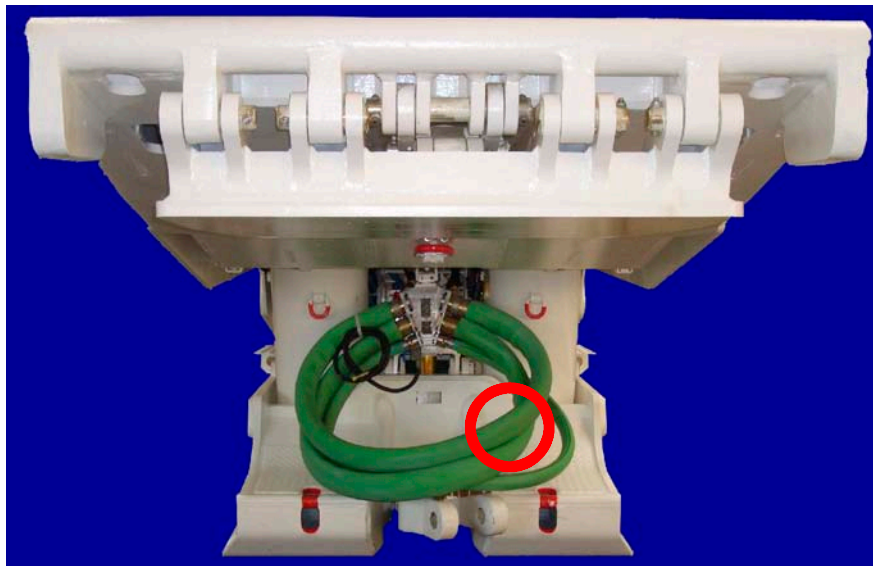
long-term storage	<p>If the equipment is to be stored for more than 6 months, the cavities in the hydraulic components must be completely filled with a preserving fluid such as e.g. HYDROCOR® CV 50. This fluid must have corrosion-protection properties and should be frost-proof within the respective temperature range of the application. All ports must be sealed with durable and suitable plugs.</p> <p>It is highly recommended not to store the equipment outdoors but in a well ventilated room. If it is not possible to store the complete equipment indoors, remove the hydraulic and electronic components and store them separately.</p>
storage outdoors	<p>Equipment parts stored outdoors must be protected against direct sunlight, precipitation and dirt - for example by using tarpaulins. These parts have to be stored such that fluid will not be allowed to collect in cavities. Fluids entering any cavities during transport or loading/unloading must be able to flow off freely.</p>
electrical equipment, rubber and plastic parts	<p>As a general rule, electrical equipment, electronic components, spare parts made of rubber or plastic - such as seals and hoses - as well as pressure fluids have to be stored in closed rooms at 15 °C. to 25 °C. protected against direct sunlight. Exceptions: see "Short-term storage".</p>
natural ageing	<p>Even with proper storage, seals and hoses are subject to natural ageing. A storage period of approx. two years is therefore quoted as an indicative value for these parts.</p>
moisture and dirt	<p>Protect all hydraulic elements during storage in a suitable manner against the ingress of dirt and moisture. The connecting surfaces of the hydraulic components must be protected against corrosion and closed with blind plates. Hydraulic plug-type connections and the connectors of the electric cables must be closed with suitable caps or plugs.</p>
plastic deformation	<p>When storing assemblies - such as props and cylinders - containing contacting joints, sealing elements may suffer plastic deformation as they are constantly subjected to static unilateral loads due to the weight of the components. This may render the seals useless or reduce the life of the sealing element. This effect is greatly influenced by the size and duration of the load and the prevailing temperature.</p> <p>Therefore, props, cylinders and similar components should only be stored in an upright position. This especially applies if the components are to be stored for a longer period of time.</p> <p>If you intend to store a machine containing any of the above-mentioned components you may have to dismantle such components in order to store them adequately.</p>
random sample inspection	<p>After a storage period of approx. two years, a random sample inspection must be performed to determine whether the measures taken and the method of storage has prevented damage.</p> <p>On request, the inspection can be carried out by DBT. The cost will be borne by the mine.</p>



Installation of the shield units

shield number The shield number is an identification feature. All shields are numbered consecutively. Firmly attached plaques showing the respective shield number are provided at the base skid.

Fig. 13: Shield number at the base, example



Tab. 5: Allocation of shield numbers

shield no.	order no	application
see Appendix	7420 163 000 00 01	face shield
	7420 163 000 00 02	transition shield
	7420 163 000 00 03	face end shield, right with side flipper and sideprotective wall
	7420 163 000 00 04	face end shield, right without side flipper and protective wall
	7420 163 000 00 05	face end shield, left with side flipper and protective wall



Corrosion protection of hydraulic components



Operation of the shield



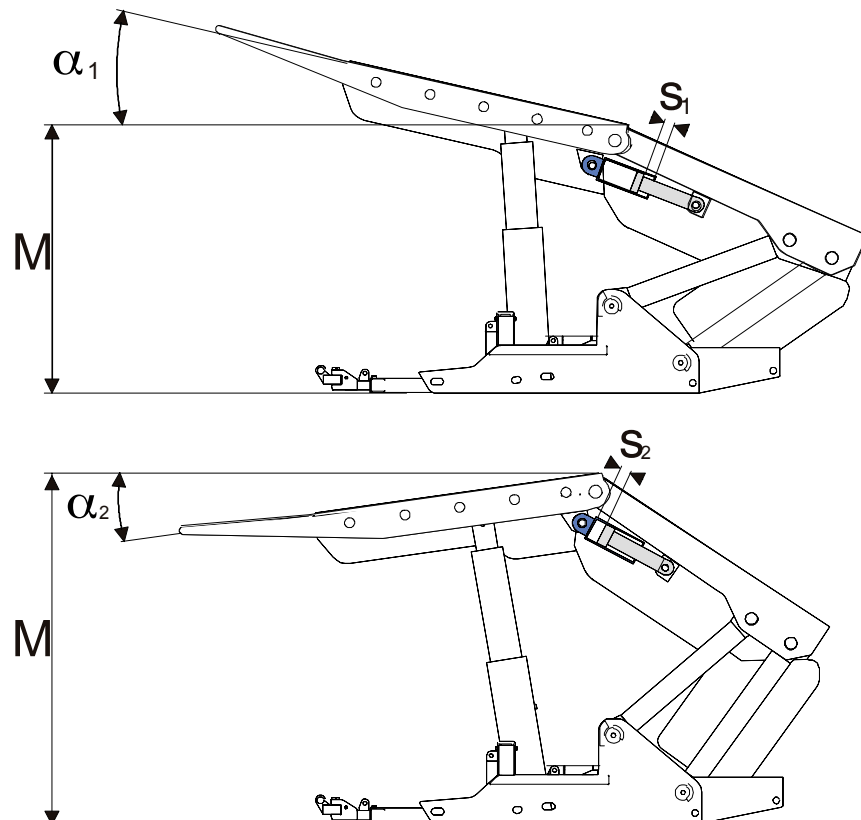
CAUTION!

Never extend or retract the stabilizing cylinders of the shield completely. They must always have sufficient residual stroke. Standard value: min. 20 mm!
The same applies analogously for the swivel canopy cylinders.

This is the only way of cushioning high peak loads, which may occur suddenly, by the hydraulic securing action of the stabilizing cylinders.

If the residual stroke is not sufficient, this may result in serious damage to the shield under unfavorable leverage conditions.

Fig. 25: Shield with extremely inclined canopy



M = height of the set shield

α = inclination angle of the canopy

S = residual stroke of the stabilizing cylinder



CAUTION!

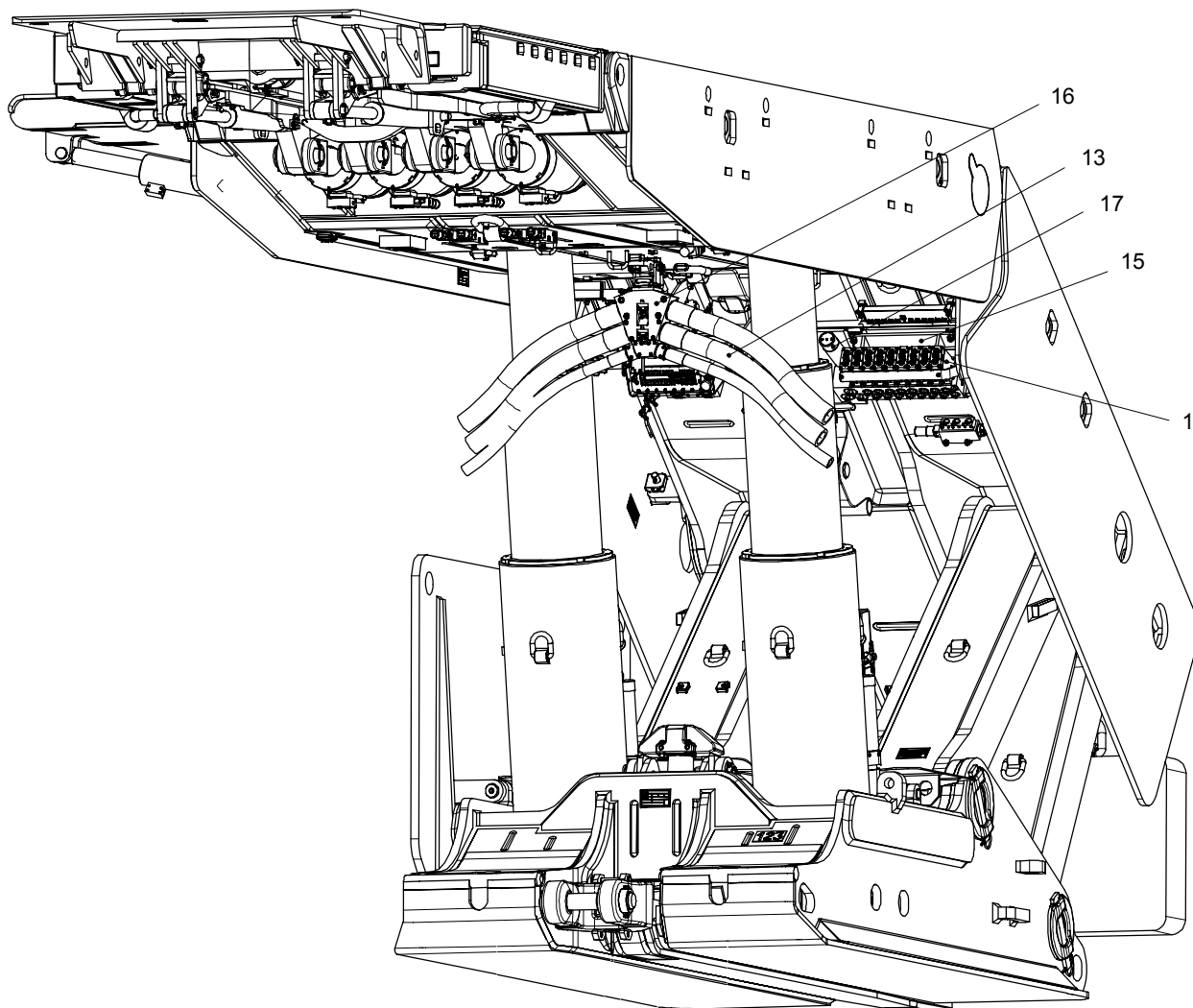
Ensure sufficient residual stroke of the stabilizing cylinders especially in the case of a tendency to roof fall-outs and/or extremely soft floor.

This applies especially if the shield control unit is equipped with an automatic positive setting function. Under unfavorable conditions - for example, soft floor and in addition, perhaps a tendency to roof fall-outs - the automatic positive setting function could lead to the stabilizing cylinders not having sufficient residual stroke or being extended or retracted completely. Therefore, operate the shield in such or similar cases without automatic positive set.



Operation of the shield hydraulics

Fig. 31: Shield hydraulics, arrangement (1), shield variants 03 and 05
key, see table 6



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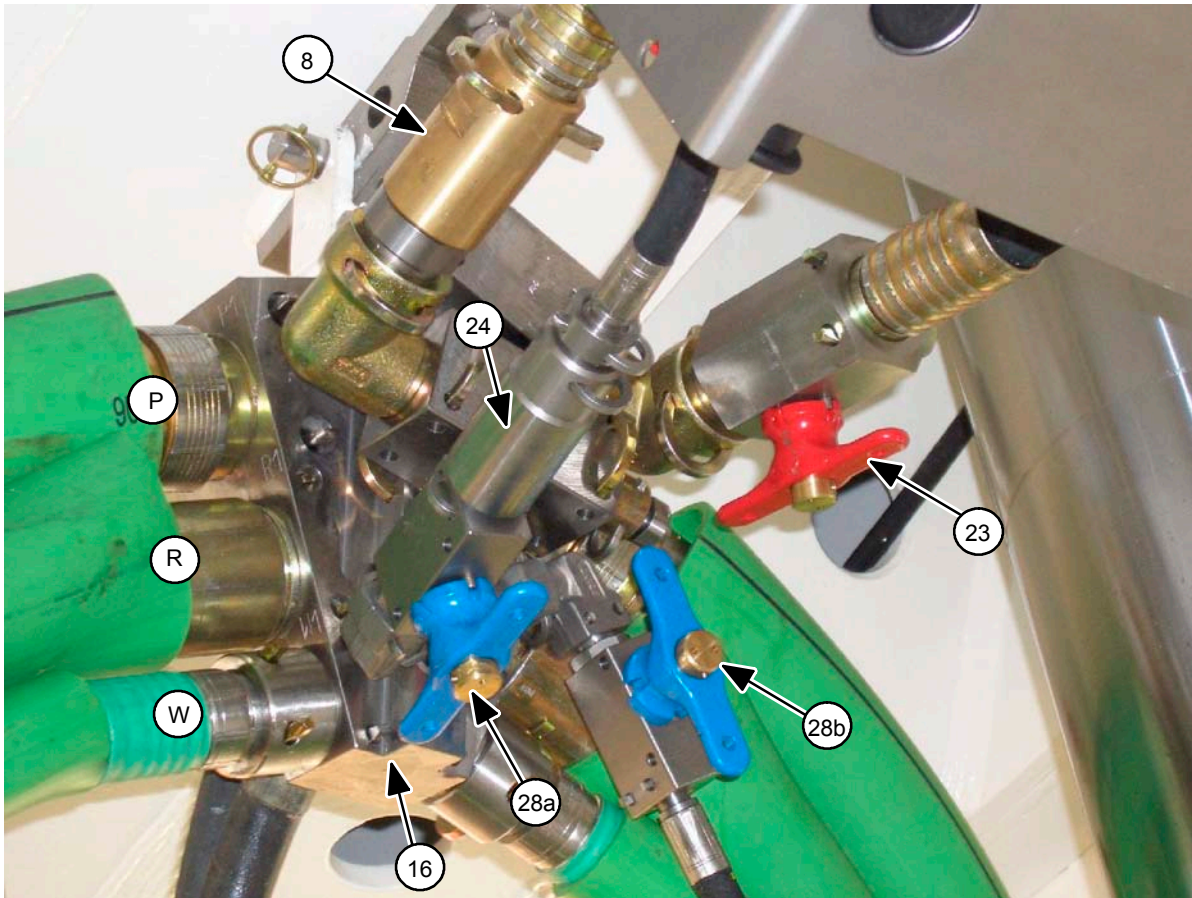
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Operation of the shield hydraulics

Fig. 41: View of the supply block from an angle below Drawing No.:



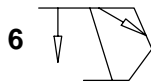
8 RV NW 25, in the return line
 16 Supply block
 23 HD ball valve interrupts the pressure supply line to the shield

24 Pipeline filter in the water feed
 28a HD ball valve, blocks the water supply
 28b HD ball valve for spray pipe

P Pressure line, DN 50SS
 R Return line, DN 50
 W Water line, DN 25



Operation of the shield hydraulics

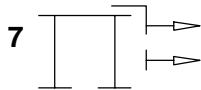


Retract stabilizing cylinder



CAUTION!
Do not exceed permissible canopy angle!
Observe value for minimum residual stroke.

Before initiating this function ensure that the adjacent shields are completely set.
The function causes the canopy tip to lower and serves to correct the attitude of the canopy. It is performed as long as the button is held depressed or until the end position has been reached.
After the attitude of the canopy has been corrected the props will have to be set again.



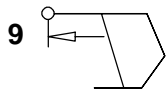
Extend seal cylinders

This function is designed to correct the attitude of a shield with respect to its adjacent shield. The seal cylinders are extended as long as the button is held depressed, until equilibrium of forces has been obtained or until the end position has been reached. When not activated, the side seal is pressed outwards by the force of the pressure springs.



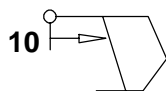
Retract seal cylinders

This function is designed to correct the attitude of a shield with respect to its adjacent shield. The seal cylinders are retracted as long as the button is held depressed or until the end position has been reached. When not activated, the side seal is pressed outwards by the force of the pressure springs.



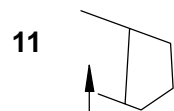
Extend flipper cylinder

The function is performed as long as the button is held depressed, until equilibrium of forces has been obtained or until the end position has been reached.



Retract flipper cylinder

The function is performed as long as the button is held depressed, until equilibrium of forces has been obtained or until the end position has been reached.



Extend baselift cylinder

The function is performed as long as the button is held depressed, until equilibrium of forces has been obtained or until the end position has been reached.



Retract both props (release support actively)

Before this function is initiated, ensure that the adjacent shields have been set completely.
This function is performed as long as the button is held depressed or until the end position has been reached.



Internal by-pass in props

If an internal by-pass in the prop is suspected, this procedure should be followed:

- ☞ Pump props up to roof at set pressure.
- ☞ Isolate the annulus side of the prop to be checked. To this end, detach the hose line at the prop annulus ports (located at the prop head and the prop cylinder) temporarily and admit pressure to the control port (extend prop) of the POCV.
- ☞ Operate the "set prop" function.

If there is an internal by-pass in the prop, for example due to damaged piston packings, fluid will flow out of the prop lower port. If this happens, the prop must be replaced. If fluid escapes from the detached hoses the POCV is defective.

Faulty pressure relief valve

A faulty pressure relief valve can usually be seen to be weeping or a check on the pressure gauge reveals it is not holding pressure. If pressure fluid still flows out at operating pressure, the pressure relief valve is defective or the discharging pressure setting of the valve used is too low.

Pressure relief or pressure relief valves of various types are used in the hydraulic circuit of a shield. pressure relief valves used on props, for example, have a high flow rate while the pressure relief valves used on shifting rams, stabilizing cylinders etc. are designed for a lesser flow rate.

The pressure relief valves for different cylinders or for the piston and ring sides of a cylinder may have different max. value settings. Please observe the information given in the hydraulic flow plans or in the spare parts catalog.

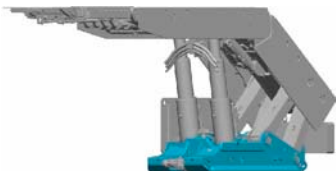
Defective or blocked filter

Operation of the shield is slow although pressure is known to be normal operating pressure. Contamination is assumed to have occurred in the hydraulic system, e.g. after repair work.

- ☞ Check the filters in the hydraulic system. Backflush filters may be cleaned by backflushing. On fine-mesh filters which are, for example, used on the control valve blocks, the filter elements must be replaced.



Shield description



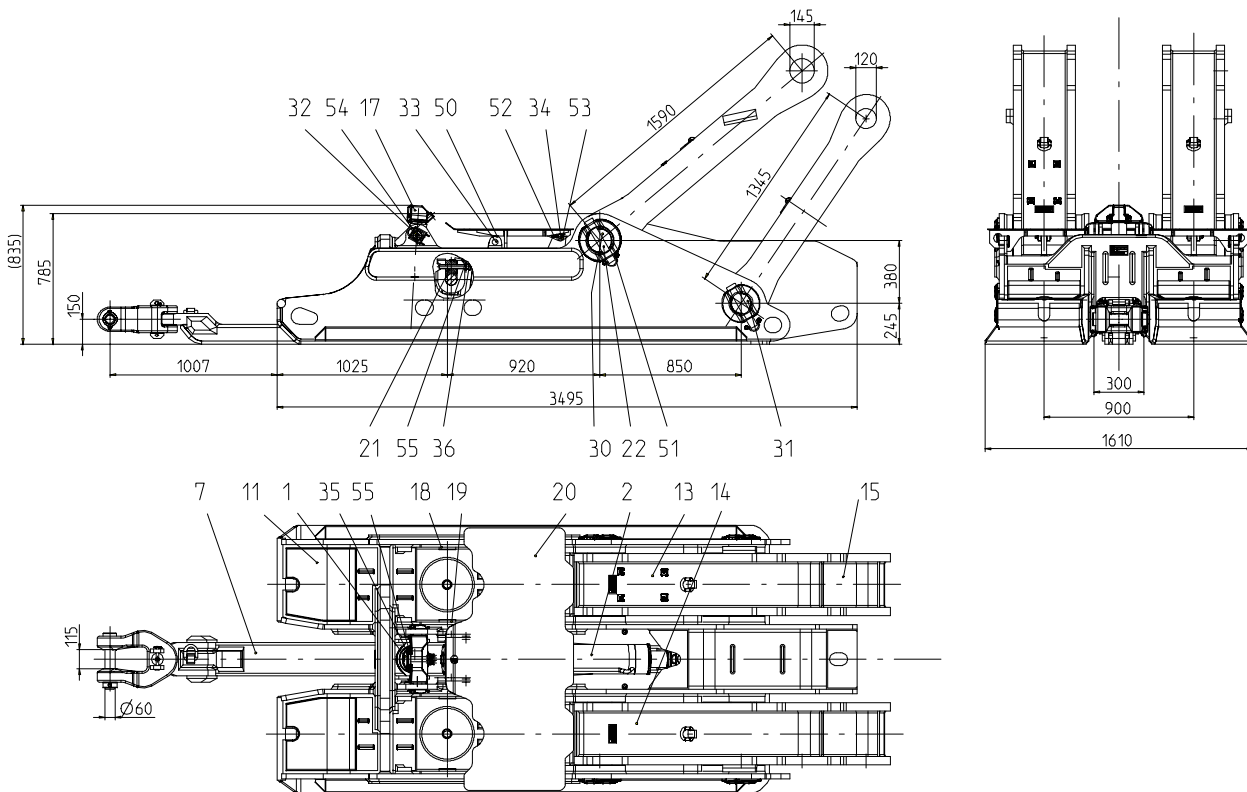
Base with lemniscatic links and central shifting unit

The solid base transmits the shield load of the hydraulic props into the floor. The props are supported in an articulated manner in ball sockets welded to the base and secured by bolted prop retainers. The links of the lemniscate system are hinge-connected with the base by pins.

The type of base described is characterized by having the shifting unit and its guiding device arranged between the skids. The shifting unit is reverse-mounted with the force of the cylinder being transmitted to the conveyor via the relay bar. With a reverse-mounted shifting unit, the force of the piston surface area is utilized to advance the shield and the smaller force of the ring surface area to advance the pan line. The connection to the conveyor is provided via a universal joint.

A baselift cylinder serves for raising the base out of a soft floor during shield advance.

Fig. 56: Base, shield variants 01 and 02



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- | | | |
|------------------------------------|---|---------------------|
| 1 base lift cylinder ZE-135/90-240 | 19 prop retainer, L.H. | 36 pin |
| 2 shifting ram ZE-150/100-960 | 20 travel path | 50 locking clip 4 |
| 7 shifting unit | 21 bracket | 51 locking clip 5,6 |
| 11 base | 22 locking plate | 52 spring cotter 5 |
| 13 front lemniscatic link, R.H. | 30 lemniscatic pin $\varnothing 144,3 \times 525$ | 53 washer |
| 14 front lemniscatic link, L.H. | 31 lemniscatic pin $\varnothing 119,3 \times 525$ | 54 circlip |
| 15 rear lemniscatic link, RH | 32 pin $\varnothing 50 \times 105$ | 55 staple DN 10 |
| 16 rear lemniscatic link, LH | 33 pin $\varnothing 29 \times 57$ | |
| 17 base lift cylinder bearing | 34 pin $35/25 \times 90$ | |
| 18 prop retainer, R.H. | 35 pin $\varnothing 16 \times 117$ | |
- refer to the spare parts catalog too



Shield description



Side seal

The side seals seal the gap between two adjacent support units. They are also used to correct the attitude with respect to the adjacent shields.

The R.H. side seal, as viewed in the direction of advance, is firmly connected to the shield canopy and/or the caving shield. The L.H. side seal is movable. It is fastened with guide pins and constantly pressed against the adjacent shield by means of compression springs. The side seals are extended and retracted by means of hydraulic cylinders.



WARNING!

Risk of injury due to unexpected movements of the side seal. The movable side seal is under spring pressure. Never remove side seal connecting elements before the side seal has been pulled together and secured by clamps.



CAUTION!

Before putting the shield unit into operation, remove the transport safety devices (marked by an * in Fig. 58) of the side seal. The movable side seals are retracted for transport and locked mechanically by means of pins. The pins are secured with coupling clamps.

Tab. 16: Gap coverings used for all shield variants

Description	variants					Ident. No.	length L in mm	Weight approx in kg
	01	02	03	04	05			
Side seal	x	-				7420 163 700 00 01	2780	2550
Side seal	-	x				7420 163 700 00 02	3280	2790
Side seal	-	-	x	x	x	7420 163 700 00 03	3640	2880



NOTICE!

If the side seal is to be movable on the opposite side, the seal cylinders and the respective guide pins have to be mirror-inverted.



WARNING!

Risk of injury! The movable side seal is under spring pressure. Never remove side seal connecting elements before the side seal has been pulled together and secured by clamps.



NOTICE!

Remove transport securing devices (items 27*, 38* and 45*, 37*) at moveable side before putting the shield into operation. All sliding surfaces and joints to be coated with lubricating paste B6 to EWN 7068



Hydraulic system

Shield hydraulics

The following Table lists the hydraulic components of the shield support. It applies for all shield variants, deviations in the quantity and/or in the positions of the components are marked.

Tab. 18: Hydraulic components

Pos.	Pcs.	Designation	Arrangement	Title
01	1	Electro-hydro control	to the left underneath the caving shield	on a support
02	1	RV, NG 20 can be unblocked hydraulically	on the right-hand prop, gobside	without compensating valve
03	1	RV, NG 20 compact can be unblocked hydraulically	on the left-hand prop, gobside	with compensating valve
04 ^{**)}	1	RV, can be unblocked hydraulically	on the cylinder for the side flap	
05	1	RV, can be unblocked hydraulically	to the left underneath the caving shield	for shifting cylinders
06	2	DBV, 462 bar with DN 20 adapter	in each case on the prop	high flow-through rate
07	2	DBV, 470 bar	on the corner cylinder	for piston space side and annular space side
08	1	RV, NW 25	on the supply block	in the return line
09	1 ¹⁾ 2 ²⁺³⁾	Twin RV, double DN 10	a) on the flipper cylinder with shield variants 01 and 02 at the front on the right under the cap with shield variants 03 to 05 b) at the front on the left under the cap with shield variants 03 to 05	a) for flipper cylinders b) for sliding cylinders
10 ^{*)}	2	RV can be unblocked hydraulically	at the front underneath the cap on the adjusting cylinder	for cylinders on the adjustment sliding cap
11	1	Twin RV	on the corner cylinder	for corner cylinders
12	1	Glycerine pressure gauge	on the left-hand prop RV, gobside	
13	1	Hose pipes		Base group
14	1	Spraying system		Base group
14 ^{**)}	1	Lines and fittings for side flap		
15	1	Brackets and accessories		Base group
16	1	Supply block	beneath the cap, centred between the props	slung beneath the CAP on a support
17	1	Storage cartridge	on the electro-hydro control	
18	4 ¹⁾ 8 ²⁾ 9 ³⁾	DBV, 380 bar	a) on the RV (Pos. 5) b) on the seal cylinder c) 2x on the flipper cylinder with shield variants 01 and 02 d) 2x on the sliding cylinder with shield variants 03 to 05 e) 2x on the cylinder for adjustment sliding cap f) on the cylinder for the side flap	a) for shifting cylinders b) for seal cylinders c) for flipper cylinders, piston space side and annular space side d) for sliding cylinders, piston space side and annular space side e) for annular space side f) for the piston space side
19	1	Water spray valve	on the left beneath the cap	only with shield variants 01 and 02
19 ^{*)}	2	Connection plate	at the front beneath the cap	for external adjusting cylinders
20	1	Dual filter, can be backflushed	to the right underneath the caving shield	manually actuated

1) Quantity for shield variants 01 and 02

2) Quantity for shield variant 04

3) Quantity for end shield variants 03 and 05

*) only for end shield variants 03 to 05

***) only for end shield variants 03 and 05



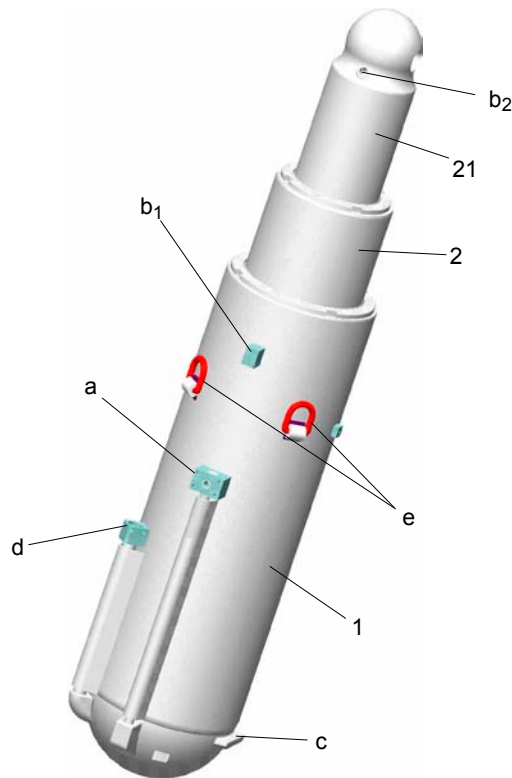
Double-telescopic prop

The prop described is a double-telescopic prop with equal load-bearing capacity at both stages. Equal load-bearing capacity of the two stages is ensured by a pilot-operated check valve which is installed in the piston pipe.

Bottom and top end of the prop are designed as a globe joint. This allows to join the prop to the base and the canopy with angular articulation. The cams at the bottom end of the prop will be fixed at the base using bolted arresting devices. The prop head is fastened to the canopy using special securing elements.

The technical data of the hydraulic prop are to be found in section "Technical data, hydraulic cylinders".

Fig. 80: Double telescopic prop, type SD-4400-345-1310/3050-CR



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- | | |
|--|--|
| 1 prop pipe | b ₂ annulus port, upper stage |
| 2 piston pipe | c cam |
| 21 piston rod | d pressure relief valve port, piston chamber |
| a valve connection plate | e load ring 3000 kg |
| b ₁ annulus port, lower stage | |

Tab. 21: Telescopic prop of shield variants

order no. telescopic prop	shield-variants	length in mm		stroke in mm	
		retrac- ted	exten- ded	upper stage	lower stage
8250 126 000 000 00 00	01 - 05	1610	3350	850	890



Hydraulic cylinder

Sliding cylinder, double acting	Type ZE-125/50-850, drawing no. 8241 341 000 00 00	
	stroke	mm 850
	piston dia.	mm 125
	piston rod dia.	mm 90
	piston surface area	cm ² 122.7
	ring surface area	cm ² 59.1
	thrust at 315 / --- bar	kN 386.5 /---
	pulling force at 315 / --- bar	kN 186.2 / ---
hydraulic cylinder of anti-topple device double-acting	Type ZE-80/50-600, drawing no. 8241 066 000 00 00	
	stroke	mm 600
	piston dia.	mm 80
	piston rod dia.	mm 50
	piston surface area	cm ² 50.3
	ring surface area	cm ² 30.6
	thrust at 315 / --- bar	kN 158.4 / ---
	pulling force at 315 / --- bar	kN 96.3 /---
hydraulic cylinder of anchoring device base - base double-acting	Type ZE-110/70-900-AB-CR, drawing no. 8241 192 000 00 00	
	stroke	mm 900
	piston dia.	mm 110
	piston rod dia.	mm 70
	piston surface area	cm ² 95
	ring surface area	cm ² 56.5
	thrust at 315 bar	kN 299
	pulling force at 315 bar	kN 177.9



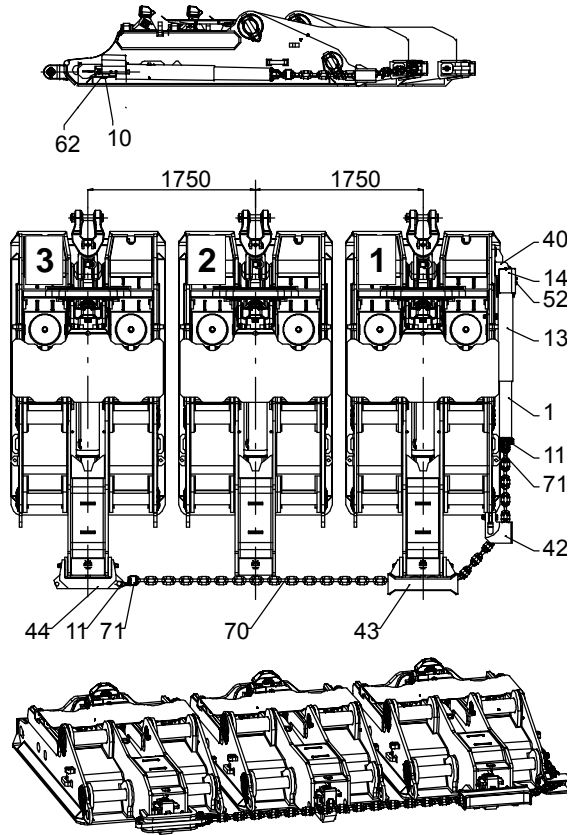
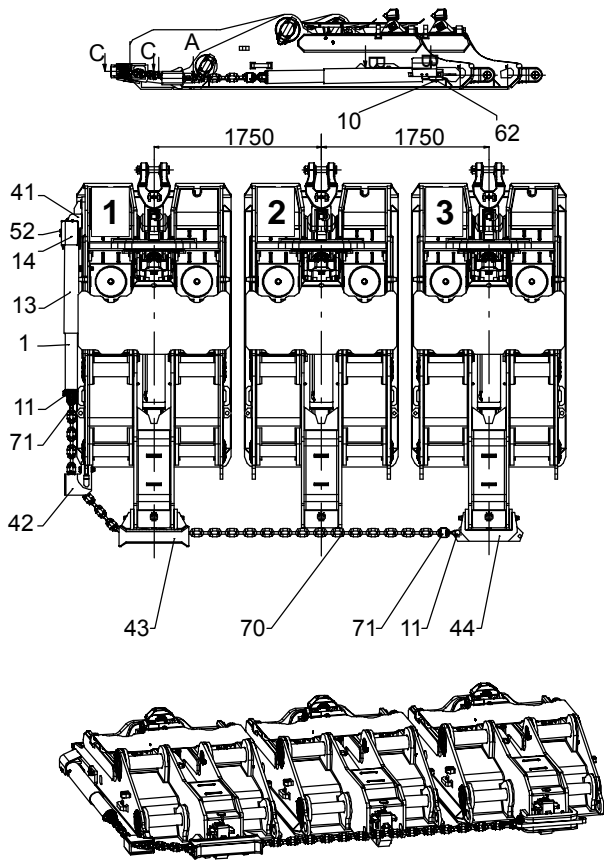
Accessories

End anchorage base - base

Fig. 99: End anchorage

L. H. (tail gate)

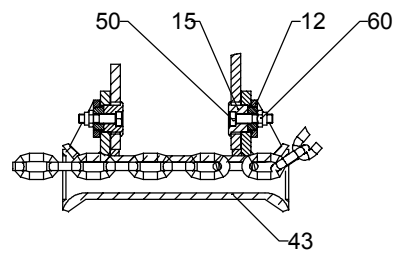
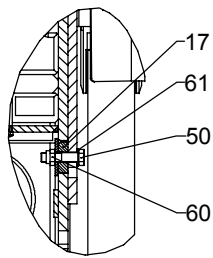
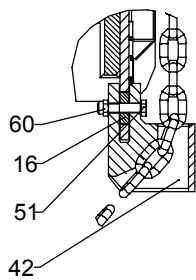
R. H. (head gate)



A-A

B-B

C-C



- 1 hydraulic cylinderZE-110/70-900
- 10 pin Ø40x125
- 11 chain shackle
- 12 washer
- 13 cylinder protection
- 14 protective plate

- 15 pin 110/86-65
- 16 bush
- 17 locking device
- 40 cylinder bracket R.H.
- 41 cylinder bracket L.H.
- 42 chain guide

- 43 chain guide
- 44 chain attachment
- 70 chain
- 71 chain connector

other: fastening and securing elements

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