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# Operation and Maintenance Manual

## Roof Support

Typ Face Shield
Doc-No.: 7420 247 000 BA 00

# About this manual

This chapter contains important information that makes it easier for you to use this manual. It also provides you with information about the structure of the manual and the symbols and signs used in it.

## Before starting work

**applicable operating manual**

Using an operating manual that is not written for the shield support at hand can result in a safety hazard for yourself and others. Make sure the information on the shield complies with that given in the operating manual.

**shield type**

This operating manual belongs to the

**Shield support 1295/2743-2x3833-1750 ***

**ID No.: 7420 249 000 00 01 (face shield)**

**ID No.: 7420 249 000 00 02 (face shield)**

and is only permitted to be used for shields of this type.

The operating manual must be accessible at all times to all persons working on or with the shield.
There should, if possible, always be an operating manual for the shield available at the place of operation.

**new operating manual**

Request a new operating manual immediately if the current operating manual is no longer complete or has become illegible.

### Persons for whom the operating manual is intended

This operating manual is intended for those persons who work with or on the shields.
All persons working on the face, at the edge of the face or at the entry must read this operating manual.

**This includes persons who:**

- are in charge of transport,
- set up the rise heading,
- perform installation/removal work,
- operate the shields,
- rectify malfunctions,
- perform daily routine work on the face,
- monitor/look after the hydraulic system,
- carry out maintenance work,
- carry out repair work.

**Supervisory personnel who:**

- initiate the activities mentioned above and/or
- supervise them.

* The shield support is referred to as the shield in the following text.

## Operation

**shield control**

In automatic mode, the shield units of a face are controlled by an automatic program without any human intervention. When traveling along the face you should therefore always bear in mind that the shield units may move automatically. Therefore, it is vital that you observe the warnings at the face entries as well as the visual and acoustic warning signals sent by the control unit in the shield unit currently operated.

Check whether all protective devices are present on the shield and in working order, see also chapter 6 “Technical data”.

You may only operate the shield control if you have comprehensive knowledge of the control elements and their functions. You must have been trained on the respective control and know the contents of the respective operating manual for that control.

You should not be in the same shield as the one you wish to operate. Always operate the shield only from a neighboring shield.

Make sure that no persons are present in the area of the shield being actuated.

During manual operation, the operator must always keep an eye on the movement range of the shield unit before and while the support is being moved, and prevent any hazards by acting with caution.

Always set the shield until the full setting pressure has been reached, since good roof support can only be ensured in this manner.

Extend the flipper towards the coal face as far as possible to prevent coal or surrounding rock from falling into the travel way.

Clean the operating controls of the control units regularly. Make sure that the operating symbols are clearly recognizable. This measure avoids operating errors and accidents which would result from this.

Keep the floor as clean as possible. Keep the mine floor free of debris. You will thus be able to extend the relay bar assembly without obstacles and advance the conveyor without problems.

Ensure that the water spraying system responds during advancement.

**inclined face**

On inclined faces it may be necessary to anchor the conveyor with respect to the support. You can thus prevent the conveyor from shifting to the side compared to the support. That reduces the risk of the relay bar assembly jamming between the skids.

Hydraulic anchorages must always be charged with the specified working pressure since only thus is a sufficient anchorage between support and conveyor ensured.

When advancing the shields, always observe the specified sequence of steps to prevent the shields from colliding with the anchorage cylinders.

On inclined faces, always advance the shields from the bottom to the top. Operate the shield to be advanced always from within the neighboring shield above. This reduces your risk of injury by falling rocks and also gives you a better view of the advancing operation.

# Storage and transport

This chapter contains important information on the correct storage and secure transport of the shields.
Following the instructions and the manuals will increase the service life of the shield. You will be able to carry out transport work more safely and quickly.
Paying careful attention to this chapter will also help you to simplify your day-to-day work.

## Storage

### Storing the equipment

**anticorrosion protection**

Components coated with temporary anticorrosion protection are protected for about six months.

**no direct exposure to sunlight**

Protect the equipment from direct exposure to sunlight.
Only store the electrical equipment, electronic components, spare parts made of rubber or plastic such as seals and hoses as well as hydraulic fluids in closed rooms at 15°C to 25°C.

**dirt and moisture**

Protect all parts of the equipment stored outdoors against moisture and dirt, e.g. by using tarpaulins.

The mounting surfaces of hydraulic components must be protected from corrosion and sealed with blind plates. Protect the hydraulic plug-type connections and the connections of the electrical cables with the caps and plugs supplied.

**short-term storage**

For short-term storage (approx. 4 weeks) of equipment outdoors, but at temperatures **above** freezing, electrical components need not be removed. Such components must especially be protected against excessive temperatures, dirt and moisture.

**long-term storage**

For long-term storage (more than 4 weeks), the equipment must not be stored outdoors. It needs to be stored in a dry, well-ventilated room.

After a storage period of approximately two years, an inspection must be performed to determine whether the measures taken and the method of storage have prevented damage.
This inspection can be carried out by Caterpillar upon request.

**natural aging**

Even with proper storage, seals and hose lines are subject to natural aging. Do not use these components if they have been stored for more than two years.

**Important!**
**Ensure during storage that any new supplies are stored separately from existing stocks in such a way that on removal, old stocks are always taken first.**

## Pressure equalization of the electronic control system

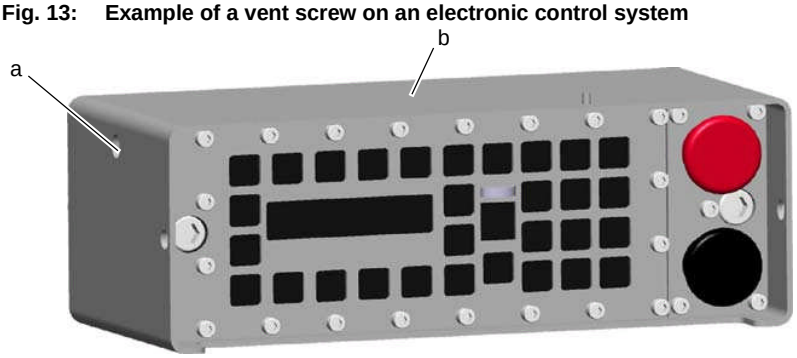
The shield units can be used in a number of different height positions at various prevailing air pressure levels.
These are equipped with a vent screw in order to enable pressure equalization between the internal and external pressure of the electronic control system housing.

☞ Release the vent screw (hex socket 4 mm) on the control system by several turns.

Pressure equalization is indicated by an audible hissing.

**Caution!**
**Make sure that the vent screw for pressure equalization on the control system is released. The foil displays may become damaged if no pressure equalization is established.**

**Fig. 13: Example of a vent screw on an electronic control system**




a vent screw

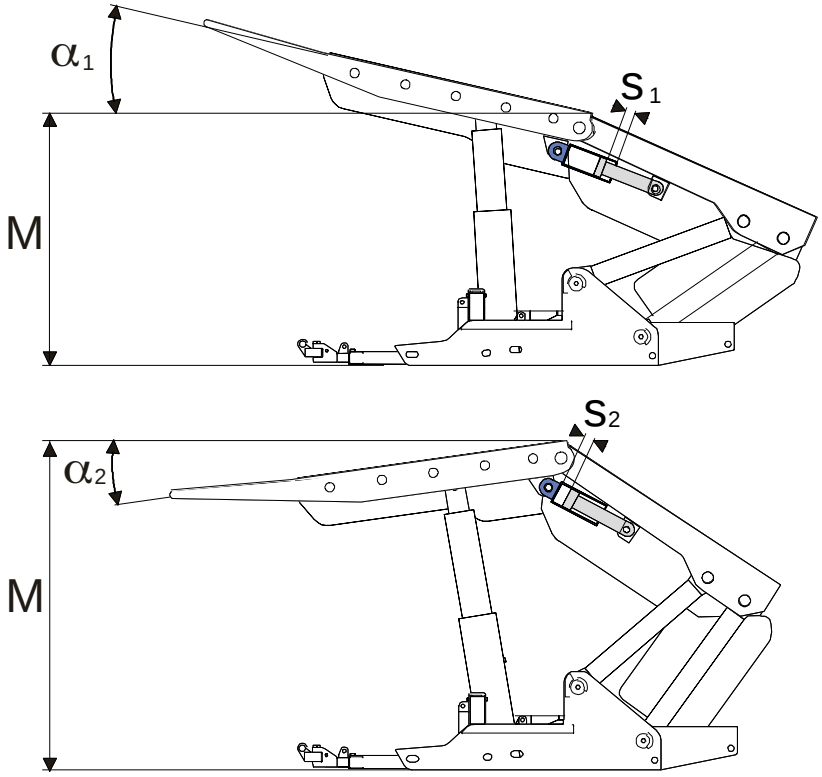
b electronic control system PMC®-R

☞ Afterwards, re-tighten the vent screw by hand.

**Caution!**
**Take care to ensure that the vent screw is tightened by hand again after the control system pressure has been equalized. If this is not done, then dirt and moisture could penetrate the control unit and firedamp protection is no longer ensured.**

# 5 Operation

**Fig. 22: Shield support with extremely inclined shield canopy**




M = height of the set shield support

$\alpha$ = angle of inclination of the canopy

s = residual stroke of the stabilizing cylinder

**Caution!**
**Ensure that the stabilizing cylinder has sufficient residual stroke when there is a tendency of roof falls and/or an extremely soft mine floor.**

This is especially true if the shield control system is equipped with an *automatic positive setting function*. Then there is a danger that under unfavorable conditions, for example a soft floor and possibly an additional tendency of roof falls, the automatic positive setting function could lead to the stabilizing cylinders not having enough residual stroke or that they even are completely extended. Therefore, in such or similar cases, move the support without automatic positive setting.

**Caution!**
**Keep the canopy from being excessively inclined by filling out the roof falls, for example, or by moving a horizontally positioned shield under smaller roof falls!**
**At this point, we would again like to explicitly emphasize that any damage caused by not complying with these instructions is not covered by the warranty.**

## Arrangement of the hydraulic components on the face shield

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

**Tab. 9: Hydraulic components on the face shield 7420 249 000 00 01 / hydraulic system no. 8112 389 000 00 00**

| Item | Quant-ity | Designation | Note |
|---|---|---|---|
| 01 | 1 | Electrohydraulic control unit, 8 functions | see separate operating manual |
| 02 | 1 | Water valve unit | see separate operating manual |
| 03 | 1 | Accumulator cartridge DN 20 SS | |
| 04 | 1 | Replaceable CV DN 20-SSO | for shifting rams |
| 05 | 1 | Dual CV | for stabilizing cylinders |
| 06 | 2 | CV, NW 25 | in the return line |
| 07 | 1 | Water filter DN 20-100 MY | |
| 08 | 1 | Double filter DN 25 SS Automatic | |
| 09 | 2 | HP ball valve DN 20-SS | see page 5.19 |
| 10 | 1 | Dual 3/2-way valve | |
| 11 | 2 | HP ball valve | see page 5.19 |
| 12 | 4 | HP ball valve | see page 5.19 |
| 13 | 1 | PRV, 80 bar DN 10 | in the return line of the auxiliary supply |
| 14 | 4 | PRV, 410 bar | - in the piston space of the props<br>- for piston space side and annular space side of the stabilizing cylinder |
| 15 | 2 | PRV, 380 bar DN 10 | - for lifting cylinders<br>- for shifting rams |
| 16 | 2 | PRV F-420 bar | for props, setting pressure 420 bar |
| 17 | 1 | CV, DN 10 | in the water spray canopy |
| 18 | 1 | CV, DN 10 | in the water spray canopy |
| 19 | 1 | Compact distributor | |
| 20 | 1 | Hose lines | subassembly |
| 21 | 1 | Water spraying system accessories | subassembly |
| 22 | 1 | Bracket and accessories | subassembly |
| 23 | 1 | Through sleeve DN 20/DN 12 | |
| 24 | 1 | Prop CV, DN 20 | |
| 25 | 1 | Prop CV, DN 20 | |
| 27 | 5 | Plug DN 10 with pressure relief | for pressure relief |
| 28 | 2 | Pressure gauge port | |
| 29 | 4 | HP ball valve | see page 5.19 |
| 30 | 1 | HP ball valve | see page 5.19 |
| 31 | 1 | Compact ball valve | see page 5.19 |
| 32 | 1 | Block ball valve | see page 5.19 |
| 35 | 3 | Glycerine pressure gauge NG 50 | |
| 36 | 1 | Distributor 2x DN 20; DN 25 | |
| 38 | 1 | Distributor, 5-way | |
| 39 | 2 | Distributor | |
| 40 | 1 | Plug DN 10 | |
| S1 | 2 | Pressure sensor | |
| Z1 | 2 | Prop | |
| Z2 | 1 | Lifting cylinder | |
| Z3 | 1 | Stabilizing cylinder | |
| Z4 | 1 | Shifting ram | |

## Repair and emergency operation

This section contains information on the functions and operation of the hydraulic control system, 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 system is **not** described here, but in a separate operating manual for the control unit.

Furthermore, it is assumed that the reader is familiar with the fundamental principles of the hydraulic shield support and the operation of the control unit.

**Warning!**
**You are only allowed to operate the controls of the electrohydraulic control unit when you know exactly what effects the functions have with respect to the shield support. You must have therefore attended a special training course to this purpose. Otherwise, there is a risk of operating errors. This could result in serious injury and even fatal accidents.**

**Warning!**
**The actuators on the electrohydraulic control unit should only be used in an emergency and for repair work and only in accordance with the special operating manuals of the mining company. During normal operation they should not be used. Otherwise, dangerous situations could arise which could result in very serious injury or death.**
**The shield support is operated in normal operation by means of the electronic control system only. It is imperative that you observe the instructions in the control unit's separate operating manual.**

The symbol plate is located on the electrohydraulic control unit. The symbols correspond to the various functions which are initiated by actuating the respective button. The meaning of the symbols and functions are described below.

**Important!**
**Note that - depending on the marking on the connecting cable - the end with the shorter distance is to be connected to the pilot valve. See also the separate operating instructions for the control unit.**

Controlling the shields during repair operation is especially dangerous since you are then operating the shield directly and immediately under which you are standing. It is therefore extremely important that you know and understand the relationships between the functions and movements of the shield.

While actuating the shield using repair mode, no other persons may stand in the shield's area of movement.

There are two pushbuttons on the cover of each individual pilot valve. When you press a button, the corresponding work valve is operated immediately.

**setting pressure is not reached / prop pressure drops again after setting**

| Possible cause | Measure required |
|---|---|
| Prop control valve is defective. | Replace prop control valve. Continue troubleshooting if the pressure continues to drop. |
| Props are damaged. | Check props for damage and replace, if necessary.<br>Remove hose from prop lowering connection and check whether pressurized fluid is escaping even though the prop is no longer being extended. If applicable: piston packing defective, replace prop. |
| Pressure relief valve defective. | Monitor pressure drop on the pressure gauge. Is pressurized fluid leaking from the pressure relief valve? If applicable:<br>Replace the pressure relief valve and retest the function. |

**canopy cannot be positioned**

| Possible cause | Measure required |
|---|---|
| The shut-off valve for the shield supply on the supply block is closed. | Open the shut-off valve.<br>Valves can only be switched when the supply line is open. |
| The shield canopy is stuck between the neighboring supports. | Determine the cause. If required, lower neighboring supports and align them in order to free the canopy. |
| The pressure of the hydraulic supply is too low. | Check whether<br>- the hydraulic supply is working properly,<br>- all shut-off valves are open,<br>- the system pressure is sufficient. |
| Piloted check valve is not working. | Check whether the pressure for controlling the valve is sufficient. Minimum approx. 80 bar.<br>The check valve may be defective. |
| Damaged or trapped hose line. | Check for damaged or kinked prop hose lines. |
| Stabilizing cylinder is defective. | Check stabilizing cylinder for damage and replace, if necessary. |

**canopy cannot be lowered**

| Possible cause | Measure required |
|---|---|
| The shut-off valve for the shield supply on the supply block is closed. | Open the shut-off valve.<br>Valves can only be switched when the supply line is open. |
| The shield canopy is stuck between the neighboring supports. | Determine the cause. If required, lower neighboring supports and align them in order to free the canopy. |
| The pressure of the hydraulic supply is too low. | Check whether<br>- the hydraulic supply is working properly,<br>- all shut-off valves are open,<br>- the system pressure is sufficient. |
| Piloted check valve is not working. | Check whether the pressure for controlling the valve is sufficient. Minimum approx. 80 bar.<br>The check valve may be defective. |
| Damaged or trapped hose line. | Check hose lines for controlling the prop / stabilizing cylinder. |
| Stabilizing cylinder is defective. | Check stabilizing cylinder for damage and replace, if necessary. |

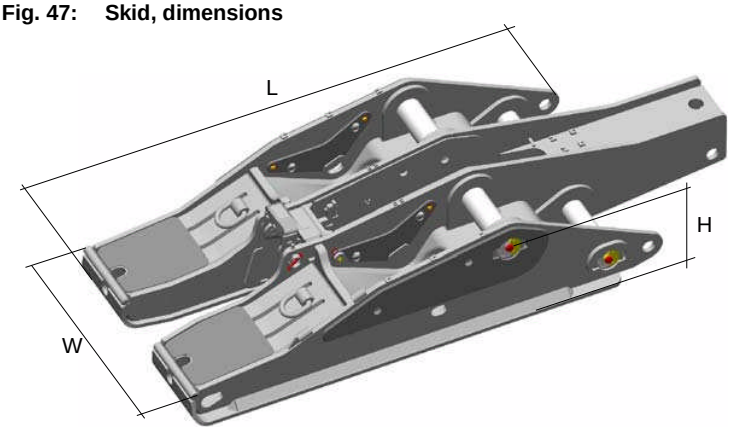
## Skid

The one-piece base frame transmits the bearing strengths of the hydraulic props to the floor. The props are mounted on hinges in the ball sockets in the skids and are held on both sides by prop retainers.
Both pairs of lemniscatic links are hinged to the base frame with a pin connection.

Characteristic for the base frame is the arrangement of the relay bar assembly in the middle between the two skids. The relay bar assembly is reverse-mounted. This means, the force applied to the piston surface of the shifting ram is used to advance the shield. Correspondingly, the conveyor is advanced with the smaller force generated via the annular surface.

The fork joint of the relay bar assembly establishes the connection to the conveyor.
With the help of the lifting cylinder, the shield can be lifted during shield advance.

**Fig. 47: Skid, dimensions**




L 4 020
W 1 650
H 620

**Warning!**
**Risk of injury due to pressurized fluid suddenly escaping at high pressure and bursting hydraulic lines caused by dangerous overpressure.**
**Never close the lowering connections on double acting props so that they are pressure-tight! Otherwise, pressure might build up in the annular space when extending the prop which is several times higher than the setting pressure.**

## Function

**set prop**

Pressurized fluid is admitted under the piston pipe via the piston space connection. The piston pipe first extends, while the pressurized fluid in the annular space is discharged into the return line.
If the piston of the piston pipe moves against the stop before the shield canopy has reached the roof, the piston rod extends. The pressurized fluid is supplied at the same time via the check valve in the bottom of the piston pipe.

**load prop**

**a)** Piston pipe extended only:
The force is transferred mechanically from the shield canopy via the prop head to the piston rod and again via the bottom of the piston rod to the bottom of the piston pipe. Further transmission of the force takes place hydraulically via the pressurized fluid under the piston pipe in the prop base and from there, mechanically into the base frame (skid).

The hydraulic pressure under the piston pipe is regulated by a pressure relief valve which is installed in the corresponding check valve. If the pressure set on the pressure relief valve is exceeded, the pressurized fluid flows out of the prop and the prop is pushed in by the nominal prop force.

**b)** Piston pipe and piston rod extended:
The force is transferred mechanically from the shield canopy via the prop head to the piston rod.
The piston rod supports itself on the pressurized fluid, which is blocked by the check valve in the bottom of the piston pipe.

Further transmission of force up to the setting of the piston pipe is as described under a).

**lower prop**

The pressurized fluid is connected to the return line under the middle prop via the control valve for the prop.

Both stages of the prop can be actively lowered. Only when the piston pipe is completely retracted is the check valve in the bottom of the piston pipe opened by the tappet and the piston rod can then retract.

A few millimeters before the piston pipe is “fully retracted”, the check valve is opened by a tappet, whereby the pressurized fluid underneath the piston pipe acts like a spring lifting the piston pipe to close the valve again. When lowering along the entire stroke, the procedure repeats itself.

**Maintenance of the hydraulic fluid**

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 and should be performed with special care. The most important properties of the hydraulic fluid should ideally be monitored automatically and recorded on a continual basis in order to be able to directly counter any harmful effects. These properties include: temperature, foaming, pH value, concentrate content and microbial load.

The operator of the equipment must compile a hydraulic fluid maintenance plan for the specific application. The maintenance plan should be prepared in close cooperation 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 below should be checked at least once every week:

- pH value
  - setpoint: 7.5 to 9.5
- concentrate content
  - setpoint: see certificate
- microbial load
  - setpoint: ≤ $10^5$ col/ml

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

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

## Quality of the process water

**for use for hydraulic fluids**

The quality of the water used to create 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.

If the limits shown in the Table 19 are maintained, it can be assumed that the water is basically suitable.

If one or several of the limit values mentioned are not complied with this should be taken into consideration when selecting a concentrate. Furthermore, water treatment may also be necessary.

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

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