HERRENKNECHT
Tunnelvortriebstechnik

TECHNICAL DOCUMENTATION

# OPERATING MANUAL

# M-1641M VISUALIZATION

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TRANSLATION

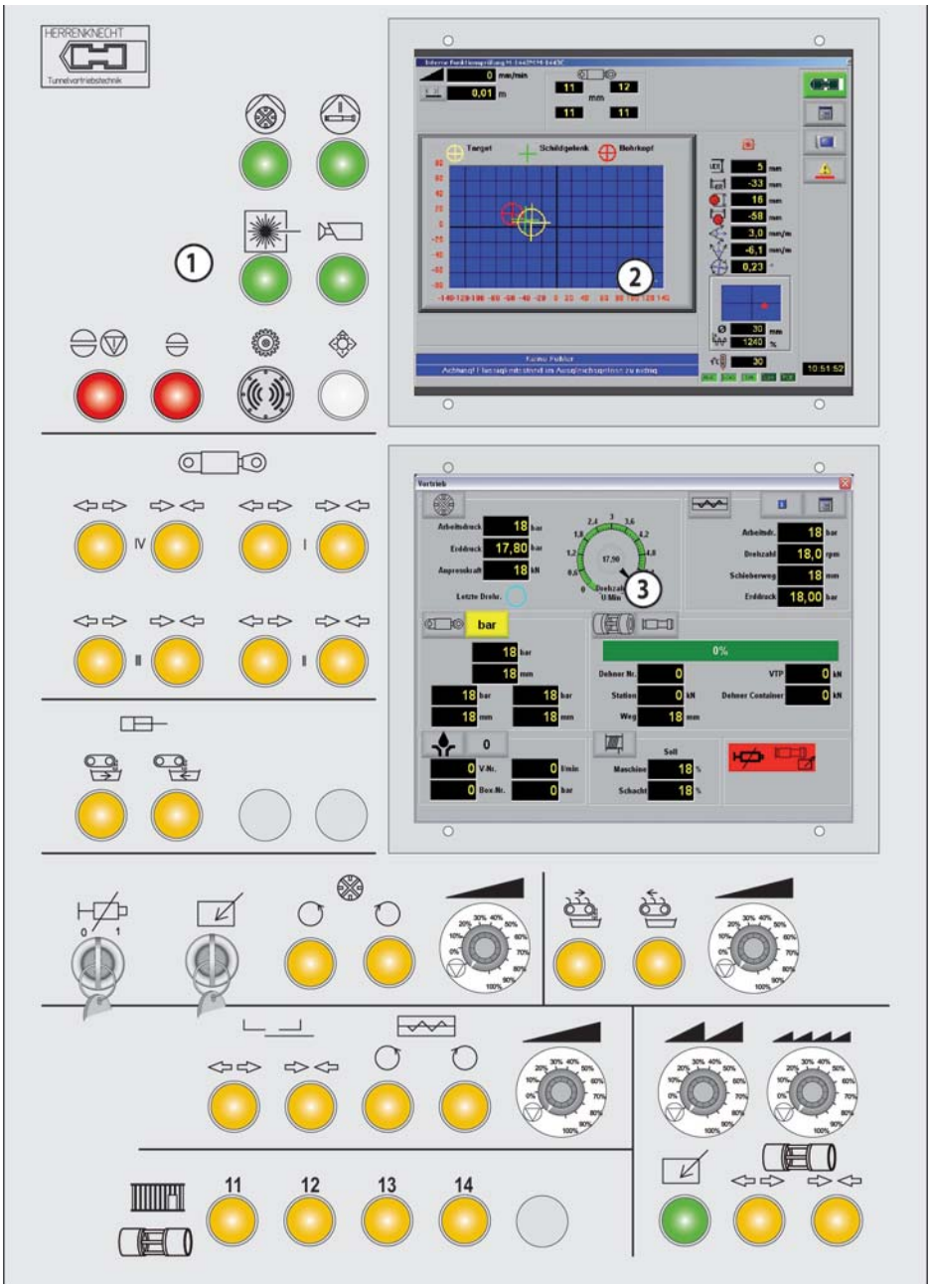
This Technical Documentation has to be kept close to the machine / system. It has to be guaranteed that people working on the machine / system have access to the Technical Documentation at all times. In addition to this Technical Documentation, the operator has to provide manuals required by the labour protection act.

This Technical Documentation is part of the machine / system and has to be completely handed over to the purchaser if the machine / system is sold.

# I. Overview

## OVERVIEW

# 1. Overview control cabin



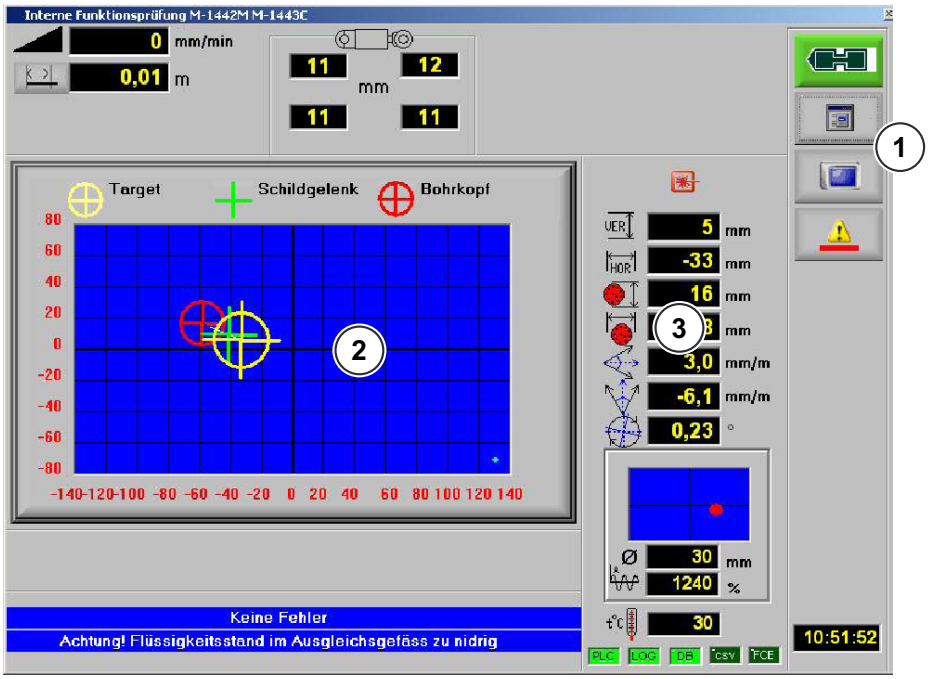

1 Control panel

2 U.N.S. Monitor

3 Tunnel boring machine visualization monitor

# 2. Screen overview

## 2.1 U.N.S. screen




*U.N.S. screen*

1 Menu navigation in the U.N.S. navigation system

2 Graphical representation of the machine position

3 Numeric representation of the machine position

A separate operating manual exists for the U.N.S.

TRANSLATION

## 2.2 Tunnelling machine screen

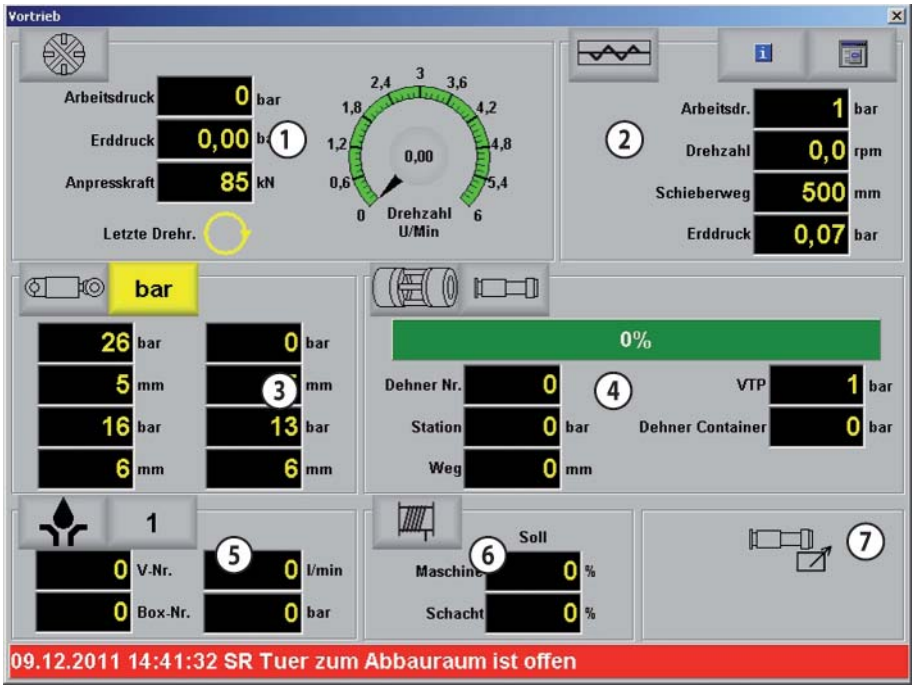
The "Advance" screen serves as the start screen (main screen) on the tunnelling machine's monitor. You can open various dialogs from here. The most important data for operating the tunnelling machine are shown on the "Advance" screen.

Before each drive, all the parameters and options in the individual screens must be checked and modified as needed.

The functions may vary depending on the operation container type. Not all functions are needed or installed for every machine/system.

All screens reflect the machine type and options. Options not installed on a machine are not shown.

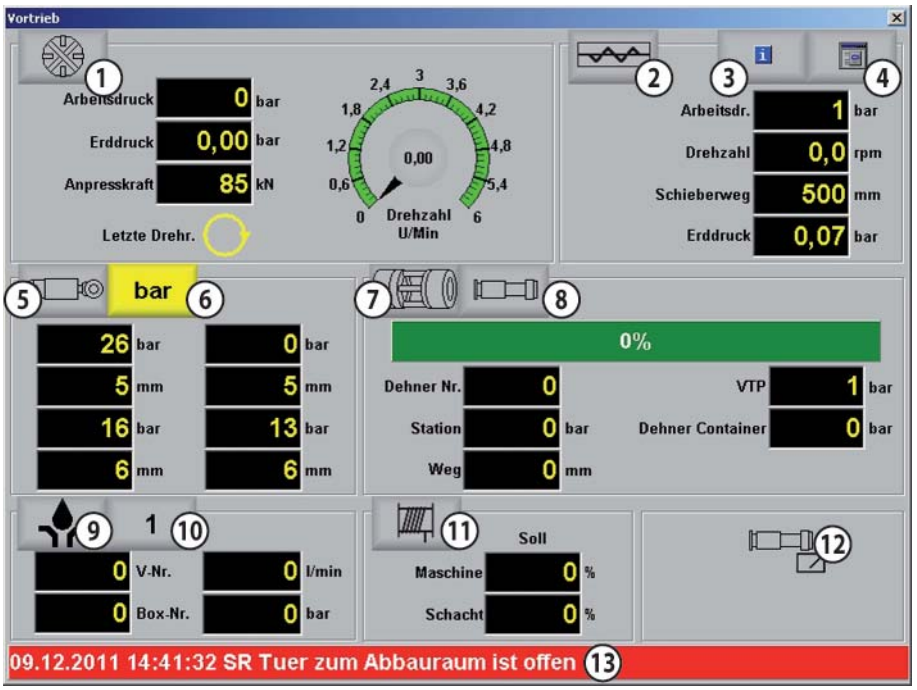
## 2.2.1 Display elements "Advance" start screen




*Display elements "Advance" start screen*

| | | | |
|---|---|---|---|
| 1 | Cutterhead displays | 5 | Bentonite displays |
| 2 | Screw conveyor displays | 6 | Winch displays |
| 3 | Steering cylinder displays | 7 | TC control priority and grease override status displays |
| 4 | Thrust cylinder/interjack displays | | |

## 2.2.2 "Advance" start screen buttons




*"Advance" start screen buttons*

| | | | |
|---|---|---|---|
| 1 | "Cutterhead (CW) Parameter Centre" button | 8 | "Advance Parameter Centre" button |
| 2 | "Screw Conveyor (SC) Parameter Centre" button | 9 | "Bentonite Parameter Centre" button |
| 3 | "Infocentre" button | 10 | "Infocentre Temperatures" button |
| 4 | Button for opening the main menu | 11 | "Rotary valve" button (all rotary valves in position 10 and left and right of it) |
| 5 | "Steering Cylinder (SC) Parameter Centre" button | 12 | TC control priority and grease override status display |
| 6 | "Toggle Units mm/bar" button | 13 | Error message button/ display |
| 7 | "Interjack Configuration" button | | |

## OVERVIEW

# II. Operation

# TABLE OF CONTENTS

## OPERATION

# 1. General notes

Depending on the equipment level, the illustrations on screen may differ from the illustrations in the operating manual. Information relating to components detailed in the operating manual only needs to be observed if the component in question is installed on your machine.

Do not transfer any third party programs to your computer. Risk of virus infection. In case of virus infection by third party programs, Herrenknecht assumes no liability for loss of data, damage to the software, or machine downtime.

**WARNING!**

*System damage*

- Damage to system assemblies/components
- Never use the sample values in the screenshots shown in the operating manual for your machine.

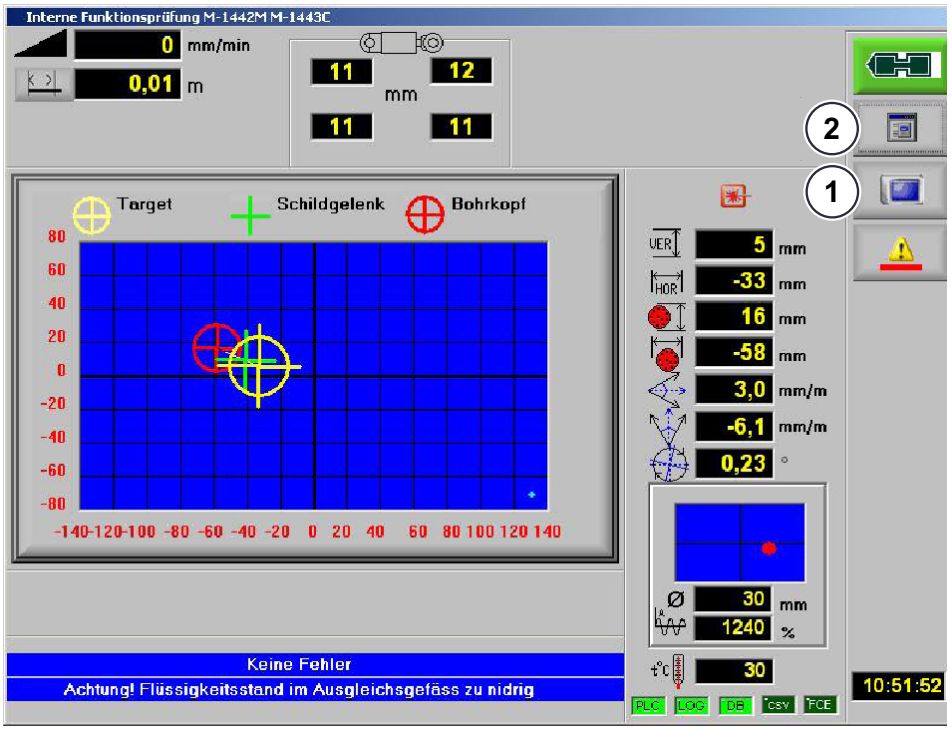
# 2. Basic operations

To operate the system select the icons directly by tapping them with a finger on the screen (touchscreen). Visualisation using a touch-sensitive screen (touchscreen) supports:

- navigation within the machine's various functional areas.
- reading off of current machine states (e.g. speed).
- reading preset values on the machine.
- value input (only in the fields with white backgrounds) and/or selecting specific settings (setup).
- enabling/disabling functions.
- selecting the components installed on the machine. These components are then visualised.

# 3. U.N.S. control elements

The computer is switched on and off, and the touchscreen enabled on the U.N.S. screen.




*U.N.S. control elements for visualisation*

| | | | |
|---|---|---|---|
| 1 | Enable/disable touchscreen | 2 | Dropdown menu for U.N.S. control, includes the language setting and other functions. |

## 3.1 Enable/disable touchscreen

Tap the "Touchscreen inactive" icon (1) to release the touchscreen function. The icon (1) toggles to "Touchscreen active". You can now navigate the visualisation.

## 3.2 Language selection

Tap the icon (2) to open the main menu. Tap the flag to set the corresponding language.

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## 3.3 Description "Change user" (login)

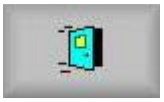
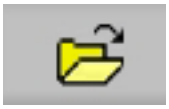
To enter or modify parameters (e.g. before starting a new drive), you always need to log in to the system.

| ITEM | CONTROL/DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|---|
| 1. | | Tap the "U.N.S." icon on the screen. | The icon's appearance changes. |
| | | | The touchscreen is enabled. |
| 2. |  | Select the "Change user" button on the "Main menu" screen. | This opens the "Change user" dialog. |
| 3. |  | "Logoff" After entering the required parameters, log off by selecting "Logoff". | If you do not enter or change any parameters for 600 seconds, you will be logged off automatically. |
| | | "Setup" | This area is designated for the customer's staff. Options and parameters can be changed here. |
| | | "Commissioning" | This area is password-protected and only accessible to Herrenknecht AG staff. |
| 4. |  | Select "Setup" to change parameters. | This opens a new dialog. |
| 5. | Username | No action needed. | The username is entered by default. |
| 6. | Password | As the password, type the container number without the letters. | Example: M-1433Cyou would enter "1433" as the password here. |
| 7. | | Press "OK" to confirm. | User change completed. |

# 4. Button icons

The button icons support the following when touched/tapped:

- Navigation in the visualization.
- Enabling/disabling functions.

| BUTTON/ICON | DESIGNATION | DESCRIPTION/FUNCTION |
|---|---|---|
|  | Quit | Touch the button to close the screen. |
|  | Apply | Touch the icon; the dialog is closed and the entries you have made are applied. |
|  | Cancel | Touch the button; the dialog is closed without saving the settings you have entered. |
|  | Print | Touch the button to print or save a hardcopy. |
|  | Open | Touch the button in the Service dialogs to load a record with stored parameters for the desired machine in the visualisation. |
|  | Change user | Touch the button to open the"Change user" dialog. |
|  | Keypad | Touch the button to open the on-screen keyboard. |
|  | Main menu | Touch the button to open the "Main Menu" screen. |

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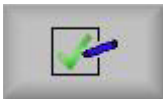
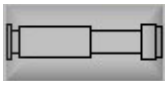
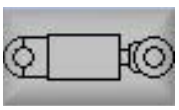
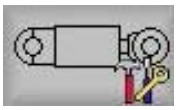
| BUTTON/ICON | DESIGNATION | DESCRIPTION/FUNCTION |
|---|---|---|
|   | Parameter centre | Touch the button to reopen the last "Parameter centre" dialog to be used on the "Advance" screen. |
|  | Messaging system | If this button is red, an error message has occurred on the messaging system.Additionally, an audible signal is output at thecontrol panel. |
|  | Release | Touch the button to open the "Release" screen. |
|  | Service | Touch the button on the "Main menu" screen to open the "Service" dialog. **CAUTION: This dialog is for Herrenknecht staff only**. |
|  | Calibrate screen | Touch the button to openthe "Screen Selection" screen.. You can calibrate the screen after selecting it. |
|  | Advance Parameter Centre (TC) | Touch the button to open the "Advance Parameter Centre (TC)" dialog. |
|  | Cutterhead (CW) Parameter Center | Touch the button to open the "Cutterhead (CW) Parameter Center" dialog. |
|  | Infocentre | Touch the button to open the "Infocentre" screen. |
|  | Steering Cylinder (SC) Parameter Centre | Touch the button to open the "Steering Cylinder (SC) Parameter Centre" dialog. |
|  | SC Cylinder stroke calibration | Touch the button to start calibrating the steering cylinders. |

| BUTTON/ICON | DESIGNATION | DESCRIPTION/FUNCTION |
|---|---|---|
|  | CW Speed calibration | Touch the button to start calibrating the cutterhead. |
|  | Save | Touch the button in the Service dialogs to store all the parameters for the current machine under a freely selectable name. |
|  | Interjack configuration | Touch the button to open the "Interjack Configuration" dialog. |
|  | Interjack selected in visualisation | The interjack station is selected in the "Interjack Configuration" dialog. |
|  | Interjack unselected on the panel | The interjack station is unselected on the panel. |
|  | The interjack is being retracted. | Shows that the interjack is being retracted (display flashes). |
|  | Interjack extending. | Shows that the interjack is extending (display flashes). |
|  | Bentonite(button greyed) | Touch the button to open the "Bentonite" screen. Bentonite lubrication is not switched on at the control panel. |
|  | Bentonite(button green) | Touch the button to open the "Bentonite" screen. Bentonite lubrication is switched on at the control panel. |
|  | Lubrication system ILubrication system II | Touch the button to open the "Bentonite" screen. Lubrication system I is controlled via the container; lubrication system II via the machine. |
|  | Actual value | Displays the actual value (text colour). |

| BUTTON/ICON | DESIGNATION | DESCRIPTION/FUNCTION |
|---|---|---|
|  | Set value | Displays the set value (text colour). |
|  | Limit value | Indicates that a limit has been exceeded (text colour). |
|  | Display grease override(with malfunction message) | This icon is displayed if the grease override has been enabled via the key switch at the control panel and a malfunction message exists. |

# 5. Navigation in the visualisation

Navigate the touchscreen by:

- Touching/tapping button icons.
- Touching/tapping specific screen areas.

# 6. Parameter input

Enter values in the visualisation by:

- Selecting a field with the mouse/entering the values via a keyboard.
- Touching/tapping the field on the touchscreen/entering the values via the keyboard.

Values can only be entered in the white fields.To make an entry, tap the white input field. You then need to enter the value via a keyboard and press "Enter" to confirm.

# 7. Enabling/disabling functions

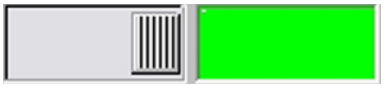
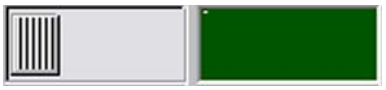
Enable/disable functions by:

- Touching/tapping button icons

Box checked: Function/Option enabled.

Box not checked: Function/Option disabled.

- Touching the dotted rectangle on the touchscreen and/or clicking with the left mouse button (see the following table).

| BUTTON | FUNCTION |
|---|---|
|  | The function is enabled:<br>The dotted rectangle is on the right and the display is light green. |
|  | The function is disabled:<br>The dotted rectangle is on the left and the display is dark green. |

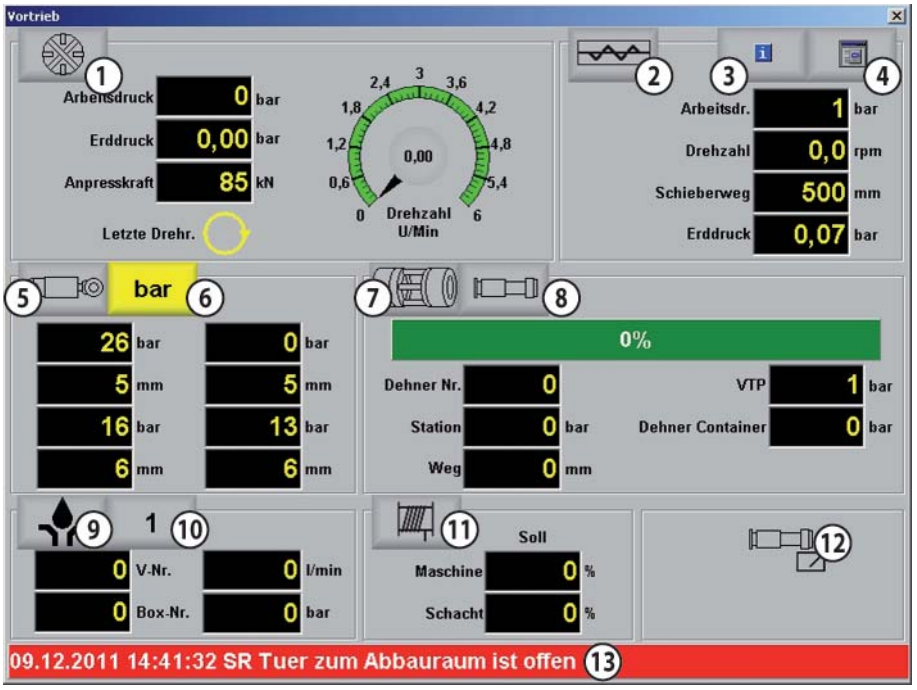
# III. Navigation and settings



TRANSLATION

# 1. Visualisation start screen "Advance"

The "Advance" screen is the start screen. The most important data for operating the tunnelling machine are shown on the "Advance" screen. From the start screen, the user can tap the button icons to access the various screens in submenu levels. From there, the user can tap button icons to open other screens.




*Visualisation start screen "Advance"*

| | |
|---|---|
| 1 | "Cutterhead (CW) Parameter Centre" button |
| 2 | "Screw Conveyor (SC) Parameter Centre" button |
| 3 | "Infocentre" button |
| 4 | Button "Main Menu" |
| 5 | "Steering Cylinder Parameter Centre" button |
| 6 | Toggle steering cylinder display mm/bar. |
| 7 | "Interjack Configuration" button |
| 8 | "Advance" parameter centre button |
| 9 | "Bentonite" parameter centre button |
| 10 | Button |

| | |
|---|---|
| 11 | Winch (only displays the current values) |
| 12 | Control priority (display only) |
| 13 | Error message display and button |

Table III - 1: Advance buttons screen

# 2. "Cutterhead (CW)" parameter centre screen

| BUTTON | FUNCTION |
|---|---|
|  | Touch the "CW" button on the "Advance" screen to open the "CW" parameter centre screen. |
|  | Touch the button on the screen: this closes the current screen. |


*Cutterhead (CW) parameter centre*

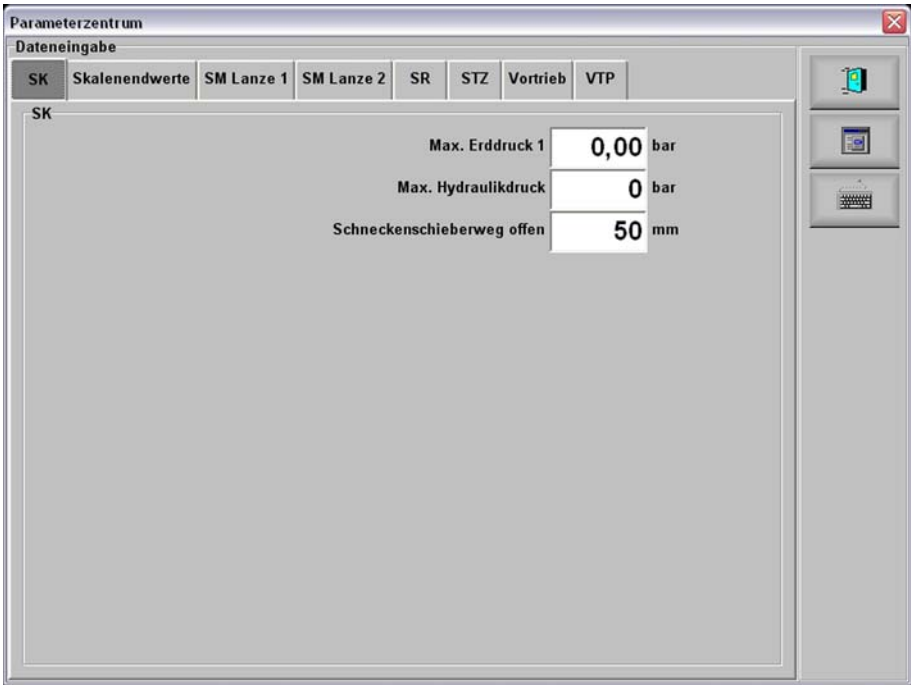
| DESIGNATION | DESCRIPTION |
|---|---|
| Max. earth pressure shield | Define the maximum permissible earth pressure on the shield.<br>If this value is exceeded, tunnelling stops automatically. |

TRANSLATION

| DESIGNATION | DESCRIPTION |
|---|---|
| Upper limit for pump operating pressure | Defines the maximum permissible operating pressure for the cutterhead pump.<br><br>If this value is exceeded, tunnelling stops automatically. |
| Lower limit for tunnelling speed. | Defines the minimum cutting tool speed. The thrust cylinders cannot be extended until this minimum speed has been reached. |
| Toggle display pressure --> speed | Select the active display on the Advance screen. |

# 3. "Screw Conveyor (SC)" parameter centre screen

| BUTTON | FUNCTION |
|---|---|
|  | Touch the button on the "Advance" screen to open the "Screw conveyor SC" parameter centre screen. |
|  | Touch the button on the screen: this closes the current screen. |




*"Screw Conveyor (SC)" parameter centre screen*

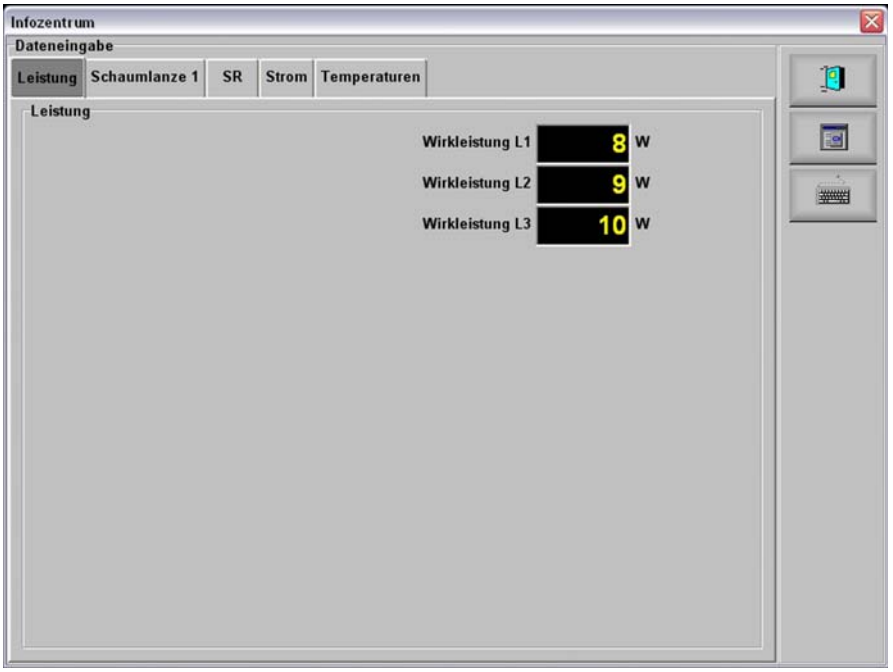
| DESIGNATION | DESCRIPTION |
|---|---|
| Max earth pressure 1 | Enter the maximum permissible earth pressure |
| Max. hydraulic pressure | Enter the maximum permissible hydraulic pressure |
| Rotary valve stroke open | Enter the maximum permissible opening stroke for the screw conveyor discharge gate.<br>The value entered here limits the hydraulic cylinder stroke on the screw conveyor discharge gate. |

# 4. "Infocentre" screen

| BUTTON | ACTIVITY FUNCTION |
|---|---|
|  | The "Infocentre" screen is opened. |
|  | Touch the button on the screen:<br>the current screen is closed. |

By default, the first screen to be opened is "Output".

The pressures and temperatures depend on the container equipment level.




*"Infocentre output" screen*

| PAGE | DESIGNATION | DESCRIPTION |
|---|---|---|
| Power | Effective power L1 | Displays the effective power L1 |
| | Effective power L2 | Displays the effective power L2. |
| | Effective power L3 | Displays the effective power L3 |
| Foam generator 1 | Pressure liquid supply | Displays the liquid supply pressure in bar |
| Cutting wheel CW | Power Controller hydraulic CW power | Displays the hydraulic output set at the controller |
| | Power Controller CW power shaft motor | Displays the output to the shaft in kW |
| | Feed pressure CW pump 1 | Displays the feed pressure to the cutting wheel drive pump in bar |
| | CW torque load | Displays the torque load relative to the permissible torque as a % |
| Current | Current L1 | Displays the current draw L 1 |
| | Current L2 | Displays the current draw L 2 |
| | Current L3 | Displays the current draw L 3 |

| PAGE | DESIGNATION | DESCRIPTION |
|---|---|---|
| Temperatures | Cont. tank oil temperature | Displays the oil temperature in the container in °C |
| | Mach. tank oil temperature | Displays the oil temperature in the machine in °C |

Table III - 2: Table of Infocentre screens

# 5. Screen "Main Menu"

| BUTTON | FUNCTION |
|---|---|
|  | Touching the button on the "Advance" screen opens the "Main menu" screen. |
|  | Touch the button on the screen: this closes the current screen. |

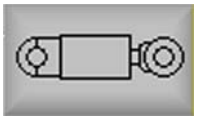
You can return to the "Main menu" screen from any screen in the visualisation.

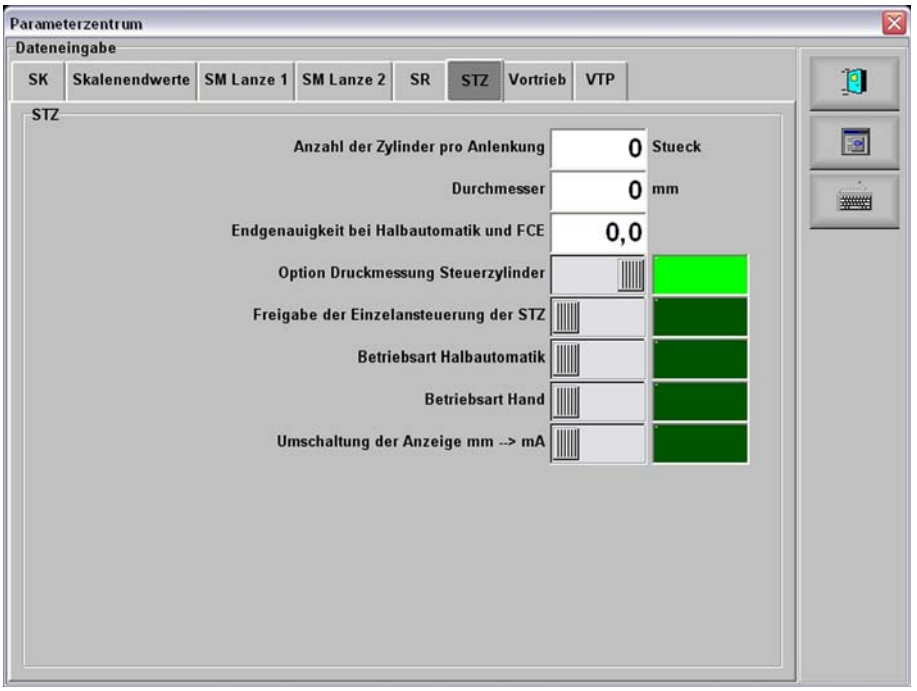

*Screen "Main Menu"*

| | |
|---|---|
| 1 | "Infocentre" button |
| 2 | Cutting wheel "CW speed adjustment" button |
| 3 | Steering cylinder "SC cylinder stroke adjustment" button |
| 4 | "Foam" button |
| 5 | "Info" button |
| 6 | "Monitor" button |
| 7 | "Messaging system" button |
| 8 | "Releases" button |
| 9 | "Service" button |
| 10 | "Parameter centre" button |

| | |
|---|---|
| 11 | "Quit screen" button |
| 12 | "Change user" button |
| 13 | "Language selection" button |
| 14 | "Print screen" button |
| 15 | "Keyboard" button |
| 16 | "Shutdown computer" button |

# 6. "Steering Cylinder (SC)" parameter centre screen

| BUTTON | FUNCTION |
|---|---|
|  | Touch the button on the "Advance" screen to open the "Steering Cylinder SC Parameter Centre" screen. |
|  | Touch the button on the screen: this closes the current screen. |



| DESIGNATION | DESCRIPTION |
|---|---|
| Cylinders per linkage | Enter as per the "Number of steering cylinders/numeric value in parameter centre SC" table |
| Diameter | Enter the cylinder diameter to compute the contact force. |
| End precision for semi-automatic and FCE | Enter the value for the control precision for semi-automatic or FCE control. |
| Option steering cylinder pressure measurement | Switch the steering cylinder pressure measurement option on/off |
| Release individual control | Switch individual control on/off |
| Semi-automatic mode | Switches semi-automatic mode on/off |
| Manual mode | Switches manual mode on/off |
| Toggle display mm->mA | Toggle the display from mm to mA |

Assignment of entries in the number of cylinders per linkage field, see table:

| NUMBER OF STEERING CYLINDERS | INPUT |
|---|---|
| 3 pcs. | 1 |
| 4 pcs. | 1 |
| 6 pcs. | 2 |
| 8 pcs. | 2 |

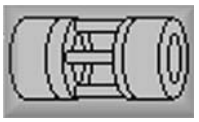
Table III - 3: Number of steering cylinders/numeric value in parameter centre SC

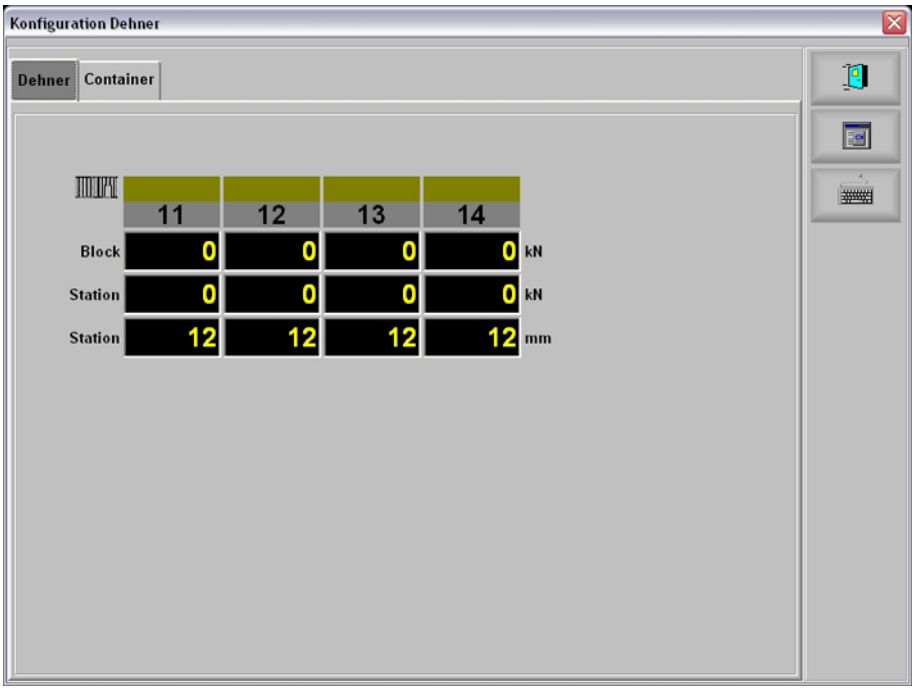
# 7. Steering cylinder "Toggle display"

| BUTTON | FUNCTION |
|---|---|
|   | Touch the button: the units in the steering cylinder display area change from "bar" to "mA" or from "mA" to "bar". The current setting is shown on the button. |

# 8. Interjack configuration screen

The interjack unit is located in the container.

| BUTTON | FUNCTION |
|---|---|
|  | Touching the button on the "Advance" screen opens the "Interjack configuration" screen. |
|  | Touch the button in the current screen: this closes the current screen. |



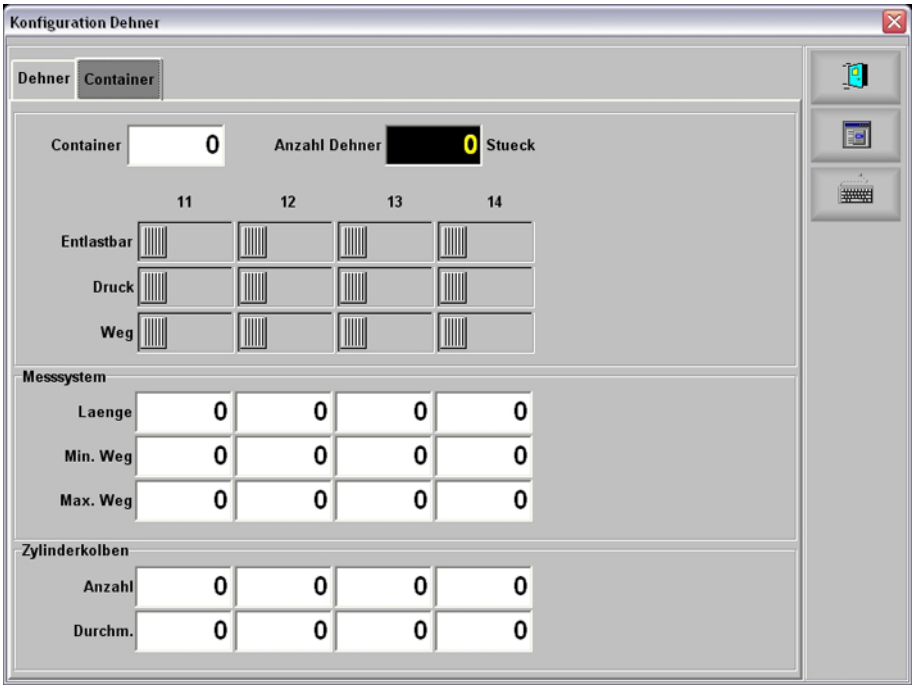

*"Interjack configuration" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Block | Pressure on hydraulic block. |
| Station | Pressure/stroke at interjack station. |

TRANSLATION

## 8.1 Screen "Container"

Touching the "Container" button on the "Advance" screen opens the "Container" screen.

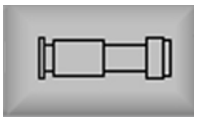


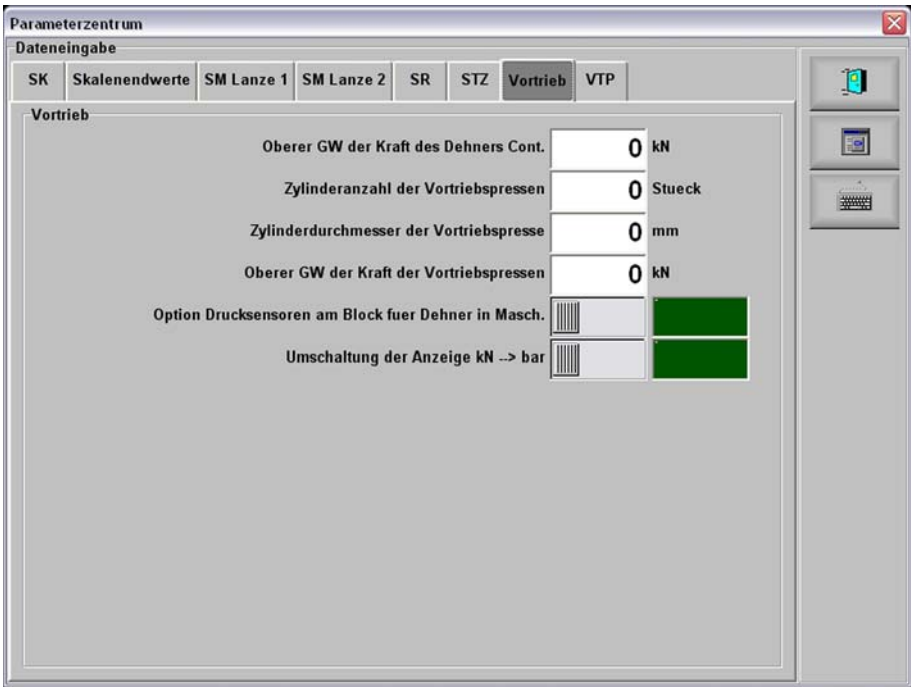

*"Interjack configuration" screen, "Container" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Container | Enter the number of interjacks connected to the container. |
| Number of interjacks | Pressure/stroke at interjack station. |
| Relievable | If a pressure holding valve is built into the system, it can be activated by enabling this option. |
| Pressure | If a pressure sensor is built into the system, it can be enabled by selecting this option. |
| Stroke | If a stroke sensor is built into the system, it can be activated by enabling this option. |
| Length measuring system | Enter the maximum measuring range of the existing stroke measurement system. |
| Measuring system min. stroke | Enter the minimum cylinder stroke which the cylinders must not drop below. |

| DESIGNATION | DESCRIPTION |
|---|---|
| Measuring system max. stroke | Enter the maximum cylinder stroke by which the cylinders are allowed to extend. |
| Number of cylinder pistons | Enter the number of cylinders installed per interjack station (this entry is required to compute the force). |
| Cylinder piston diam. | Enter the interjack cylinder diameter (this entry is required to compute the force). |

# 9. "Advance" parameter centre screen

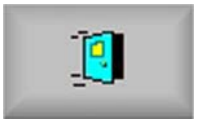
| BUTTON | FUNCTION |
|---|---|
|  | Touching the button on the "Advance" screen opens the "Thrust cylinders" screen. |
|  | Touch the button on the screen: this closes the current screen. |

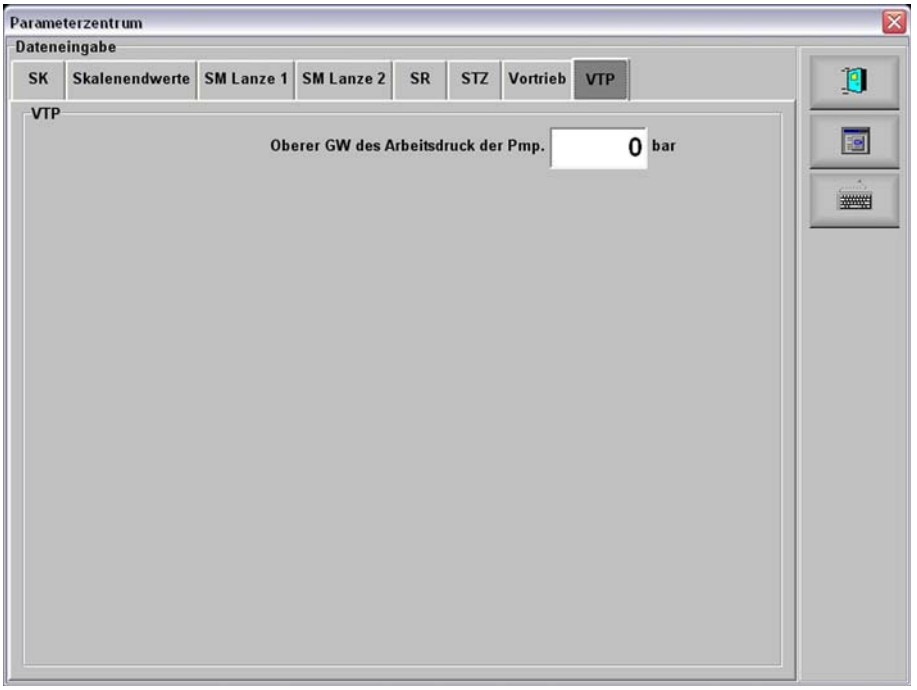



| DESIGNATION | DESCRIPTION |
|---|---|
| Upper limit for container interjack force | Input field for the upper force limit of the force for jacking the pipes in the jacking frame. |
| Thrust cylinder count | Input field for the number of thrust cylinders used. |
| Thrust cylinder diameter | Input field for the diameter of the thrust cylinder piston diameter. |

| DESIGNATION | DESCRIPTION |
|---|---|
| Upper limit of thrust cylinder force | Input field for the upper force limit of the thrust cylinder force. |
| Option pressure sensors on block for machine interjacks | If only one sensor exists in the block, this function can be enabled by selecting this option. |
| Toggle display kN -> bar | You can toggle between the units [kN] and [bar]. The current unit is displayed on the "Advance" start screen. |

## 9.1 Thrust cylinder TC parameters

| BUTTON | FUNCTION |
|---|---|
| Touch the "TC" button in the "Parameter Centre" screen to open the "Thrust cylinder" screen. | |
|  | Touch the button on the screen: this closes the current screen. |




| DESIGNATION | DESCRIPTION |
|---|---|
| Upper limit for pump operating pressure | Enter the upper limit for the jacking pump operating pressure. |

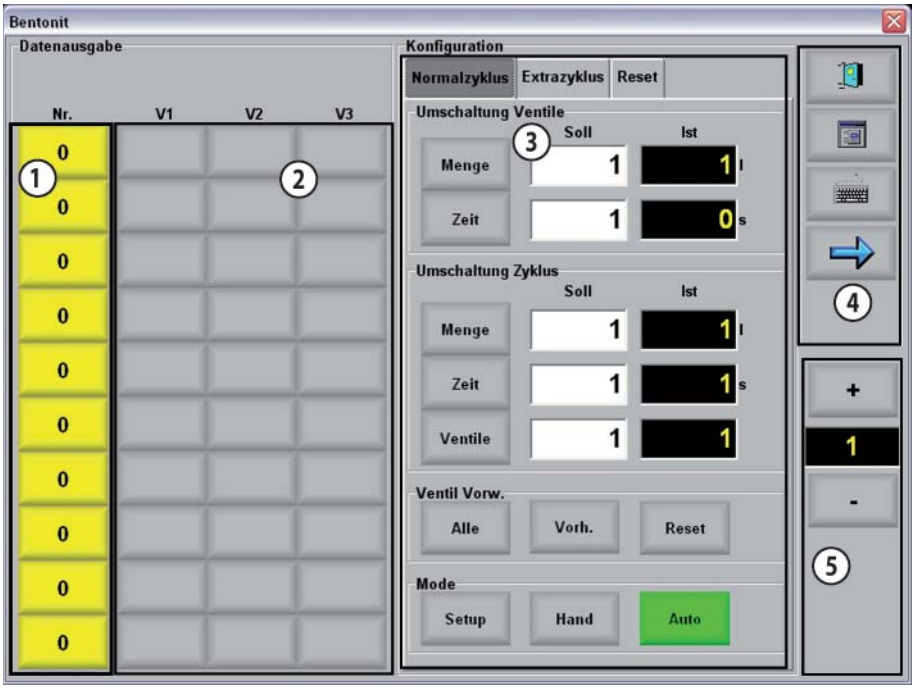
# 10."Bentonit" screen

| BUTTON | FUNCTION |
|---|---|
|  | Touching the button on the "Advance" screen opens the "Bentonite" screen. |
|  | Touch the button on the screen: this closes the current screen. |
|  | Touch the button on the screen:<br>This opens the next screen. |

When the "Bentonit" screen is opened, the content of the "Normal cycle" screen is shown by default.

## 10.1 "Normal cycle" screen

Touching the "Normal cycle" button on the "Bentonite" screen opens the "Normal cycle" screen.




*"Bentonit" screen "Normal cycle" screen*

| | | | |
|---|---|---|---|
| 1 | Bentonite station display | 4 | Menu bar |
| 2 | Bentonit valve display | 5 | Preselection bentonite stations area |
| 3 | Configuration area | | |

### 10.1.1 Preselection and configuration area

The "Preselection/configuration" area lets you select all the valves to be activated in the current lubrication cycle. You must change to "Setup" mode for this.

| CONTROL/ DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|
|   | Touch the "Setup" button in the "Mode" area. | The colour of the "Setup" button changes from grey to green. "Setup" mode is now active. |
|     | Press the "Normal cycle" or "Extra cycle" button. | The colour of the selected button changes from light grey to dark grey. |

The expansion stages are labelled by the number of their Profibus dupline gateways.

Expansion stage 1: 1 to 42 stations = one Profibus dupline gateway.

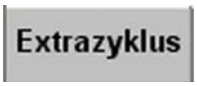
Expansion stage 2: 1 to 80 stations = two Profibus dupline gateways.

You only need to select the expansion stage (1...42 stations or 1...80 stations) once after installation or modifying the bentonite lubrication system.

TRANSLATION

## Operation mode preselection

After completing the valve preselection, the valve operating modes are preselected.

| CONTROL/ DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|
|  | Press the "Normal cycle" button. | The colour of the "Normal cycle" button changes from light grey to dark grey. "Normal cycle" mode is active. You can select the valves to be operated in the normal cycle. |
| | | or |
|  | Press the "Extra cycle" button. | The colour of the "Extra cycle" button changes from light grey to dark grey. "Extra cycle" mode is active. You can select the valves to be operated in the extra cycle. |
|  | Press the "Manual" button. | The colour of the "Manual" button changes from grey to green. "Manual" mode is active. |
| | | or |
|  | Press the "Auto" button. | The colour of the "Auto" button changes from grey to green. "Automatic" mode is active. |

Manual preselection

– This operating mode was introduced for testing individual valves.

- You can only preselect one valve.
- Extra cycle is blocked.
- Delivery rates and lubrication times are still displayed.

| CONTROL/ DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|
|  | Touch the "All" button in the "Valve preselection" area. | The colour of the "All" button changes from grey to green. Preselection of all valves is activated. |

In case of a pipe change, this selection (dupline cable interrupted, no station present) gives you a simple approach to selecting all bentonite valves.

In operation (lubrication cycle) non-existent stations and valves are omitted.

If you always want to process all lubrication stations, you only need to preselect all stations for the whole drive once.

| CONTROL/ DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|
|  | In the "Valve preselection" area, press the "Exists" button. | The colour of the "Exists" button changes from grey to green. Preselection of all existing valves is enabled. |

This selection preselects all existing stations and valves; non-existent stations and valves are unselected.

To allow the existing bentonite stations to be identified, the bentonit voltage must be switched on.

If you always want to process all lubrication stations, you only need to preselect all existing stations once, until you install a new lubrication station.

TRANSLATION

| CONTROL/ DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|
|   | Touch the "Reset" button in the "Valve preselection" area. | The colour of the "Reset" button changes from grey to green. All conditions are reset. |

This selection resets all conditions.

## 10.1.2 Preselecting bentonite valves and stations individually

### Preselection bentonite station and valves

Correctly installed and connected bentonite stations provide feedback to the control unit that lets the unit know that the station is physically connected to the bus.

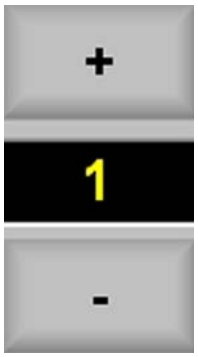
If this feedback exists, the background colour for this field changes from grey to yellow.

The bentonite stations are preselected by preselecting one or multiple valves on the bentonite stations.

You can select all valves (including valves that do not exist).

| ITEM | CONTROL/DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|---|
| 1 |   | Touch the desired valve button. | The colour of the selected valve button changes from grey to yellow. The bentonite valve is preselected. |

Repeat these steps until you have preselected all the desired valves on the first 10 stations.

| ITEM | CONTROL/ DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|---|
| 2 |  | Touch the "+" button in the "Preselection" area. | The number of stations displayed is increased by 10. |
| | | Touch the "-" button in the "Preselection" area. | The number of stations displayed is decreased by 10. |
| 3 | | Preselect the desired valves as described for Item 1. | The colour of the selected valve button changes from grey to yellow. The bentonite valve is preselected. |

Repeat items 1 to 3 until all of the desired bentonite valves and stations are preselected.

| ITEM | CONTROL/ DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|---|
| |   | Touch the "Setup" button in the "Mode" area. | This opens the "Bentonite Setup" screen. |
| | | Enter the required parameters for bentonite lubrication. | The procedure is complete. |

You can press the "Print" button to grab a screenshot.

### 10.1.3 "Bentonit Setup" screen

After enabling "Setup" you can enter or modify the parameters for the individual bentonite stations and bentonite valves in the edit fields. The "Setup" screen is divided into 4 areas.

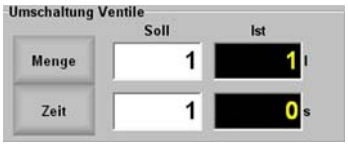
You can press the "Print" button to grab a screenshot.

If various selection fields are activated in "Mode" (yellow background) this mode causes a switchover to the next valve that reaches its set value first.

**Example:**

If Volume [l] and Time [sec] modus is active, and if the flow rate is not achieved in the preset time, a switchover to the next valve occurs automatically when the preset time elapses.

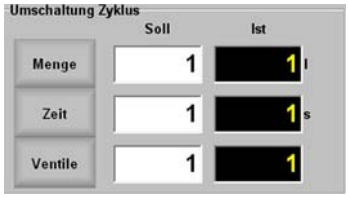
#### Defining the switch conditions for the valves in a cycle

| ITEM | CONTROL/DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|---|
| |   | Depending on the requirements, press the "Volume" or "Time" button in the "Switchover valve" area. You can also enable both modes at the same time. | The colour of the selected button(s) changes from grey to green. |

| ITEM | CONTROL/DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|---|
| | | Press the "Target" edit field. | The colour of the "Target" edit field changes from blue to white. |
| | | Enter the desired value in the "Target" edit field and confirm. | This stores the value you entered. |

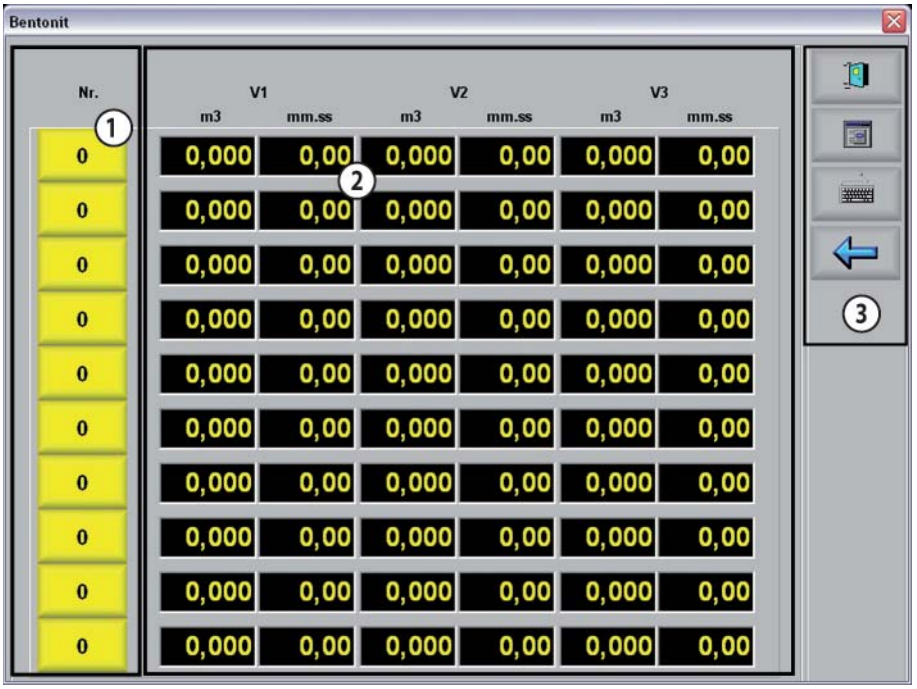
### Defining the switchover conditions for a cycle

The values you enter apply to all connected bentonite valves operated in the cycle in question. The values entered here determine the flow rate or the valve opening time.

| ITEM | CONTROL/DISPLAY ELEMENT | ACTIVITY | FUNCTION |
|---|---|---|---|
| |  | Depending on the requirements, press the "Volume" or "Time" button in the "Switchover valve" area. You can also enable both modes at the same time. | The colour of the selected button(s) changes from grey to green. |
| | | Press the "Target" edit field. | The colour of the "Target" edit field changes from blue to white. |
| | | Enter the desired value in the "Target" edit field and confirm. | This stores the value you entered. |

## 10.2 Area: Monitoring

The bentonite consumption is logged separately for each valve and displayed in [$m^3$]. 3 valves (V1, V2, V3) are assigned to each bentonite station. In case of time-driven lubrication, the individual lubrication volumes can be compared to determine whether the lubrication points are working correctly. If the volume for a valve is far lower than that of the neighbouring valves, this indicates that the valve is not working correctly. The lubrication time is also logged individually for each valve and displayed in [minutes.seconds]. Again, 3 valves (V1, V2, V3) are assigned to each bentonite station. In case of volume-driven lubrication, you can compare the individual lubrication times to determine whether the lubrication points are working correctly. If the lubrication time for a valve is far longer than that of the neighbouring valves, this indicates that the valve is not working correctly.




*"Bentonite monitoring" screen*

| | | | |
|---|---|---|---|
| 1 | Display number of active station | 3 | Menu bar |
| 2 | Display valves | | |

# 11."Bentonite line" screen

| BUTTON | FUNCTION |
|---|---|
|  | 1 = Line 1 display for bentonite stations 1 - 42<br>2 = Line 2 display for bentonite stations 43 - 80 |

# 12."Winch" screen

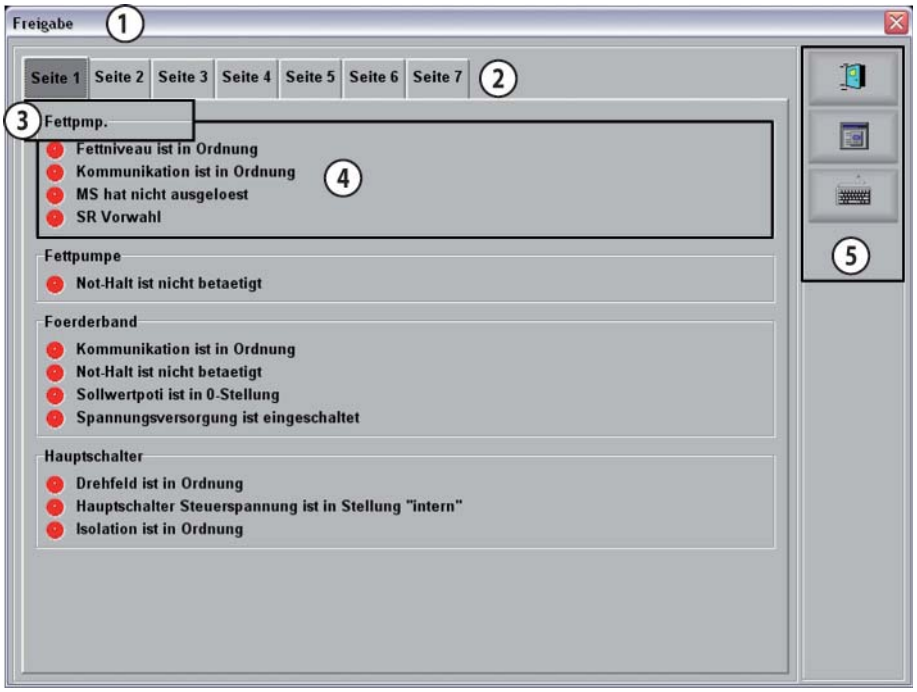
| BUTTON | FUNCTION |
|---|---|
|  | The button is not active. |

# 13."Release" screen

| BUTTON | ACTIVITY FUNCTION |
|---|---|
|  | Touch the button on the "Main menu" screen. This opens the "Release" screen. |
|  | Touch the button in the current screen: the current screen is closed. |

## 13.1 "Release" screen

When the "Release" screen is opened, the content of the "Page 1" screen is shown by default.




*Example "Release page 1" screen*

| | | | |
|---|---|---|---|
| 1 | Title | 4 | Conditions for function<br>Green: ready for operation<br>Red: not ready for operation |
| 2 | Tab | 5 | Menu |
| 3 | Display function | | |

The number of pages in the tab depends on the system. Touch a button to open the page assigned to the button.

TRANSLATION

## Page content in tabular form

| PAGE | FUNCTION | CONDITIONS FOR FUNCTION |
|---|---|---|
| 1 | Grease pump | Grease level is OK. |
| | | Communication is OK. |
| | | Motor circuit switch tripped. |
| | | CW preselection. |
| | | Emergency stop not actuated. |
| | Belt conveyor | Communication OK. |
| | | Emergency stop not actuated. |
| | | Set value potentiometer is at 0 position. |
| | | Power supply switched on. |
| | Main switch | Rotating field is OK. |
| | | Control voltage main switch is in "internal" position |
| | | Insulation is OK. |
| 2 | Machine winch | Control point is selected. |
| | | Hydraulics are in operation. |
| | | Communication is OK. |
| | | Emergency stop is not actuated. |
| | Shaft winch | Control point is selected. |
| | | Hydraulics are in operation. |
| | | Communication is OK. |
| | | Emergency stop is not actuated. |
| | Foam generator 01 | Communication is OK. |
| | | Motor circuit switch on liquid pump not tripped. |
| | | Emergency stop is not actuated. |
| | | Service switch is not actuated. |
| | | Power supply is switched on. |
| | | Excavation chamber door is closed. |

| PAGE | FUNCTION | CONDITIONS FOR FUNCTION |
|---|---|---|
| 3 | Foam generator 02 | Communication OK. |
| | | Motor circuit switch on liquid pump not tripped. |
| | | Emergency stop is not actuated. |
| | | Service switch is not actuated. |
| | | Power supply is switched on. |
| | | Excavation chamber door is closed. |
| | Screw conveyor discharge gate | Hydraulics operation |
| | | Communication is OK. |
| | | Oil level and oil temperature are OK. |
| | Motor-circuit switch preselection | Grease pump is OK. |
| | | Slurry pump is running. |
| | | Hydraulics in operation. |
| 4 | CW motor 01 | Control point is selected. |
| | | Communication is OK. |
| | | Motor circuit switch not tripped. |
| | | Emergency stop not actuated. |
| | | Oil level is OK. |
| | | Motor pilot line is OK. |
| | | Service switch is not actuated. |
| | | Power supply is OK. |
| | | Thermistor is OK. |
| | CW preselection | Grease pump is OK. |
| | | Hydraulics in operation. |
| | | Communication is OK. |
| | | Maximum pressure not exceeded. |
| | | Oil temperature is OK. |
| | | Set point potentiometer is in 0 position |
| | | Excavation chamber door is closed. |
| | SC | Hydraulics in operation. |
| | | Machine power supply is switched on. |

TRANSLATION

| PAGE | FUNCTION | CONDITIONS FOR FUNCTION |
|---|---|---|
| 5 | Advance pump motor 02 | Control point selected |
| | | Main switch is active. |
| | | Communication is OK. |
| | | Motor circuit switch not tripped. |
| | | Service switch is not actuated. |
| | | Tank monitoring is OK. |
| | TC preselection forward external | CW pressure is OK. |
| | | Hydraulics in operation and ready. |
| | | CW crawl speed not active |
| | | Pipe Thruster option is not selected. |
| | | Service switches are not actuated. |
| | | Set point potentiometer is in 0 position |
| | | Control cabin has control priority. |
| 6 | TC internal preselection | Pressure of thrust cylinders/interjack is OK. |
| | | CW pressure is OK. |
| | | Hydraulics in operation and ready. |
| | | CW crawl speed not active |
| | | Minimum CW speed reached. |
| | | Service switches are not actuated. |
| | | Set point potentiometer is in 0 position |
| | | Control cabin has control priority. |
| | TC preselection backward extern | Hydraulic in operation and ready |
| | | CW crawl speed not active |
| | | Service switches are not actuated. |
| | | Set point potentiometer is in 0 position |
| | | Control cabin has control priority. |

| PAGE | FUNCTION | CONDITIONS FOR FUNCTION |
|---|---|---|
| 7 | TC preselection backward internal | Gripper cylinder pressure is OK. |
| | | TC pressure is OK. |
| | | CW pressure is OK. |
| | | Hydraulics in operation and ready |
| | | CW crawl speed is not active. |
| | | Service switches are not actuated. |
| | | Set point potentiometer is in 0 position |
| | | Control cabin has control priority. |

Table III - 4: List of releases required for operating the tunnelling system

| ABBREVIATION | MEANING |
|---|---|
| CW | Cutting wheel (cutting tool) |
| TC | Thrust cylinders |
| MCS | Motor circuit switch |
| SC | Steering cylinders |
| SC | Screw conveyor |

Table III - 5: List of abbreviations used

# 14."Messaging system" screen

| BUTTON | ACTIVITY | FUNCTION |
|---|---|---|
|  | Touch the button on the "Main menu", or the error message displayed on the "Advance" screen. | This opens the "Messaging system" screen. |
|  | Touch the button on the "Messaging system" screen. | This updates the content of the messaging system screens. |
|  | Touch the button on the "Messaging system" screen. | This closes the "Messaging system" screen. |

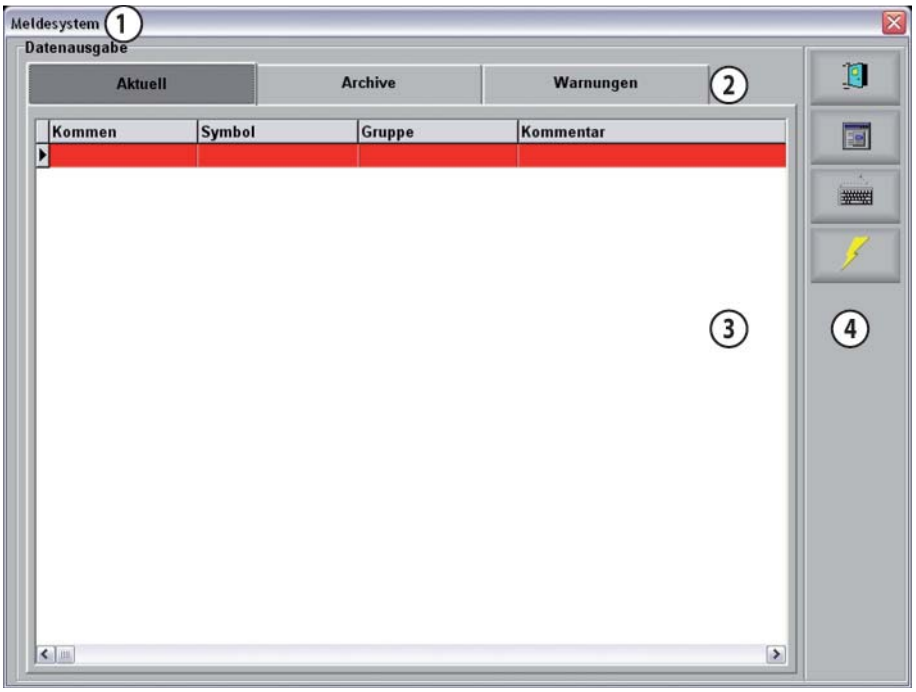
There are two message categories.

- **Current malfunctions:** When this message occurs, the "Reset" button flashes and audible signal is given (cycle: 1 Hz). Messages of this category cause a system response (for example: any affected assemblies are switched off in case of excess temperature).
- **Warnings:** When this message occurs, the "Reset" button flashes. Messages in this category are for information purposes and do not cause a system response.


*Illustration of a typical error message*

## 14.1 "Current" screen

When the "Messaging system" screen is opened, the content of the "Current" screen is shown by default.




*"Messaging system" screen, "Current" screen*

| | | | |
|---|---|---|---|
| 1 | Title | 3 | Display range |
| 2 | Tab | 4 | Menu bar |

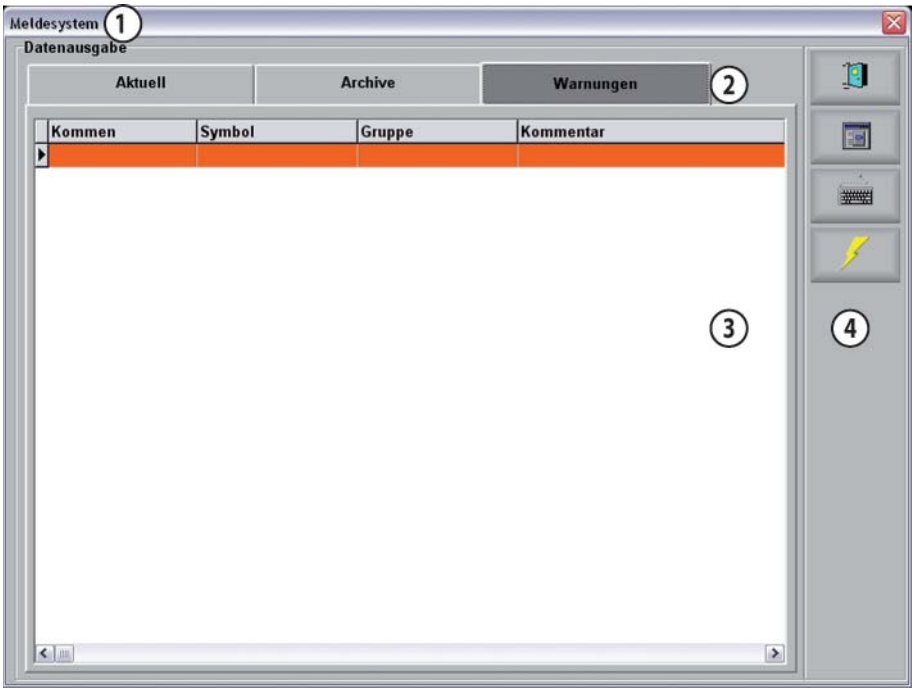
The "Current" screen shows all the current malfunctions that have occurred on the tunnelling system highlighted in red.

These malfunctions are kept on the screen until they have been resolved.

TRANSLATION

## 14.2 "Warnings" screen

Touch the "Warnings" button on the "Messaging system" screen to open the "Warnings" screen.

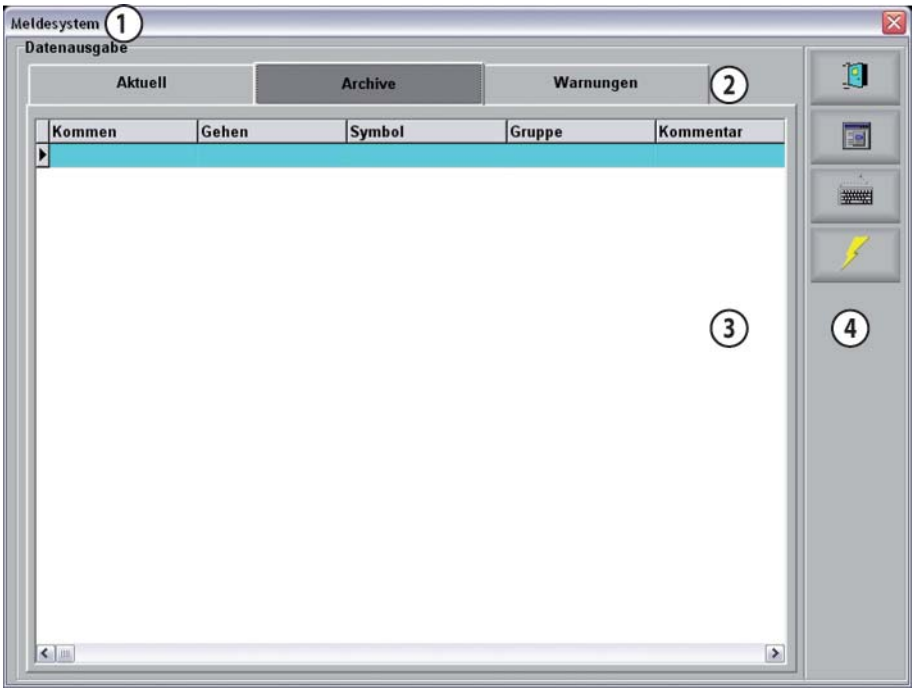



*"Messaging system" screen, "Warnings" screen*

| | | | |
|---|---|---|---|
| 1 | Title | 3 | Display range |
| 2 | Tab | 4 | Menu bar |

## 14.3 "Archives" screen

Touch the "Archives" button on the "Messaging system" screen to open the "Archives" screen.




*"Messaging system" screen, "Archives" screen*

| | | | |
|---|---|---|---|
| 1 | Title | 3 | Display range |
| 2 | Tab | 4 | Menu bar |

The archive contains the malfunctions and warnings that have been resolved or no longer exist.

TRANSLATION

# 15."Speed calibration" screen

| BUTTON | ACTIVITY FUNCTION |
|---|---|
|  | Touching the button in the "Main menu" opens the "Screen Calibration" screen. |
|  | Press the button to store the values you enter. |
|  | Press the button to close the first tab and show the next tab. |
|  | Press the button to close the last tab and show the first tab again. |
|  | Touch the button on the screen.The current screen is closed. |

## 15.1 "Adjust min. values", "Adjust max. values" screen

When the "CW Speed adjustment" screen is opened, the content of the "Adjust min. values" screen is shown by default.

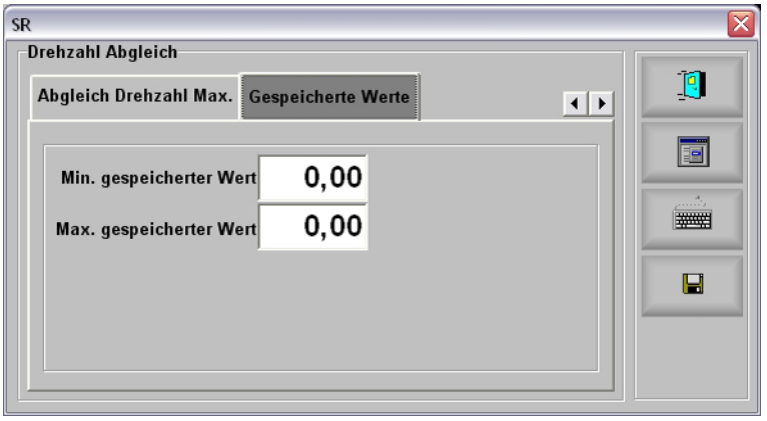
The "Adjust min. values" and "Adjust max. values" screen have identical layouts and functionality. This manual shows and explains the "Adjust min. values" screen as an example.


*"CW speed adjustment, Adjust max. values" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Actual value | Displays the current value from the speed encoder. |
| Saved value | Displays the stored actual value. |

## 15.2 "Stored values" screen

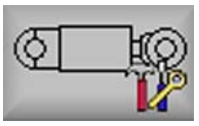
Touching the "Stored values" button on the "CW speed adjustment" screen opens the "Stored values" screen.




*"CW speed adjustment, Stored values" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Min. saved value | Displays the stored min. value. The value can be edited manually. |
| Max. saved value | Displays the stored max. value. The value can be edited manually. |

# 16."Cylinder stroke adjustment" screen

| BUTTON | ACTIVITY FUNCTION |
|---|---|
|  | Touching the button in the "Main menu" opens the "Speed adjustment" screen. |
|  | Press the button to store the values you enter. |
|  | Press the button to close the first tab and show the next tab. |
|  | Press the button to close the last tab and show the first tab again. |
|  | Touch the button on the screen. The current screen is closed. |

## 16.1 "Adjust min. values", "Adjust max. values" screen

When the "SC cylinder stroke adjustment" screen is opened, the content of the "Adjust min. values" screen is shown by default. The "Adjust min. values" and "Adjust max. values" screen have identical layouts and functionality. This manual shows and explains the "Adjust min. values" screen as an example.

Illustration of the screen with 3 steering cylinders as an example. The number of steering cylinders displayed on the screen depends on the number of steering cylinders installed with stroke measurement.

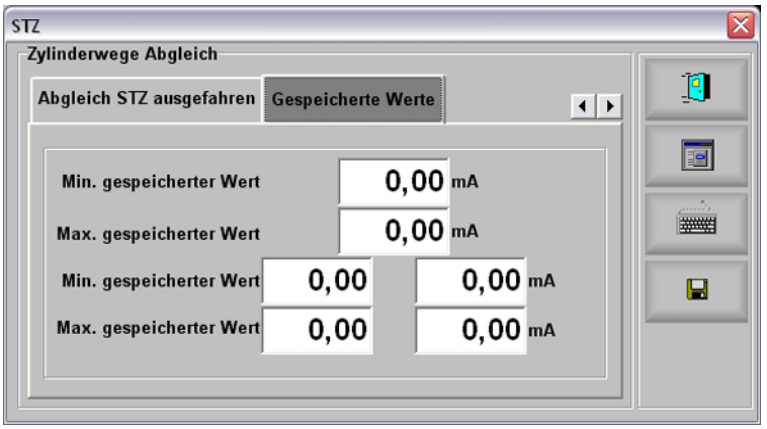
TRANSLATION

*"SC cylinder stroke adjustment, Adjust min. values" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Actual value | Displays the current value from the stroke sensor in [mA]. |
| Stored value | Displays the stored actual value. |

### 16.1.1 "Stored values" screen

Touching the "Stored values" button on the "SC cylinder stroke adjustment" screen opens the "Stored values" screen.




*"SC cylinder stroke adjustment, Stored values" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Min. saved value | Displays the stored min. value. The value can be edited manually. |
| Max. stored value | Displays the stored max. value. The value can be edited manually. |

# 17."Foam generator 1"

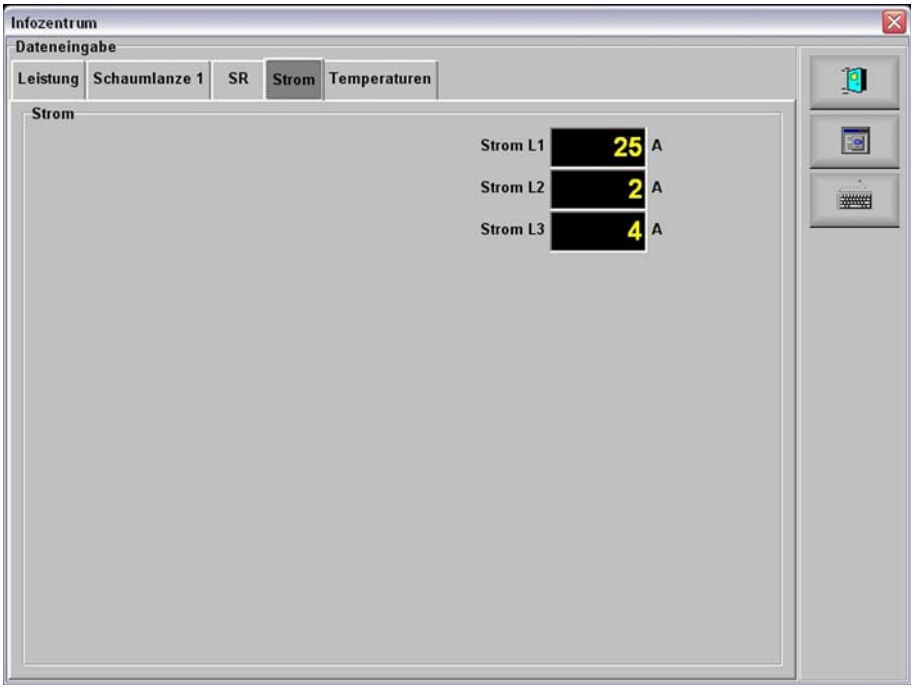
| BUTTON | ACTIVITY FUNCTION |
|---|---|
|  | This opens the "Foam" screen. |
|  | The current screen is closed, the "Advance" screen is opened. |


*"Infocentre foam generator" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Pressure liquid supply | Displays the liquid supply pressure in bar |

TRANSLATION

# 18."Current" screen

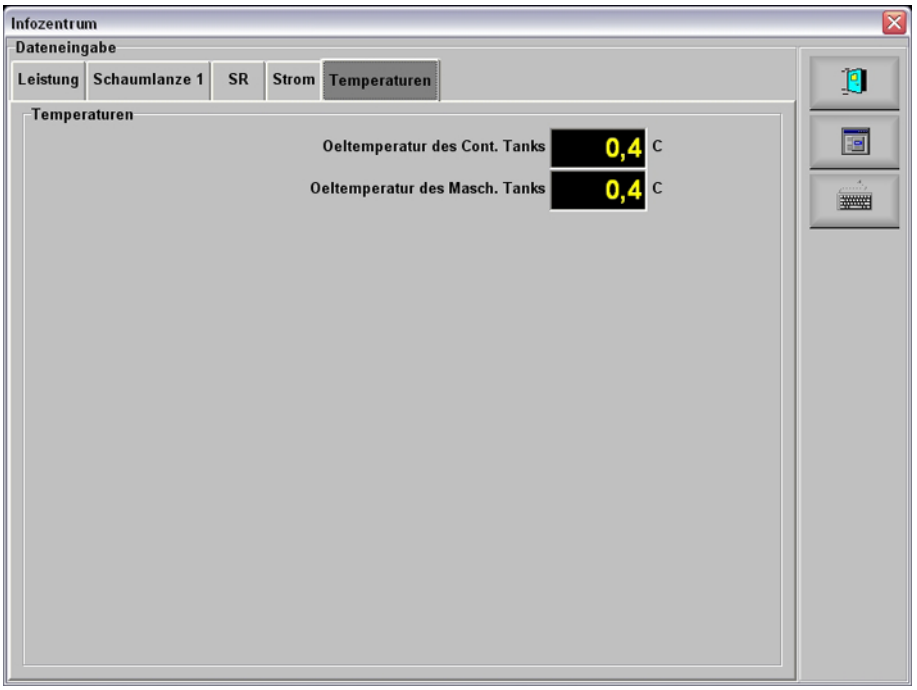



*"Infocentre current" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Current L1 | Displays the current draw L 1 in A |
| Current L2 | Displays the current draw L 2 in A |
| Current L3 | Displays the current draw L 3 in A |

# 19."Temperatures" screen

Touch the "Temperatures" button on the "Infocentre" screen to open the "Temperatures" screen.




*"Infocentre Temperatures" screen*

| DESIGNATION | DESCRIPTION |
|---|---|
| Container tank oil temperature | Displays the current oil tank temperature in the container in °C. |
| Machine tank oil temperature | Displays the current machine tank temperature in °C. |

# 20.Language selection

## 20.1 Available languages

| | | |
|---|---|---|
| 1. German | 4. Italian | 7. Turkish |
| 2. English | 5. Russian | 8. Spanish |
| 3. French | 6. Chinese | 9. Portuguese |

Table III - 6: List of available languages

For each operator language installed, the corresponding flag is shown in the "Languages" menu.

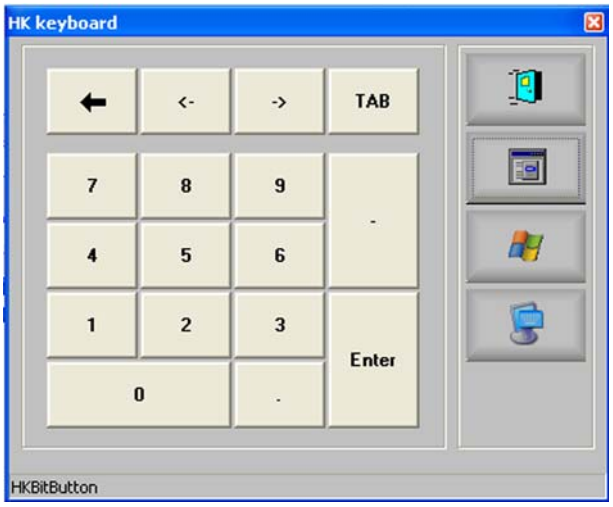
## 20.2 Selecting a language

**Approach:**

1. Touch the flag icon in the "Main menu" to open the Language menu.
2. Touch the corresponding flag to switch the visualisation to the selected language.
3. Tap the "QUIT" button to leave the Language menu.
   ⇨ The operator language has now been set to the desired language and the corresponding flag is shown in the main menu.

# 21."Keyboard" screen

| BUTTON | ACTIVITY FUNCTION |
|---|---|
|  | Touching the "Main menu" button on the "Advance" screen opens the "Main menu" screen. |
|  | Touching the "Keyboard" button opens the "Herrenknecht keyboard" |
|  | Touch the button on the screen: this closes the current screen. |




*Graphic HK keyboard*

| BUTTON | ACTIVITY FUNCTION |
|---|---|
|  | Touch the button, the keyboard changes the screen. |
|  | Touching the button opens the Windows keyboard - the keyboard changes the screen. |


*Graphic Windows keyboard*