

Portable Sampling System PSS-STS to determine total mercury concentrations in flue gases

Instruction Manual

Version 1.01.00

Software Version: 1.00





Embracing Challenge

Get help

For more information about using your M&C product, please contact M&C TechGroup. We will answer your questions about commissioning, handling and technical service. With our experience and know-how, we will get your M&C product running in no time - and with no charge.

**Please contact our service center in Ratingen, Germany,
for US Service Ventura, California**

For faster service, please have this information ready when you contact us:

- Product model
- Product serial number
- M&C order or invoice number

- Germany service center:
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1 About this Instruction Manual

Welcome to the M&C product manual. The goal of this document is to give a broad overview of the main functions of the STS and to help you to get started.

If you have any questions about this instruction manual, please contact M&C or one of our official distributors.

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This instruction manual does not claim to be complete and it may be subject to technical modifications. We appreciate any feedback you may have to this document .

Any copy of this document or of its content is not allowed without explicit approval of M&C.

With the release of this version all older manual versions will no longer be valid.

The original instruction manual is in German.

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2 Safety Information

Read this important safety information carefully before installing the STS. Follow these safety precautions during commissioning, start-up and regular operation.

2.1 Intended Use

The portable sample system STS (sorbent trap sampler) is intended for use in general purpose areas (non-hazardous environments). It may only be operated in compliance with the information on page 14 chapter 'Technical Data' . You must meet the requirements of the ambient temperature and characteristics in particular.

Do not use this product for any other purpose. Improper use and handling can create hazards and cause damage. For more information, please refer to the safety information in this instruction manual.

2.2 Personal Safety

Read this instruction manual carefully before commissioning and operating the device. If you have any questions regarding the product or the application, please don't hesitate to contact M&C or an M&C authorized distributor.

Follow all instructions and warnings closely.

The product described in this instruction manual has been built and tested in our production facility. All analyzers are packed to be shipped safely. To ensure the safe operation and to maintain the safe condition, all instructions and regulations stated in this manual need to be followed.

This instruction manual includes all information regarding proper transportation, storage, installation, operation and maintenance of this product by qualified personnel.

2.3 Warning Signs and Definitions



DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



NOTICE NOTICE is used to address practices not related to physical injury.



High Voltage! Caution, risk of electric shock!



High Pressure! Caution, system might be under pressure.



Hot Surface! Caution, hot surface! Do not touch!



Hazardous Gas! Caution, hazardous and toxic gas! Do not inhale!



Qualified Personnel 'Qualified personnel' are experts who are familiar with the installation, mounting, commissioning and operation of these types of products.



Safety Gloves! Put on safety gloves for your protection.



Pull Main Plug! Unplug power supply before opening!



Wear protective equipment Working with chemicals, sharp objects or extremely high temperatures requires wearing protective equipment.


Wear safety glasses

Protect your eyes while working with chemicals or sharp objects. Wear safety glasses to prevent anything from getting into your eyes.


Note

'Note' indicates important information relating to the product or highlights parts of the documentation for special attention.


Do you need help?

Please contact M&C!

2.4 Safety regarding M&C components


Qualified personnel

Installation, commissioning, maintenance, inspections and any repairs of all M&C products and components must be carried out by qualified personnel in compliance with the current regulations.

M&C components may only be used in the areas specified by M&C. Protect the device from direct sunlight, rain and moisture.

Operate the device only in the permitted temperature and pressure ranges. For details, please refer to the technical data on page 14 chapter 'Technical Data'.

Don't repair or maintain this product without M&C's specific maintenance- and service instructions.

When replacing parts, use only original M&C spare parts.


Pull Main Plug!

If there is any indication that safe operation of the STS is no longer possible, turn off the power and disconnect the device from the power supply immediately.

Then protect the defective device against accidental switch-on and mark it clearly as defective.



2.5 Working on Electrical and Electronic Devices

Only qualified and authorized personnel are permitted to work on equipment which operates on 115 or 230 V AC supply voltage. Ensure that the generally accepted engineering standards and all of your national and local regulations are observed.



Note

Before connecting the device, please make sure that the supply voltage matches the specified voltage on the type plate.



High Voltage!

Protect yourself and others against damages which might be caused by high voltages. Disconnect the power supply before opening the device for access. Make sure that all external power supplies are disconnected.

Please make sure to take appropriate precautions even by working on unplugged or low-voltage devices. Unplugged devices need to be properly grounded to prevent damage to internal electronics from electrostatic discharges (ESD).

2.6 Not certified in Hazardous Areas

This device is NOT certified to be installed or operated in hazardous areas.



WARNING

Explosion hazard!

For general purpose areas ONLY. Don't use the device in hazardous areas.



3 Introduction

Congratulations on your purchase of the portable sampling system PSS-ST5. We know from experience that you will surely enjoy this reliable and durable M&C product.

M&C is one of the premium and performance-driven companies in the business. With this in mind, our customers benefit from a number of significant advantages. We offer proven, durable and advanced products and solutions. We have listened to our customers needs, when designing our products, allowing M&C to provide premium products at a comparatively lower cost over the entire life cycle.

Our products and special systems are designed and tested in our own facilities by our highly skilled staff that are always quality-oriented. We carefully package our goods and send them to our customers worldwide.

With our 30 years of experience in customer-specific solutions for almost 30 different industries and applications, it is our goal to provide you with an excellent product. Our products offer fast commissioning, safe and reliable day-to-day operation and low maintenance.

We expect that our products fully meet your expectations. If you have any questions regarding the product or the application, please don't hesitate to contact M&C or your M&C authorized distributor. Our service does not end with the delivery of the products.

Thanks again for your purchase.

We appreciate your business.



4 Product Overview

The portable sampling system PSS-STS (Sorbent Trap Sampler) meets the requirements of DIN CEN/TS 17286:2019-07 (mercury measurement with Sorbent Traps). In this mercury measurement, a defined volume flow is directed through two traps. The use of two Sorbent Traps in independent parallel gas paths ensures a high reliability of the measurement results. The traps are divided into up to six sections. The criteria which these sections must meet are defined in the relevant regulations. The analysis of the Sorbent Traps is carried out in the laboratory.

Typical applications are sampling of flue gases from combustion plants.

The portable sampling system PSS-STS is a reliable and precise sampling system which is used for the determination of total mercury concentrations in flue gases.

The Sorbent Traps are inserted into the heated probe and removed after a defined and programmed collection cycle. If required, the probe can be equipped with new traps for further collection cycles. The traps in the probe are tested for gas tightness before and after each collection cycle.

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The Sorbent Traps are inserted into the heated probe and removed after a defined and programmed collection cycle. If required, the probe can be equipped with new traps for further collection cycles. The traps in the probe are tested for gas tightness before and after each collection cycle.

The device is controlled by a front-panel PC and an internal programmable logic controller (PLC). The user-friendly software intuitively guides the user through all measurement settings, automatic leak tests and the entire sampling process. All measurement data is recorded by the software and then automatically generated in the format of a report.

Downstream of the probe, there is a cooler to separate the condensate. For volume control of the flue gas, pumps and mass flow controllers (MFCs) are controlled by the PLC.

The main components of the system are the sample probe for the Sorbent Traps, the heated sample gas line, the cooler, the volume flow control, the vacuum sensors, the peristaltic pumps for condensate removal, the filter and the electronics.

4.1 Receiving the Analyzer

The STS sampling system is usually delivered in 6 packaging units. The following parts are in the packaging units:

- Sample probe designed to take up the Sorbent Traps (Sorbent Traps are not included) with control and power cable (IP42 connection on one side)
- Heated sample line with two inner liners
- Cooler unit with power cable (IP42 connection on one side) and Ethernet cable (double-sided IP68 connection)

- Control unit with power cable (IP42 connection on one side) and Ethernet cable (double-sided IP68 connection)
- Optional: Condensate vessel TK13/LA5 with filling level alarm
- Optional: Audit MFC (mass flow controllers) with power supply cable and Ethernet cable (double-sided IP68 connection)
- Instruction manual

**Note**

Please note that there are no materials or tools included in the package you might need for assembly or installation.

4.2 Type Plate and Serial Number

The type plates with the serial numbers are placed on the individual system components:

- **Sample probe**

The type plate is on the electric terminal box.

- **Heated sample line**

The type plate is on one of the gas connections.

- **Cooler unit**

The type plate is placed on the inlet recess on the side of the case.

- **Control unit**

The type plate is placed on the lateral surface of the case.

- **Optional: Condensate vessel**

The type plate is placed laterally on the vessel.

- **Optional: Audit MFC**

The type plate is on the case lid.

**Note**

Please always quote the serial number when making enquiries or ordering spare parts.

5 Operating Principle

The operating principle is a volume flow system with which a defined volume flow is routed through sorbent traps. Quality assurance is guaranteed by using two independent volume flows. In addition, the sorbent traps contain up to six sections. The criteria that these sections must meet are defined in the relevant regulations.

5.1 Flow Chart

The following gas flow diagram shows an PSS-STS with a maximum of two possible sorbent traps.

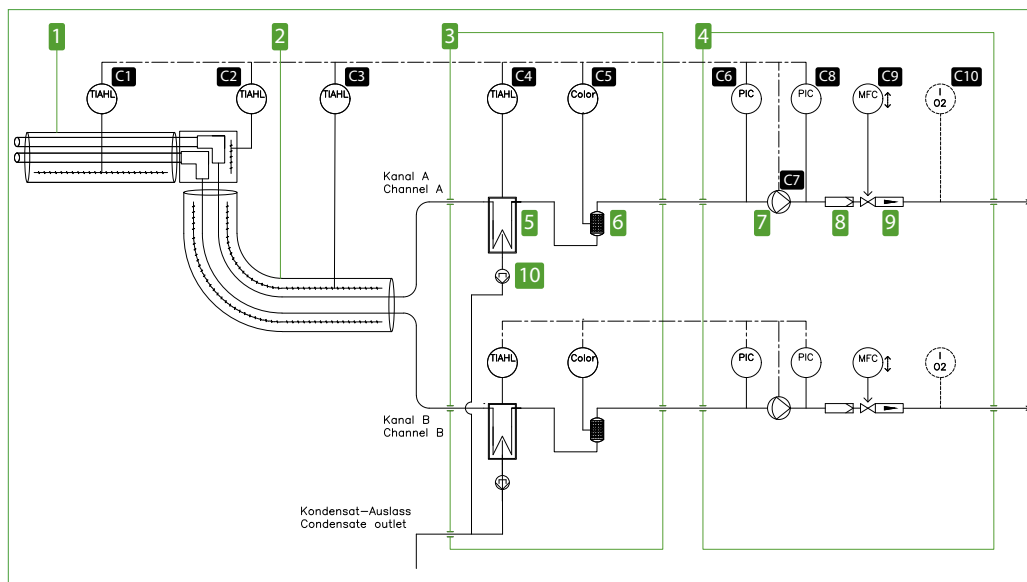


Fig. 1: Flow chart

- | | |
|--|---|
| 1 Sample probe | 2 Heated gas sample line |
| 3 Cooler unit | 4 Control unit |
| 5 Cooler unit: heat exchanger | 6 Cooler unit: safety equipment |
| 7 Control unit: sample gas pump | 8 Control unit: filter |
| 9 Control unit: control valve | 10 Cooler unit: peristaltic pump |
| C1 Sample probe with temperature alarm high/low | C2 Elbow screw connections with temperature alarm high/low |
| C3 Heated gas sample line with temperature alarm high/low | C4 Cooler unit with temperature alarm high/low |
| C5 Cooler unit: condition monitoring of safety equipment | C6 Control unit: pressure measurement before sample gas pump |
| C7 Control unit: sample gas pump control | C8 Control unit: pressure measurement after sample gas pump |
| C9 Control unit: mass flow control | C10 Option for control unit: measurement of the O ₂ content |

6 Technical Data

Sample Probe PSP-ST5			
Immersion depth	1 m [≈ 3.3 ft]	1.5 m [≈ 4.9 ft]	2 m [≈ 6.6 ft]
Part No. for 230 V AC	07A2340	07A2350	07A2360
Part No. for 115 V AC	07A2340a	07A2350a	07A2360a
Sampling temperature	Up to 200 °C [392 °F]		
Ambient temperature	+5 to +40 °C [41 to 104 °F]		
Temperature controlling	Via control unit		
Ready for operation	After 30 min.		
Time for cooling to +50 °C [122 °F]	Approx. 1 hour until sample probe reaches approx. +50 °C [122 °F]		
Connection gas OUT	Tube connection DN 4/6, stainless steel		
Number of Sorbent Traps	For two traps with a length of approx. 400 mm and Ø 10 mm		
Heating capacity	1200 W		
Power supply	230 or 115 V AC		
Electrical connection	1.5 m [≈ 4.9 ft] long cable		
Device fuse	16 A		
Ethernet connection	IP68		
Electrical equipment standard	EN 61010		
Protection class terminal box	IP42 EN 60529		
Material	Stainless Steel 904L, others on request		
Protective tube for sorbent Traps	Yes, screw-on		
Mounting flange	DN 65 PN 6 or 3", with Kamlock fitting		
Weight	Approx. 18 kg [≈ 39.7 lbs] for 2 m [≈ 6.6 ft] immersion depth		

Cooler Unit PSS-ST5-C	
Part No. for 230 V AC	07A2200
Part No. for 115 V AC	07A2200a
Dew point gas OUT	Setting range: +2 to +15 °C [35.6 to 59 °F], factory setting: +5 °C [41 °F]
Dew point stability gas OUT	Under constant conditions < ± 0.1 °C [< ± 0.18 °F]
Temperature gas IN	*Max. +180 °C [356 °F] with stainless steel bulkhead fitting
Water vapor saturation gas IN	*Max. +80 °C [176 °F]
Ambient temperature	*+5 to +40 °C [41 to 104 °F]
Storage temperature	-25 to +65 °C [-13 to 149 °F]
Connection gas IN	Tube connection DN 4/6
Connection gas OUT	Tube connection DN 4/6
Connection condensate OUT	Tube connection DN 4/6
Material of wetted parts	Stainless Steel 316 Ti, glass, PVDF, PTFE, Novopren
Ready for operation	After 3 min.
Power supply	115 or 230 V AC ±10 %, 50/60 Hz
Electrical connection	2 m [≈ 6.6 ft] long cable



Cooler Unit PSS-STS-C	
Part No. for 230 V AC	07A2200
Part No. for 115 V AC	07A2200a
Device fuse	10 A, time-delay, 5 x 20 mm
Power consumption	At 230 V: max. 1620 VA, 115 V: max. 920 VA
Electrical equipment standard	EN 61010
Protection class	IP42 EN 60529
Housing version	Portable impact-resistant plastic case with integrated trolley and pull-out handle
Housing color	Black
Dimensions (W x H x D)	451 x 654 x 279 mm [≈ 17.8" x 25.8" x 11.0"] with casters and handle
Weight	Approx. 16 kg [≈ 35.3 lbs]
Option: Shoulder straps (Part No. 90G0270)	Padded and adjustable shoulder straps made of robust polyester material for mounting on the cooler unit.

** Technical data with max. specifications are to be evaluated under consideration of the total cooling capacity at 25 °C [77 °F] and an outlet dew point of 5 °C [41 °F].*

Control unit PSS-STS-M	
Part No.	07A2100
Ambient temperature	*+5 to +40 °C [41 to 104 °F]
Storage temperature	-25 to +65 °C [-13 to 149 °F]
Operating pressure	0.7 to 1.4 bar abs.
Number of connections gas IN	2
Number of connections gas OUT	2
Connection gas IN	Tube connection DN 4/6
Connection gas OUT	Tube connection DN 4/6
Material of wetted parts	SS 316Ti, glass, PVDF, PTFE, Novopren
Ready for operation	After 30 min.
Power supply	115 or 230 V AC ±10 %, 50/60 Hz
Electrical connection	2 m [≈ 6.6 ft] long cable
Device fuse	4 A, time-delay, 5 x 20 mm
Electrical equipment standard	EN 61010
Protection class	IP42 EN 60529
Housing version	Portable impact-resistant plastic case with integrated trolley and pull-out handle
Housing color	Black
Dimensions (W x H x D)	451 x 654 x 279 mm [≈ 17.8" x 25.8" x 11.0"] with casters and handle
Weight	Approx. 16 kg [≈ 35.3 lbs.]
Option: Shoulder straps (Part No. 90G0270)	Padded and adjustable shoulder straps made of robust polyester material for mounting on the control unit.

** Technical data with max. specifications are to be evaluated under consideration of the total cooling capacity at 25 °C [77 °F] and an outlet dew point of 5 °C [41 °F].*

Gas Sample Line with two inner liners PSS-ST5-B	
Part No. for 230 V AC	07A2500
Part No. for 115 V AC	07A2500a
Power consumption with DN 4/6	85 W/m
Ambient temperature	-20 to + 60 °C [- 4 to 140 °F]
Sample lines end caps	Type C (connection fitting) and type Y (end fitting) for 2 inner liners
Power supply	230 V AC or 115 V AC, supplied via control unit
Electrical connection	1.5 m [≈ 4.9 ft] cable with 7-pin connection for cooler unit
Temperature sensor connection	Integrated in 7-pin connection for cooler unit
Electrical device standard	EN 61010
Length of sample line	*5 m [≈ 16.4 ft]
Inner liner	PTFE, DN 4/6, 2 replacable inner liners
Heating	+200 °C [392 °F]
Outer jacket	Corrugated polyamide tube, black
Application areas/smallest bending radius	Mobile and stationary, indoor and outdoor installation/320 mm [≈ 12.6"]
Weight	Approx. 5.6 kg [≈ 12.3 lbs]

* Other lengths on request, max. length at 230 V: 15 m, max. length at 115 V: 11 m

Optional: Condensate Vessel TK13/LA5	
Part No.	09K4320
Operating pressure at 20 °C	Atmospheric
Medium temperature	0 bis 50 °C [32 to 122 °F]
Ambient temperature	0 bis 55 °C [32 to 131 °F]
Storage temperature	-15 to + 65 °C [5 to 149 °F]
Connection condensate IN	2 x DN 4/6
Connection condensate OUT	Plug valve opening ø 11.5 mm [≈ 0.5"]
Material of wetted parts	PE, rubber, PVDF
With filling level alarm	Yes, float switch
Switching capacity	48 V 0.5 A 10 W
Dimensions (W x H x D)	230 (vessel diameter) x 308 x 310 mm (including plug valve opening) [≈ 9.1" x 12.1" x 12.2"]
Content	Approx. 10 l [≈ 2.2 gal]
Weight	Approx. 1 kg [≈ 2.2 lbs]

Optional: Audit MFC PSS-ST5-A	
Part No.	07A2400
Gas flow	2 NI/h (at 2 bar abs.) to 87 NI/h
Operating pressure	2 to 8 bar abs.
Accuracy	Deviation < 1 %
Reproducibility	Deviation < 1 %
Power supply	115/230 V AC
Electrical connection	2 m [≈ 6.6 ft] long cable
Device fuse	4 A, time-delay, 5 x 20 mm
Electrical equipment standard	EN 61010
Protection class	IP42, EN 60529
Housing version	Portable impact-resistant plastic case with handle
Housing color	Black
Dimensions (W x H x D)	292 x 285 with handle x 120 mm [≈ 11.5" x 11.2" with handle x 4.7"]
Weight	Approx. 3 kg [≈ 6.6 lbs]

Please note: NI/h and NI/min refer to the German standard DIN 1343 and are based on these standard conditions: 0 °C [32 °F], 1013 mbar.

6.1 Dimensions

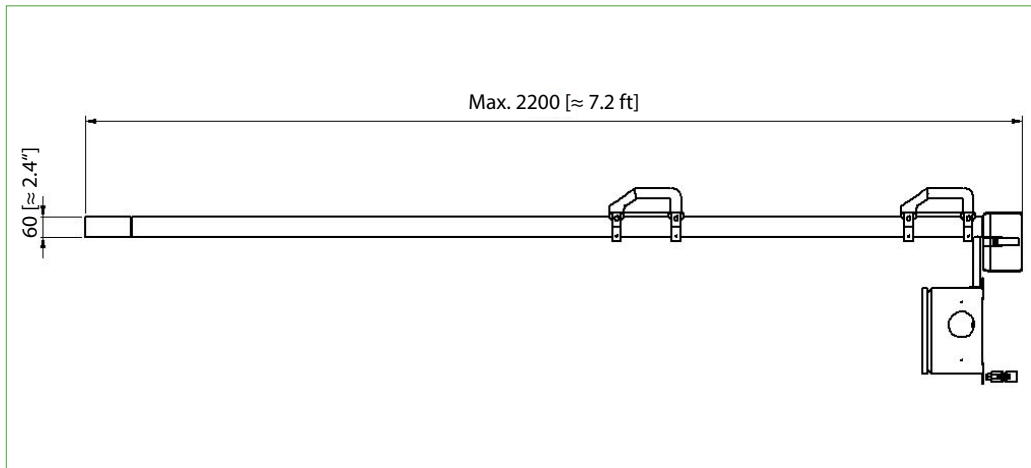


Fig. 2: View sample probe PSP-ST5

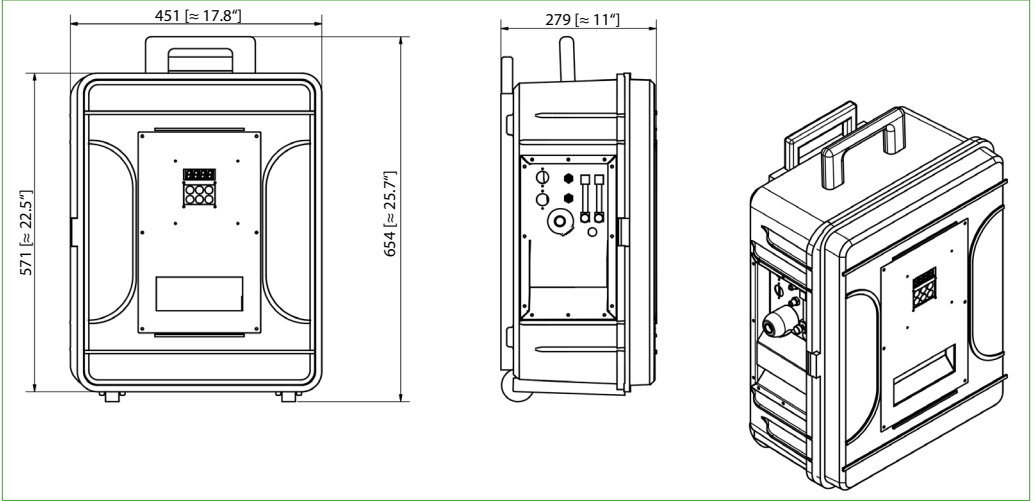


Fig. 3: Case dimensions for cooler unit (upright)

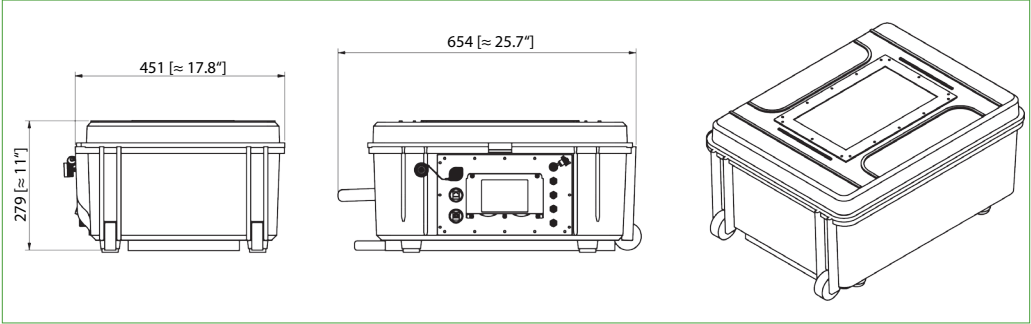


Fig. 4: Case dimensions for controller unit (horizontal)

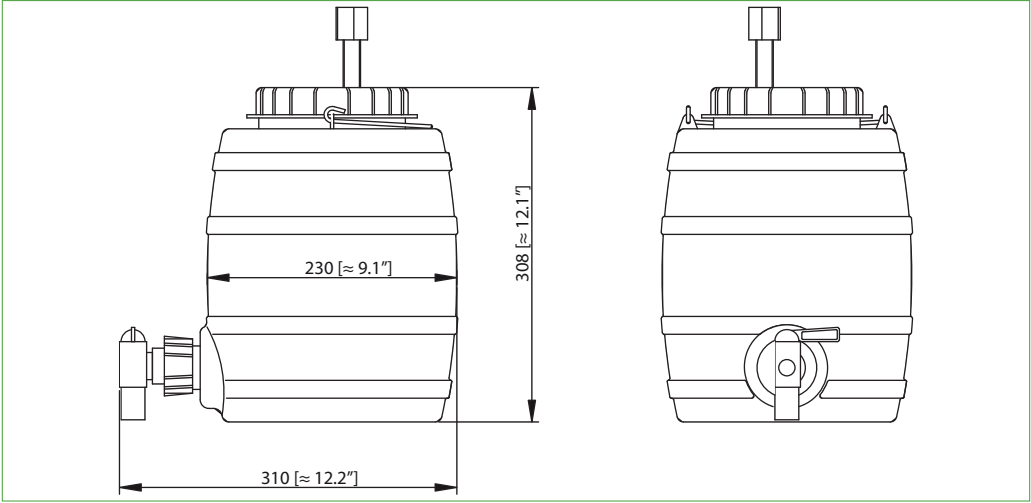


Fig. 5: Dimensions TK13/LA5

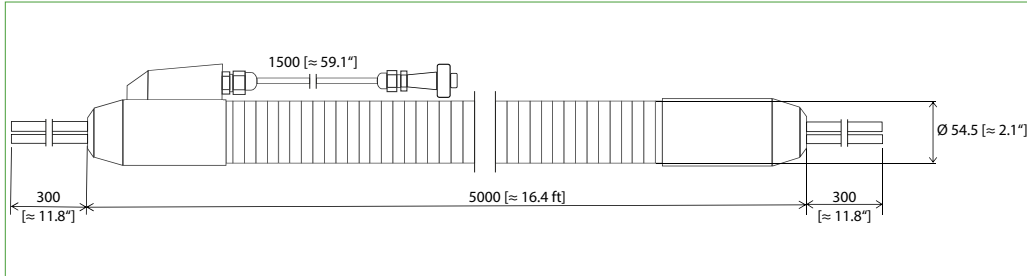


Fig. 6: Dimensions for heated gas sample line PSS-STS-B

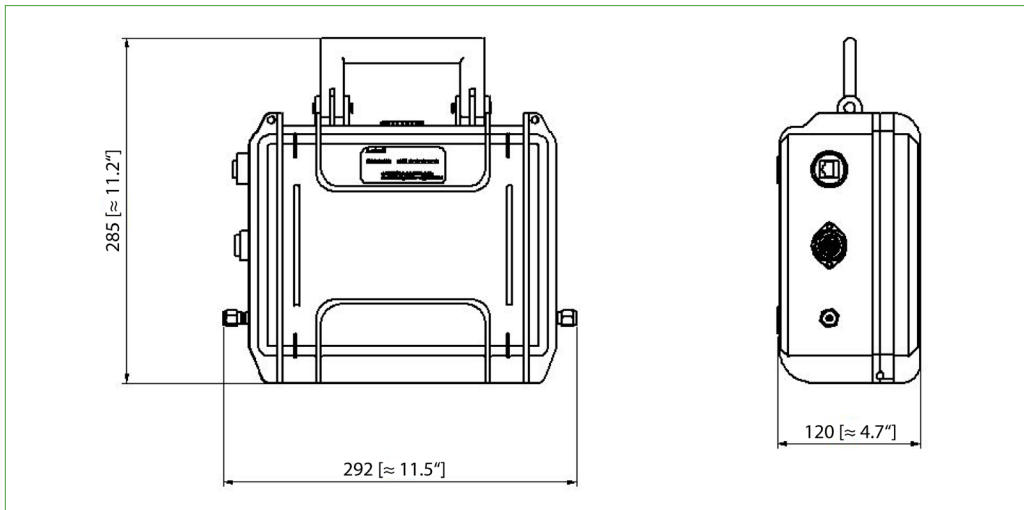


Fig. 7: Case dimensions for Audit MFC (mass flow controller)

6.2 Sample Probe Connections

The connections of the probe are placed laterally on the electric terminal box.

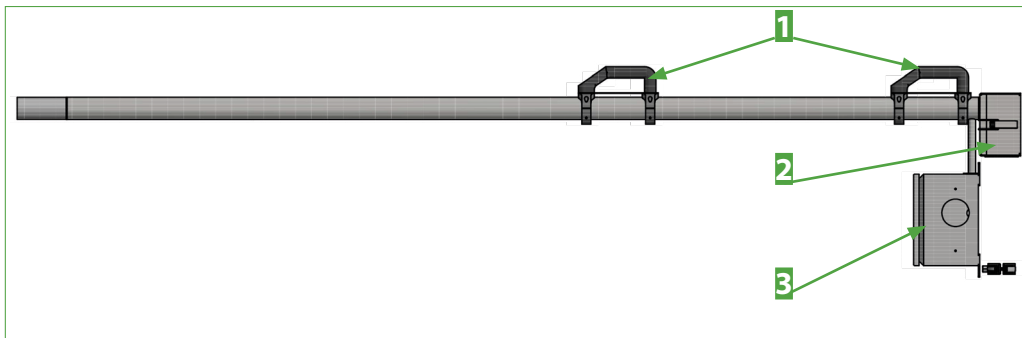


Fig. 8: Connections of the sample probe

- 1** Electric terminal box
- 2** Carrying handle
- 3** Sample gas IN and OUT

6.3 Cooler Unit Connections

The connections of the cooler unit are placed on the side of the cooler unit.

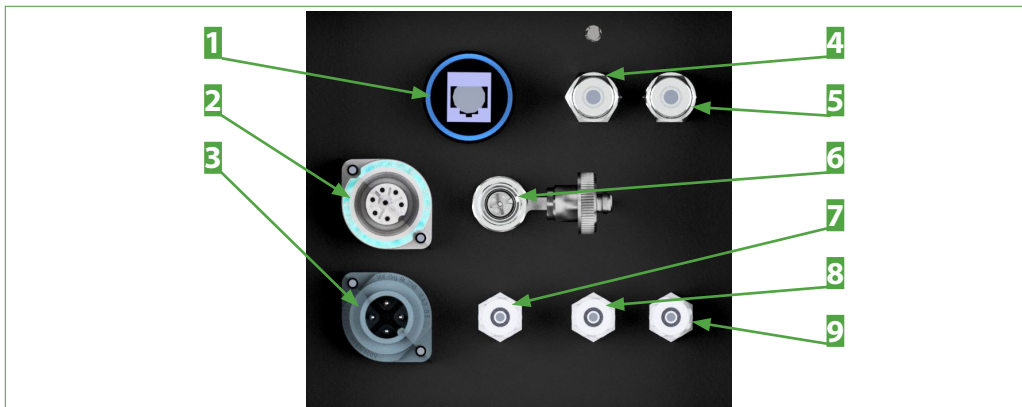


Fig. 9: Connections of the cooler unit

- 1** Ethernet port
- 2** Connection of the heated sample line
- 3** Mains connection
- 4** Sample gas IN A
- 5** Sample gas IN B
- 6** LA 5 connection
- 7** Condensate outlet
- 8** Sample gas OUT A
- 9** Sample gas OUT B

6.4 Connections of the Control unit

Electrical and pneumatic connections are located at the rear of the control unit.

When the lid is open, Ethernet and USB ports are still available on the front panel. The connections on the front panel are protected with caps.

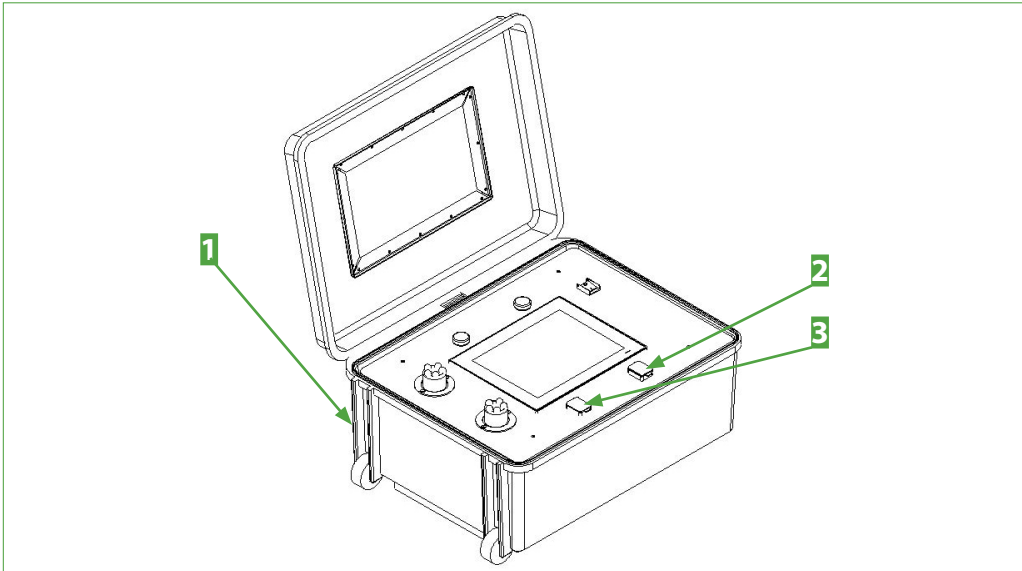


Fig. 10: Connections of the control unit

- 1** Connections at the rear
- 2** USB port with protective cap
- 3** Ethernet port with protective cap



Note You can connect a USB stick or an external keyboard to the USB port.

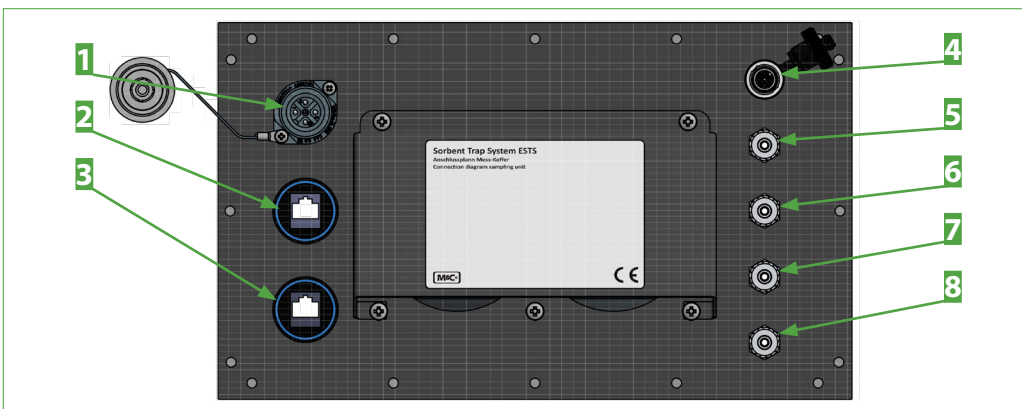


Fig. 11: Connections at the rear of the control unit

- 1** Mains connection with cover
- 2** Ethernet port 1
- 3** Ethernet port 2
- 4** Signal connection with cover
- 5** Sample gas IN A
- 6** Sample gas IN B
- 7** Sample gas OUT A
- 8** Sample gas OUT B

7 Graphical User Interface (GUI) of the Control Unit

The sampling system is controlled by a front-panel PC and an internal programmable logic controller (PLC). The user interface, also called HMI (Human-Machine-Interface), provides the interface between the sampling system and the user.

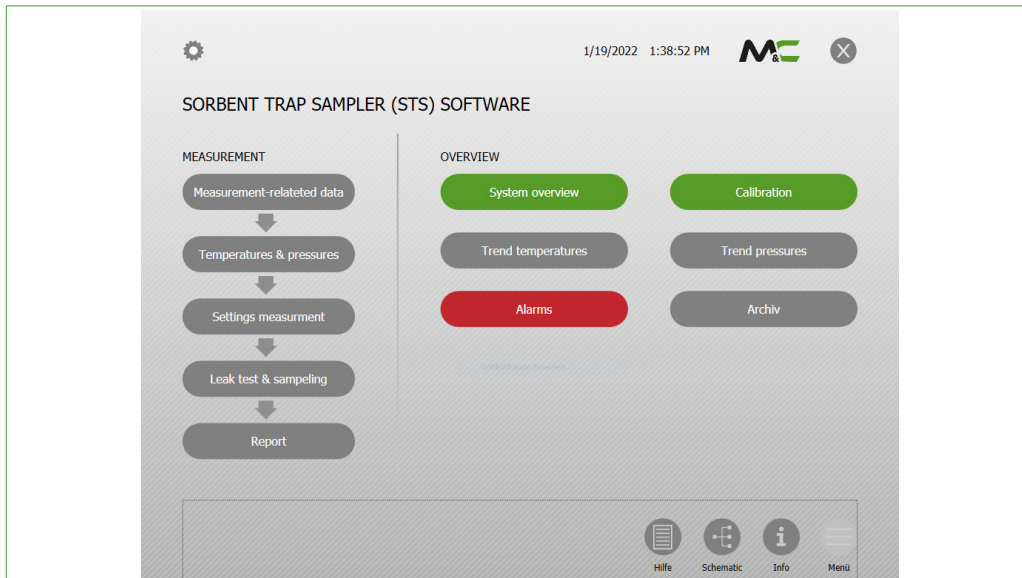


Fig. 12: Main menu of the sampling system

The following chapters provide explanations regarding the setup of the main menu and the structure of the menu.

The illustrations in this instruction manual may differ slightly depending on the operating mode. Reading this description does not replace familiarizing yourself with navigating through the menus directly on the unit.



Note

Familiarize yourself with navigating through the menus directly on the device.

7.1 Keyboard inputs

When entering data, use the keypad of the front panel PC or connect an external keyboard to the USB connection at the control unit.

You open the keypad by double-clicking on an input field.

For entries, proceed as follows:

Keyboard entries

- 1 Doubleclick into the input field. The keypad opens.
- 2 Enter the requested details via the keypad of the front-panel PC or via an external keyboard.

**Note**

The blue frame around the input field shows that the entered value has not yet been accepted.

- 3 Press the enter key on the keypad in order to confirm the new value.
Only when the blue frame is no longer displayed, the system has accepted the value.

8 Page Layout

The pages consist of four parts: menu bar, status bar, central display field and information line. On every page, the menu bar, the status bar and the information line remain visible. The central display field changes according to the opened page.

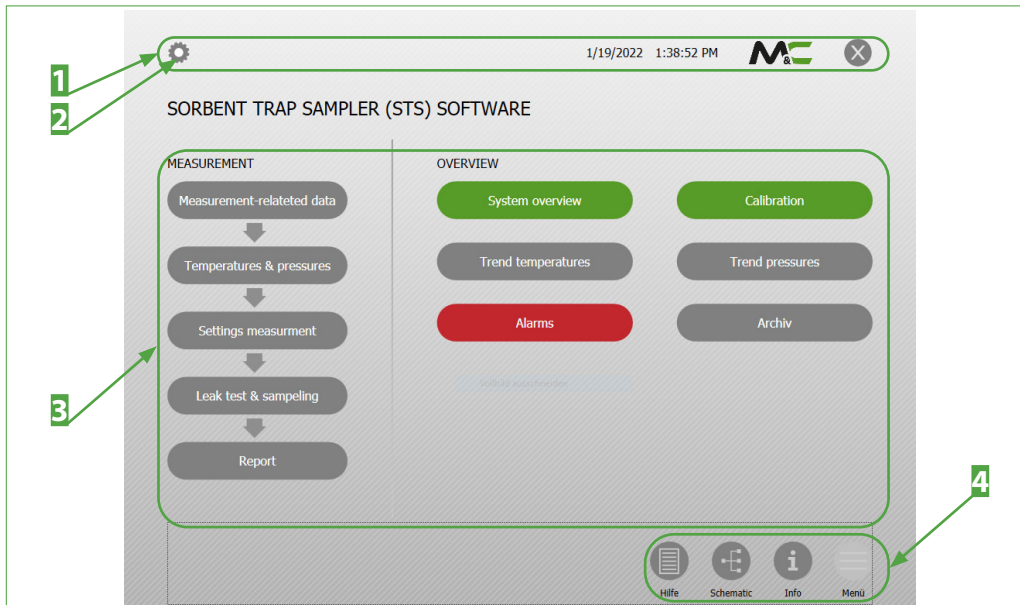


Fig. 13: Main Menu

- | | |
|--------------------------------|--|
| 1 Status bar | 2 Gear icon to show or hide the menu bar (here menu bar hidden) |
| 3 Central display field | 4 Information line |

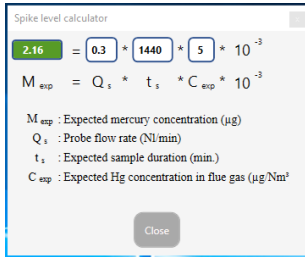
8.1 Menu Bar

The menu bar at the top of the screen can be shown and hidden by the "Menu" button in the status bar. The following menu items are displayed in the menu bar:

- Extras
- Maintenance
- Language
- Settings
- Manual

Menu Items Extras | **Description**

Extras ->
Spike level calculator



Here, the expected mercury amount can be calculated in µg. After the calculation, close the spike level calculator by clicking on the cross in the header line or on the "Close" button.

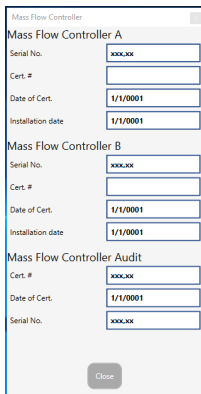
Example Calculation:
An expected flue gas concentration of 5 µg/Nm³ Hg, a flow rate of 0.3 l/min and a measuring period of 5 days result in the following:

$$M_{exp} = 0.3 \text{ l/min} * 1440 \text{ min/day} * 5 \text{ days} * 10^{-3} \text{ m}^3/\text{l} * 5 \text{ µg/Nm}^3 = 10.8 \text{ µg}$$

(This calculation runs in the background of the calculator)
A spike level of 10.8 µg ± 50 % is appropriate.

Menu Item Maintenance | **Description**

Maintenance -> Mass Flow Controller (MFC)



This page shows details regarding the mass flow controllers (MFCs): mass flow controller A, mass flow controller B and mass flow controller audit (optional).

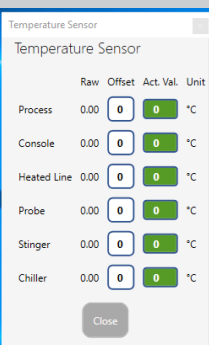
Here, the certificate data of the individual MFCs are provided. After each mandatory calibration of the MFCs by the manufacturer or a qualified body, the new data is entered here.

You close the page by clicking on the cross in the header line or on the "Close" button.

Note

Should the MFCs be exchanged, the new certificate data are entered here: certificate number and date, serial number and installation date.

Maintenance -> Temperature Sensor | **Description**



Here, the raw value measured by the temperature sensor is displayed in °C oder °F.

To recalibrate the temperature sensor, the raw value can be changed by entering an offset. The actual value shows the changed temperature value in °C or °F.

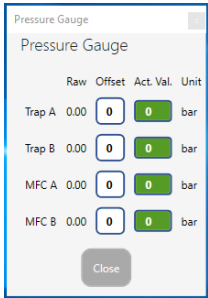
Six temperature sensors are available: in the process, in the control unit, in the heated sample line, in the sample probe, in the probe tube and in the cooler unit.

You close the page by clicking on the cross in the header line or on the "Close" button.



Menu Item Maintenance | **Description**

Maintenance -> Pressure gauge

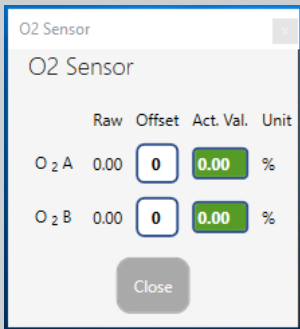


Here, the raw value measured by the pressure gauge is displayed in bar.

To recalibrate the pressure gauge, the raw value can be changed by entering an offset. The actual value shows the changed pressure in mbar. Four pressure gauges are available: Trap A, Trap B, MFC A and MFC B.

You close the page by clicking on the cross in the header line or on the "Close" button.

Maintenance -> O2 Sensor



Here, the raw value measured by the chemical oxygen sensor is displayed in vol%. The raw value can be changed by entering an offset. The actual value shows the changed oxygen value in vol%.

Two chemical oxygen sensors are used: O₂ A und O₂ B.

You close the page by clicking on the cross in the header line or on the "Close" button.

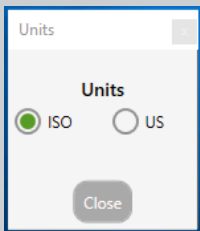
Note

It is recommended to adjust the O2 value before each measurement. The reason for this is the drift of the sensors due to aging.

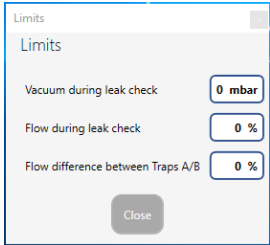
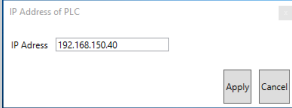
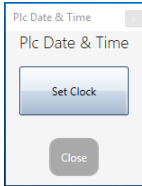
Menu Item Settings | **Description**

Settings -> Signal Input

Settings -> Unit



Select the units in which the values are indicated. ISO or US units are available.

Menu Item Settings	Description
<p>Settings -> Limit values</p> 	<p>Please enter the following limit values here:</p> <ul style="list-style-type: none"> Minimum vacuum during the leakage test in mbar. Permissible percentage gas flow during the leakage test. Permissible difference in percent between Trap A und Trap B.
<p>Settings -> IP Address of the PLC</p> 	<p>This page shows the IP address used. Enter a new IP address. Then confirm the new address by clicking on the "Accept" button.</p>
<p>Settings -> PLC Date & Time</p> 	<p>Here you transfer the system time to the PLC.</p> <hr/> <p>Note Consider change of summer and winter time.</p> <hr/> <p>Check settings after time change.</p>
<p>Manual -> Quick Start</p>	<p>Shows a short description of the most important buttons and menu items. Read the manual carefully before commissioning the device.</p>
<p>Manual -> Operating Manual</p>	<p>Shows the instruction manual for this device. Read the manual carefully before commissioning the device.</p>
<p>Manual -> Troubleshooting</p>	<p>Shows a table with Alarm messages and their impacts. This table is an extract from the manual. Read the manual carefully before commissioning the device.</p>



8.2 Status Bar

The status bar displays general date and time information that is important for the measurement. The status line always remains visible when changes are made in the central display field. Fig. 14 shows the status line of the main menu. No information about the measurement is displayed in the status line of the main menu.



Fig. 14: Status bar of the main menu

- 1 Gear icon to show/hide the menu bar
- 2 Current date
- 3 Current time
- 4 Button to close the program

The status bar of the following pages contain additional information about the measurement.

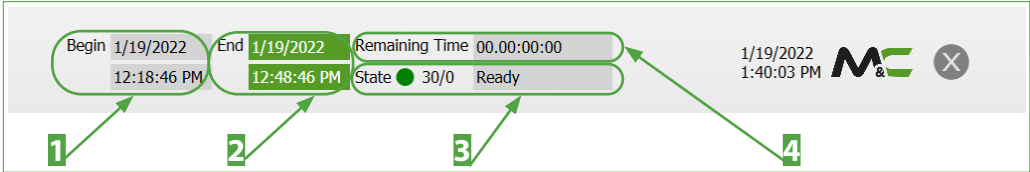


Fig. 15: Status bar of the following pages

- 1 Start day and start time of the measurement
- 2 End day and end time of the measurement
- 3 Status of the measurement, colored indicator shows front panel PC is connected to PLC ("green") or not ("red")
- 4 Remaining duration of the measurement

8.3 Main Display Field

The central display field shows the selected page. Fig. 16 shows the display field of the main menu.

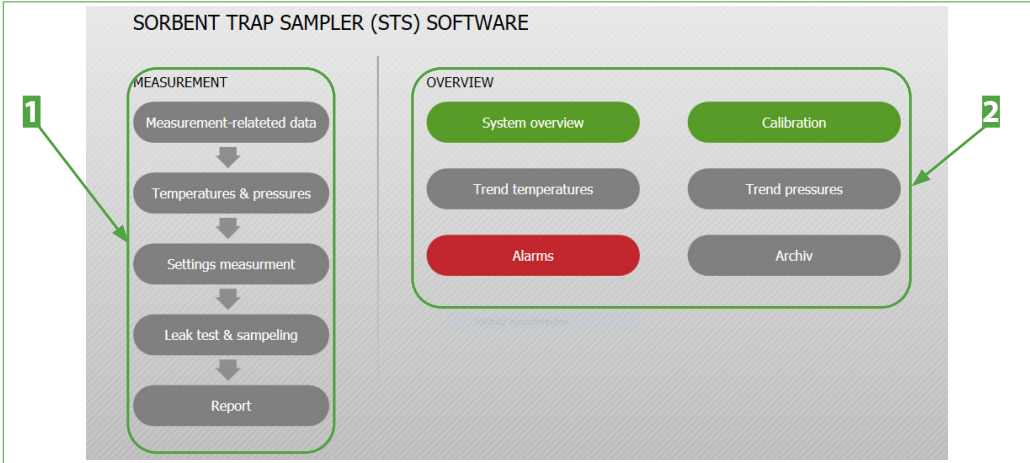


Fig. 16: Central display field of the main menu

- 1 Steps to carry out the measurement
- 2 Overview

8.4 Information Line

The information line is located at the bottom of the pages. It offers four buttons on the right side. You open the entire operating instructions, the system overview, the main menu or information on the central display panel with these buttons. The status bar always remains visible when changes are made in the central display field.

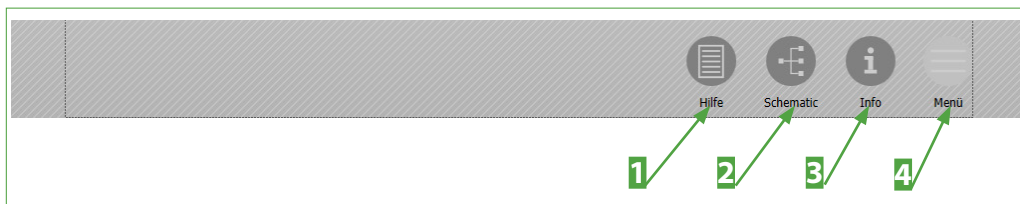


Fig. 17: Information line in the main menu

- 1** Button opens the instruction manual
- 2** Button opens the system overview
- 3** Button opens information on the contents of the central display field
- 4** Button opens the main menu



Note

Arrow buttons for navigation are displayed in the information line of the following pages.

9 Menu Structure

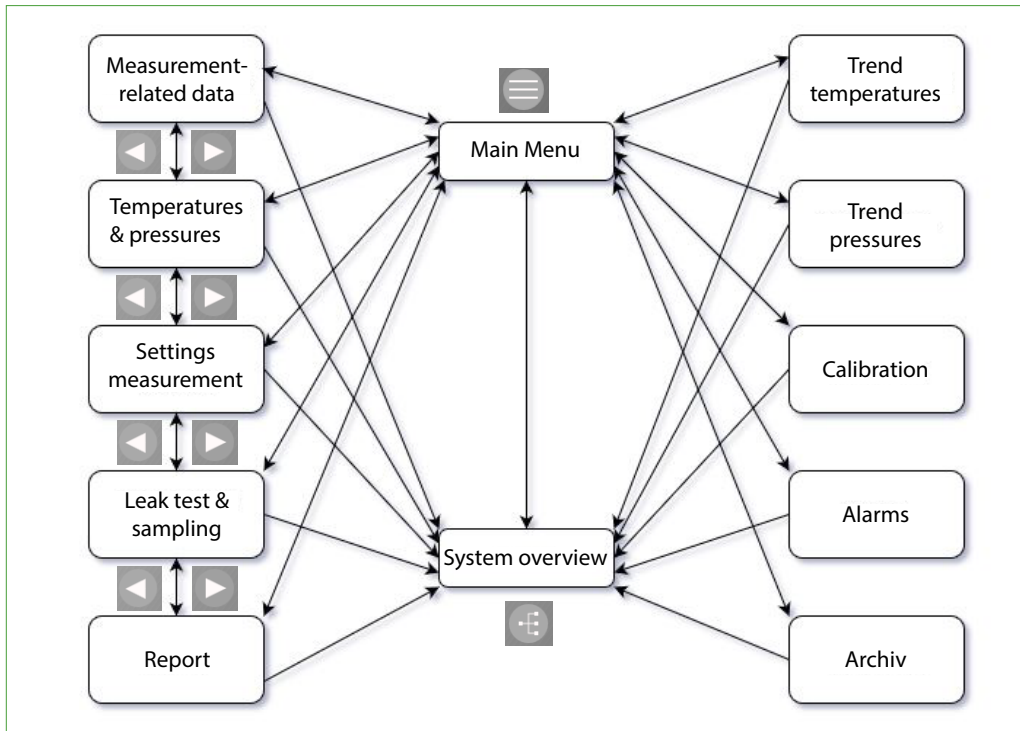


Fig. 18: Menu Structure

9.1 Main Menu

The buttons in the main menu are divided into Measurement and Overview. To perform a measurement, various settings are required. The buttons on the left side of the display field will guide you through the required input fields. The overviews on the right side of the display field are used for monitoring and control

The overview buttons on the right side will open the following pages:

- System Overview
- Trend temperatures
- Alarms
- Calibration (non-mandatory calibration)
- Trend pressures
- Archiv

**Note**

All pages of the user interface can be accessed from the main menu.

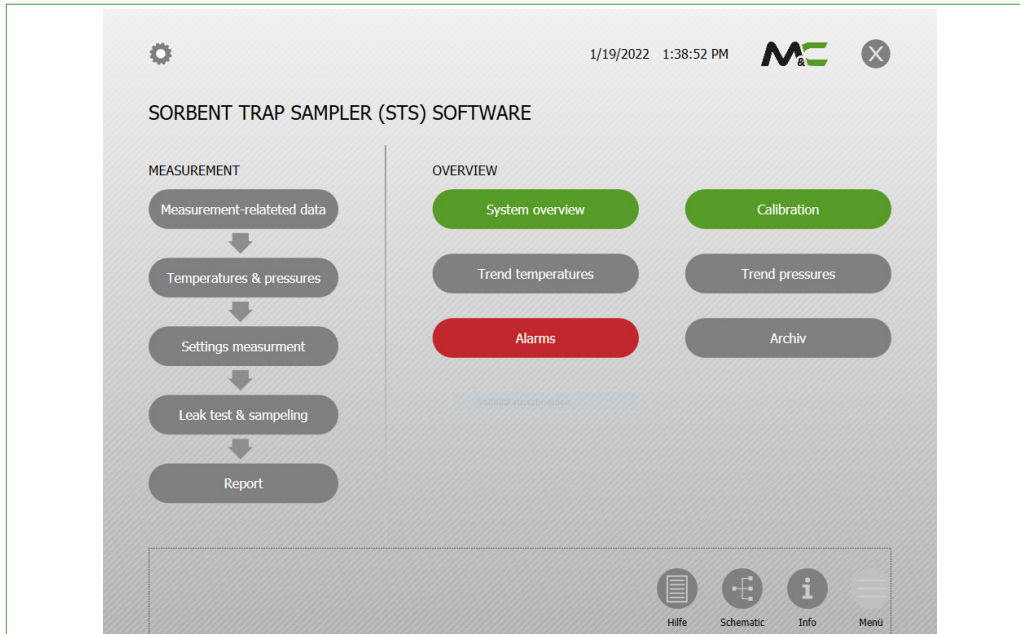


Fig. 19: Main menu with buttons

The buttons on the left side are connected with consecutive arrows. You open the following pages with these buttons:

- Measurement-related data
- Temperatures & pressures
- Settings measurement
- Leak test & sampling
- Report

The arrows indicate that you are being guided through the data and inputs for the measurement.

If one of these pages is open, forward and back arrows for navigation will appear in the information line. The pages can be opened with the buttons from the main menu or with forward and backward arrows in the information line.

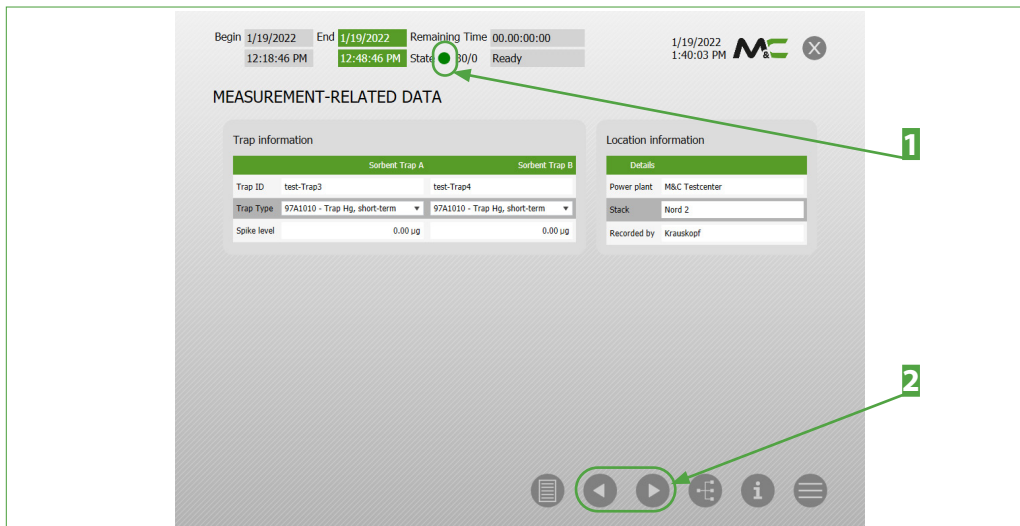


Fig. 20: Page "Measurement-related data" with arrow buttons in the information line

- 1** Indicator next to status: front panel PC is connected to the PLC ("green") or not ("red")
- 2** Arrow buttons in the information line

The status bar shows:

- Start day and start time of the measurement
- End day and end time of the measurement
- Remaining duration of the measurement
- Information regarding the status of the portable sampling system PSS-ST5

9.2 System Overview Page

In the system overview, all components that are used in the measurement are graphically displayed. Each of the green areas can change its color to red. If you click on one of these areas, the page on which this value was entered opens. For example, a red temperature value opens the "Temperatures & pressures" page.

The following figure shows the system overview with the individual components.

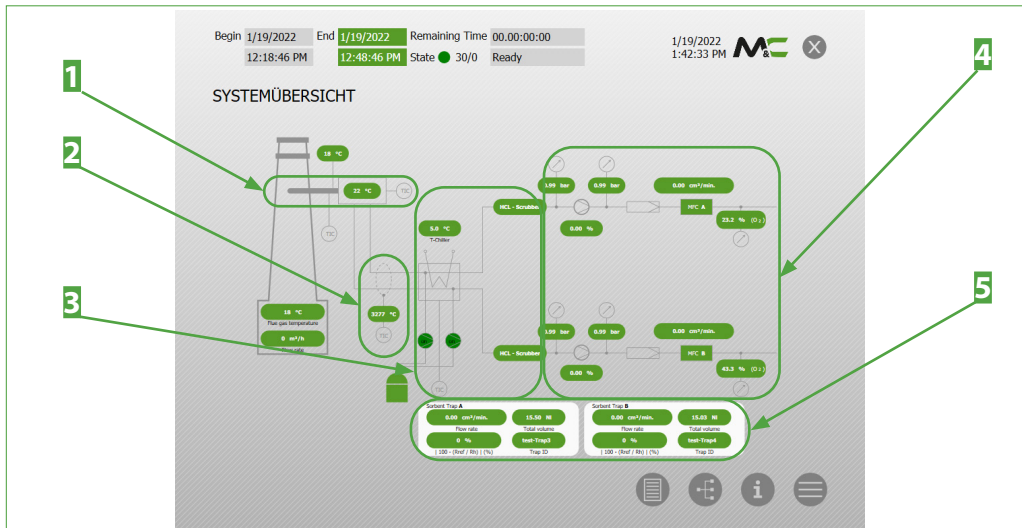


Fig. 21: System Overview with classification of the components

- 1 Sample probe
- 2 Gas sample line with 2 inner liners
- 3 Cooler unit
- 4 Control unit
- 5 Information about the MFCs in the control unit



Note

With the "System Overview" button in the information line, you can access the system overview from any page.

9.3 Mandatory Calibration of MFCs



Note

The mandatory calibration of mass flow controllers (MFCs) must be carried out by the manufacturer or a qualified body.

The precision of flow controllers must be proved annually as part of quality assurance. A calibration report must be prepared for each device using officially certified and computer-aided calibration equipment.

This calibration must be carried out by the manufacturer of the MFCs or a qualified body.



Note

Enter each new certificate number and certificate date in the fields under the menu item "Maintenance -> Mass flow controller".

9.4 Non-Mandatory Calibration of MFCs

The mass flow controllers can be calibrated internally with the PLC between the required official calibrations. A calibration report is also generated for this calibration.

On this page, a calibration of the individual MFCs can be performed and the results can be displayed in report form and exported as PDF.

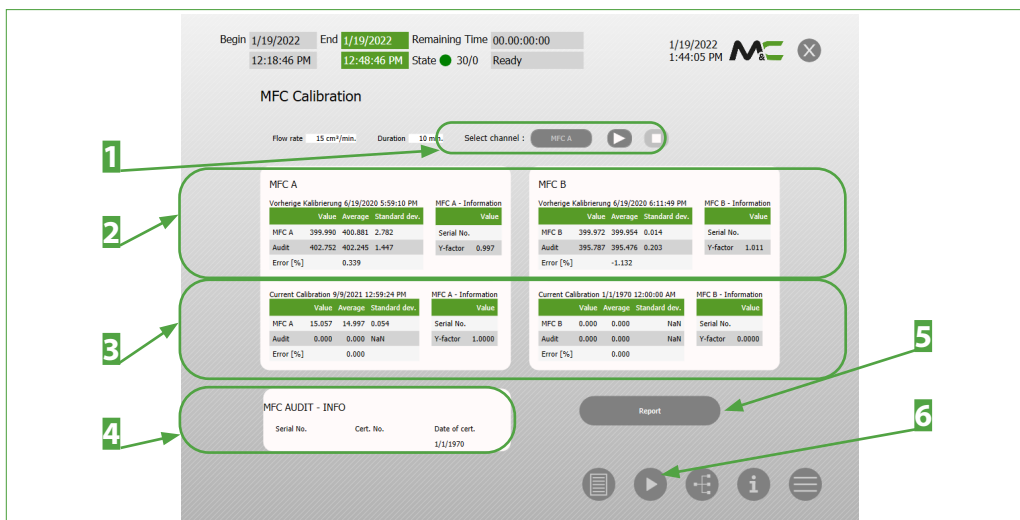


Fig. 22: Calibration of the MFCs

- 1 Starting and stopping the calibration, select channel
- 2 Values of the previous calibration
- 3 Values of the current calibration
- 4 Information about the MFC Audit (optional)
- 5 Button for creating a calibration report
- 6 Arrow button

Further pages are available for calibration. Click on the arrow button and the MFC calibration report header opens. Click again on the arrow button and the report list opens. The report header with the report list is printed together as a calibration report.



Note

The calibration report consists of the report header and report list.

9.5 Trend Temperatures

The diagram shows the values of the temperature sensors over a period of time.

In Table 2 in Fig. 23, it is possible to check only those temperature sensors whose curve is to be shown on the diagram.

However, if you move the cursor over the diagram, all values of the temperature sensors are displayed.



Note

The cursor shows the values of all temperature sensors. The diagram only shows the temperature sensors selected from table 2.

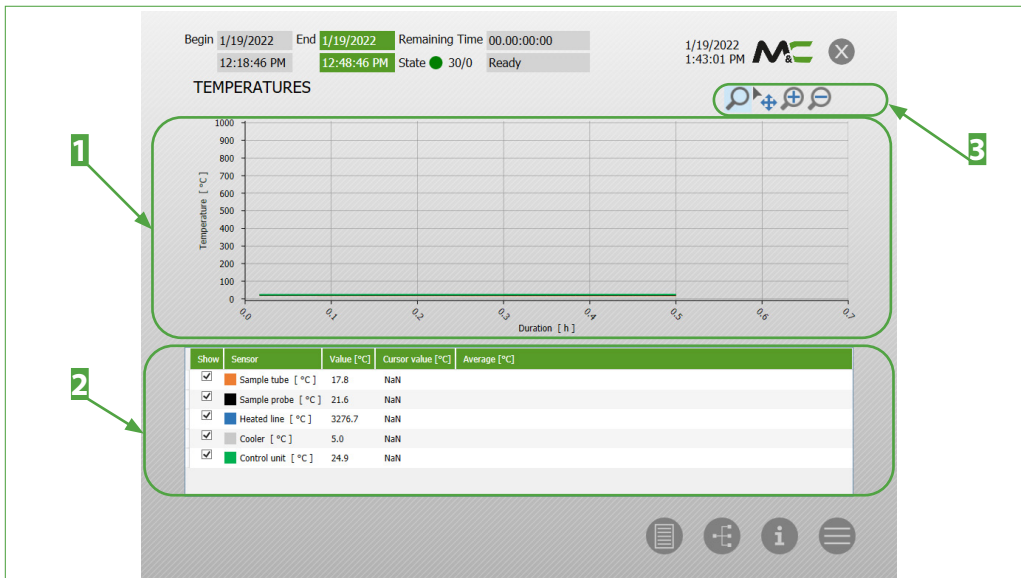


Fig. 23: Trend development of the temperatures over the measuring period

1 Display area: temperature over time

2 Table of the existing temperature sensors

3 Zoom functions

9.6 Trend Pressures

The diagram shows the values of the pressure sensors over a period of time.

In table 2 in Fig. 24, it is possible to check only the pressure sensors whose curve is to be presented in the diagram.

However, if you move the cursor over the diagram, all values of the pressure sensors are displayed.



Note

The cursor shows the values of all pressure sensors. The diagram only shows the pressure sensors selected from table 2.

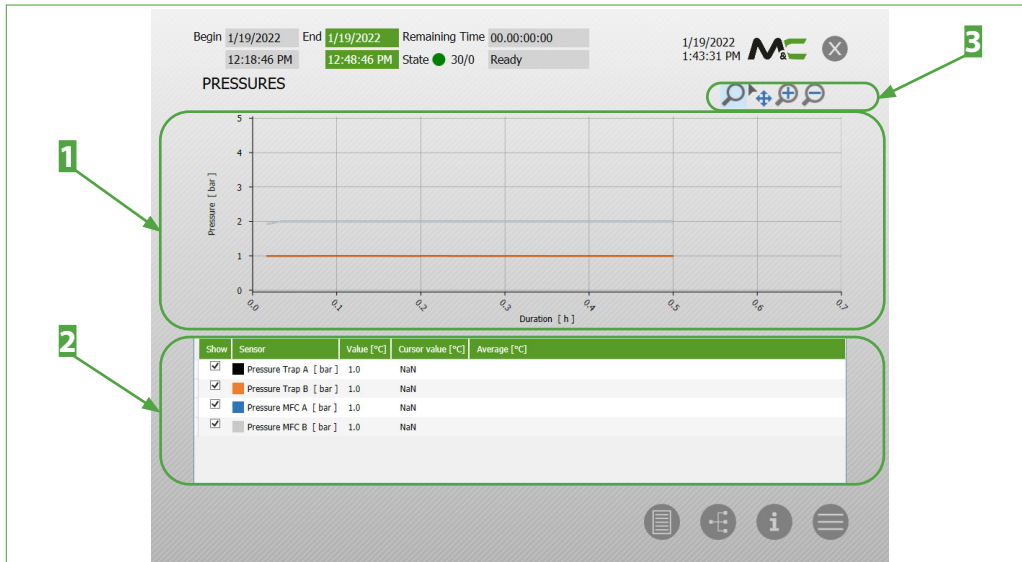


Fig. 24: Trend of the pressures over the measuring period

- 1 Display area: Pressure over time
- 2 Table with the values of the pressure sensors
- 3 Zoom functions

9.7 Alarm Page

The page “Alarms” lists all possible points in the system where an alarm can be triggered. If the color of the buttons switches from green to red, then an alarm has occurred at this point.

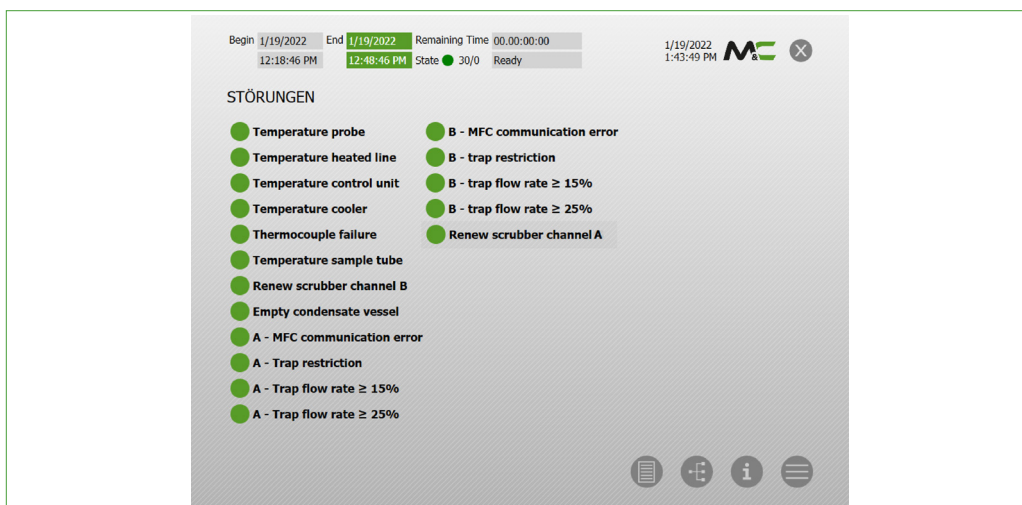


Fig. 25: List of possible alarm messages



Note

Faults "A - Sorbent trap flow \geq 25 %" and "B - Sorbent trap flow \geq 25 %" are only applicable for trap type "Long".

Fault aborts the measurement if the flow differs by more than 25 % from the set flow.

9.8 Archiv

If you click on the "Archiv" button, a page with a list opens. On this page, the existing reports of the individual measurements are listed. The list shows the file name, date, time and status of the measurement.

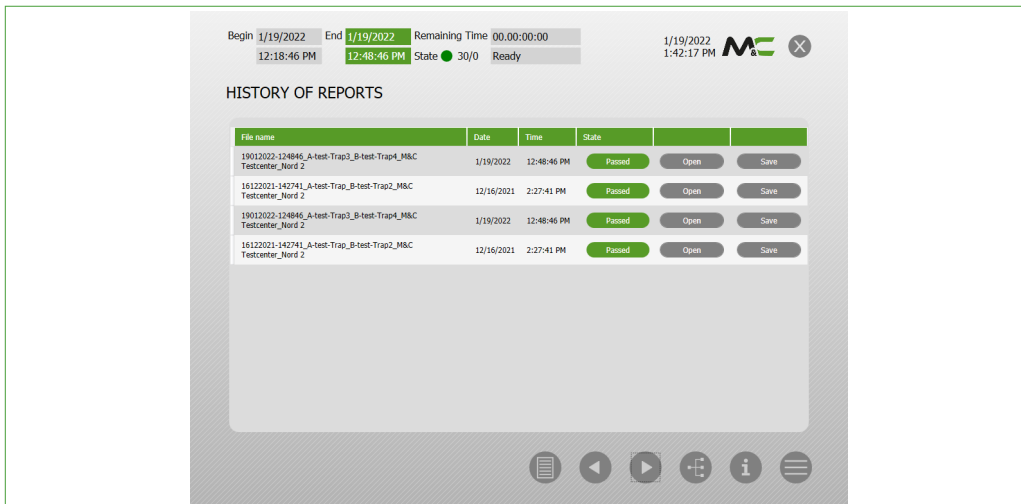


Fig. 26: History of Reports

9.9 Measurement-related Data

On this page, the information about the traps and the information about the site is entered. The Trap IDs are stated on the traps and on the package inserts.



Note

Only for trap type "Long":

Faults "A - Sorbent trap flow \geq 25 %" and "B - Sorbent trap flow \geq 25 %".

Fault aborts the measurement if the flow differs by more than 25 % from the set flow.

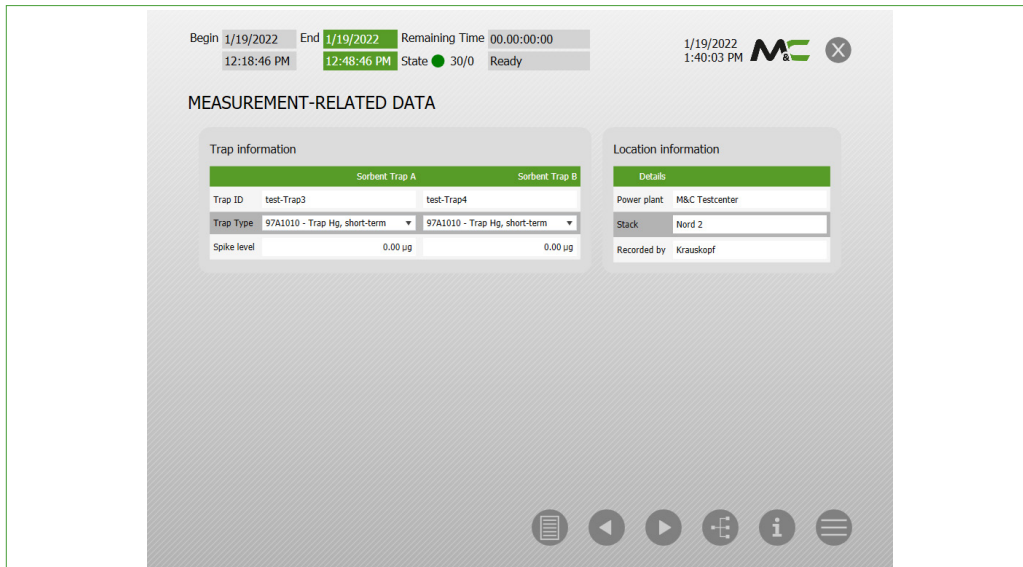


Fig. 27: Measurement-related Data

9.10 Temperatures & Pressures

The target temperatures for the individual parts of the STS System are entered here. Alarms for exceeding or falling below the set point temperatures are also defined. Additionally, the duration of the exceeding or under run can be defined before the alarm is triggered.

CAUTION

Exceeding the upper cooler alarm threshold stops the measurement to protect the device from condensate ingress.

Alarm limits are set here for the pressures of the traps and the MFCs. With the button "Reset Min/Max" the hysteresis value is set to the current value.

You can monitor the quality of the temperature control by following these steps:

1. Wait until the temperature is adjusted.
2. Press the "Reset min/max" button.

The hysteresis value is set to the current temperature value. A change of the temperature value upwards (hysteresis max.) or downwards (hysteresis min.) can be read.

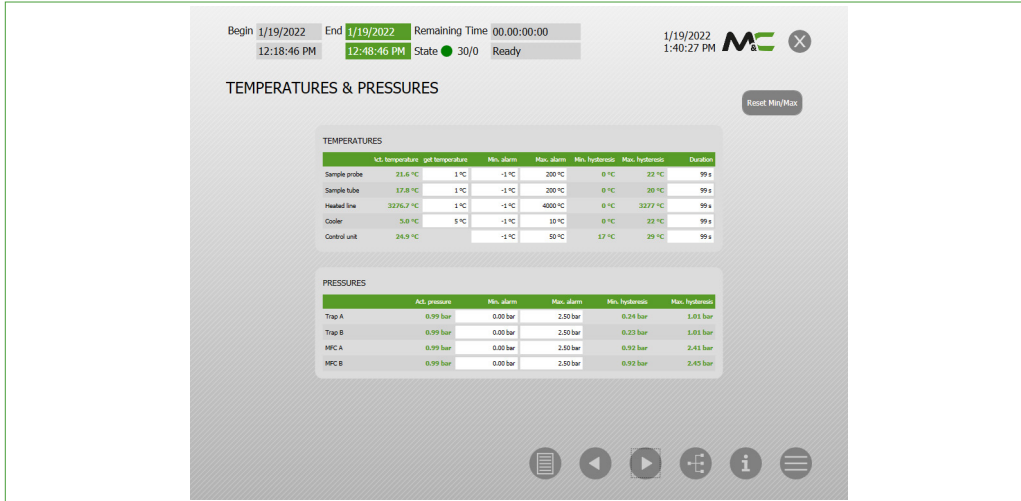


Fig. 28: Settings temperatures and pressures

9.11 Settings Measurement

On the “Settings measurement” page, the information relating to the gas sampling, the measuring period and the measured data is entered.

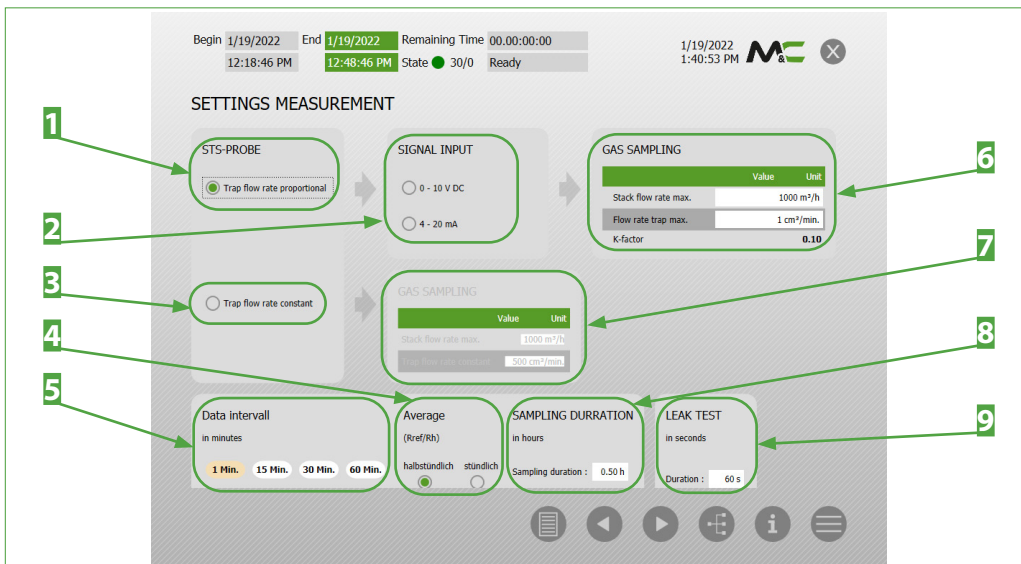


Fig. 29: Settings measurement

- 1 Sample gas: proportional volume flow
- 2 Signal input with proportional volume flow
- 3 Sample gas: constant volume flow
- 4 Optional: Mean value specification R_{ref}/R_h
- 5 Measuring period Data interval
- 6 Flow rate data at proportional volume flow
- 7 Flow rate data at constant volume flow
- 8 Duration of the measurement
- 9 Duration of the leak test

9.12 Leak Test & Sampling

All entries are summarized on the page “Leak test & sampling”.

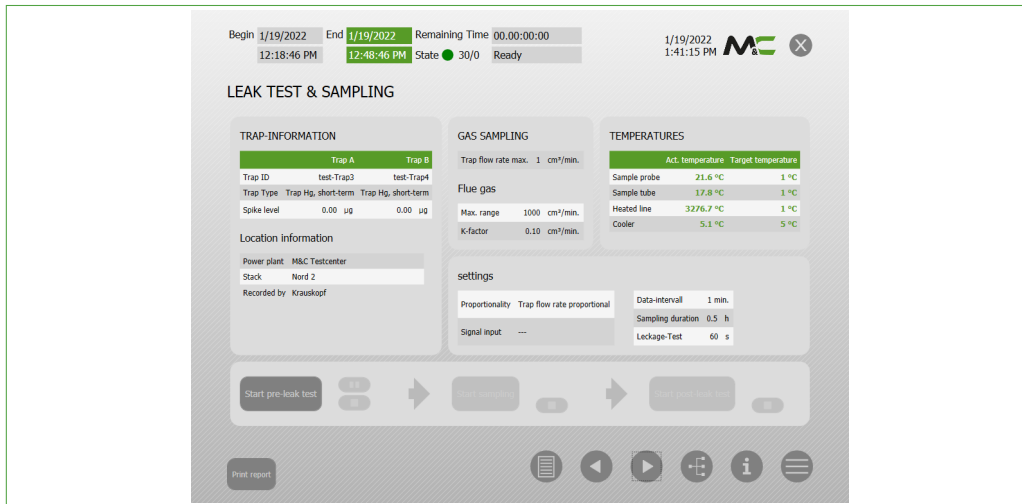


Fig. 30: Settings of leak test & sampling

9.13 Report

The report lists the measurements performed. The report head and the report results table are printed out together as a report.

The report header includes the information relating to the traps and the pre- and post-STS leak tests.



Fig. 31: Report header

The report results table lists the measured values. The number of values measured per collecting period is defined on the page “Settings measurement”. The data interval can be set to 1, 15, 30 or 60 minutes.



Note

If no data interval is selected on the page "Settings measurement", then 1 minute will automatically be defined as interval.

Begin 1/19/2022 12:18:46 PM End 1/19/2022 12:48:46 PM Remaining Time 00:00:00:00 State 30/0 Ready 1/19/2022 1:41:59 PM

TABLE OF RESULTS

Date	Stack Flow rate [cm³/h]	Stack T [°C]	Sample probe T [°C]	Heated line T [°C]	Flow MFC: A [cm³/min]	Flow MFC: B [cm³/min]	Trap A Vol. Liter	Trap B Vol. Liter	Pressure A [bar]	Pressure B [bar]	Proport. sample A [%]
1/19/2022 12:19:46 PM	1000.0	19	22	3277	50.31	49.84	0.50	0.50	0.99	0.99	0.00
1/19/2022 12:20:46 PM	1000.0	19	22	3277	498.83	499.82	1.00	1.00	0.99	0.99	0.00
1/19/2022 12:21:46 PM	1000.0	19	22	3277	498.87	499.86	1.50	1.49	0.99	0.99	0.00
1/19/2022 12:22:46 PM	1000.0	19	22	3277	498.89	499.89	2.00	1.99	0.99	0.99	0.00
1/19/2022 12:23:46 PM	1000.0	19	22	3277	499.90	499.89	2.50	2.49	0.99	0.99	0.00
1/19/2022 12:24:46 PM	1000.0	19	22	3277	499.91	499.90	3.00	2.99	0.99	0.99	0.00
1/19/2022 12:25:46 PM	1000.0	19	22	3277	499.91	499.91	3.50	3.49	0.99	0.99	0.00
1/19/2022 12:26:46 PM	1000.0	19	22	3277	499.92	499.91	4.00	3.99	0.99	0.99	0.00
1/19/2022 12:27:46 PM	1000.0	19	22	3277	499.92	499.92	4.50	4.49	0.99	0.99	0.00
1/19/2022 12:28:46 PM	1000.0	19	22	3277	499.93	499.92	5.00	4.99	0.99	0.99	0.00
1/19/2022 12:29:46 PM	1000.0	19	22	3277	499.93	499.92	5.50	5.49	0.99	0.99	0.00
1/19/2022 12:30:46 PM	1000.0	19	22	3277	499.93	499.92	6.00	5.99	0.99	0.99	0.00
1/19/2022 12:31:46 PM	1000.0	19	22	3277	499.93	499.93	6.50	6.49	0.99	0.99	0.00
1/19/2022 12:32:46 PM	1000.0	19	22	3277	499.93	499.93	7.00	6.99	0.99	0.99	0.00
1/19/2022 12:33:46 PM	1000.0	19	22	3277	499.94	499.93	7.50	7.49	0.99	0.99	0.00
1/19/2022 12:34:46 PM	1000.0	19	22	3277	499.94	499.93	8.00	7.99	0.99	0.99	0.00
1/19/2022 12:35:46 PM	1000.0	19	22	3277	499.94	499.93	8.50	8.49	0.99	0.99	0.00

Fig. 32: Report results table

10 Operating Principle of the Portable Sampling System (PSS-STS)

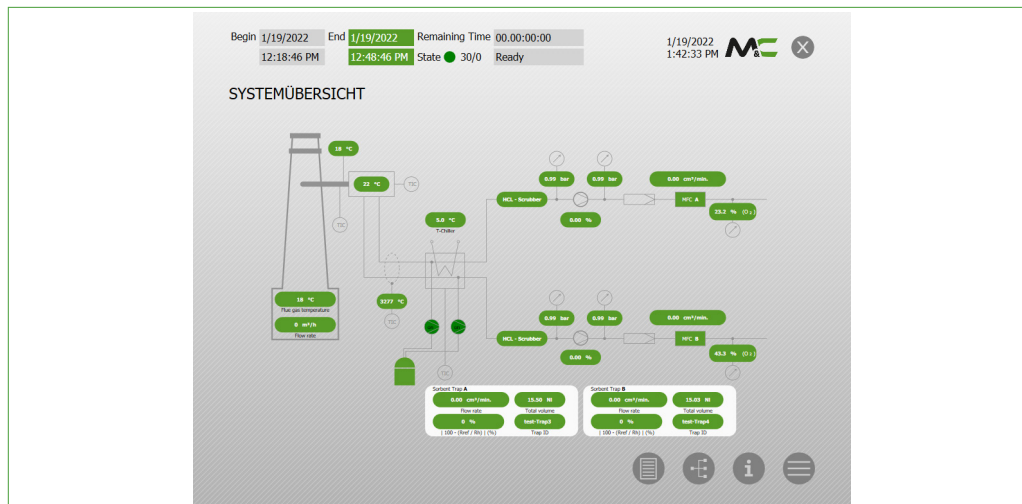


Fig. 33: System overview

The system overview shows how the Sorbent Trap System works. On the far left is a symbolic representation of the stack in which the probe with the gas paths A and B is mounted. To check the tightness of the two gas paths, the probe must be pulled out before and after the measurement and the gas inlet must be closed.

Before the measurement, the tightness criterion is achieved by the following conditions:

- The measured flow is less than 5 % of the selected flow.
- An absolute pressure of below 500 mbar abs. is reached.
- Both of these conditions are met for 20 seconds.

After the measurement, the tightness criterion is fulfilled with the following conditions:

- The measured flow is less than 5 % of the lowest flow that occurred during the measurement.
- An absolute pressure is reached that is lower than the lowest absolute pressure that occurred during the measurement.
- Both of these conditions are met for 20 seconds.

Gas paths A and B are designed redundantly and are equipped with a cooling stage downstream of the probe to separate the condensate from the flue gas. Behind this cooling stage, an acid scrubber/silica gel cartridge is mounted and monitored by a colorimeter. Before the gas flow passes through the MFC, the gas flows through a 0.1 μm fine filter. Behind the MFC, a chemical oxygen measuring cell can be placed optionally.

11 Installation



WARNING

Explosion hazard!

Do not use the device in explosive areas or for measuring explosive gases.

In the case of strongly charging processes, connect the sample probe to the system potential (equipotential bonding terminal). The leakage resistance must be $< 10^6 \Omega$ everywhere.

WARNING for heavy loads. The entire portable sampling system is heavier than 40 kg [\approx 88.2 lbs]. The individual units do not weigh more than 20 kg [\approx 44.1 lbs].

Transport the units of the portable sampling system one at a time.



Electrical Voltage!

Attention electric shock!

When installing high-voltage systems with nominal voltages up to 1000 V, the requirements of VDE 0100 and your relevant standards and regulations must be observed!

This also applies to any connected alarm and control circuits. Before opening the modules, they must always be disconnected from the power supply.



Hot Surface!

Caution hot surfaces!

The sample probe and the gas sampling line are heated up to 200 °C [392 °F].

During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.



The sampling system STS consists of 4 units:

- Sample probe designed to take up the sorbent traps (delivery without sorbent traps) with controller and power cable.
- Heated sample line with two inner liners.
- Cooler unit with power cable and Ethernet cable (IP68 connection on both sides).
- Control unit with power cable and Ethernet cable (IP68 connection on both sides).

11.1 On-Site Requirements for Installing the Sample Probe

Observe the following check list, in order to determine the optimum **sampling point**:

- Select the optimum sampling point in compliance with the generally applicable guidelines or in consultation with the responsible bodies.

- Position the sampling point in such a way that there is sufficient space to install and remove the sample probe. Also take into account the insertion length of the probe tube (according to the probe length).
- Ensure good accessibility to the sample probe. To change the sorbent traps, the sample probe must be completely detached from the sample socket and removed from the process.
- The mounting flange connection of the socket must have a size of DN 65 PN 6 or 3".
- Provide a heat-resistant support tray for the sample probe, e.g. a rack. The sample probe is placed there while the sorbent traps are replaced.
- If the ambient temperature in the socket area is $> 80\text{ }^{\circ}\text{C}$ [$176\text{ }^{\circ}\text{F}$] due to radiant heat, a heat radiation reflection plate must be installed on site to protect the probe.
- The entire system requires approx. 30 A distributed over three power plugs for heating. Make sure that two electric circuits are available.

11.2 Installation of the Sample Probe



WARNING

In the case of high charging processes, connect the sample probe to the plant potential (electrical bonding terminal). The bleeder resistance must be $< 10^6\ \Omega$ everywhere.

The operating position of the sampling probe must be aligned so that the traps are next to each other in the gas flow.

The sample probe is attached to the on-site process flange with a camlock fitting.

11.3 Preparing the Installation of the Electrical Gas Sample Line

- A minimum bending radius of 320 mm [$\approx 12.6''$] must be taken into account during installation.
- Check that your power supply voltage corresponds to the specification on the type plate.

- Check whether the materials in contact with the medium are resistant.
- Use caution when routing the gas sample line close to machine parts with elevated temperatures.
- Lay the gas sample line freely movable to prevent jamming.
- Please note: The ambient temperature at the sensor position determines the internal temperature in the entire sample line. Therefore, the sensor should be placed in the range of the highest ambient temperature to avoid overheating.
- Install the sample line protected from the wind, since wind causes considerable heat loss at the outer jacket.
- Different ambient temperatures in the area where the tube is laid cause different internal temperatures. In areas of lower ambient temperature, the internal temperature of the tube is lower, at higher ambient temperature it is accordingly higher than the controlled temperature value.
- Do not pull the sample line at the fitting. Every fitting is resistant to pressure, but susceptible to tension.

The gas sample lines are normally delivered in a rolled-up condition. Please make sure that the sample lines are not pulled off, as this would result in the smallest bending radius being undercut. The sample lines must be unrolled.

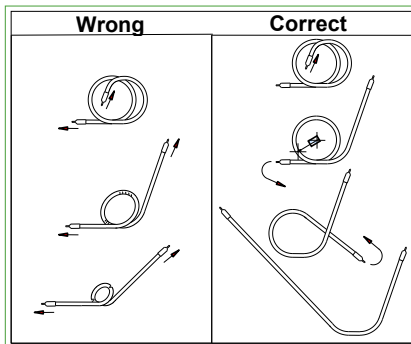


Fig. 34: Observe minimum bending radius

The sample line axes should be parallel so that the direction of movement is on the same level.

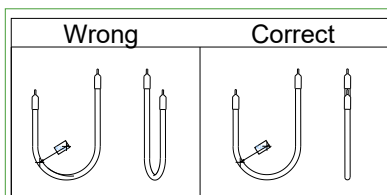


Fig. 35: Parallel sample line axes

To prevent kinking when using hand tools, a kink protection must be provided according to the working position.

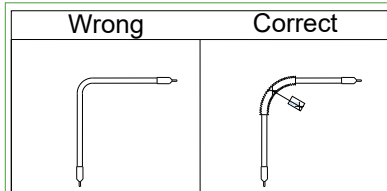


Fig. 36: Anti-kink protection

At the connection points, a straight piece, which is approx. 5 times the diameter of the sample line in length, must be included in the planning.

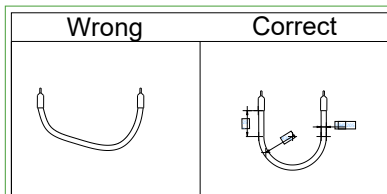


Fig. 37: Straight connection points

11.4 Installation Instructions Cooler Unit

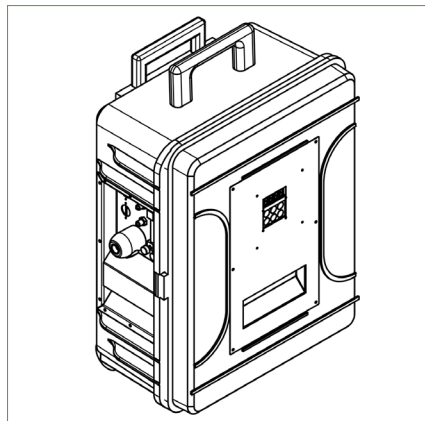


Fig. 38: Vertical operating position of the cooler unit

- To ensure that the case of the cooler unit stands securely and stable, it should be placed on an even, horizontal surface.
- The operating position is exclusively vertical. Only then is the proper separation and discharge of the condensate in the heat exchanger of the cooler guaranteed.

- The case should be placed at a distance from heat sources and be freely ventilated so that no disturbing heat accumulation occurs.
- If the unit is installed in outdoor areas, adequate protection against direct sunlight and moisture must be provided. In winter, the installation site must be frost-free; observe the protection class of the case.
- The unit should only be operated in an upright position with the door closed. Any unused connectors must be closed with the appropriate covers. IP42 means protection against ingress of foreign particles $\geq 1 \text{ mm}$ [$\approx 0.04''$] and dripping water up to an angle of $\leq 15^\circ$.
- To ensure the operational safety of the portable cooler unit and the downstream control unit and to avoid false alarms, the cooler unit must not be used outside the specified temperature range.
- The downstream control unit must always be operated at temperatures well above the set gas outlet dew point. This prevents subsequent condensation of the gas in the connecting lines to the control unit.

11.5 Installation Instructions Control Unit

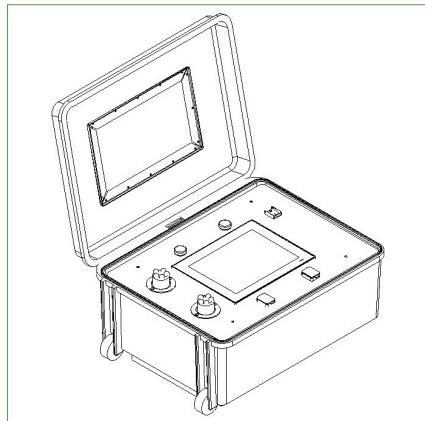


Fig. 39: Horizontal operating position of the control unit

- The case of the control unit should be placed on an even, horizontal surface to ensure that it stands securely and stable.
- The operating position is exclusively horizontal. Only then can the correct and precise operation of the mass flow controllers be guaranteed.
- The case should be placed away from heat sources and freely ventilated so that no disturbing heat accumulation occurs.
- If the unit is installed in outdoor areas, adequate protection against direct sunlight and moisture must be provided. In winter, the installation site must be frost-free; observe the protection class of the case.

- The device may only be operated in a horizontal position. Any plugs that are not used must be closed with the appropriate caps. When the cover is closed, the device complies with protection class IP42. IP42 means protection against foreign particles $\geq 1 \text{ mm}$ [$\approx 0.04''$] and dripping water up to an angle of $\leq 15^\circ$.

**Note**

IP42 only with closed cover.

The cover of the device may be opened for operation. When the cover is open, the device does not meet protection class IP42.

- To ensure the operational safety and accuracy of the portable control unit and to avoid false alarms, the control unit must be used in the specified operating position and temperature range.

11.6 Installation Instructions Condensate Vessel TK13/LA5 (optionally)

- To ensure that the condensate vessel stands securely and stable, it should be placed on an even, horizontal surface.
- The operating position is only vertical. Only then is the proper functioning of the integrated float switch guaranteed.
- The condensate vessel is supplied with the integrated float switch LA5 with 1 m [$\approx 3.3 \text{ ft}$] connection cable LIYY 2 x 0.14 mm² for filling level monitoring.



Fig. 40: Vertical operating position of the optional condensate vessel

12 Supply Connections of the Portable Sampling System (PSS-STS)

Each part of the portable sampling system has electrical and medium supply connections.

12.1 Electrical Connections Sample Probe

The sample probe has a mains connection and an signal connection.

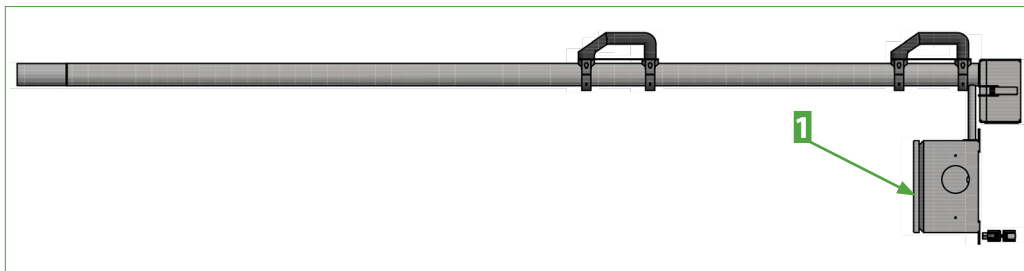


Fig. 41: Electrical connections at the sample probe

1 Electrical terminal box

12.2 Electrical Connections Cooler Unit

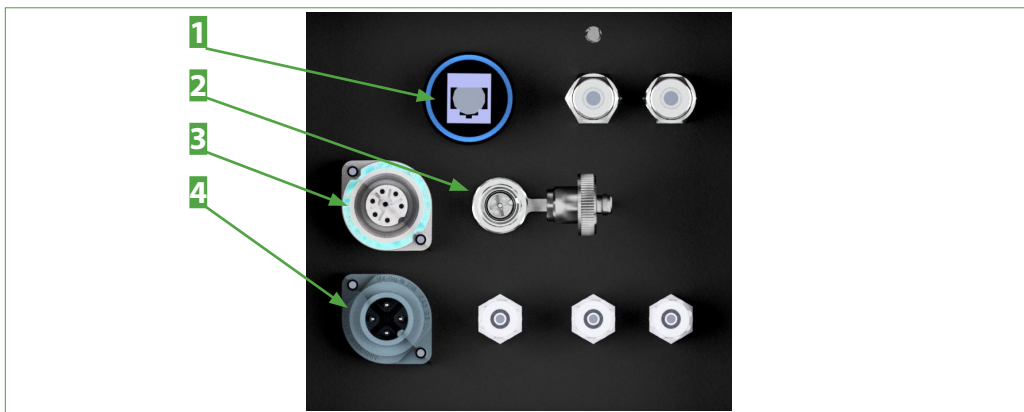


Fig. 42: Electrical connections at the cooler unit

1 Ethernet connection

2 LA 5 connection

3 Connection to the heated sample line

4 Mains connection

12.3 Electrical Connections Control Unit

The power supply connections of the control unit are located at the rear of the device.

If you open the cover of the control unit, there is another Ethernet and a USB port on the front panel below the front-panel PC. These two connectors are protected by caps.

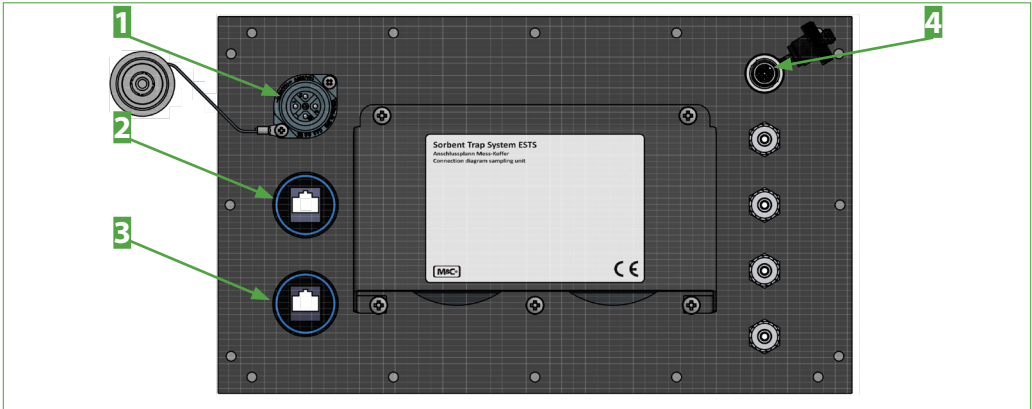


Fig. 43: Electrical connections at the rear of the control unit

- 1 Mains connection
- 2 Ethernet port 1
- 3 Ethernet port 2
- 4 Signal connection

12.4 Electrical Connections Audit MFC (Optional)

The audit MFC has an electrical connection and two Ethernet ports.



Fig. 44: Electrical connections on the sides of the audit MFC

- 1 Ethernet port
- 2 Mains connection
- 3 Ethernet port

12.5 Gas Connection Sample Probe

The sample probe has a connection for the electrically heated sample line.

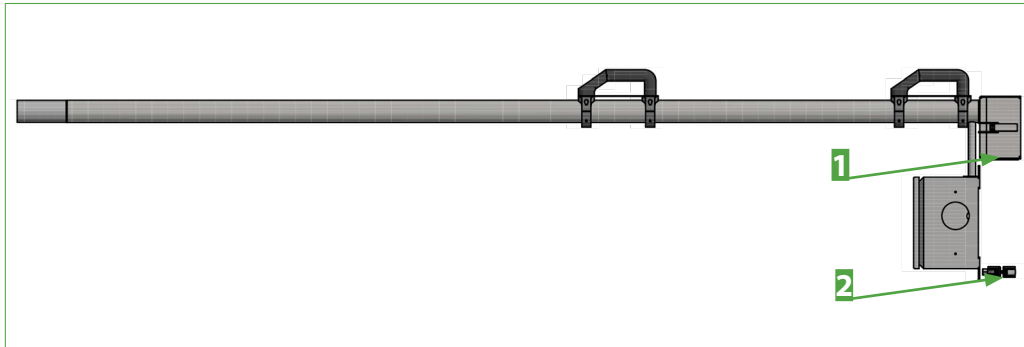


Fig. 45: Gas connections at the sample probe

1 Gas connections at the probe

2 Clamp for fastening the heated line

12.6 Gas Connections Cooler Unit

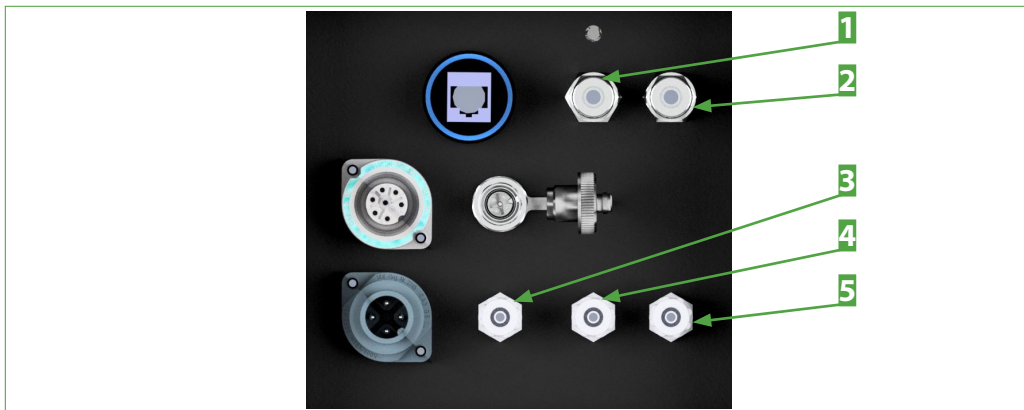


Fig. 46: Gas connections at the cooler unit

1 Sample gas IN A

2 Sample gas IN B

3 Condensate connection

4 Sample gas OUT A

5 Sample gas OUT B

12.7 Gas Connections Control Unit

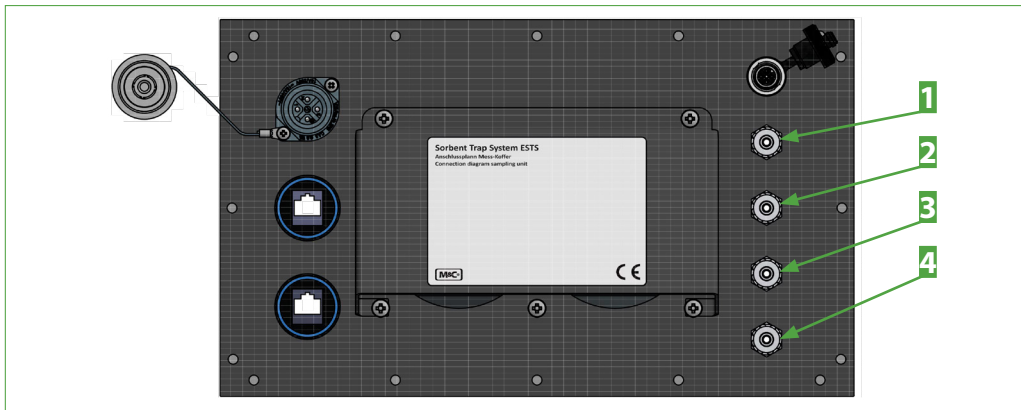


Fig. 47: Gas connections at the control unit

- 1 Sample gas IN A
- 2 Sample gas IN B
- 3 Sample gas OUT A
- 4 Sample gas OUT B

12.8 Gas Connections Audit MFC (Optional)

The Audit MFC has a sample gas IN and a sample gas OUT connection.



Note

The gas flow direction through the Audit MFC is fixed. Observe the indicated flow direction.



Fig. 48: Gas connections on the sides of the Audit MFC

- 1 Gas connection OUT
- 2 Gas connection IN

13 Start-Up

Prior to initial commissioning, all system and process-specific security measures must be complied with.

When switching on, please ensure that the correct mains voltage according to the specifications on the type plate of the individual components is used.

ATTENTION Device destruction due to incorrect mains voltage!
Observe the correct mains voltage according to the type plate specifications!



Note For heating up, the entire system requires approx. 30 A distributed over three power sockets. Make sure that two circuits are available.



Hot Surface! Caution hot surfaces!
The sample probe and the gas sampling line are heated up to 200 °C [392 °F].



During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.



13.1 Preparing the sample probe

The sample probe requires a heat-resistant support in the immediate vicinity of the sampling point during the measurement process.

Two sawhorses or a heat-resistant table top near the sampling point are good support options. The support must be able to withstand a temperature of at least 200 °C.

13.2 Cooler unit: preparing CM1 color change sensors

Two CM1 color change sensors including evaluation electronics are installed in the cooler unit. The sensors are attached to the two glass filter bodies to detect the color change of the indication material in the filter in the event of a liquid breakthrough. Both filters are filled with indication material ex works. The CM1 sensors are set to the sensitivity of this indication material.

**WARNING**

Measurement canceled due to triggering of the color change sensor.

Check the indication material regularly and replace the indication material before it is used up.

Only use the indication material available from M&C.

The CM1 color change sensors are set exclusively for this material.

Depending on the process conditions, a filling of 150 g per filter is sufficient for approx. 2 weeks of measurement.

**Note**

For information on replacing the adsorption material and adjusting the sensitivity, refer to chapter '15.1 Cooler unit: indication material replacement/sensor calibration'.

13.3 Connecting gas and condensate lines

1. Connect the sample probe to the connection fittings C of the heated gas sample line. Do not interchange the gas connections A and B.
2. Connect the end fittings Y of the heated gas sample line to the the cooler unit. Do not interchange the gas connections A and B.
3. Connect the condensate outlet of the cooler unit to a condensate container or similar. Optionally, connect the TK13/LA5 condensate vessel.
4. Connect the cooler unit to the control unit. Do not interchange the gas connections A and B.

13.4 Connecting electrical lines

1. Connect the signal connection of the sample probe to the signal connection of the control unit.
2. Connect the Ethernet port of the cooler unit to the Ethernet port 1 of the control unit.
3. Optionally: Connect the float switch LA5 of the condensate vessel TK13/LA5 to the LA5 port of the cooler unit.
4. Connect the cooler unit and the control unit to the mains voltage.

5. Connect the sample probe, which lies securely on the heat-resistant support, to the mains voltage. Wait approx. 1/2 hour until the operating temperature is reached. The connected sample probe reaches a temperature of approx. 200 °C.

13.5 Preparing the Sorbent Traps

Sorbent Traps are usually stored in a plastic bag for transport. Follow these steps to prepare the Sorbent Traps:

1. Remove a transport bag containing two Sorbent Traps from the container with the new Sorbent Traps.
2. Take out one Sorbent Trap with instruction leaflet from the transport bag. The Sorbent Trap is protected by a transport tube. Note on the instruction leaflet: Trap A.
3. Take the second Sorbent Trap with instruction leaflet out of the transport bag. The Sorbent Trap is protected by a transport tube. Make a note on the instruction leaflet: Trap B.
4. Open the transport tubes. Remove the Sorbent Trap A and B from the transport tubes.
5. Place the two transport tubes with plugs and with the instruction leaflets back into the transport bag and put the transport bag aside for later use.

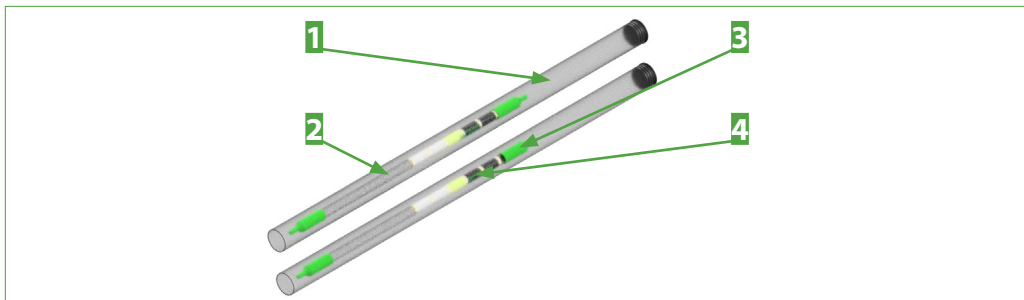


Fig. 49: Sorbent Traps inside the transport tubes

- | | |
|----------------------------|---|
| 1 Transport tube with plug | 2 Sorbent Trap with two protection caps |
| 3 Protection cap | 4 Tapered side with carbon layer |

13.6 Preparing the Measurement: Entering General Data

You start the preparation for measuring by clicking on the button “Measurement-related data” in the main menu.

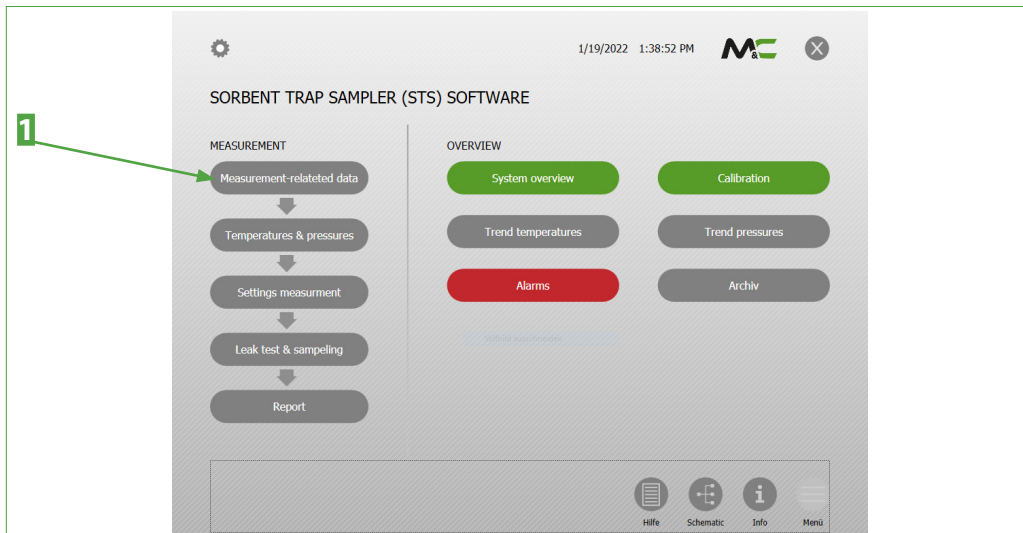


Fig. 50: Enter measurement-related data

1 Button “Measurement-related data”

Enter the information about the traps in the input fields of the “Measurement-related data” page. The “Measurement-related data” page must be completed before the sorbent traps are fixed in the sample probe.



Note

Use the keypad of the front-panel PC or connect an external keyboard for input.

Double-click in the input field. The keypad opens.

The blue frame around the input field indicates that the entered value has not yet been accepted.

Press the Enter key on the keypad to confirm the new value. The system has only accepted the value when the blue frame is no longer displayed.

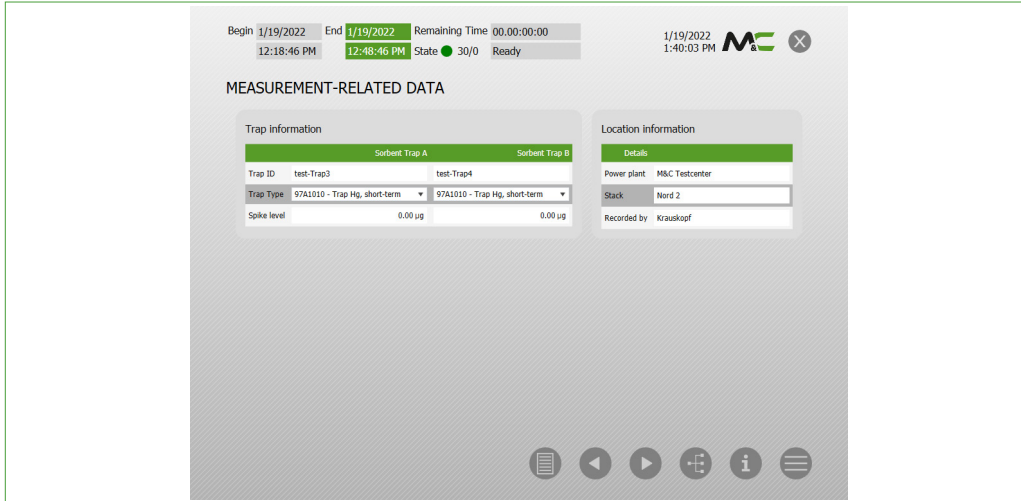


Fig. 51: Measurement-related data

Fill in the following fields on the “Measurement-related data” page:



Note

Do not mix up the traps. Check the instruction leaflet and compare the trap ID.

1. Enter Trap ID

Here, enter the trap IDs of the two sorbent traps Trap A and Trap B. The trap IDs can be found on the traps.

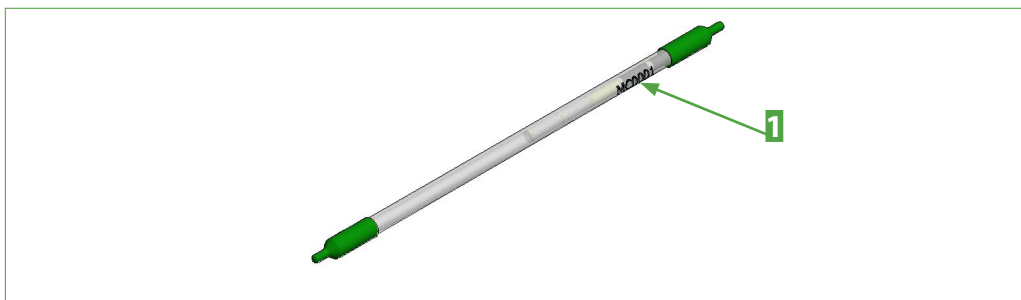


Fig. 52: Trap ID is on the sorbent trap

1 Trap ID

2. Trap Type

More than 12 different types of traps are listed here. Select from the list the corresponding trap type which belongs to the trap ID.

3. Spike Level

For official measurements, a defined quantity of mercury is doped in the last section of the sorbent trap. The spike level is indicated on the tubes. Enter the spike level of the individual traps here.

4. Site Information

Enter the information on the power plant, stack and the person entering the required data here.



Note

Each input field has a maximum of 26 characters. Special characters that are not recognized by the system are replaced by spaces.



Note

Use the arrow keys in the information line to navigate through the pages that must be filled in for the measurement.

13.7 Preparing the Sample Probe for the Sorbent Traps



Hot Surface!

Caution hot surfaces!

The sample probe and the gas sampling line are heated up to 200 °C [392 °F].

During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.



The sample probe is heated and rests securely on the selected resting option (see chapter 13.1 for information on suitable rest places). Proceed as follows to attach the sorbent traps:

1. The sorbent traps are conical on one side. The carbon layers are also located there. Remove the protective cap of Sorbent Trap A and Sorbent Trap B on this side.
2. Set the protective caps aside for later use.

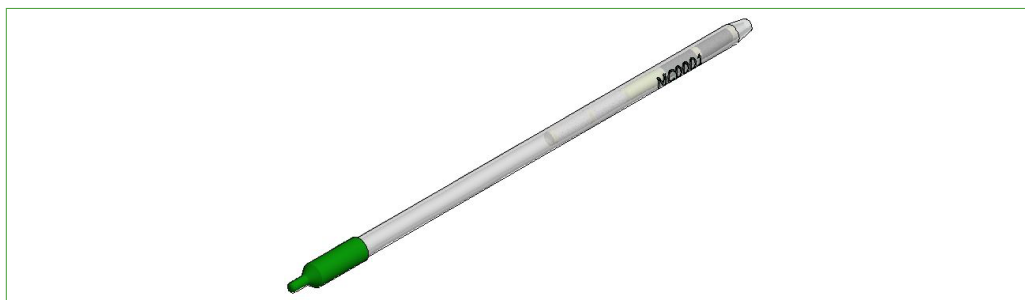


Fig. 53: Sorbent Trap with protective cap on the side without carbon layer

3. Carefully insert Sorbent Trap A with the tapered side without the protective cap into holder A.



Note

Do not mix up the traps. Sorbent Trap A belongs in holder A and Sorbent Trap B in holder B.

4. Slide Sorbent Trap A into the sample probe until the carbon layers are no longer visible.
5. Hand-tighten the fitting to secure Sorbent Trap A in place. A soft Teflon® seal will hold the trap in the fitting.
6. Carefully guide Sorbent Trap B with the tapered side without the protective cap into holder B.
7. Slide Sorbent Trap B into the sample probe until the carbon layers are no longer visible.
8. Hand-tighten the fitting to secure Sorbent Trap A in place. A soft Teflon® seal will hold the trap in the fitting.
9. Leave the second protective cap on the Sorbent Traps. For the Pre-Leak Test, leave the protective caps on Sorbent Traps A and B.

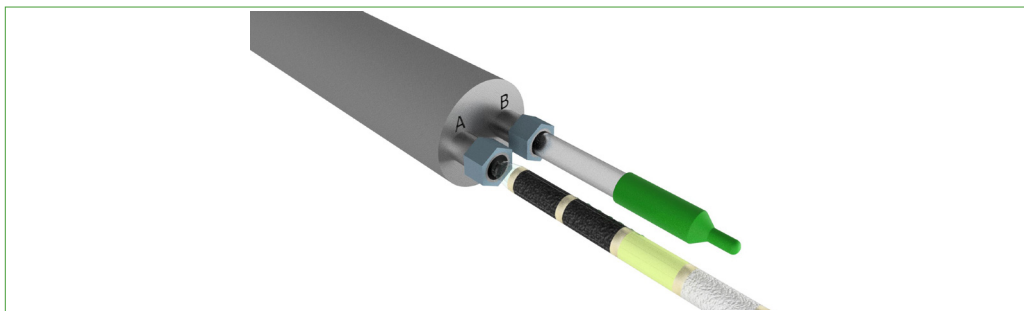


Fig. 54: Sorbent Trap with cap in sample probe for pre-leak test

13.8 Preparing the Measurement: Enter Detailed Data

The “Temperatures & pressures” and “Settings measurement” pages must be completed before the measurement.

On the “Leak test & sampling” page, all entries are summarized. There you start the pre-leak test, the measurement and the post-leak test.

13.8.1 Temperatures and Pressures

CAUTION

Exceeding the upper cooler alarm threshold stops the measurement to protect the device from condensate ingress.

On the “Temperatures & Pressures” page, enter the target temperatures for the individual control circuits of the STS system. Define the alarm limits for under running and exceeding the set point temperatures and the maximum time allowed for exceeding and under running.

Set the alarm limits of the pressures for the traps and the MFCs.



Set temperature	Set temperature	Min. alarm	Max. alarm	Min. hysteresis	Max. hysteresis	Duration	
Sample probe	21.6 °C	1 °C	-1 °C	200 °C	0 °C	22 °C	99 s
Sample tube	17.8 °C	1 °C	-1 °C	200 °C	0 °C	20 °C	99 s
Heated line	3276.7 °C	1 °C	-1 °C	4000 °C	0 °C	3277 °C	99 s
Cooler	5.0 °C	1 °C	-1 °C	10 °C	0 °C	22 °C	99 s
Control unit	24.0 °C	1 °C	-1 °C	50 °C	17 °C	29 °C	99 s

Set pressure	Min. alarm	Max. alarm	Min. hysteresis	Max. hysteresis	
Trap A	0.99 bar	0.00 bar	2.50 bar	0.24 bar	1.01 bar
Trap B	0.99 bar	0.00 bar	2.50 bar	0.23 bar	1.01 bar
MFC A	0.99 bar	0.00 bar	2.50 bar	0.92 bar	2.41 bar
MFC B	0.99 bar	0.00 bar	2.50 bar	0.92 bar	2.43 bar

Fig. 55: Settings for temperatures and pressures



Note

The values entered here are also used for the subsequent measurements.

Enter the new values here in case of changes.

1. Enter target temperature and alarm limits

This list contains the temperatures of the sample probe (in the process), the heated tube, the cooler and the control unit. The target temperatures can be entered as default values.

The minimum and maximum alarm values indicate the temperature at which the alarm is triggered if the temperature falls below or exceeds the set point. If the alarm lasts for a certain period of time, the actual temperatures turn red.

The hysteresis values indicate how far the alarm value has been exceeded or fallen below. The duration on the right side of the table shows the allowed duration of this under- or overrun. If the set point temperature has been under run or exceeded for longer than the specified period, the actual temperature is shown in red.



Note

Wait until the target temperature is reached, then click on the button "Reset min/max". The hysteresis values are set to the target temperature.

A change of the temperature value to higher (hysteresis max.) or lower temperature values (hysteresis min.) is shown.

2. Enter min. and max. pressure

This list shows the pressures of Trap A and Trap B and the two MFCs: MFC A and MFC B. The minimum and maximum pressure can be entered as default values.

The minimum and maximum alarm value show the pressure at which the alarm is triggered if the pressure falls below or exceeds the alarm value. In case of an alarm, the actual pressure turns red.

The hysteresis values indicate how far the alarm value has been exceeded or under run.

13.8.2 Data for Gas Sampling

On the page "Settings measurement", information relating to gas sampling, the measuring period and data for measuring are entered.

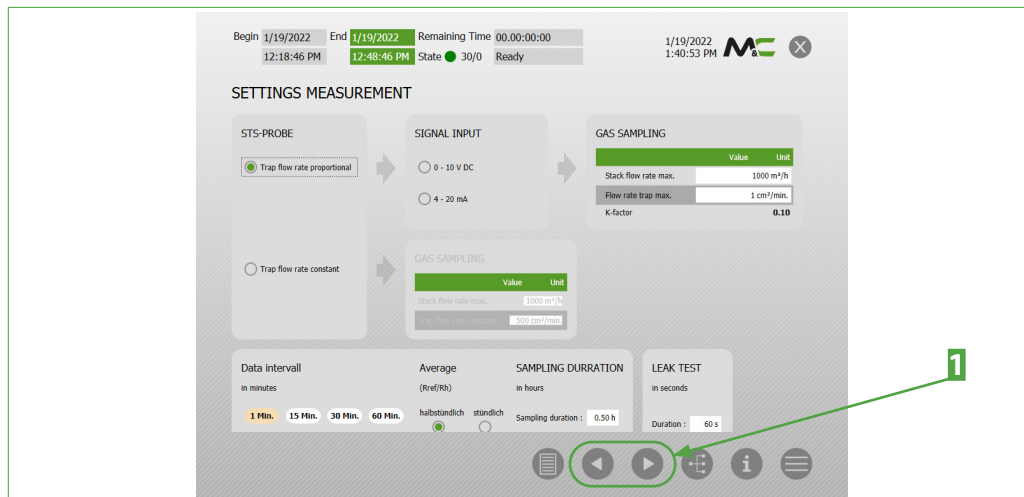


Fig. 56: Entering settings for gas sampling

1 Arrow buttons in the information line

1. STS-Probe: Entering type of volume flow

The STS-Probe is the sample gas taken from the stack. Here, it is indicated whether the sample gas has a constant volume flow or whether the flow of the sample gas changes proportionally. Different input fields are activated by the selection. If the sample gas flow is proportional, a signal corresponding to the proportional flow is sent to the PLC of the system. This signal is taken into account by the PLC during the measurement. The signal can be in the range 0 to 10 V DC or 4 to 20 mA.

2. Specify signal input for proportional volume flow

The selection ranges of the signal input only appear if the "proportional" field under "STS-Probe" has been clicked. With a proportional sample gas flow, a signal corresponding to the proportional flow is transmitted to the PLC of the system. This signal is taken into account by the PLC during the measurement. The signal can be in the range 0 to 10 V DC or 4 to 20 mA.

3. Gas sampling with proportional flow rate: Enter flow rate

Here you enter the desired flow rate. You can enter values between 2 to 87 NI/h. The desired flow rate depends on the specifications for the measurement.

The proportional factor K is calculated at proportional gas flow by dividing the maximum stack flow by the maximum trap flow:

$$K = \text{max. stack flow} / \text{max. trap flow.}$$

4. Gas sampling at constant flow rate: Enter flow rate

Here you enter the desired flow rate. You can enter values between 2 to 87 NI/h. The desired flow rate depends on the specifications for the measurement.

5. Specify data interval

The volume of data recorded by the PLC is very high. Here, you have the possibility to set the time interval between the measurements that are listed in the report. With a shorter collection period of 30 minutes, a maximum of 30 measurement data can be collected. The selected data rates are displayed with a dark background.



Note

If no data rate is selected, then 1 minute is automatically set as the rate.

For longer measurements, a longer data interval is recommended.

6. Specify average value (optionally)

Depending on the plant, the average value $R_{\text{ref}}/R_{\text{H}}$ can be determined half-hourly or hourly. For plants that are permitted to use a half-hourly mean value, the "half-hourly" mean value must be selected here.

7. Runtime: Specify collection time in hours

The sorbent traps remain in the probe for the duration of the measurement. This time is called collection period. The maximum collection period is 2 weeks or 336 hours. The collection period depends on the traps and the specifications for the measurement.

**Note**

The collection duration is specified in hours. 45 minutes correspond to 0.75 hours.

Click into the input field behind "Sample Duration [h]:". The input field changes its color. Use the keyboard to enter the collection period. A blue frame around the input marks the newly entered value. Now press the Enter key to confirm the new value. The blue frame disappears and the value has been accepted.

**Note**

The blue frame around the input field indicates that the entered value has not yet been accepted. Only when the blue frame is no longer displayed, has the system accepted the value.

8. Leakage test: specify runtime in seconds

For official measurements, the duration of the tightness measurement is specified. The duration is entered here in seconds. The value corresponds to the maximum time it may take for the leak test to be completed. It should be noted that the lines must be pumped empty for the leak test. Pumping empty can take different amounts of time, depending on the length of the line.

13.8.3 Leak Test & Sampling

All settings are summarized on the "Leak test & sampling" page. The entries cannot be changed on this page. If you want to change entries, use the arrow keys to go back to the corresponding input page.

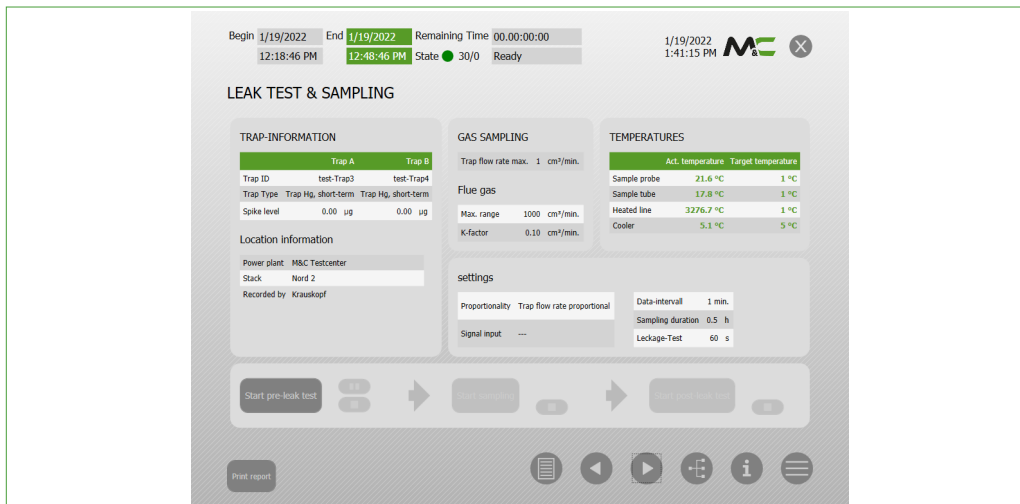


Fig. 57: Page "Leak test & sampling"

13.9 Start Pre-STS Leak Test

A complete measurement includes the pre-STS leak test, the actual measurement and the post-STS leak test. The results of these measurements are recorded in the report. The report results table is filled in during the measurement.



Hot Surface!

Caution hot surfaces!

The sample probe and the gas sampling line are heated up to 200 °C [392 °F].

During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.



1. Check the sorbent traps in the sample probe. Both Sorbent Traps should be firmly fitted in the holder. The carbon in the Sorbent Trap is not visible from the outside. One protective cap on each trap is placed on Sorbent Trap A and B.
2. Check the settings on the "Leak test & sampling" page.



Note

Check entries.

Previous entries cannot be changed when the Pre-STS leak test has been started.

3. Click on the button "Start Pre-STS Leak Test" and start the test.

In the status line, the message: "Status: pre-leak test in progress" appears.

The two buttons "Pause" and "Stop" next to the "Start Pre-STS Leak Test" button become active. The "Pause" and "Stop" buttons suspend or cancel the pre-STS leak test.



Note

The "Pause" button stops the timer.

In case of leakage problems, it is not necessary to wait until the end of the leakage test, but immediate action can be taken to rectify the fault.

If the pre-leak test has been successfully completed, the status line indicates: "Status: pre-leak test successful".

The button "Start STS-Probe" becomes active.

13.10 Start Measurement



Hot Surface!

Caution hot surfaces!

The sample probe and the gas sampling line are heated up to 200 °C [392 °F]. The process flange and any blind plate are also hot.

During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.



The sample probe is heated and rests securely on the resting place. Proceed as follows:

1. Remove the protective caps from sorbent trap A and B.
2. Store the protective caps safely for later use.



WARNING

WARNING of heavy loads.

The hot sample probe must be attached to the process flange for measurement.

Get help to transport and fasten the hot sample probe.



Do not inhale!

WARNING OF HAZARDOUS GASES! Do not inhale!

3. Fasten the protective tube with the screw.

4. Check whether the process flange is closed by a blind plate. If present: remove the blind plate and place it on a suitable heat-resistant support.
5. Transport the hot sample probe to the process flange. Pay attention to the heated sampling line and the electrical connection of the sample probe.
6. Attach the sample probe to the process flange using the Kamlock connection.
7. Click on "Start STS-Probe" and start the measurement. The message "Status: Sampling process in progress" appears in the status bar.

The date of the start time and the stop time are displayed in the status line. The remaining time shows the remaining duration of the measurement in hours, minutes and seconds.



Note

Open page "System Overview" during the measurement.

The system overview shows the actual values of the entire system. All information you may need during the measurement is summarized on this page.

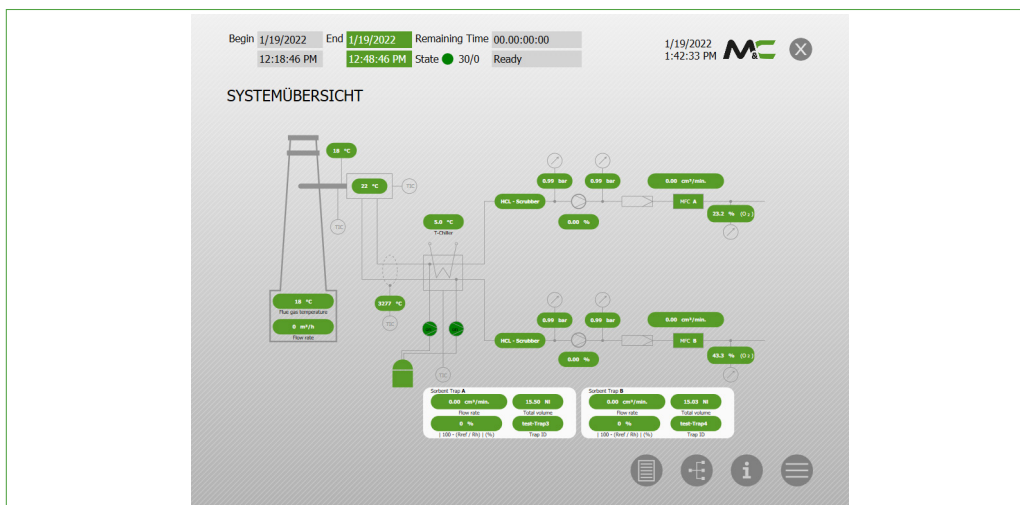


Fig. 58: Page "System Overview" during the measurement

13.11 Start Post-STS Leak Test



Hot Surface!

Caution hot surfaces!

The sample probe and the gas sampling line are heated up to 200 °C [392 °F].

During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.

**WARNING**

WARNING of heavy loads.

The hot sample probe must be attached to the process flange for measurement.



Get help to transport and fasten the hot sample probe.

**Do not inhale!**

WARNING OF HAZARDOUS GASES! Do not inhale!

At the end of the measurement, the final leak test will be carried out. The sample probe is attached to the process flange. Proceed as follows:

1. Hold the sample probe firmly and loosen the Kamlock fastening.
2. **WARNING OF HAZARDOUS GASES! Do not inhale!** Carefully pull the sample probe out of the process flange. Pay attention to the sorbent traps and the connections of the sample probe when pulling them out.
3. Transport the hot sample probe to the resting place and place the probe securely on the resting place.
4. If applicable: Close process flange with blind plate.
5. Remove the protection tube by unscrewing the fixing screw.
6. Place one protective cap on each trap: Sorbent Trap A and B.
7. Click on the button "Start Post-STS Leak Test".

**Note**

Pausing the post-STS leak test is not possible. It can only be discontinued with the "Stop" button.

Interrupted Post-STS leak tests are failed tests.

After the post-STS leak test, the message in the status bar changes to status: "Ready".

The entire measurement is completed.

13.12 Removing Sorbent Traps out of the sample probe



Hot Surface!

Caution hot surfaces!

The sample probe and the gas sampling line are heated up to 200 °C [392 °F].

During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.

After the measurement, sorbent traps A and B are removed from the sample probe. Proceed as follows:

1. Wait until: "Status ready" appears in the status bar.
2. Click the "Print Report" button to view the created report.
3. Hold Sorbent Trap A by the glass tube. The sorbent trap is pulled into the sample probe by negative pressure. Danger of glass breakage!
4. Carefully open the screw connection of Sorbent Trap A.
5. Carefully pull Sorbent Trap A out of the sample probe.
6. Put the second protective cap on the trap. Sorbent Trap A is now sealed. Put Sorbent Trap A aside and let it cool down.
7. Hold Sorbent Trap B by the glass tube. The sorbent trap is pulled into the sample probe by negative pressure. Danger of glass breakage!
8. Carefully open the screw connection of Sorbent Trap B.
9. Carefully pull Sorbent Trap B out of the sample probe.
10. Put the second protective cap on the trap. Sorbent Trap B is now sealed. Put Sorbent Trap B aside and let it cool down.
11. Place Sorbent Trap A and B in the corresponding transport tubes and close the transport tubes.
12. Place the transport tubes with the Sorbent Traps in the plastic transport bag. The transport bags are collected in an appropriate container and later forwarded to the laboratory for evaluation.

13.13 Prepare follow-up measurement



Hot Surface!

Caution hot surfaces!

The sample probe and the gas sampling line are heated up to 200 °C [392 °F].

During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.

The hot sample probe is placed on the resting place after a measurement. To prepare a new measurement, proceed as follows:

1. Remove a transport bag with two sorbent traps from the container with the new sorbent traps.
2. Take Sorbent Trap A and B out of the transport bag. Open the transport tubes. Put the transport bag and the transport tubes aside for later use.

The sorbent traps have the sorbent trap IDs on them. You start the subsequent measurement by entering the sorbent trap data. See page 53 chapter 13.2 Cooler unit: preparing CM1 color change sensors.

14 Calibration

14.1 General

As standard, the MFC's are calibrated and delivered with the gas composition declared in DIN CEN/TS 17286:2019-07.

The test gas consists of the following gases:

- 81,00 Vol.-% N₂
- 12,00 Vol.-% CO₂
- 7 Vol.-% O₂



Do not inhale!

WARNING OF HAZARDOUS GASES! Do not inhale!

14.2 Calibration of the Mass Flow Controllers A and B

For calibration you need:

- Test gas
- Audit MFC
- Short piece of flexible tubing to connect Audit MFC and sample gas outlet on the control unit

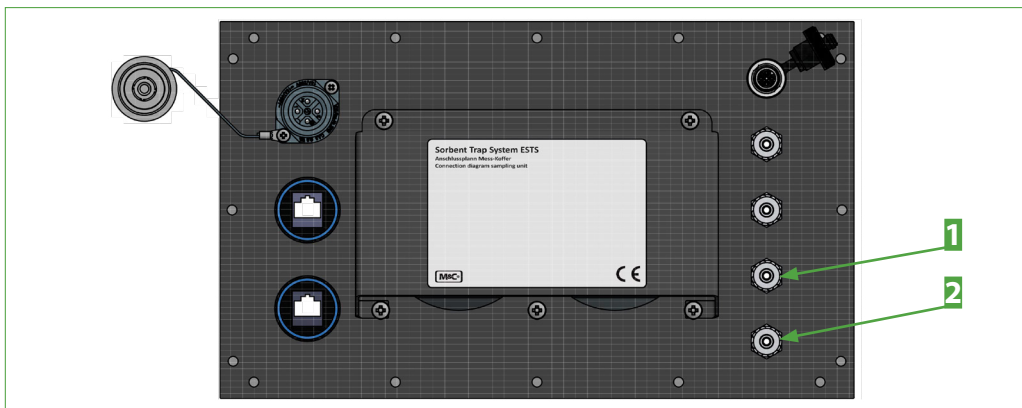


Fig. 59: Connections sample gas OUT A and B at the rear of the control unit

1 Sample gas OUT A

2 Sample gas OUT B

Proceed as follows for calibration with the Audit MFC:

1. Calibration MFC A: connect the Audit MFC to the outlet of the measuring channel marked A using the shortest possible piece of flexible tubing.
2. **WARNING OF HAZARDOUS GASES!** Do not inhale! Apply the test gas to the Measuring gas IN A port of the control unit.
3. Connect the Audit MFC to the mains voltage.
4. Connect the Audit MFC to the Ethernet port on the control unit.
5. Start the calibration on the user interface (HMI) of the control unit by selecting the "Calibration" item in the main menu.
6. On the "Calibration" page, enter the flow rate to be calibrated and the duration of the calibration. Select the channel MFC A.

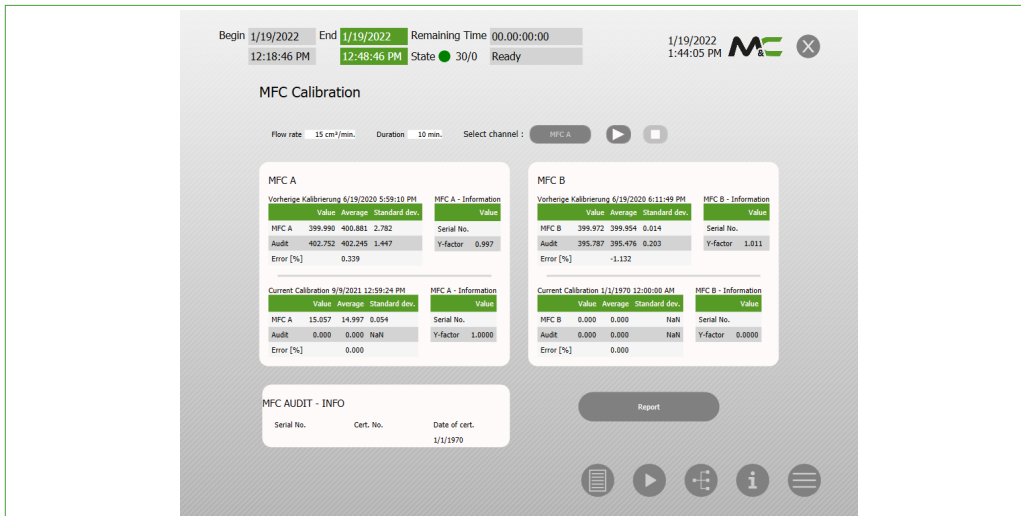


Fig. 60: Calibration of the MFCs

- 1 Enter flow rate
- 2 Enter duration of the calibration (at least 10 min)
- 3 Select channel, start and stop calibration



Note

The calibration must take at least 10 min. A longer calibration is possible.

7. Click on the "Start" button. A 1-minute conditioning starts and is followed without interruption by the minimum 10-minute calibration of the selected channel.

8. **WARNING OF HAZARDOUS GASES! Do not inhale!** Connect the test gas to sample gas ON B.
9. Disconnect the short piece of flexible tubing from the output of the measuring channel labeled A and connect it to the output of the measuring channel labeled B.
10. On the Calibration page, enter the flow rate to be calibrated and the duration of the calibration. Select the channel MFC B.
11. Click on the "Start" button. A 1-minute conditioning starts and is followed without interruption by the minimum 10-minute calibration of channel MFC B.
12. Turn off the test gas supply.
13. **WARNING OF HAZARDOUS GASES! Do not inhale!** Detach the short piece of flexible tubing from the outlet of the measuring channel marked B and keep it for later calibrations.

Once the calibration of both channels is complete, the result can be viewed using the arrows in the navigation bar.



Note

We recommend to use an Audit MFC calibrated to your sample gas composition. The Audit MFC can be recalibrated for you at Bronkhorst Deutschland Nord GmbH.

If you use an Audit MFC which is calibrated according to DIN CEN/TS 17286:2019-07, you must apply a correction factor according to your gas composition after the measurement.

	Test gas composition			Correction factor
	CO2	O2	N2	
	19	0	81	0.9796
	18	1	81	0.9825
	17	2	81	0.9854
	16	3	81	0.9883
	15	4	81	0.9912
	14	5	81	0.9941
	13	6	81	0.997
DIN CEN/TS 17286:2019-07	12	7	81	1
	11	8	81	1.003
	10	9	81	1.006
	9	10	81	1.009
	8	11	81	1.012



	Test gas composition			
	CO2	O2	N2	Correction factor
	7	12	81	1.015
	6	13	81	1.018
	5	14	81	1.021
	4	15	81	1.024
	3	16	81	1.027
	2	17	81	1.031
	1	18	81	1.034
	0	19	81	1.037



Note

During a measurement, the mass flow controllers (MFCs) cannot be calibrated.

The calibration of the MFCs can be repeated prior to or after a measurement.

15 Service and Maintenance

Before starting any service or maintenance work, please make sure that any work carried out on the device is in compliance with all relevant regulations and standards.



Qualified Personnel

The service and maintenance work should be carried out exclusively by qualified personnel, preferably by M&C or your authorized M&C distributor.



High Voltage!

Disconnect power supply before opening the device for access.
Make sure that all external power supplies are disconnected.

Please make sure that you also follow the appropriate precautions by working on unplugged or low-voltage devices. Unplugged devices need to be properly grounded to prevent damage to internal electronics from electrostatic discharges (ESD).

- Make sure that the upstream sample gas conditioning system is working properly in case of a faulty reading.
- Make sure that there are no leaks in the sample gas lines. Check that all gas fittings are connected correctly.
- Use only original M&C spare parts and consumables.

15.1 Cooler unit: indication material replacement/sensor calibration



WARNING

Measurement canceled due to triggering of the color change sensor.

Check the indication material regularly and replace the indication material before it is used up.

Only use the indication material available from M&C.

The CM1 color change sensors are set exclusively for this material.



Note

The sensor must be calibrated after replacing the indication material.

The relay switches during calibration. Make sure that no damage can occur due to the switching of the relay.

You will need the following material:

- Unused indication material (Purafil select and silica gel/silica gel, see chapter '16 Consumables and Spare Parts List').



- A small screwdriver for pressing the “Alarm Reset” button on the evaluation electronics
- If necessary for cleaning: Compressed air or a brush.

Carry out the following steps to replace the indication material and calibrate the sensors:

1. Unscrew the green GL nuts from both filter bodies. The GL nuts remain on the flexible tubes.
2. Open the retaining strap and remove the sensors from the filter bodies. The sensors are marked A (sensor in the back) and B (sensor in the front).
3. Unscrew the filter bodies with the used indication material from the filter heads.
4. Dispose the used indication material. If necessary, clean the filter bodies with compressed air or a brush.



Note

Purafil stains strongly! Use gloves when filling the indication material into the filter body.

5. Fill the rear filter body approx. 4 cm high with Purafil select.
6. Fill the rest of the filter body with silica gel. The filter body should be filled to the extent that approx. 1 cm is still empty between the thread and the indication material.
7. Screw the rear filter body back into the filter head. Screw the green GL nut onto the filter body.
8. Position the sensor A at the upper end of the filter body. The sensor must be placed completely on the indication material.
9. Attach the sensor A to the filter body. Observe the labeling of the sensor when doing so.
10. Use the narrow screwdriver and briefly press the “Alarm Reset” button on the evaluation electronics of the sensor A once. Press again within 1 second and hold for 5 seconds. The LED on the evaluation electronics starts to flash orange. The LED then lights up green, i.e. the correct color has been calibrated (relay switches).
11. Now fill the front filter body approx. 4 cm high with Purafil select.

12. Fill the rest of the filter body with silica gel. The filter body should be filled to the extent that approx. 1 cm is still empty between the thread and the indication material.
13. Screw the front filter body back into the filter head. Screw the green GL nut onto the filter body.
14. Position the sensor B at the upper end of the filter body. The sensor must be placed completely on the indication material.
15. Attach the sensor B to the filter body. Observe the labeling of the sensor when doing so.
16. Use the narrow screwdriver and briefly press the "Alarm Reset" button on the evaluation electronics of the sensor B once. Press again within 1 second and hold for 5 seconds. The LED on the evaluation electronics starts to flash orange. The LED then lights up green, i.e. the correct color has been calibrated (relay switches).

**Note**

If the LED flashes in sequence: 2 x pause, 2 x "red" flashes, this indicates a communication error. The color change sensor does not communicate with the evaluation electronics.

For more information see chapter '17.1.1 List of Alarm Messages'.

15.2 Mandatory Maintenance Work

To perform a measurement according to DIN CEN/TS 17286:2019-07, it is mandatory to perform maintenance once a year. This maintenance consists of the following:

- A 3-point-calibration of the MFCs by a laboratory or the manufacturer (Bronkhorst).
- Inspection of the temperature sensor with a certified reference sensor.
- Inspection of the pressure sensors with a certified reference sensor.



16 Consumables and Spare Parts List

The demand for wear and spare parts depends on the specific operating conditions.

When contacting us for spare parts, please have the device type designations and the serial number ready. Both can be found on the type plates of the units.

Sample Probe		
Part No.	Description	Comments
	Ferrules	

Cooler Unit		
Part No.	Description	Comments
97K0101	ECM-2/ECP(1/2)000C G/GL14 WT, jet-stream-heat exchanger, material: Duran® glass, connections: sample gas GL 18-6/6 mm and GL 14, condensate GL 25-12 mm	
90F5110	Adsorption material silica gel, dry pearls with humidity indicator, quantity 1 kg [≈ 2.2 lbs]	Recommendation: A filling of 150 g [≈ 0.3 lb] per filter body is sufficient for approx. 2 weeks measuring
90F5105	Adsorption material Purafil® select, quantity: 750 g	Color change from light violet to brown/black as an indication of saturation.
01P1307	Peristaltic pump SR25.2-W, 0.3 NI/h, 115 / 230 V AC with PVDF tube screw connection DN 4/6	Spare part
90P1020	SR25.2: caster carriers, complete	Recommended spare part
90P1050	SR25.2: conveying belt	Recommended spare part
90P1007	SR25 pump tube with PVDF tube screw connection DN 4/6	Wear part

Control unit		
Part No.	Description	Comments
08A2600	G2.2 Add-on sample gas pump N3-R, 1-head-version, 24 V DC brush-free, rotational speed adjustable, delivery rate 3.5 NI/min, parts in contact with medium: head PPS, diaphragm PTFE-coated, valves: Kalrez®	
98A1540	Electrochemical O2 sensor for industrial use, 3-pin-Molex-plug, MB 0-25 vol% O2, resistant against acid gases and CO2, unleaded	
04F1000	Universal filter type FPF-0,1GF, for front-panel installation, with ultra-fine optical fiber filter element, filter porosity: 0.1 µm, connection: G 1/8" i, material: PTFE, Viton®, glass, PVDF	



Control unit		
Part No.	Description	Comments
97A2000	HI-TEC digital mass flow controller MFC, range: 29,2-1460 sccm, gaskets: Viton® 51415, plunger: Kalrez® 6375, connections: 6 mm ferrule, output signal : PROFINET input signal : PROFINET, power supply: +15-24 V DC	

17 Appendix

17.1 Trouble Shooting

If the portable sampling system PSS-STS malfunctions, please also refer to the instruction manual stored directly in the front-panel PC or the list of possible alarm messages. You will find “Quick Start”, “Operating Instructions” and “Troubleshooting” in the menu bar under the menu item “Manual”.

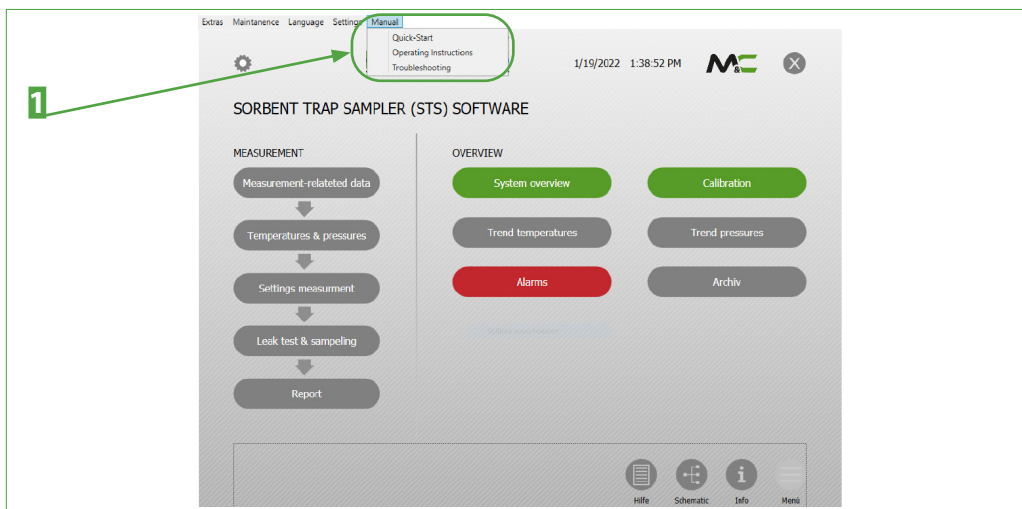


Fig. 61: Menu item “Manual”

1 Menu bar with menu item “Manual”

17.1.1 List of Alarm Messages

The Alarms menu lists all possible points in the system where an alarm can be triggered. If the color of the buttons changes from green to red, an alarm has occurred at this point. If you click on the red button, the values that have triggered the alarm will be displayed.

The following table lists the alarm messages.

Display	Description	Impact
● Temperature probe	Is triggered if the set limit values have been exceeded for longer than the waiting time indicated.	
● Temperature heated line	Is triggered if the set limit values have been exceeded for longer than the waiting time indicated.	

Display	Description	Impact
● Temperature control unit	Is triggered if the set limit values have been exceeded for longer than the waiting time indicated.	Switches the measurement off after the waiting time, if 45 °C [113 °F] is exceeded because the MFC can no longer measure correctly.
● Temperature cooler	Is triggered if the set limit values have been exceeded for longer than the waiting time specified.	Switches the measurement off.
● Thermocouple failure	Triggers in the event of cable break.	
● Renew scrubber channel A	Is triggered if the colorimeter from drying tower A reports a breakdown.	Stops pump A.
● Renew scrubber channel B	Is triggered if the colorimeter from drying tower B reports a breakdown.	Stops pump B.
● A - MFC communication error	Is triggered if no more data is received by MFC A.	Switches pump A off.
● A - Trap restriction	Is triggered when the flow rate differs more than 20 % from the desired flow rate set.	
● A - Trap flow rate ≥ 15%	Is triggered when the flow rate differs more than 15 % from the desired flow rate set.	
● A - Trap flow rate ≥ 25%	For long-term measurements only: is triggered when the flow rate differs more than 25 % from the desired flow rate set.	Only long-term measurements: Cancels the measurement
● B - MFC communication error	Is triggered if no more data is received by MFC B.	Switches pump B off.
● B - trap restriction	Is triggered when the flow rate differs more than 20 % from the desired flow rate set.	

Display	Description	Impact
B - trap flow rate \geq 15%	Is triggered when the flow rate differs more than 15 % from the desired flow rate set.	
B - trap flow rate \geq 25%	For long-term measurements only: is triggered when the flow rate differs more than 25 % from the desired flow rate set.	Only long-term measurements: Cancels the measurement
Empty condensate vessel	Is triggered if the condensate container reports "full".	Stops the measurement.



Do you need help?

Please contact M&C, if you need help with troubleshooting!

17.2 Quick Start: Prepare and Perform a Follow-up Measurement



Warning

Read the operating instructions. Follow the safety instructions.

This quick start is for qualified and experienced personnel only.



You need a sound knowledge of the mobile sampling system and of the dangers associated with commissioning and operating to follow the instructions.



Hot Surface

Caution hot surfaces!

The sample probe and the gas sample line are heated up to 200 °C [392 °F].



During general electrical and mechanical work on the assembly, wear personal protective equipment (PPE) in accordance with the risk assessment.

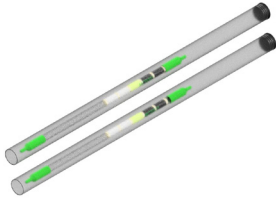


Please note: The measurement described here is a follow-up measuring. The measurement is performed after the initial measuring. Information on the first measurement at a new measuring point can be found in the instruction manual on page 43 chapter 11 Installation, page 49 chapter 12 Supply Connections of the Portable Sampling System (PSS-ST5) and page 53 chapter 13 Start-Up.



Steps Quick Start: Prepare and Perform a Follow-up Measurement

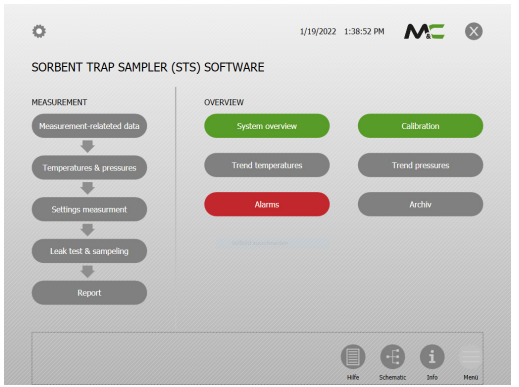
1 Take a bag with two traps.
The traps are in closed transport tubes. The transport tubes are closed with a plug.



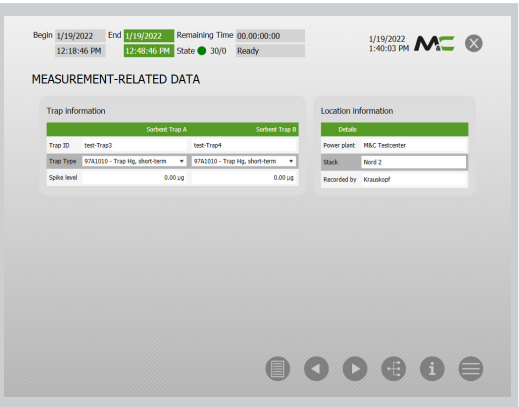
2 Take a trap with instruction leaflet out of the bag.
Trap ID is indicated on the transport tube and on the trap
Instruction leaflet: Trap ID, trap type and spike level



3 Start in the main menu.
Click on button "Measurement-related data".



4 Double-click in the input field of Trap A "Trap ID".
Keypad opens.
Alternatively: Connect an external keyboard to the USB port.

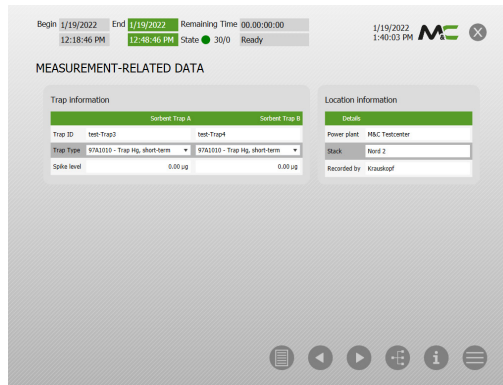




Steps Quick Start: Prepare and Perform a Follow-up Measurement

5 Enter: Trap A: trap ID, trap type, indicate spike level.

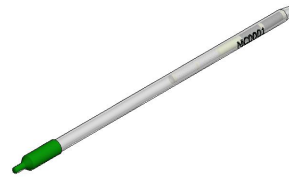
Check: details regarding power station, stack and person who has entered the data. In case of changes, enter new text.



6 Note on the instruction leaflet:
Trap A
Current date and current time

7 Put the instruction leaflet back into the bag.

Open the transport tube. Take trap A out of the transport tube. Keep the transport tube with plug.



Remove the cap on the side with the carbon and keep the cap.

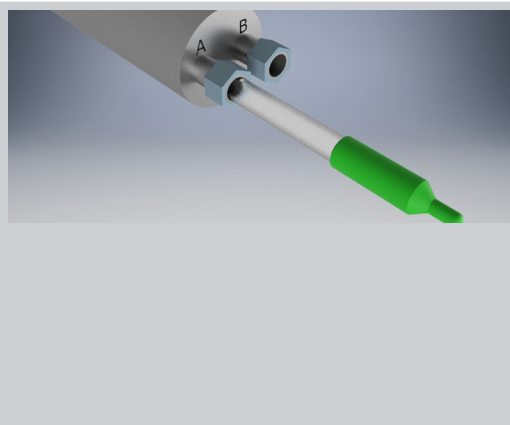
The glass tube of the trap is conical on this side.

8 **Caution! Hot sample probe. Wear personal protective equipment.**

Remove protective tube.

Slide the trap with the conical side into the sample probe.

The side with the carbon must be pushed deep enough into the fitting so that the carbon is completely within the heated area. The carbon is not visible from the outside.

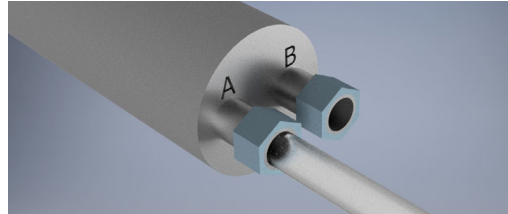


Steps Quick Start: Prepare and Perform a Follow-up Measurement

9

Caution! Hot sample probe. Wear personal protective equipment. Tighten the screw connection only hand-tight.

A soft Teflon® seal holds the trap in the screw connection.

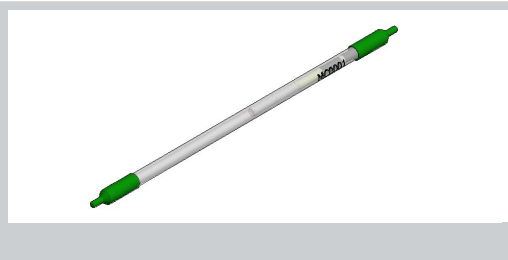


10

Take the second trap with the instruction leaflet out of the bag. Keep the bag.

The trap ID is indicated on the transport and on the trap.

Instruction leaflet: trap ID, trap type and spike level



11

Note on the instruction leaflet:

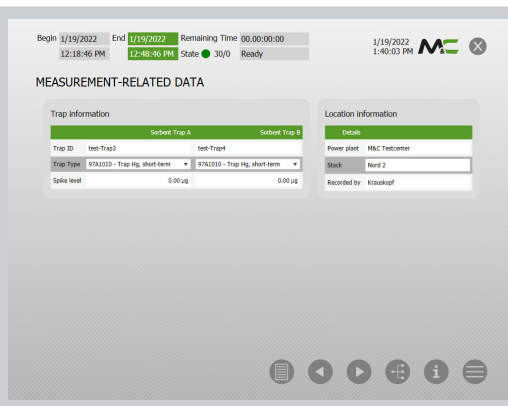
Trap B

Current date and current time

12

Enter: trap B: trap ID, trap type, spike level

Click right arrow button.



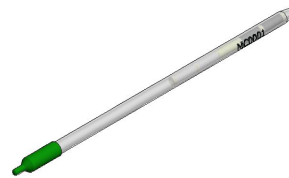
13

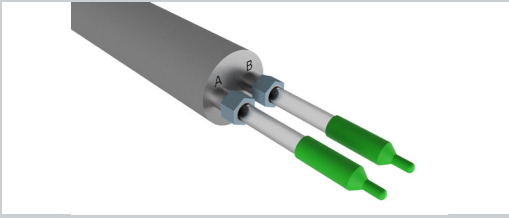
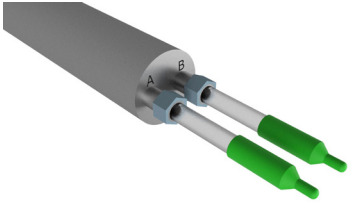
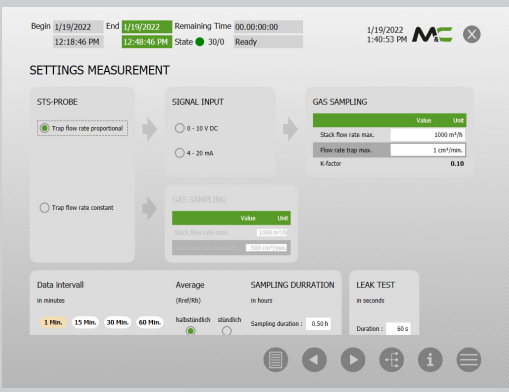
Put the instruction leaflet back into the bag.

Open the transport tube. Take trap B out of the transport tube. Keep the transport tube and the plug.

Remove the cap on the side with the carbon and keep the cap.

The glass tube of the trap is conical on this side.

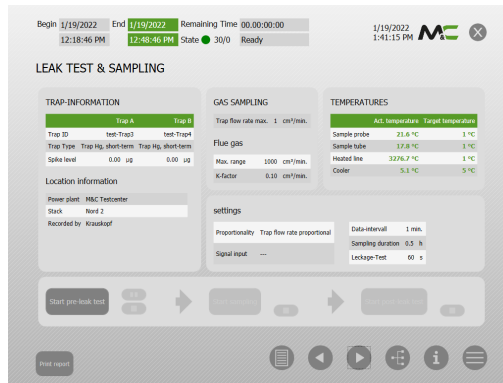


Steps	Quick Start: Prepare and Perform a Follow-up Measurement	
<p>14</p>	<p>Caution! Hot sample probe! Wear personal protective equipment. Push Trap B with the conical side into the sample probe.</p> <p>The side with the carbon must be pushed deep enough into the screw connection so that the carbon is completely within the heated area. The carbon is not visible from the outside.</p>	
<p>15</p>	<p>Caution! Hot sample! Wear personal protective equipment. Tighten the screw connection only hand-tight.</p> <p>A soft Teflon® seal holds the trap in the screw connection.</p>	
<p>16</p>	<p>Select: Specify data interval. If no data interval is selected, 1 minute is automatically selected.</p> <p>Check: constant or proportional flow rate. Select new flow rate type if changes are made.</p> <p>Check: signal input only with proportional flow.</p> <p>Check: duration of the measurement in hours.</p> <p>Check: desired flow rate.</p> <p>Check: Proportionality factor "K" is calculated only for proportional flow. Enter flow stack max. and flow trap max. "K" only in case of proportional flow.</p> <p>Check: Duration of the leak tests. Also applies to the pre- and post-leak-test.</p> <p>Click on the right arrow button.</p>	

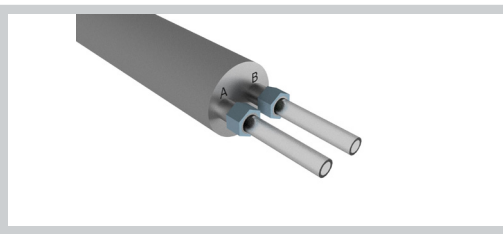
Steps Quick Start: Prepare and Perform a Follow-up Measurement

17 Check: All values on this page must be green prior to the start of the pre-STs leak test.

Start pre-STs leak test.



18 **Caution! Hot sample probe! Wear personal protective equipment.** After successful pre-STs leak test, remove caps of trap A and trap B.



19 **Caution! Hot protective tube. Wear personal protective equipment.** Fasten the protective tube.

20 **Caution! Hot sample probe! Wear personal protective equipment.** Check: Is the probe flange seal on the probe flange?

21 Check: Is the flange at the stack closed with blind plate?

Warning! Hazardous gases! Do not inhale! Hot blind plate. Wear personal protective equipment. Remove the blind plate.

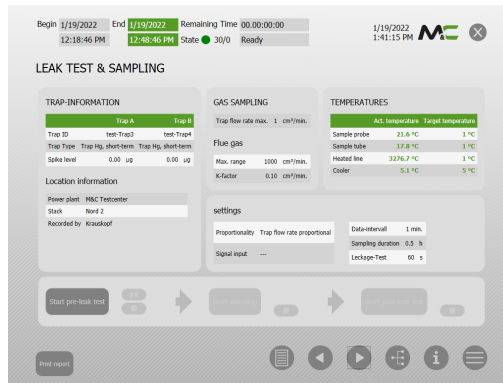
22 **Warning! Hazardous gases! Do not inhale! Hot sample probe. Wear personal protective equipment.** Insert the sample probe into the flange at the stack and fasten it with the Kamlock connection.

23 Check: All values on this page must be green prior to the start of sampling.

Start STs sampling.

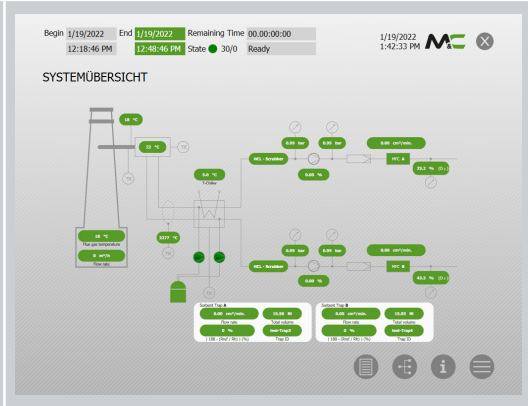
Note date/stop time.

Click on "System overview" button.



Steps Quick Start: Prepare and Perform a Follow-up Measurement

24 The system overview shows the actual values during the measurement. Values shown in red are alarms.



25 Check: Measurement completed?
Status: Sampling successful

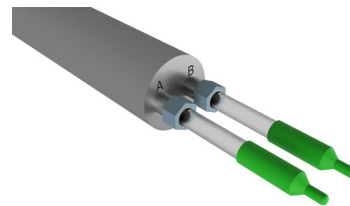
26 **Warning! Hazardous gases! Do not inhale! Hot sample probe. Wear personal protective equipment.** Loosen the Kamlock connection of the sample probe on the stack flange. Remove the sample probe from the stack and place it on a suitable surface.

27 If available, close the flange on the stack with blind plate.

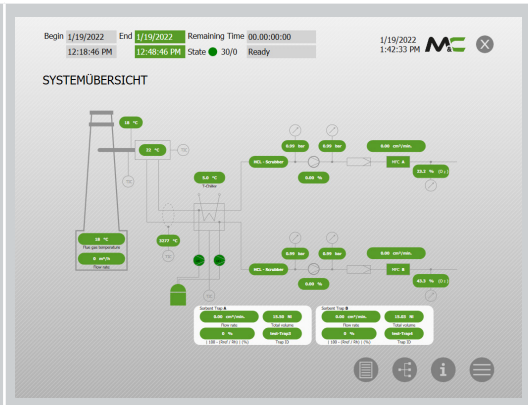
Warning! Hazardous gases! Do not inhale! Hot blind plat. Wear personal protective equipment. Fasten the blind plate at the stack flange.

28 **Caution! Hot protective tube. Wear personal protective equipment.** Remove protective tube.

29 **Caution! Hot sample probe. Wear personal protective equipment.** Place caps on trap A and trap B for post-STs leak test.



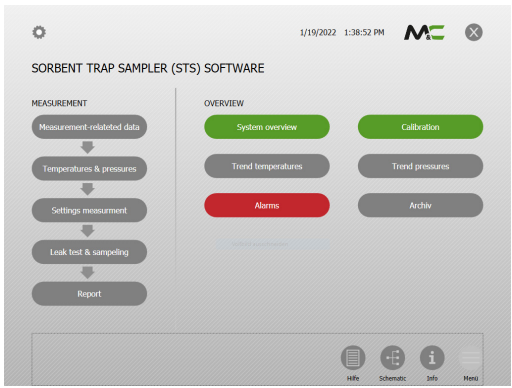
30 Click on "Main Menu" button.



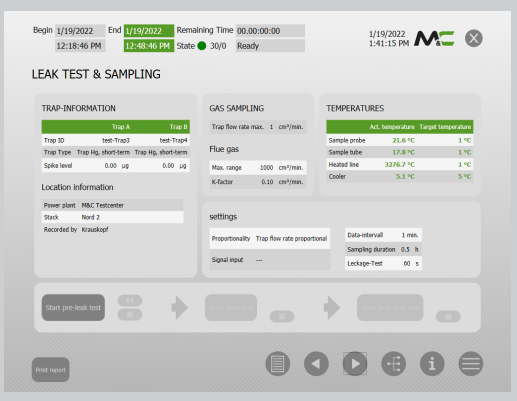


Steps Quick Start: Prepare and Perform a Follow-up Measurement

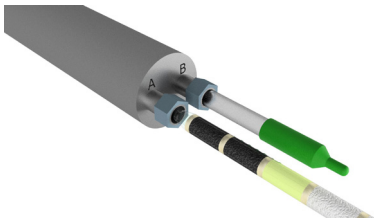
31 Click on button "Leak test & sampling".



32 Check: All values on this page must be green prior to starting the post-STS leak test.
Start post-STS leak test.
Post-STS leak test completed?
Status: Ready



33 **Caution! Hot sample probe! Wear personal protective equipment.** Remove trap A from the sample probe.
Attention negative pressure!



ATTENTION

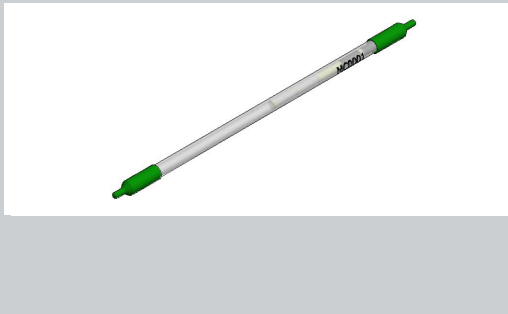
Beware of broken glass! Due to the negative pressure, trap A is drawn into the probe. Hold trap A firmly.

Steps Quick Start: Prepare and Perform a Follow-up Measurement

34 **Caution! Hot trap A. Wear personal protective equipment. Let trap A cool down.**

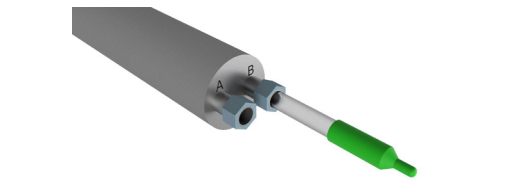
Place the cap back on. After cooling down, slide trap A into the transport tube and close the transport tube with the plug.

Put the transport tube into the bag with the instruction leaflet.



35 **Caution! Hot sample probe! Wear personal protective equipment.** Remove trap B from the sample probe.

Attention negative pressure!



ATTENTION

Beware of broken glass! Due to the negative pressure, trap B is drawn into the probe. Hold trap B firmly.

36 **Caution! Hot trap B. Wear personal protective equipment. Let trap B cool down.**

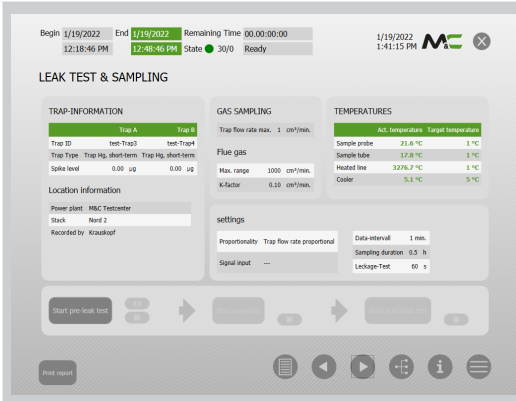
Place the cap back on. After cooling down, slide trap B into the transport tube and close the transport tube with the plug.

Put the transport tube into the bag with the instruction leaflet.



37 Check: trap A and trap B are in one bag together with the instruction leaflets.

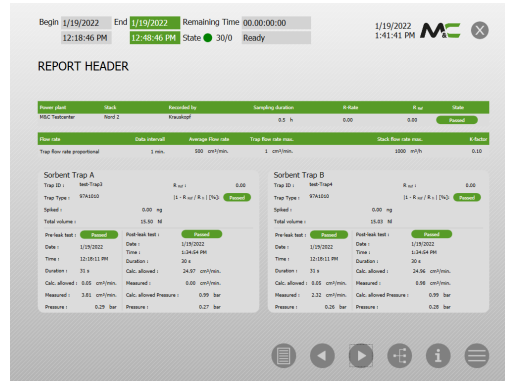
38 Click on the "Print Report" button at the bottom on the left.



Steps Quick Start: Prepare and Perform a Follow-up Measurement

39 Save report on storage medium (e.g. USB stick).

Alternatively: Save report on front-panel PC.



40 Send the report on a storage medium (e.g. USB stick) and the bag with Trap A and Trap B including instruction leaflets to the laboratory for analysis.

17.3 Additional Information

More information about the analyzer can be found on our website:

www.mc-techgroup.com

17.4 Declaration of Conformity

CE Certification

The STS complies with the following EU directives:

EMC directives

The STS complies with the EC directive 2014/30/EU 'Electromagnetic compatibility'.

Low Voltage Directive

The STS meets the requirements of the Low Voltage Directive 2014/35/EU.

To ensure the compliance with this EC directive, the STS conforms to the DIN EN 61010 standard.



Declaration of Conformity

The EU Declaration of conformity can be downloaded from the M&C website or directly requested from M&C.

17.5 Certificates

Calibration certificates are attached.

17.6 Warranty

In case of a device failure, please contact M&C immediately or your authorized M&C distributor.

We have a warranty period of 12 months from the delivery date. The warranty covers only appropriately used products and does not cover the consumable parts. Please find the complete warranty conditions in our terms and conditions.

The warranty includes a free-of-charge repair at a M&C facility or the free replacement of the device. If you return a device to M&C, please be sure that it is properly packaged and shipped with protective packaging. The repaired or replaced device will be shipped free of delivery charges to the point of use.

For more information about shipping and handling of returned devices, please see page 92 chapter 17.9 Shipping and Handling.

17.7 Liability and Disclaimer

This instruction manual is an original M&C document. It does not claim to be complete and it may be subject to technical modifications. We are not responsible for any printing errors or errors in the content of the manual. Please be assured that precautions have been taken to prevent errors in our product documentation to provide you with the best possible and accurate information.

We are not liable for the content of translations from sources which are not authorized by M&C. Copy of this document or of its content is not allowed without explicit approval of M&C. With the release of this version, all older instruction manual versions will no longer be valid.

Liabilities for indirect and direct damages that are related to the delivery or the usage of this instruction manual are excluded.

M&C® is a registered trademark of M&C TechGroup Germany GmbH.

17.8 Storage

If you plan to store your M&C product before installing and operating, please follow these storage recommendations. Make sure that the device is stored in a protected, dry and well ventilated area. Please cover the device with an appropriate cover to protect it from dirt and liquids.



If you have any questions about the proper storage of your M&C products, please feel free to contact us.

17.9 Shipping and Handling

If you need to ship your M&C product to another department inside your company or back to M&C, please follow these shipping and handling recommendations.

Please ship the device in its original packaging. This is the best way to protect the device. If the original packaging is not available any more, please use a sturdy cardboard box with enough packaging material to protect the device from damages during shipping.

If you send your M&C product in for maintenance work at our M&C facility, please send the properly packaged device to the M&C TechGroup address in the USA or Germany as needed.

17.10 Proper Disposal of the Device

At the end of the life cycle of our products, it is important to take care of the appropriate disposal of obsolete electrical and non-electrical devices. To help protect our environment, please follow the rules and regulations of your country regarding recycling and waste management.



18 About Us

18.1 M&C's Group of Companies

The M&C group of companies with its German head office and worldwide market activities enjoys the reputation as one of the well-known and strongest partners in the market.

Our company, our products, special systems and overall performance are well-established in the market. We continuously belong to the best of the best of our industry. This makes us very proud. Our core competences are to find qualified solutions for even the most complex and demanding measuring tasks. We are developing answers to solve the technical demands of the future. With our focus on premium services, we are reliable, innovative and an overall cost-effective market partner worldwide.



To learn more about M&C, please visit our website:

www.mc-techgroup.com

18.2 The Quality-Oriented M&C Catalog

M&C offers national and international services, project planning and construction of special systems with a wide range of products. Our catalog covers a large variety of high-quality products with in-depth knowledge of various customer applications. Our product excellence and innovative solutions make M&C a world class company.

You can find the following product groups in our catalog. The combination of products from these groups offers a complete solution for most industrial needs. We develop, manufacture and test our products in accordance with a wide range of national and international standards.



Probes

Comprehensive range of probes with a large spectrum of available options for an almost unlimited range of applications. Different materials available (Hastelloy®, Titan, PTFE, etc.)



Coolers

Optimised gas and condensate separation, low maintenance and self-monitoring. Compact design for wall mounting or 19" rack.



Filters

Suitable for all processes, due to the modular and user-specific configuration possibilities of the filter components. Filter enclosures available in glass, stainless steel, PVDF, PTFE or in different metal combinations.



Portable components

Developed for high-quality gas analysis at different locations.



Compact systems

Compact standard systems designed for a 19" enclosure or a plate structure.



Oxygen analyzer

A broad variety of products with high measuring accuracy. Direct measuring is based on paramagnetic measuring principle (dumb-bell-type).



18.3 Technical Consulting Services

M&C has earned a reputation as one of the most capable and experienced companies in the world, especially when it comes to difficult or complex measurement projects. We are proud that our customers have confidence in our products and continue to experience repeat business.

We also offer technical consulting for our components, devices and complete systems. We support our customers in finding individual solutions for their specific measuring tasks.

These individual solutions lead to new concepts of designing and building custom-made devices or complete systems. The dedication and commitment to finding solutions to the most complex and challenging tasks for our customers sets us apart from our competitors.

We have custom-made application experiences in many different fields worldwide. With this experience, we are able to support our customers by seeking and finding errors, trouble shooting during day-to-day operation or identifying hard to find interferences.

18.3.1 Ideas, Suggestions and Feedback

All our activities are designed to meet and exceed the demands of the market and the specific interests of our customers. That's why M&C is very interested in developing products, processes and services which are in demand and up-to-date.

This means that your feedback, ideas and suggestions are very important to us.

Please let us know what kind of new improvements and innovations you would like to see at M&C. Tell us what you like about M&C and what needs improvement.

Please send us an e-mail or feel free to just call us ...

We appreciate your comments.





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