Process Insights
Premium Insights Into Process

CHILLED-MIRROR HYGROMETERS

USER GUIDE

Dew Point Mirror 973 SF_6

Meets Compliance

Fast and Precise

Reliable

Revision 11E0325
Date 01/2025

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Certificates and declarations of conformity

To ensure that you have the latest versions of our certifications, the certificates are available online. They can be accessed via the following link:

https://www.process-insights.com/about-us/iso-9001-certificates/

PREMIUM INSIGHTS
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EU-KONFORMITÄTSERKLÄRUNG CE

EU Declaration of Conformity CE

Hersteller **(Firma und Anschrift)** Manufacturer (Name and Address)	Process Insights GmbH Max-Eyth-Str. 30 70736 Fellbach Germany
Erzeugnis Product	SF6 Analysator / Taupunktspiegel SF6b Analyzer / Dew Point Mirror
Typbezeichnung Model/Type	973 SF6

Person, die bevollmächtigt ist, die technischen Unterlagen zusammenzustellen:
Authorised person to compile the corresponding technical documents:

Name und Anschrift Name and Address	Dr. Vitali Scherbahn Neuköllnische Allee 134, 12057 Berlin, Germany

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller. Das bezeichnete Erzeugnis entspricht den Anforderungen folgender Europäischer Richtlinien:
This declaration of conformity is issued under the sole responsibility of the manufacturer. The described product is in accordance with the requirements of the following European Directives:

2011/35/EU	Niederspannungsrichtlinie	Low Voltage Directive
2012/19/EU	Elektro-und Elektronik-Altgeräte Richtlinie	Waste electrical and electronic
2014/30/EU	EMV-Richtlinie	EMC Directive
2011/65/EU 2015/863/EU	RoHS-Richtlinie	Restriction of Hazardous Substances

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Angabe der einschlägigen harmonisierten Normen oder der anderen technischen Spezifikationen, die der Konformitätserklärung zugrunde gelegt wurden:
References to the relevant harmonized standards used or references to the other technical specifications in relation to which conformity is declared:

EN 61010-1:2010 / A1:2019

EN IEC 61326-1 :2021

EN 55011:2016+A1:2017+A2:2021
EN IEC 61000-3-2:2019+A1:2021
EN 61000-3-3:2013+A1:2019+A2:2021+AC:2022
EN 61000-4-2:2009
EN 61000-4-3:2006+A1:2008+A2:2010
EN 61000-4-4:2012
EN 61000-4-5:2014+A1:2017
EN 61000-4-6:2014
EN 61000-4-11:2004+A1:2017
EN IEC 61000-6-2:2019

Das Erzeugnis entspricht dem Stand der Technik.
The product is state of the art.

Bei eigenmächtigen Änderungen an den gelieferten Erzeugnissen und / oder nicht bestimmungsgemäßer Verwendung erlischt die Gültigkeit dieser Konformitätserklärung.
Any unauthorised changes to the supplied products and/or any improper use invalidates this declaration of conformity.

Berlin, 17.10.2024
(Ort, Datum)
(Place, date)

Benjamin Mattejiet, Geschäftsführer
Managing Director

1 General Information

The following symbols are used to highlight information:

 Notice	 Danger	 Warning

- **Note**: Useful information for the smooth operation of your measuring device.
- **Danger**: Failure to observe the described hazardous situation can result in serious injury or death.
- **Warning**: Failure to heed the warning described may result in damage to your measuring device.


Notice

Read the user guide before putting the measuring device into operation.

Keep the user guide handy for future reference.

Improper use of the measuring device may void the warranty.

1.1 Terms of Warranty

Process Insights GmbH guarantees that all of their products are made from high quality materials and by appropriately trained personnel. Process Insights GmbH grants a warranty of 24 months from shipment ex works for its products under normal conditions of use within the specified limits of use. Under this warranty, Process Insights GmbH will, at its option, repair or replace any component which, upon verification by Process Insights GmbH or an authorized representative, proves defective during the warranty period.
The device must be returned to Process Insights GmbH or an authorized agent for inspection and repair. The costs of the return are to be borne by the customer.

Improper or unauthorized maintenance, storage, repair or modification of any kind may void the warranty. The warranty is also void if misused, neglect, accident, corrosion or improper installation.

This warranty is exclusive and supersedes any express or implied obligation on the part of Process Insights GmbH.

Process Insights GmbH is not liable for any other claims or damages, neither for direct nor indirect consequential damages, resulting from the use of their products.

1.2 Safety Notices

Danger

When operating the measuring device, observe the general rules for handling electrical devices.

The voltage indicated on the measuring device's rating plate must match the voltage of your power supply.

Keep people with pacemakers away.

Use gloves and safety goggles if necessary.

Wear tight-fitting clothing and tie back long hair if necessary.

Before working on live parts, switch off the measuring instrument beforehand.

Disconnect the measuring instrument from all external cables before opening it.

Parts of the measuring instrument can become very hot during operation.

Avoid touching open contacts as this can result in an electrostatic discharge that can destroy the measuring electronics.

If the measuring device is dropped, struck or damaged in any way, switch off the power immediately and stop using the measuring device. Contact Process Insights or an authorized representative for inspection or repair.

If you experience any problems while operating the device that you cannot resolve yourself, please contact Process Insights Technical Service.

Danger

Danger of contact with sulfur hexafluoride SF_6

Sulfur hexafluoride (SF6) is a pressurized liquid gas.
If heated, the container may explode.
Use a breathing apparatus (isolation device) in case of lack of oxygen. High concentrations of the gas can cause suffocation. Symptoms can include loss of mobility and loss of consciousness. The victim does not notice the suffocation.
Ensure adequate ventilation.
Contact with the evaporating liquid can cause frostbite of the skin.

Danger

Danger of contact with sulfur dioxide SO_2

Sulfur dioxide (SO_2) is a pressurized, poisonous gas.
If heated, the container may explode.
Gases and vapors are poisonous and must not be inhaled. Sulfur dioxide causes severe skin burns and serious eye damage.
Use a Class E respirator.
Wear protective gloves, protective clothing, eye protection or face protection.

1.3 Transport and Shipping

Each transport or shipment of the measuring instrument must be carried out in the Peli case (if one was supplied). An optional Peli case can be ordered for certain measuring instruments.

For rack mount units, the design requires the meter to be supported on the front and rear frames for transport and shipping.

Do not exert any direct pressure on the front panel to avoid damaging the touchscreen and the input elements.

Before shipping, plug any gas inlet and outlet connections with suitable plugs; eEmpty any existing cooling water lines and seal the inlets and outlets with suitable plugs. This prevents the ingress of dirt and moisture and protects the connections from damage.

Make sure the optoelectronic module is installed correctly.

1.4 Disposal

1.4.1 Packaging Material

The packaging material can be recycled. Please ensure that the packaging is disposed of in an environmentally friendly manner.

1.4.2 Disposal of Electrical and Electronic Components

Electrical and electronic devices often contain components that can potentially pose a risk to human health and the environment if improperly handled or disposed of. However, these components are necessary for the proper operation of the device. Components marked with this symbol

must not be disposed of with normal household waste.

1.5 Target groups

1.5.1 Operator

The operator is familiar with the operation of the analyser and its associated work processes. He knows the dangers that can arise when working with the analyser. He/she is able to prevent and avoid dangers during operation. The operator has been instructed in the operation of the analyser.

1.5.2 Operating company

The operating company is responsible for compliance with all safety and health regulations. The operating company must ensure that all persons working on the analyser have access to the relevant information, and they have been instructed in the operation of the analyser.

1.6 Intended Use

The Dew Point Mirror is used to measure frost and dew points, humidity, SF6 purity and SO_2 concentration in gas insulated switchgear systems. Use the device only to determine these parameters.

1.7 Change Log

Table 1: Table of Revisions

Revision	Date	Description
05E	12/2022	• New layout
06E	03/2023	• Naming changed to Process Insights GmbH • Contact information changed in imprint and chapter 10
07E	10/2023	• Minor corrections throughout the entire manual
08E	08/2024	• Voltage fluctuations rate added
09E	10/2024	• New safety symbols in all chapters • Scope of delivery updatet in chapter 3 • Mains fuses and replacement added in chapters 3 and 4 • Naming changed to Process Insights GmbH
10E	12/2024	• Safety notes added throughout the entire manual
11E	01/2025	• Address changed to Fellbach • New chapter „Certificates and declarations of conformity“ added

2 Introduction and Product Description

2.1 Working Principle of the Analyzer

The 973 was specifically designed for measurement of humidity, SF_6 purity and SO_2 concentration in gas insulated switchgear systems. Data is diplayed as follows:

- Humidity measurement data is displayed in ppmv or ppmw.
- Frost/Dew Point is displayed at either gas compartment pressure or standard pressure.
- SF_6 purity measurement is displayed directly in % Volume SF_6.
- SO_2 concentration is measured with an electrochemical cell with results displayed in ppmv.

Both the humidity and purity measurements utilize accurate and reliable condensation techniques.

The 973 is equipped with a gas recovery system that stores the sampled gas during the measurement process in its internal storage cylinder. After completion of the measurement, the stored gas is pumped back into the original compartment or into another vessel. The compartment pressure is also measured.

The 973 is equipped with a user configurable full color active matrix LCD with integrated touch screen. The 973 can be configured for measurement of Humidity and % Volume SF_6 with either automatic or manually initiated Pump Back. Use the bi-directional RS-232 communications port to transfer all measurement data to a computer.

Easily check the 973 calibration at any time by using the built-in Ice Test function. The Ice Test provides instant verification of system accuracy and integrity.

The 973 is equipped with a full color active matrix liquid crystal display with an integral touch panel. The display has a high contrast ratio and a wide viewing angle for best readability. Data is displayed in large, easy to read fonts. Using the on-screen function and menu keys, you can easily configure each line of the display and navigate the menus.
Versions equipped with the SO_2 option will have alternative display and data line formats. Please refer to Kapitel 5.3 ab Seite 33 for further information on the measurement of SO_2 concentration.

3 Product

This section gives you an overview of the Dew Point Mirror and its most important components.

3.1 Scope of Delivery

The analyzer is delivered in a sturdy transport case.

The contents of this package include:

Contents	SF_6	SF_6 with SO_2 option
Analyzer 973 SF6	✓	✓
6 m Stainless Steel armored PTFE tubing	optional	optional
SF6 coupling DN8 with quick coupling (Rectus)	optional	optional
SF6 coupling DN20 with quick coupling (Rectus)	optional	optional
90° Angle for Rectus-Coupling	optional	optional
Torque wrench with Allen blade	-	✓
Serial cable DB9 3m 1:1 male/female	✓	✓
RS-232 / USB adapter	✓	✓
USB stick with 973-SF6 software and operation manuals	✓	✓
Power cable (country specific)	✓	✓
Hex key for SO2 module	-	✓
SO2 dummy sensor	-	✓
Sterile cotton swabs	✓	✓
User guide	✓	✓
Calibration certificate	✓	✓

Notice

Optionally available couplings and tubes can be ordered separately from Process Insights GmbH.

3.2 Label

The analyzer is labeled on the back. The label states name of the device, serial number, year of manufacture, specification of the mains voltage, power consumption and contact address of Process Insights GmbH.

Notice

Make sure that your power source corresponds to the information on the type label. The analyzer has been successfully tested and calibrated in this version.

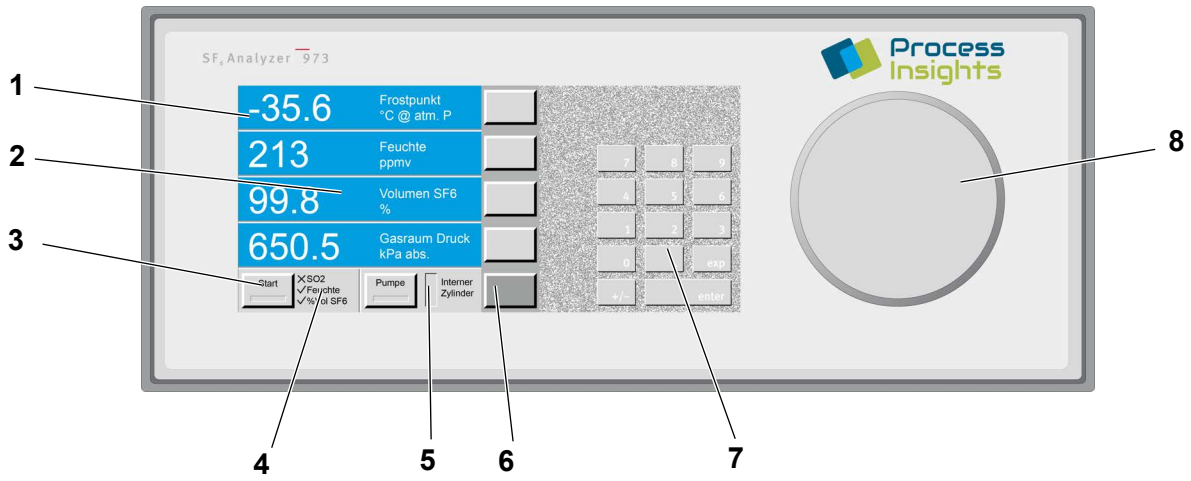
If you have any questions, please contact ourntechnical support.

3.2.1 Measurement Ranges

See Chapter 8.1, page 67.

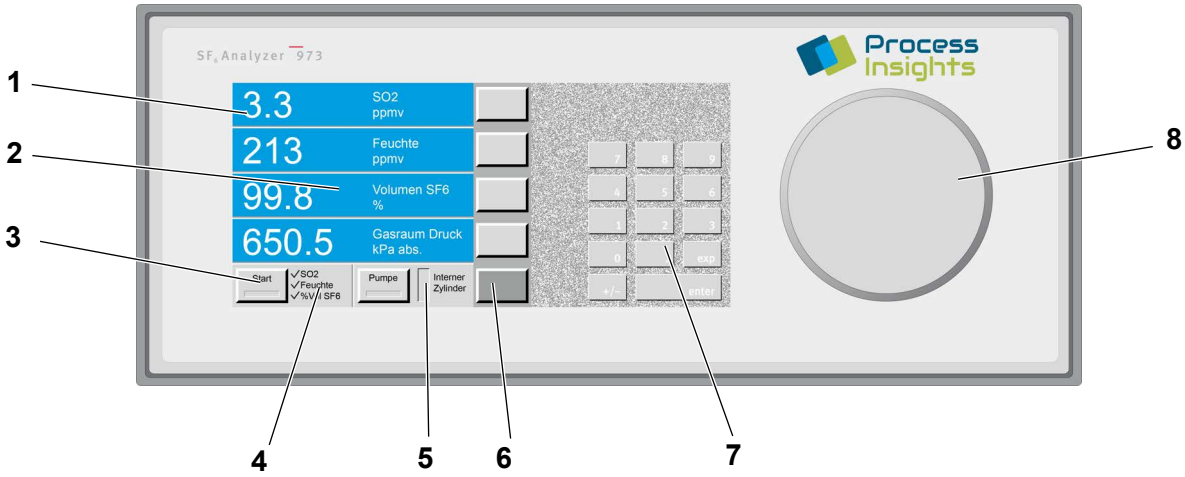
3.3 Components of the Analyzer

The components and connections of the analyzer are located on the front panel and on the rear of the device.



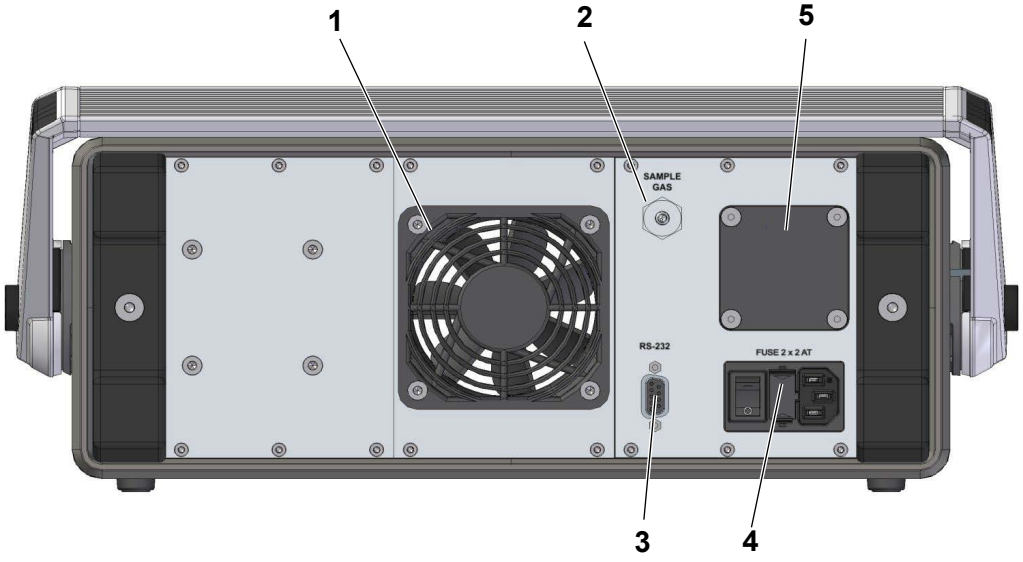
1 Touch Screen
2 Four Data lines
3 Two Fixed function keys
4 Status of Measurement
5 Internal Cylinder Capacity
6 Five Menu Keys
7 Numeric keypad
8 Optoelectronic module

Fig. 1: Components on the front plate 973 SF_6



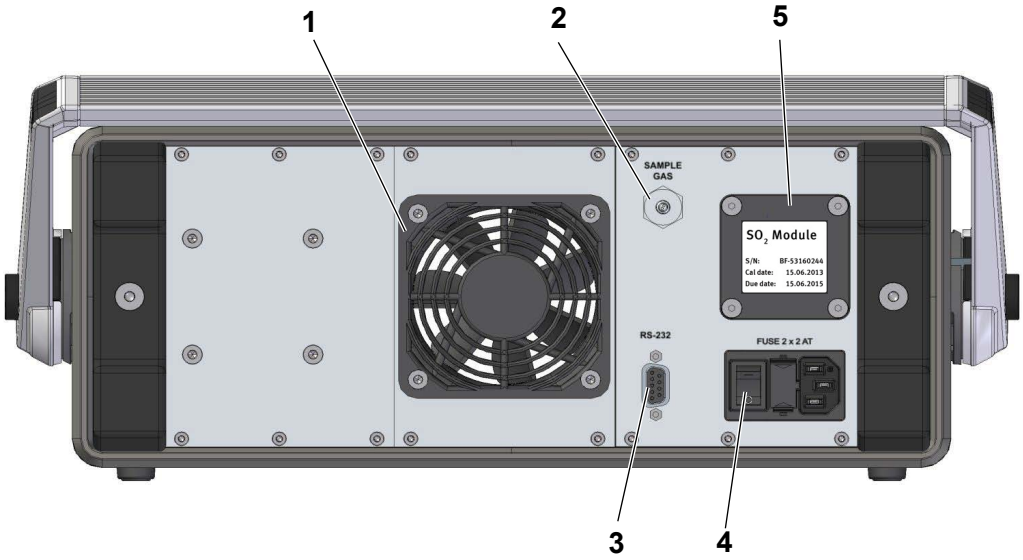
1 Touch Screen
2 Four Data lines
3 Two Fixed function keys
4 Status of Measurement with SO_2 option
5 Internal Cylinder Capacity
6 Five Menu Keys
7 Numeric keypad
8 Optoelectronic module

Fig. 2: Components on the front plate 973 SF_6 with SO_2 option



1 Fan
2 Gas Inlet with Quick Coupling
3 RS-232 Serial Interface
4 Main Switch, power socket and fuse holder
5 SO_2 cell cover for optional fitting of SO_2 sensor

Fig. 3: Components on the back plate 973 SF_6



1 Fan
2 Gas Inlet with Quick Coupling
3 RS-232 Serial Interface
4 Main Switch, power socket and fuse holder
5 SO_2 Sensor with Calibration and Replacement Date

Fig. 4: Components on the back plate 973 SF_6 with SO_2 option

- Power Connection
  The AC power cord is connected to the power socket on the instrument back panel. The power socket also includes the power switch. The power supply voltage is 100 - 240 V AC +/- 10% at 50/60Hz. The power supply is internally fused and will automatically switch off in case of an overload. To restart the power supply, the instrument main switch must be switched to *0* and *I* again.
- SO_2 Module (Optional)
  When fitted, the SO_2 module is mounted to the back panel of the 973 which allows the SO_2 sensor to be easily replaced by the user. The sensor has to be replaced every two years. The calibration and replacement dates are indicated on the SO_2 module.
- Gas Inlet Quick Coupling
  The sampling line is connected to the sample gas inlet. If the instrument is not in use the inlet should be protected with the blue cover.
- RS-232 Serial Interface Connector
  The RS-232 connector is used when connecting the 973 to a computer. Use the supplied 9 pin 1:1 cable to connect the 973 to a desktop or laptop computer. This cable has a male connector on one end and a female connector on the other end. It is most often referred to as a serial extension cable.
- Fan
  When the 973 is switched on, the cooling fan always runs independent of the ambient and instrument temperatures.

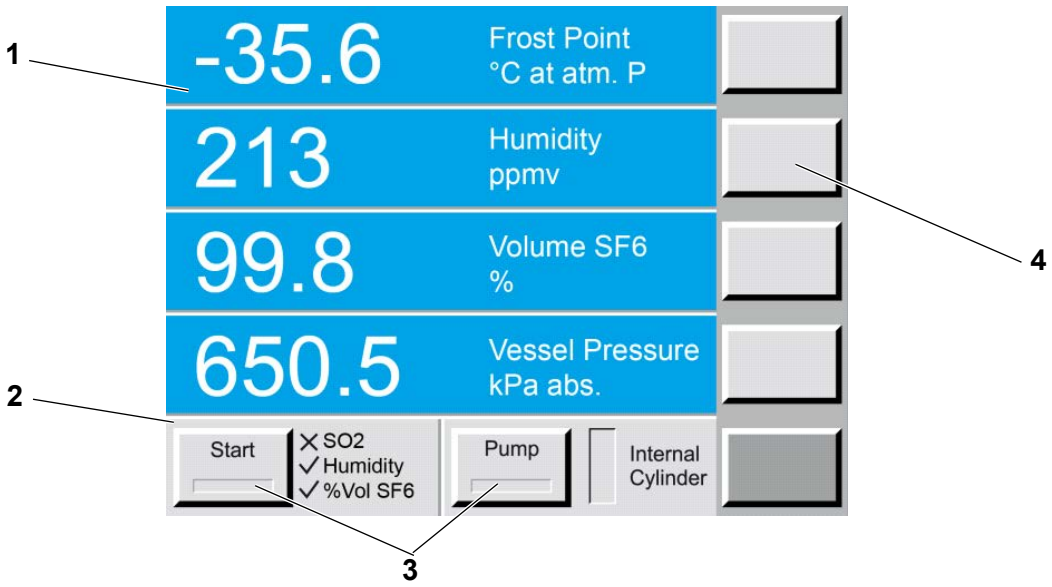
3.3.1 LCD Colour Display with Touch Screen

The analyzer is equipped with an active matrix liquid crystal display with an integrated touch screen. The display has a high contrast and a wide viewing angle, which ensures good readability. The data is displayed in large, easy-to-read characters. The buttons and menus on the screen can be customized (see *Chapter 5.10, page 42)*. Several humidity, temperature and pressure parameters, in SI or non-SI units, can be displayed.

The Dew Point Mirror is operated via the touch screen. Use your fingers or a stylus to operate the buttons on the display.

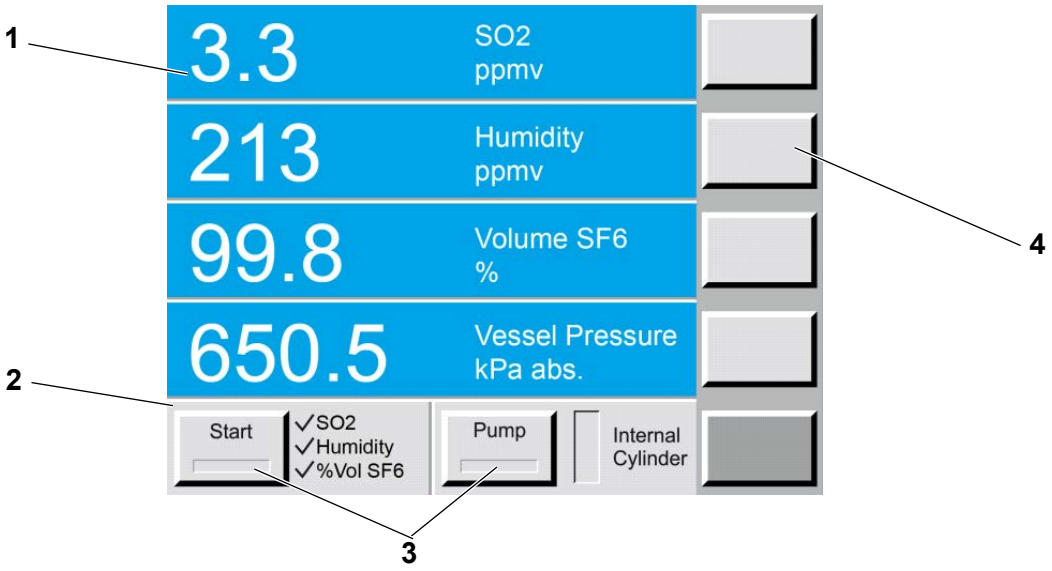
You can calibrate the touch screen to your preferred point of contact (see Chapter 7.2 on page 52).

After you have switched on the device, the configurable main menu is shown on the display.



1 Data lines, numeric and graphic
2 Status line
3 Function buttons
4 Menu buttons

Fig. 5: Main Menu, 973 SF_6 without SO_2 option



1 Data lines, numeric and graphic
2 Status line
3 Fixed funtion keys
4 Menu buttons

Fig. 6: Main Menu, 973 SF_6 with SO_2 option

3.3.1.1 Data Lines

- Data Line 1
  This line displays the measured Dew/Frost Point. The unit is °C at atmospheric pressure.
  In the standard configuration (Fig. 5:) instruments equipped with the SO_2 option show the SO_2 concentration expressed in ppm_v. The standard SO_2 configuration is shown in Fig. 6: .
- Data Line 2
  This line displays the humidity content in either ppm_v (parts per million by volume) or ppm_w (parts per million by weight). Both units are pressure independent.
- Data Line 3
  This line displays the purity in % Volume SF_6.
- Data Line 4
  This line indicates the current pressure of the gas compartment. The unit is kilo Pascal absolute pressure.

3.3.1.2 Status Line and Fixed Function Keys

The status line (**2**) of the display has two fixed function keys (**3**). The measurement process is started by pressing the *Start* button. The *Pump* button allows you to manually activate pump back of stored gas in the internal cylinder. The function keys are fixed and are available at all times.
The status line contains the status display, indicating the current operation mode. The level indicator of the internal cylinder indicates the current storage capacity. A 973 without SO_2 option will display an *X* next to *SO2* to indicate that the measurement of SO_2 concentration is not available.

3.3.1.3 Menu Buttons

The menu buttons (**4**) are located on the right-hand side of the display. Depending on the menu item, functions are assigned to the buttons.

The bottom button (menu selection button) is used to activate the available menus. The text on the button below indicates which menu is currently displayed. The text on the buttons above changes according to the functions available in the selected menu.

Notice

The menu selection is circular. After reaching the last menu item, the first menu item is displayed again.

You can use the ± key on the numeric entry field to navigate backwards through the menus. Use the Enter key to exit the menu.

3.3.2 Carrying Handle

To adjust the position of the carrying handle, press the buttons on both sides. Release the buttons when the handle is in the desired position. Ensure that the handle has locked into place before lifting the control unit.

Fig. 7: Adjusting the carrying handle

3.3.3 Measuring Head

Fig. 8: Measuring head

The heart of the analyzer is the measuring head.
The measuring head was designed in such a way that it is both highly sensitive and precise, as well as robust and easily accessible for regular cleaning.

3.3.4 SO_2 Module (Optional)

The 973 internal optional SO_2 module allows to measure SO_2 concentration in SF_6 gas compartments. The module is conveniently mounted on the back panel of the instrument with internally connected sample gas connection.

The module uses an electrochemical cell specifically for SO_2. The measurement cell is designed to provide accurate and stable results for two years in normal operation. Calibration checks can be performed using gas standards with certified SO_2 concentration. Please contact Process Insights GmbH or your local supplier for further information.

Fig. 9: SO_2 Module, disassembled

See Chapter 7.7, page 62 for the replacement of the SO_2 module.

4 Set-Up

The following chapter provides instructions for the initial set-up of the analyzer.

4.1 Ambient Conditions

Your analyzer is a precision laboratory device. Although it does not require any special environmental requirements, it works best in stable environments without rapid changes in ambient temperature. For optimal operation, the ambient conditions should be in the following range if possible:

- Ambient temperature: between **+15 and +35° C**
- Ambient humidity: between **5 and 95% RH** (non-condensing)

4.2 Installation Type

Table Model
The analyzer is prepared for use as a table model. The minimum space requirement is 0.6 x 0.6 m.

4.3 Preparation for Measurement

The 973 needs an AC power source. The label on the back panel indicates the acceptable input voltage range.
The analyzer has been designed to work with a power range between
100 - 240 V AC +/- 10% at 50/60 Hz. This normally covers all usual AC line voltages.

4.4 Switching On

1. The power socket and the main power switch are on the back panel of the instrument. Use the provided power cable to connect the instrument to the AC power.
2. Take the supplied power cable and plug the cable into the socket on the back of the device.
3. Then insert the plug into the power supply (socket) with the required voltage.
4. Press the on / off switch (**1**) and switch the analyzer on.
5. The display turns on. If this is not the case, check the power supply.

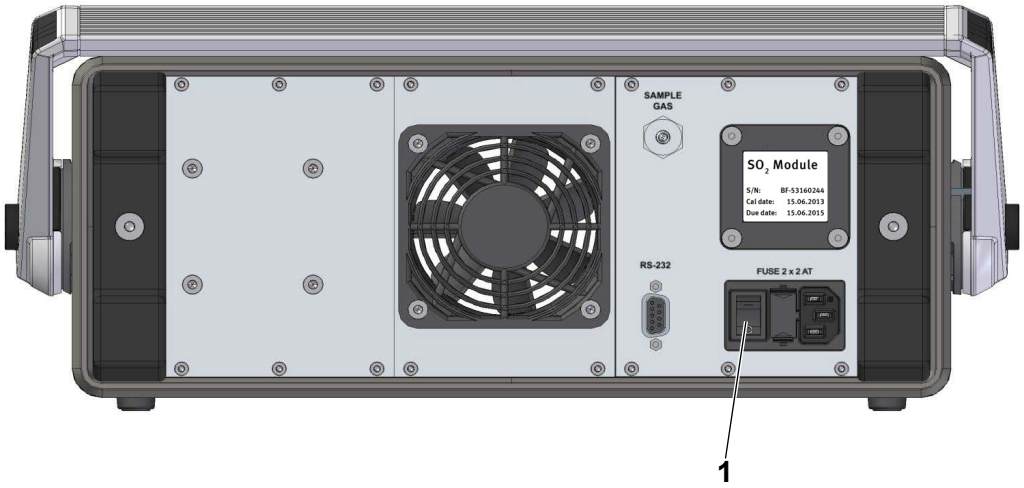


Fig. 10: Switching on

Replacing a defective fuse

The measuring device is protected against overcurrent with two mains fuses (fine fuse, slow-blow, 5 x 20 mm, 2 AT, 250 V AC).

If the measuring device cannot be switched on, check the mains fuses.

Proceed as follows:

1. Switch the on/off switch to off.
2. Remove all connection cables from the device and unplug the mains connection cable from the mains socket.
3. Pull out the fuse holder (**2**) with the two mains fuses.
4. Replace defective fuses with new fuses of the same type and rated current.
5. Insert the fuse holder into the measuring device.
6. Connect the measuring device and switch the on/off switch to on.

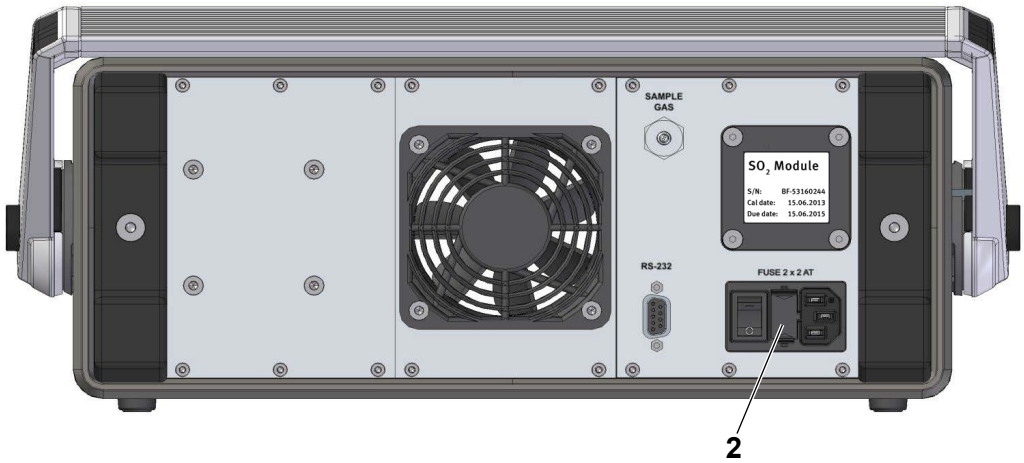


Fig. 11: Fuse holder

4.5 Connecting the Serial Interface

1. Connect the serial cable between the analyzer and a computer if you want to transfer measured data.
2. If your computer is equipped with a USB interface, use the provided RS-232/USB converter. See Chapter 6.1, page 47.

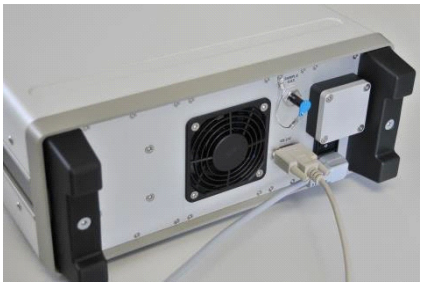


Fig. 12: Serial Interface

4.6 Connecting the SF_6 Gas Line

Danger

Danger of contact with sulfur hexafluoride SF_6

Sulfur hexafluoride (SF6) is a pressurized liquid gas.

If heated, the container may explode.

Use a breathing apparatus (isolation device) in case of lack of oxygen. High concentrations of the gas can cause suffocation. Symptoms can include loss of mobility and loss of consciousness. The victim does not notice the suffocation.

Ensure adequate ventilation.

Contact with the evaporating liquid can cause frostbite of the skin.

Notice

To prevent contamination, the blue cover caps on the analyzer and sampling tube should always be put in place when the instrument is not in use.

Use the delivered quick coupling on the alayzer side of the sampling tube to connect your sample line to the *SAMPLE GAS* inlet. The analyzer includes a DN8 and a DN20 quick coupler.

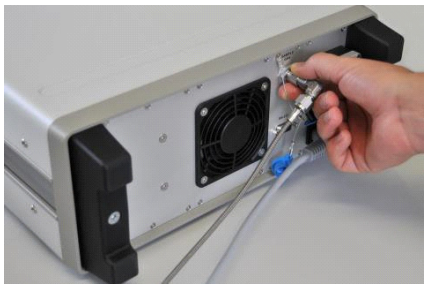


Fig. 13: Sample gas line connection

Fig. 14: DN8 and a DN20 quick coupler

4.6.1 Evacuating the Sampling Line

Danger

Danger of contact with sulfur hexafluoride SF_6

Sulfur hexafluoride (SF6) is a pressurized liquid gas.

If heated, the container may explode.

Use a breathing apparatus (isolation device) in case of lack of oxygen. High concentrations of the gas can cause suffocation. Symptoms can include loss of mobility and loss of consciousness. The victim does not notice the suffocation.

Ensure adequate ventilation.

Contact with the evaporating liquid can cause frostbite of the skin.

The sampling tube must be evacuated before the initial measurement. Once evacuated, there is no need to re-evacuate the line, even if moving the connection to the next compartment.

1. Make sure that a SF_6 coupling DN8 or DN20 is properly installed on the sampling line.
2. Connect one end of the sampling line with the analyzer sample inlet. Do not connect the other end to an outlet.
3. Tap the lower right key *Menu key* and select *Control Set- up*. *Control Setup* is displayed on the key, while on the upper keys the available menu options are indicated.
4. Tap the *Evacuate Hose* key.
5. In the pop-up window, tap OK. The evacuation starts.

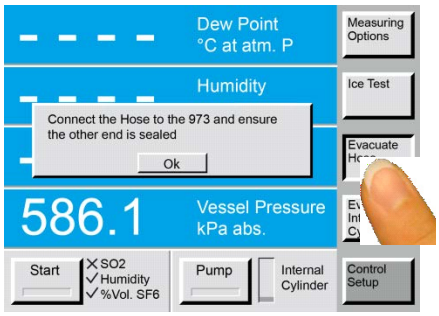


Fig. 15: Sample line evacuation

6. After the evacuation has started, a pop-up window shows the decreasing pressure of the sampling gas tube during evacuation.
7. After reaching the set residual pressure of 20 kPa, the evacuation process is stopped automatically and the window closes. The instrument and the sampling tube are now ready for measurement. Tap the *Cancel* key during evacuation to manually stop evacuation.

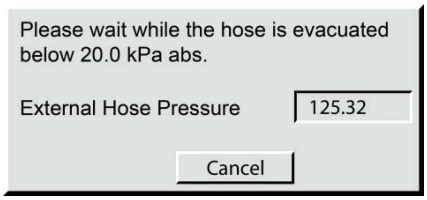


Fig. 16: Pop-up window during evacuation

4.6.2 Evacuating the Internal Cylinder

Danger

Danger of contact with sulfur hexafluoride SF_6

Sulfur hexafluoride (SF6) is a pressurized liquid gas.
If heated, the container may explode.
Use a breathing apparatus (isolation device) in case of lack of oxygen. High concentrations of the gas can cause suffocation. Symptoms can include loss of mobility and loss of consciousness. The victim does not notice the suffocation.
Ensure adequate ventilation.
Contact with the evaporating liquid can cause frostbite of the skin.

If the content of the internal cylinder is unknown, or contaminated SF_6 gas is stored inside the cylinder, the internal storage cylinder can be evacuated.

1. Tap the lower right key *Menu key* and select *Control Set- up*. *Control Setup* is displayed on the key, while on the upper keys the available menu options are indicated.
2. Tap the *Evacuate Internal Cylinder* key.
3. Disconnect the quick coupling from the *SAMPLE GAS* inlet or connect the analyzer to an SF_6 reclaimer.

4. Tap *OK* in the pop-up window.

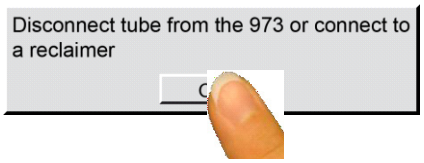


Fig. 17: Confirmation for disconnected sample line

5. The dialogue box indicates the current internal cylinder pressure during evacuation. After evacuating below 20 kPa residual pressure, the internal pump automatically stops. Tap the *Cancel* key during evacuation to manually stop evacuation.

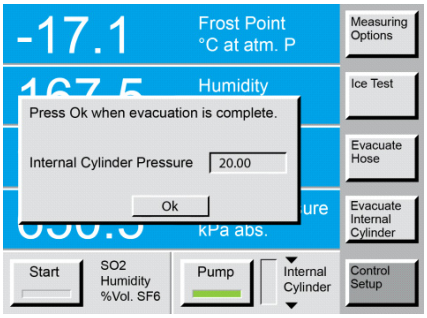


Fig. 18: Internal cylinder evacuation

6. If the analyzer is connected to an external reclaimer, evacuation can be continued with the reclaimer until the desired residual pressure is reached. Tap the *Cancel* key during evacuation to manually stop evacuation.

4.6.3 SF_6 Gas Connection to the Compartment

Danger

Danger of contact with sulfur hexafluoride SF_6

Sulfur hexafluoride (SF6) is a pressurized liquid gas.

If heated, the container may explode.

Use a breathing apparatus (isolation device) in case of lack of oxygen. High concentrations of the gas can cause suffocation. Symptoms can include loss of mobility and loss of consciousness. The victim does not notice the suffocation.

Ensure adequate ventilation.

Contact with the evaporating liquid can cause frostbite of the skin.

Notice

The quick couplers are self-sealing. When moving the sample line from one compartment to another compartment, there is no need to re-evacuate.

If the sampling tube was properly evacuated before the first measurement, it is now ready to connect to the gas compartment.

Remove the dust caps from fittings, check both threads are clean, carefully screw on the fitting and ensure for proper sealing.

Fig. 19: Connection to compartment

5 Measurement Options and Measurement

The following chapter gives you instructions on how to configure the measurement of your analyzer.

5.1 Menu Navigation

The various menus of the right column of keys are navigated by using the key in the lower right corner of the touch screen. Each time you press the lower right key, a new menu appears on the keys directly above it. The menu is circular, meaning that once you go past the last menu, the first one appears again and the process starts over. You can use the ± key on the keypad to move backward through the menus. Use the *Enter* key to clear the menu.

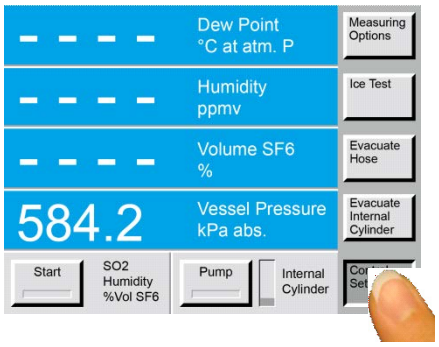
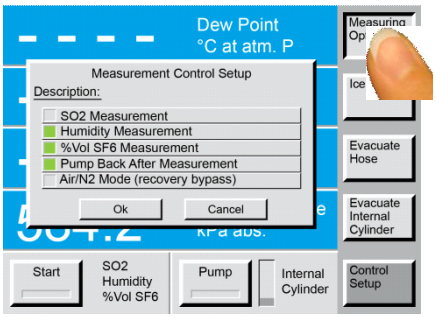


Fig. 20: Menu Navigation

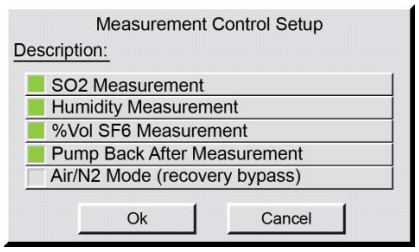
5.2 Selecting Measurement Options

Select either the humidity measurement, % volume SF_6 measurement, or both. In addition, you can select automatic pump back of the stored gas after the termination of the measurement. If the instrument has an SO_2 module installed, you can also choose to activate or deactivate the SO_2 measurement.
The standard 973- SF_6 configuration shows humidity measurement, % volume SF_6 measurement and automatic pump back. The configuration can be changed. After restarting the instrument, the configuration will be set back to standard.

1. Tap the lower right menu key (Fig 20) to select the *Control Setup* menu. *Control Setup* is displayed on the key while the keys above change to available menu options. Note that the top key indicates *Measuring Options*.
2. Tap the *Measuring Options* menu key at the top right corner of the screen. The *Measurement Control Setup* window is displayed.
   Choose for the standard 973 configuration without the SO_2 module between *Humidity Measurement*, *% Vol SF6 Measurement*, and *Pump Back After Measurement.*



Choose for the 973 equipped with the SO_2 option, between **SO2** *Measurement, Humidity Measurement*, *% Vol SF6 Measurement*, and *Pump Back* After Measurement.



5.2.1 Measuring Mode Examples

Notice

The examples shown include the measuring options for the 973 when equipped with the SO_2 option. If the SO_2 measurement option is not available, the *SO2 Measurement* button is disabled and thus cannot be selected.

Select *Humidity Measurement*, and disable *SO2 Measurement, % Vol SF6 Measurement* and *Pump Back After Measurement*. Tap the *Ok* button.
In this configuration, only humidity measurement is performed. The sample gas is collected and held in the internal cylinder and is not pumped back automatically.

Select *% Vol SF6 Measurement*, and disable *SO2 Measurement, Humidity Measurement* and *Pump Back After Measurement*. Tap the *Ok* button.
In this configuration, only the SF_6 purity measurement is performed. The sample gas is collected and held in the internal cylinder and is not pumped back automatically.

Select *SO2 Measurement* and *% Vol SF6 Measurement*, and disable *Humidity Measurement* and *Pump Back After Measurement*. Tap the *Ok* button.
In this configuration, SO_2 measurement and % volume SF_6 measurement will be performed without humidity measurement and automatic pump back.

Select *Humidity Measurement*, *% Vol SF6 Measurement* and *Pump Back After Measurement.*
Tap the *Ok* button.
In this configuration, humidity and SF_6 purity measure- ments will be performed, followed by automatic pump back of the sample gas. This is the standard 973 configuration.

Select the *Humidity Measurement* and *Air/N2 Mode*. Tap the *Ok* button.
In this configuration, only the humidity measurement is performed. The measured gas will be pumped to atmosphere without being stored in the internal storage cylinder. This mode is only used for the measurement of air or nitrogen (N_2) and should never be used for measurement of SF_6 gas.

5.3 Activation of SO_2 Measurement (Optional)

If your analyzer is not equipped with an SO_2 measurement, but has a serial number 12-0000 or higher, then your analyzer is "SO_2 ready". This means that, to enable the SO_2 measurement you only need to replace the installed measurement cell cover with an SO_2 sensor. Please follow the instructions in Chapter 7.7, page 62 to install the SO_2 sensor. In addition to installing the SO_2 sensor, you will need to activate the SO_2 measurement as follows:

1. Press the bottom right corner menu key until the *Other Settings* menu is displayed.
2. Press the *Activation Codes* key.

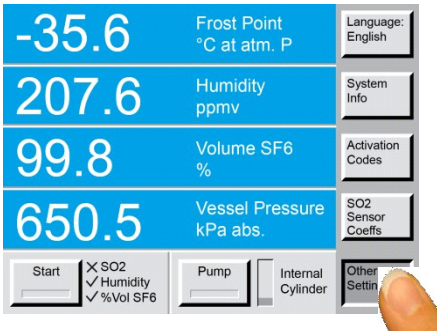


Fig. 21: Other settings

3. A window opens for the activation code provided by Process Insights GmbH or your local supplier.
4. Enter your activation code.
5. Press *Ok* to confirm the activation code.

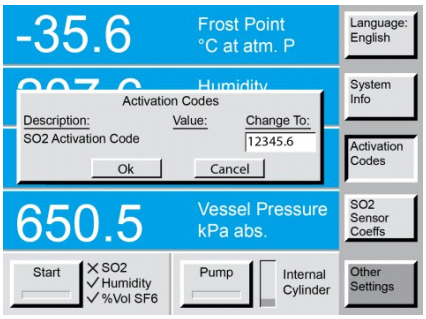


Fig. 22: Enter activation code

6. If the correct code was entered, a window appears confirming the activation of the SO_2 measurement. The analyzer recognizes the type of the sensor fitted and displays its ppm range.

7. Press *Ok* to confirm. The analyzer is now ready to perform SO_2 measurements.

Notice

If a wrong code was entered, a window appears indicating that the code is not valid. Press *Ok* and try again.
If your code is not accepted by the analyzer, please contact Process Insights GmbH or your local supplier.

5.4 Set Coefficients for a New SO2 Measurement Cell (Optional)

After installation of a new SO_2 Measurement Cell, the analyzer coefficients must be adjusted.

1. Press the bottom right corner menu key until the *Other Settings* menu is displayed.

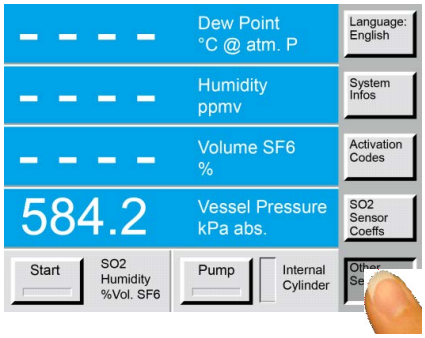


Fig. 23: Other settings menu

2. Press the *SO2 Sensor Coeffs* key to open the pop-up window.

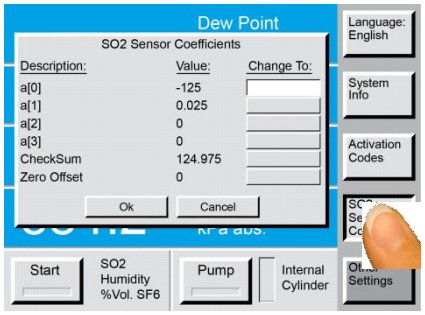


Fig. 24: SO_2 sensor coefficients menu

3. Enter the sensor coefficients, which can be found on the datasheet of the sensor (including the CheckSum).
4. Press *Ok* to confirm. The sensor is now ready for operation.

5.5 SO_2 Zero Function

Changes in the SO_2 sensor zero response are due to inherent drift of the electrochemical sensor used to measure SO_2 concentration. The SO_2 zero function enables the application of a zero offset (from software version 170704a). This offset can be used when the 973 indicates an incorrect SO_2 value [ppm_v].

1. Perform an SO_2 measurement (see Chapter 5.6, page 36) with **100 %Vol SF_6 gas**. Use a certified pure SF_6 gas cylinder.

Warning

Warning of Incorrect Reference Gas

Incorrect reference gas can corrupt the correction. Electrochemical sensor response is carrier gas-dependent. Only use SF_6, for the zero correction of the SO_2 sensor.

2. After the measurement has been completed, the measured value is displayed. This value is subsequently used by the analyzer as an offset to correct the SO_2 measurement.

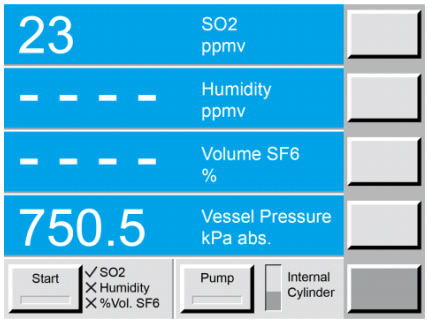


Fig. 25: Measurement result and offset value

3. To perform a zero offset correction, press and hold the number *2* on the numeric keypad for approximately 3 seconds.A dialog window opens. Tap *OK* to adjust the SO_2 zero offset. Confirm with *OK (*or *Cancel* to abort).
4. The result can be viewed in the *SO2 Sensor Coefficients* Menu under *Zero Offset* and, if necessary, edited manually. The zero offset has no effect on the linearity of the SO_2 measurement response.

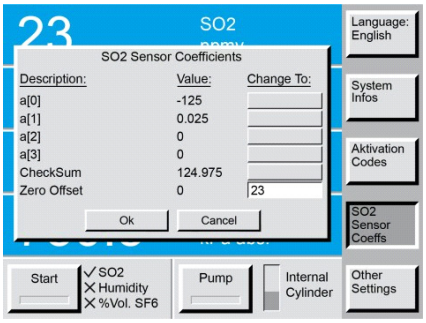


Fig. 26: Zero offset

Notice

If the message *SO2 zero offset adjusting is not possible*, either no SO_2 sensor is installed or no SO_2 measurement was performed. SO_2 measurement is necessary to calculate the offset.

5.6 Performing a Measurement

Notice

If you intend to collect measurement data automatically, install the Excel Protocol sheet before starting measurement.
See Chapter 6.2, page 47.

5.6.1 Measurement without SO_2 Option

As soon as the analyzer is connected to the gas compartment, the current vessel pressure is indicated. The standard configuration for the pressure unit is kPa absolute. The input pressure range is 120...1'000 kPa abs.
When the analyzer is switched on, the standard measuring mode is *Humidity Measurement*, *% Volume SF6 Measurement* and *Pump Back After Measurement* (see Chapter 5.2.1, page 32).

1. Press the *Start* button. The *Start* button and the *Pump* button turn green. Because the SO_2 measurement is disabled, an *X* appears next to *SO2*. The pump starts and the humidity clock, located next to the *Start* button, begins to spin. During the measurement, SF_6 gas flows from the gas compartment through the hose and the measuring head into the internal storage cylinder. The internal cylinder trend arrows and level indicator show the rising pressure in the internal storage cylinder.
2. After completion of the humidity measurement, the spinning clock stops. Both the measured Frost/Dew Point and the humidity content in ppm_v are displayed. Then the % Volume SF_6 measurement starts and the corresponding clock begins to spin. The internal cylinder trend arrows and level indicator show the rising pressure in the internal storage cylinder.

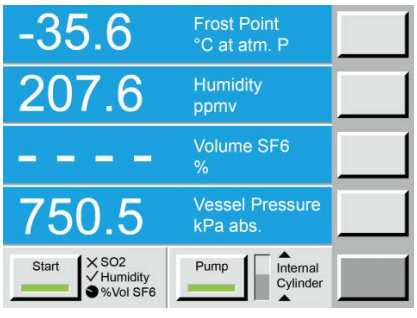


Fig. 27: Measurement

3. The pump back starts during the % volume SF_6 measurement. The trend arrows and level indicator show the decreasing pressure of the internal storage cylinder.
4. After completion of the % volume SF_6 measurement, the spinning clock stops and the

measured % volume SF_6 is displayed. The mirror heats up, as indicated by the red *Start* key. During the heating phase the *Start* key is locked.

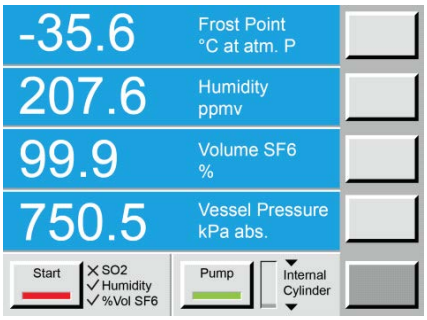


Fig. 28: Mirror heating up

5. After completion of pump back, the measuring head pressure is reduced to 100 kPa abs. (approximately corresponds to atmospheric pressure). After stabilization of the displayed gas compartment pressure (approx. 5 seconds), the measurement results are available on the data lines as well as on the serial interface for data transfer to the excel protocol (see Chapter 6.2, page 47).
   The measurement data for humidity and % volume SF_6 remain stored and displayed until the next measurement is started (by pressing the *Start* button). The vessel pressure measurement always indicates the current pressure at the 973 sample gas input. After completion of the measurement, the gas compartment pressure is displayedas long as the sampling tube is connected to the gas compartment.
   After connection of the sampling tube to the next gas compartment, the next measurement can be started by tapping the *Start* button.
6. After completion of the measurements, disconnect the SF_6 coupling from the gas compartment and close it with the yellow screw cover. Then disconnect the quick coupling from the 973 and cover the gas inlet as well as the coupling of the tube with the blue caps. The last measured SF_6 remains in the sampling tube. A correctly closed sampling tube is protected from dust and ambient air. If the measurement was stopped with a normal pump back sequence, 100 kPa abs. pressure (~0 kPa gauge) will remain in the internal storage cylinder. In this configuration, the analyzer can also be transported.

5.6.2 Measurement with SO_2 Option

As soon as the 973 is connected to the gas compartment, the current vessel pressure is indicated. The standard configuration for the pressure unit is kPa absolute. The input pressure range is 120...1'000 kPa abs.
When the analyzer is switched on, the standard measuring mode with *SO_2 Measurement*, *Humidity Measurement*, *% Volume SF_6 Measurement* and *Pump Back After Measurement* is activated (see Chapter 5.2.1, page 32).

1. Press the *Start* button. The *Start* button and the *Pump* button turn green. The pump starts and the *SO2* clock, located next to the *Start* button, begins to spin. During the measurement, SF_6 gas flows from the gas compartment through the hose and the SO2 module into the internal storage cylinder.
2. Once the SO_2 measurement is complete, the spinning clock stops and the measured SO_2 concentration is displayed.
3. The 973 then automatically initiates humidity measurement. The spinning clock indicates that measurement is in progress. During humidity measurement, SF_6 gas flows from the gas compartment through the measurement head, and into the internal cylinder.

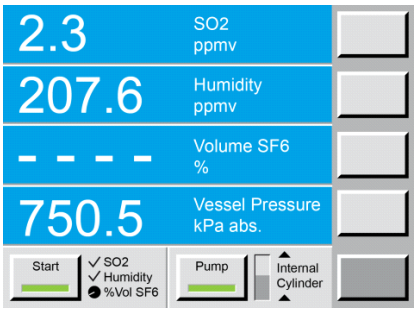


Fig. 29: Measurement

4. The pump back starts during the % volume SF_6 measurement. The trend arrows and level indicator show the decreasing pressure of the internal storage cylinder.
5. After completion of the % volume SF_6 measurement, the spinning clock stops and the measured % volume SF_6 is displayed. The mirror heats up, as indicated by the red *Start* key. During the heating phase the *Start* key is locked.

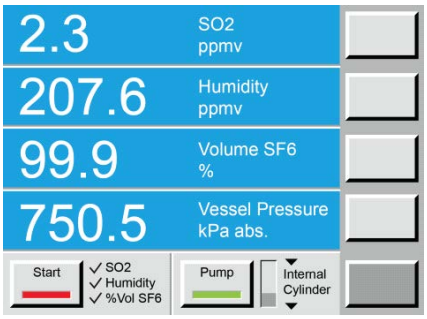


Fig. 30: Mirror heating up

6. After completion of pump back, the measuring head pressure is reduced to 100 kPa abs. (approximately corresponds to atmospheric pressure). After stabilization of the displayed gas compartment pressure (approx. 5 seconds), the measurement results are available on the data lines as well as on the serial interface for data transfer to the excel protocol (see Chapter 6.2, page 47).
   The measurement data for SO_2 and % volume SF_6 remain stored and displayed until the next measurement is started (by pressing the *Start* button). The vessel pressure measurement always indicates the current pressure at the 973 sample gas input. After completion of the measurement, the gas compartment pressure is displayedas long as the sampling tube is connected to the gas compartment.
   After connection of the sampling tube to the next gas compartment, the next measurement can be started by tapping the *Start* button.
7. After completion of the measurements, disconnect the SF_6 coupling from the gas compartment and close it with the yellow screw cover. Then disconnect the quick coupling from the 973 and cover the gas inlet as well as the coupling of the tube with the blue caps. The last measured SF_6 remains in the sampling tube. A correctly closed sampling tube is protected from dust and ambient air. If the measurement was stopped with a normal pump back sequence, 100 kPa abs. pressure (~0 kPa gauge) will remain in the internal storage cylinder. In this configuration, the analyzer can also be transported.

5.7 Measuring Range Limitations

The lower measuring limits of the 973 are approximately 40 ppm_v (depending on pressure) for humidity and 80% for volume SF_6. If the measured value for humidity or % volume SF_6 is below this measuring limit, the analyzer indicates these conditions as follows:

If the measured value of humidity is below the measuring limit of the 973, the display shows the symbol **<** ("smaller than") followed by the lower limit humidity value indicated in °C frost point and ppm_v. This indicates that the actual measured humidity value is below the displayed value, and below the measuring limit of the instrument.

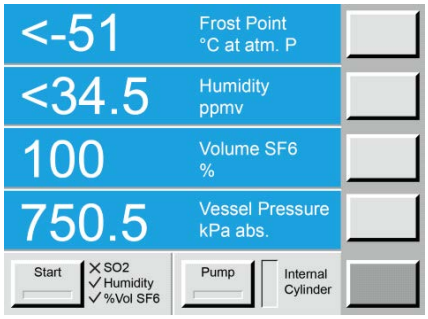


Fig. 31: Range limitation for humidity and frost point

If the measured value of % volume SF_6 is below the measuring limit of the 973, the display shows *<80*.
This indicates that the actual % volume SF_6 value is below the measuring limit of the instrument. If the instrument indicates a reading of *>100* for % Volume SF_6, service or calibration may be needed. Please contact the manufacturer or your local supplier for further information.

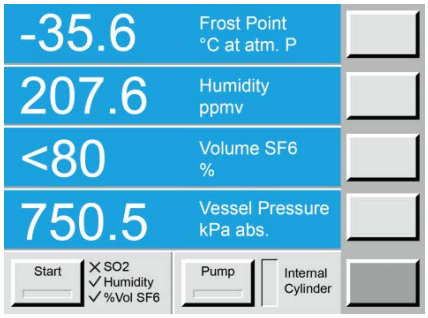


Fig. 32: Range limitation for SF_6

5.8 Alarm Messages and Abortion of Measurement

If the gas compartment pressure is too low, or if the SF_6 coupling is not correctly connected to the gas compartment, underpressure will build up in the sampling tube. In this case the measurement stops automatically. The 973 displays that the pressure is too low.
Make sure the sample line is correctly connected on both sides and the minimal gas pressure of at least 120 kPa abs is available.

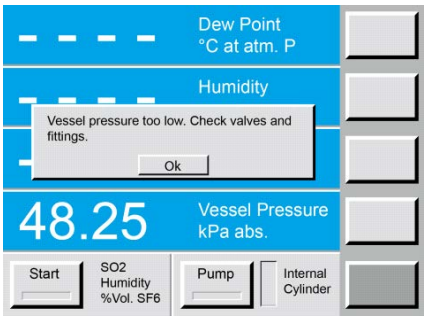


Fig. 33: Alarm message for low pressure

If the gas compartment pressure is too high to allow the pump back, the 973 turns the pump off automatically and indicates that the compartment pressure is too high. The maximum pump back pressure is 900 kPa abs.
Connect the 973 to a gas compartment or an SF_6 reclaimer with a lower pressure to pump back the stored SF_6.

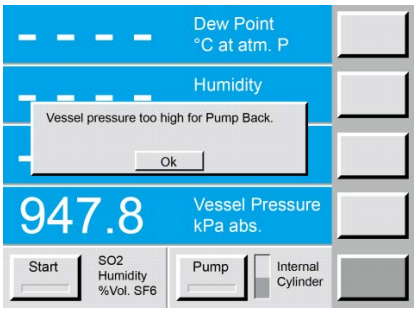


Fig. 34: Alarm message for high pressure

If the measurement is aborted due to low or high pressure conditions, the 973 will heat up the mirror, restore the measuring head pressure to 100 kPa abs (approximately atmospheric pressure), and stop. Pump back of the stored gas into the internal cylinder can be started by pressing the *Pump* key.

The measurement can be aborted manually by pressing the *Start* key again. The Pump back can be stopped manually by pressing the *Pump* button.

5.9 Measurement of Air or Nitrogen (N_2)

The 973 is equipped with a measuring mode for air or nitrogen. The measured air/nitrogen is not stored in the internal cylinder and will be pumped to the ambient air through a small vent inside the analyzer.

1. Activate the Air/N_2 measurement mode in the *Measuring Options* Menu by selecting *Humidity Measurement* and *Air/N2 Mode*.
2. Tap the *Ok* key. In this measuring mode, only the humidity measurement is performed, without storing the gas in the internal cylinder.

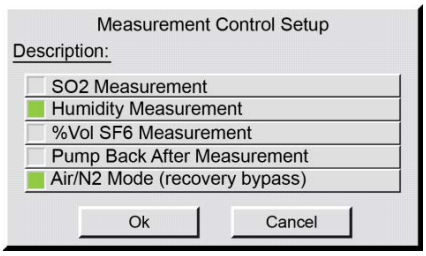


Fig. 35: Select measurement mode

3. Press *Start*. During measurement, the analyzer pumps gas through the gas connection port, to the measuring head and through a vent to the ambient air.

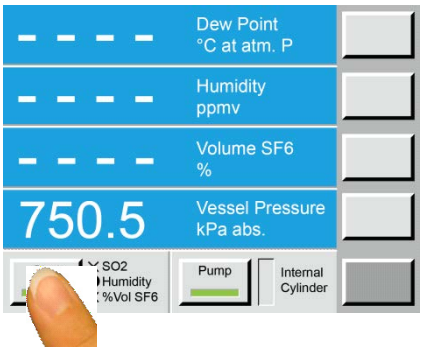


Fig. 36: Start measurement

4. Once the humidity value is stable, the analyzer beeps and displays the measured value.

5.10 Additional Settings

5.10.1 Language Selection

Available languages are:

- English
- German
- French
- Spanish
- Italian

Set a language:

1. Tap the lower right menu key to go to the *Other Settings* menu.
2. Tap the *Language* key until your preferred language is displayed.
3. Clear the settings menu by pressing the *Enter* key.

Notice

The selected language remains displayed as long as the analyzer is in operation. After restart, the display language is set back to the standard configuration. If you wish to save your chosen language in the power-up default of the analyzer, see Chapter 5.10.6, page 44.

5.10.2 Parameter Selection

Select which parameter should be displayed in each data line:

1. Tap the lower right menu key to go to the *Parameter* menu.
2. Press the arrow key corresponding to the data line you wish to change. With each new tap the parameter of the data line changes.
3. Clear the settings menu by pressing the *Enter* key.

Notice

The parameters remains displayed as long as the analyzer is in operation. After restart, the display language is set back to the standard configuration. Both the parameters of the instrument and those of the Excel Protocol are independent of each other and must be separately selected.

5.10.3 Unit Selection

Change the units of the displayed values:

1. Tap the lower right menu key to select the *Units* menu. *Units* appears on the key and the keys show the various units. Note that each of the keys shows different types of units. Unlike the *Parameter* menu, the keys do not correspond to the data lines, but rather to different unit types.
2. To change temperature units, press the key labeled *Temp*. Note that the corresponding unit changes each time the key is pressed. Also note that any data line that is currently indicating

temperature data also changes to the new unit.

3. Change other units such as *Pressure*, *Flow Rate*, etc. with the same method. In addition to setting the *Pressure* units, the mode may be set to either absolute or relative mode. Relative mode is often referred to as 'gauge mode' or 'over-pressure'.

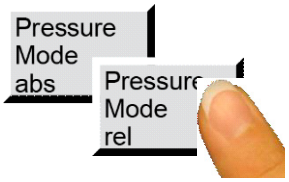


Fig. 37: Selection of relative or absolute pressure mode

4. Clear the settings menu by pressing the *Enter* key.

Notice

The changed units remain displayed as long as the instru- ment is in operation. After restart of the instrument, the display is set back to the standard configuration. Both the units of the instrument and those of the Excel Protocol are independent of each other and must separately be selected.

5.10.4 Fore Color Changing

Fore color affects the color of the numbers and letters. To change a data line's fore color:

1. Tap the lower right menu key to select the *Fore Color* menu. *Fore Color* is displayed on the key.
2. Press the arrow key corresponding to the data line you wish to change. Note that the fore color of the data line changes with each press of the key.
3. Change the fore color on any of the other data lines in the same way.
4. Clear the settings menu by pressing the *Enter* key.

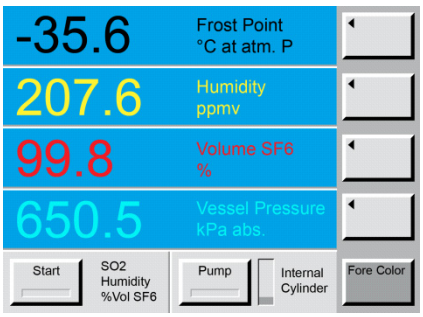


Fig. 38: Changing the fore color

5.10.5 Back Color Changing

Back color affects the color of the data lines. To change a data line's back color:

1. Tap the lower right menu key to select the *Back Color* menu. *Back Color* is displayed on the key.

2. Press the arrow key corresponding to the data line you wish to change. Note that the back color of the data line changes with each press of the key.
3. Change the fore color on any of the other data lines in the same way.
4. Clear the settings menu by pressing the *Enter* key.

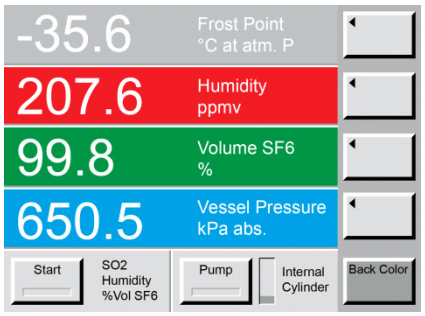


Fig. 39: Changing the back color

Notice

The changed selections of the *Fore Color* and *Back Color* menus remain displayed as long as the analyzer is in operation. After restart of the analyzer the display is set back to the standard configuration.

5.10.6 Saving the Default Configuration

The analyzer is delivered with a standard configuration. Options that are changed during normal use are not saved. The instrument reverts to its default settings after powering up.
Save your preferred configuration as default:

1. Press and hold the key *1* of the keypad for about 5 seconds.
2. You will hear a beep and a window prompts for confirmation to store the current configuration as new default.
3. Press *OK* to confirm the new default, or *Cancel* to abort.

5.10.7 Other Default Settings

Measurement Options

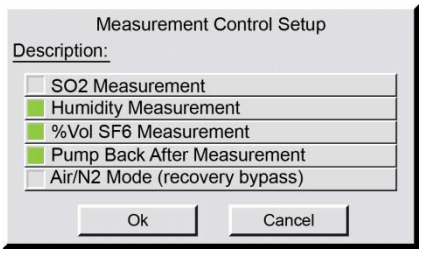


Fig. 40: Default settings for analyzer without SO_2 option.

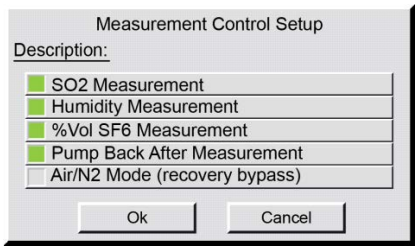


Fig. 41: Default settings for analyzer with SO_2 option.

Units

Absolute or Relative Pressure Mode

The default configuration includes the units for all parameters as well as the absolute or relative pressure mode.

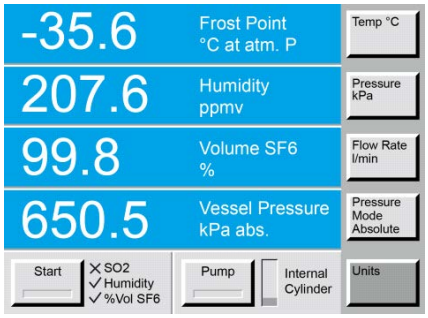


Fig. 42: Default Units

Parameters

The default configuration includes the parameter selection of the data lines.

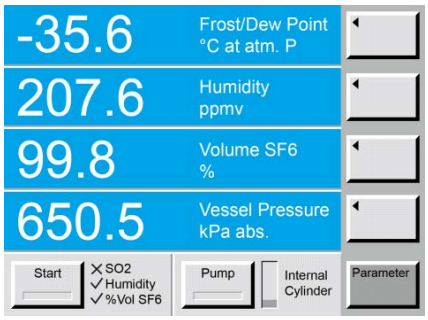


Fig. 43: Default parameters

Colors

The default configuration includes the fore and back color selection.

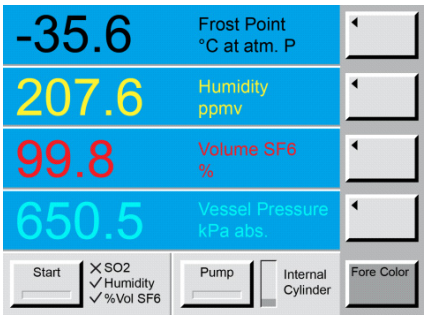


Fig. 44: Default color settings

5.10.8 Restore Color Settings and Baud Rate

1. Press and hold the key *9* of the keypad for about 5 seconds.
2. You will hear a beep and a window prompts for confirmation to restore the standard color and Baud Rate (standard = 9600) configuration.
3. Press *OK* to restore, or *Cancel* to abort.

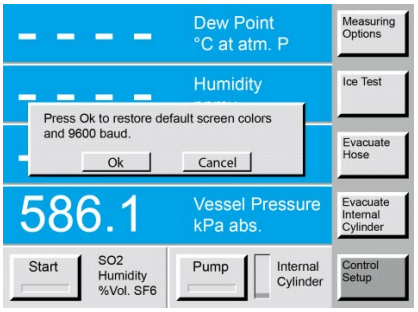


Fig. 45: Restore color and baud rate settings

6 Data Collection

6.1 RS-232 to USB Adapter Installation

The ES-U-1001-R10 RS-232 / USB adapter is a standard accessory that is supplied with the analyzer.
This product is supported on multiple Operating Systems; Windows, MAC-OS, Linux, Android and WinCE 4.2 onwards.
In Windows 7, 8 and 10 this adapter works without any driver installation (Plug and Play).
In other cases: http://www.ftdichip.com/Drivers/VCP.htm
Installation instructions may be downloaded from: http://www.ftdichip.com/US232R

Fig. 46: RS-232 to USB adapter

6.2 Data Collection over RS-232 with the Excel Protocol

1. Locate the 973-SF_6 protocol on the provided USB flash drive.
2. Double click on: 973-SF6 Protocol VXX (XX = equals version no. supplied on CD).
3. After opening the 973-SF_6 protocol a macro safety warning may appear. If so, select *Enable Macros*.
4. The protocol initially has only one worksheet named 'Feeder 1'. You may add additional sheets as required using the *New Worksheet* function in Excel. Additional worksheets will be added with names such as 'Feeder 2', 'Feeder 3',...
5. Click on the cell below the field **Read Data from COM**. An arrow appears on the right side. By clicking on the arrow the window for the input selections of the COM Port Number opens.

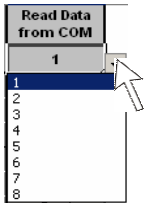


Fig. 47: Input field for COM port number

6. After input of the COM Port Number the window Parameter Selection opens, with which you can confirm whether your selection should apply to only this worksheet, or to all worksheets (Feeder 1...n) of the file. Although not required, it is generally preferable to copy the parameter changes to all sheets.
7. In order to change the different units, click on the correspondent unit field. An arrow field is shown on the right side. By clicking on this arrow a selection window with available units opens. The selection of units of the Excel Protocol is independent of the display of the analyzer.

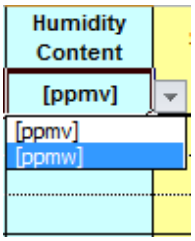


Fig. 48: Select an available unit

8. Enter the gas compartment identification in the appropriate fields (the three leftmost columns).

Feeder Bay	Gas Comp.	Phase
1	B0	R
1	B0	S
1	B0	T

Fig. 49: Gas compartment identification

9. Use the *Start* button to initiate a measurement. After completion of a measurement, the measuring results for humidity and % SF_6 (and SO_2 if your instrument is equipped with the SO_2 option) are available on the display and on the serial port.The pres sure value on the display indicates the current gas compartment pressure as long as the sampling tube is connected to the corresponding gas compartment. Data is now ready for transfer.
10. The measurement is complete if all selected modes are confirmed with a check mark and the red light of the start button is off after the end of the mirror heating phase. If your instrument is not equipped with an SO_2 module then an *X* will remain next to *SO2* indicating that no SO_2 measurement has taken place. If your instrument is equipped with the SO_2 option, and that measurement mode was selected, a check mark will appear next of *SO2*.

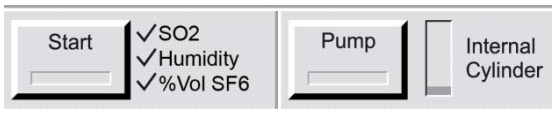


Fig. 50: Measurement completed

11. By clicking the *Read* button the measured values for **Dew/Frost Point**, **Humidity Content, SF6 Vol** and **Pressure** are transferred into the corresponding cells of the Excel sheet. If your instrument is not equipped with an SO_2 module, the **SO2** line will simply remain empty. If your analyzer is equipped with the SO_2 option, the SO_2 reading will be deisplayed in its column.
12. Additionally the **Date** is recorded. The value for the pressure measurement corresponds with the measured value at the moment when the **Read** button is pressed. The stored data for **Dew/Frost Point**, **Humidity Content** and **SF6 Vol** remain stored in the 973 until the next measurement is started.
13. The instrument type and serial number are automatically stored in the last line at the bottom of the page.
14. Note that data communication can be accomplished after completion of the measuring cycle. If the **Read** button is pressed during the measurement, a message appears which requests you to wait for completion of the measurement. If this message is displayed, just click **Ok** and wait for the measurement to complete, then press the corresponding **Read**

button again.

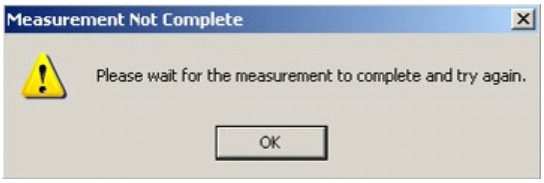


Fig. 51: Incomplete measurement warning

7 Care and Maintenance

7.1 Calibration of the Touchscreen

Interval:
- If necessary

If necessary, calibrate the touchscreen to your preferred point of contact. Left-handed and right-handed persons may have different pressure points when operating the touchscreen.

Proceed as follows:

1. Press *Enter* on the numeric keypad for 3 to 4 seconds. Two tones indicate that the command has been accepted.

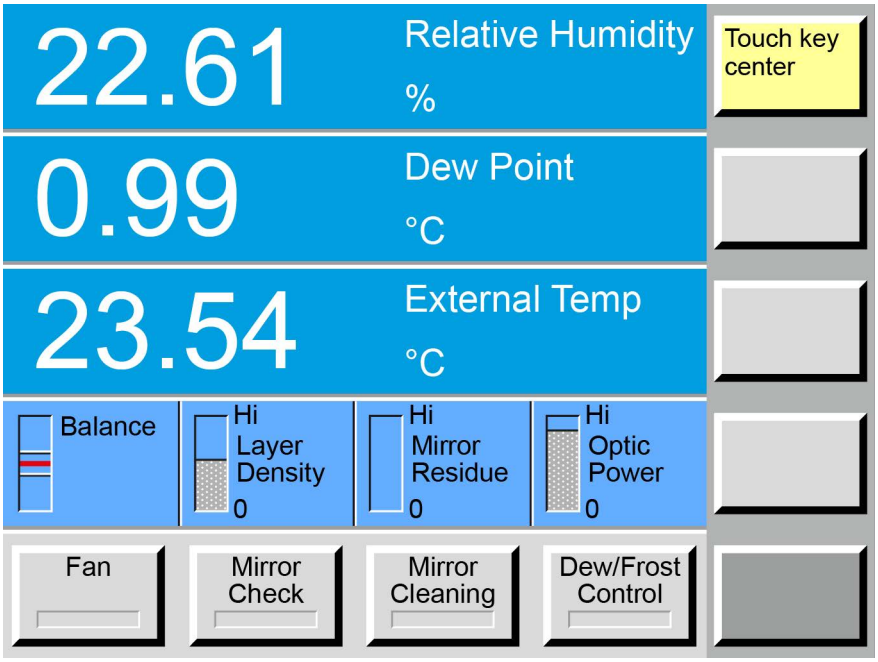


Fig. 52: Calibrate the touchscreen (the display on your analyser may look different)

2. Tap the center of the yellow button in the top-right corner. This button says *Touch Key Center*.
3. After tapping this button, it changes color and another button turns yellow.

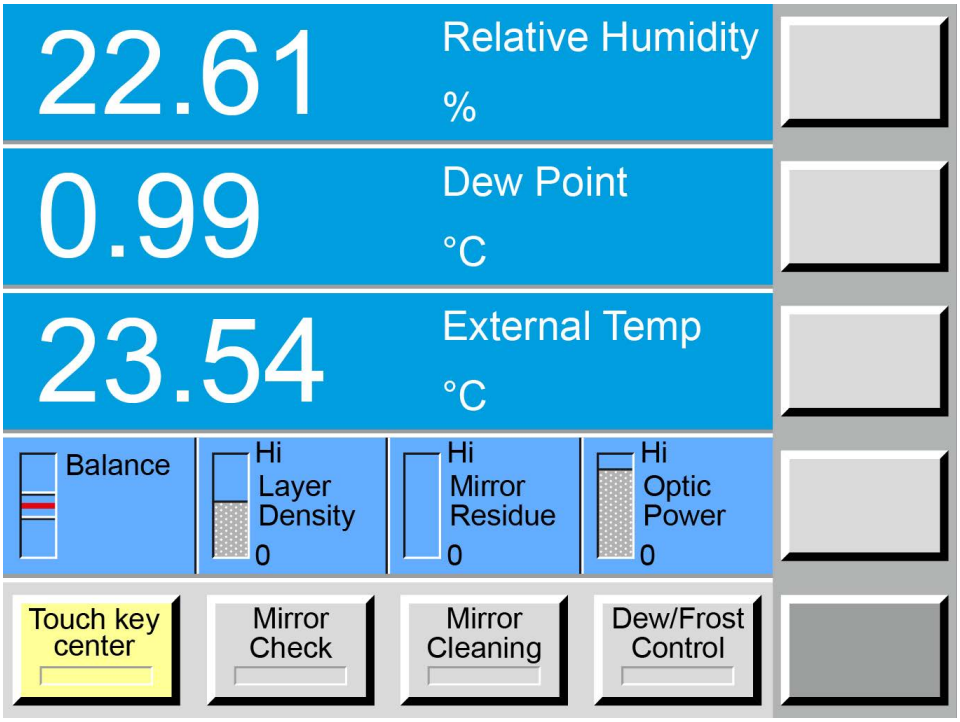


Fig. 53: Calibration (the display on your analyser may look different)

4. Tap the button, now highlighted in yellow, in the bottom left corner of the touch screen. As soon as you press this button, it changes its color.
5. Repeat step 4 until the touch screen calibration is complete.
6. Now test the touchscreen calibration by repeatedly touching each of the six empty menu buttons on the right. If they do not respond correctly to tapping, repeat the calibration.

7.2 Check and Clean Mirror

Interval:
- *Before each measurement*
- *If necessary*

In order to obtain a high accuracy of the measurements, the mirror must be free from contamination. The flush-mounted mirror is accessible after removing the cover and the optical unit.

7.2.1 Preliminary Tasks

The measuring head is located on the right side of the front panel. In order to reach the mirror or the other optical components, the head cover (**1**) and the optical unit (**2**) must first be removed.

Proceed as follows:

1. Turn the head cover (1) counterclockwise (after about three turns the head cover can be removed).

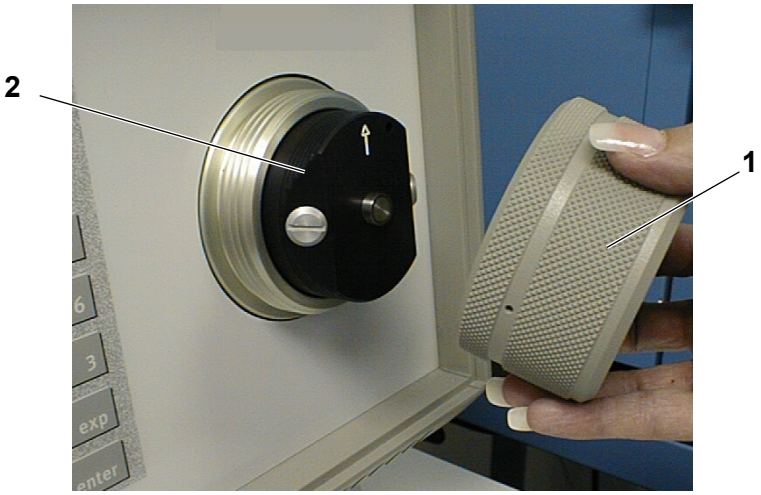


Fig. 54: Head cover and optical unit

2. Remove the optical unit (**2**) by pulling it out. The oval O-ring seals the measuring head.

Warning of Impurities

Avoid touching the surface of the optical unit with your fingers to prevent contamination of the contacts, the O-ring, the optical area and the gas duct.

Warning

Fig. 55: Remove optical unit

7.2.2 Task

Proceed as follows:

1. Check the mirror for contamination. Use a magnifying glass if necessary. If there is evidence of contamination, or if you suspect contamination is present, use the following procedure to clean the mirror.
2. Clean the mirror with a cotton swab or a lint-free paper towel moistened with distilled water.
3. Dry the mirror with a dry cotton swab or a lint-free cloth.

Warning

Improper cleaning

Never try to polish the mirror. The surface of the mirror is slightly roughened in order to achieve better dew formation.

Notice

If necessary, the mirror can be cleaned with methanol or alcohol. After using "chemical agents", the mirror must always be cleaned with water. This will remove any chemical residues.

7.2.3 Final Tasks

1. Install the optical unit. Note the position of the guide pin.
2. Put on the cover cap or the button-clamp assembly and tighten it by hand - but not too tight.

7.3 Exterior Cleaning

Interval:
- *If necessary*

Proceed as follows:
1. The front panel, including the touch screen and the numeric keyboard, is self-contained; clean with a liquid glass cleaner or a mild glass cleaner with a lint-free cloth.
2. The rear fan covers require periodic cleaning. Use oil-free compressed air to remove dust and debris.

7.4 System Information

Here you can get information about the model, the software version or the serial number:

1. Tap the menu selection button in the lower right corner.
2. Tap the *System Info* button.
3. Exit the display with OK.

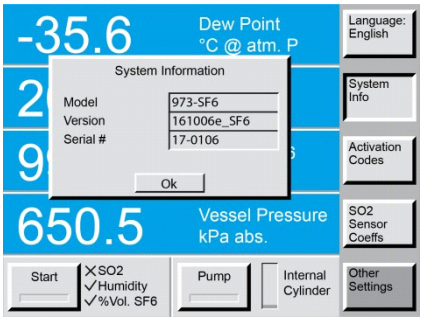


Fig. 56: System Information

7.5 Ice Test

Interval:
- *If necessary*

The test can be performed at any time. Process Insights GmbH recommends an ice test if the results of the measurements do not meet your expectations or the analyzer is assumed to be faulty.

Proceed as follows:

1. Press the lower right menu key and select the *Control Setup* menu. *Control Setup* appears on the key while the keys above change to the available menu options.

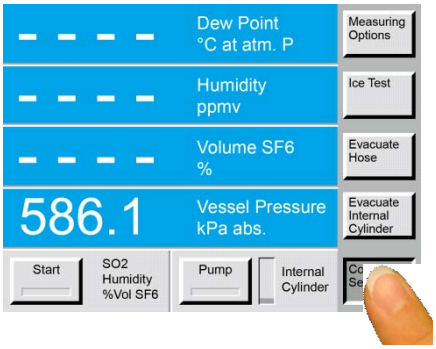


Fig. 57: Select control setup menu

2. Press the *Ice Test* menu key. A window requests you open the measuring head.

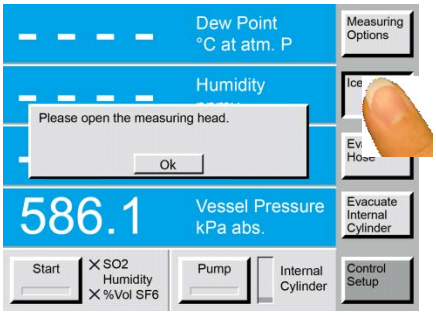


Fig. 58: Ice test

3. Twist-open the screw cover counter- clockwise.

Fig. 59: Remove lid

4. Once the screw cover has been removed, the black optical module can be removed by pulling it straight toward you. The mirror is now visible and you are ready to perform the Ice Test.

Fig. 60: Remove optical module

5. Confirm that you opened the measuring head and are ready for the Ice Test by pressing the *Ok* button. The test starts immediately after pressing the *Ok* button.

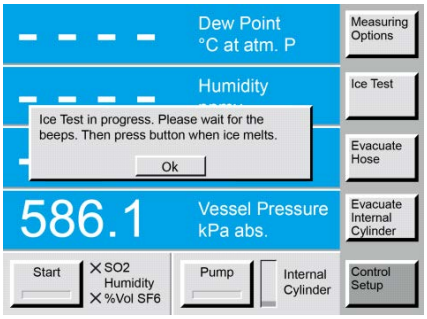


Fig. 61: Initiate ice test

6. Visually observe the mirror. As soon as the mirror tempera- ture crosses 0 °C, the ice will melt into liquid water drops (phase transition).

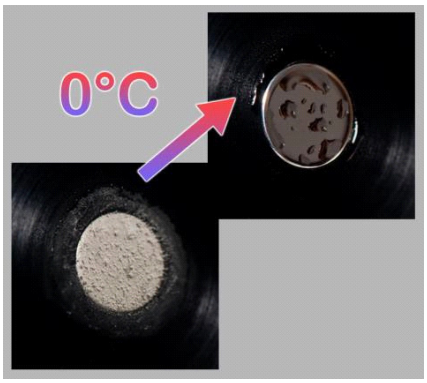


Fig. 62: Phase transition

7. When you observe the phase transition on the mirror, press the *Ok* button. The mirror temperature is measured at that moment and a dialog box appears with the test results.

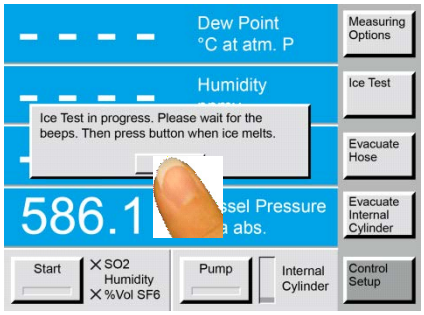


Fig. 63: Confirm transition phase

8. If the measured ice-melt temperature was in the range of ± 0.2 °C, the check is successful and will be indicated with the calibration status *PASS*.

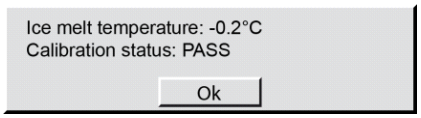


Fig. 64: Ice test passed

9. If the measured ice-melt temperature was outside the range of ± 0.2 °C, the check was not successful and will be indicat- ed with the calibration status *FAIL*. In this case the ice test should be repeated. If it continues to fail, the instrument should be sent to the manufacturer or an authorized agent for evaluation and/or repair.

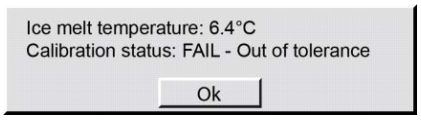


Fig. 65: Ice test failed

10. Press the *Ok* button on the *PASS/FAIL* status window.

11. The next window requests you to clean the mirror.

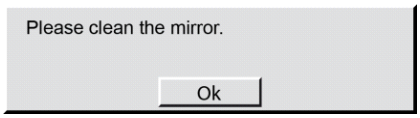


Fig. 66: Clean mirror

12. Click OK and proceed as described in Chapter 7.2.2 and Chapter 7.2.3, page 54.

7.6 SF_6 Condensation Test

Danger

Danger of contact with sulfur hexafluoride SF_6

Sulfur hexafluoride (SF6) is a pressurized liquid gas.
If heated, the container may explode.
Use a breathing apparatus (isolation device) in case of lack of oxygen. High concentrations of the gas can cause suffocation. Symptoms can include loss of mobility and loss of consciousness. The victim does not notice the suffocation.
Ensure adequate ventilation.
Contact with the evaporating liquid can cause frostbite of the skin.

Interval:
- *If necessary*

The analyzer measures the condensation temperature of SF_6 to determine its purity. By measuring SF_6 gas with at least 99.9% purity, you can evaluate the performance of the instrument and whether recalibration is necessary.

Proceed as follows:

1. Connect the sample hose to the analyzer and run the *Evacuate Hose* procedure (see Chapter 4.6.1, page 26).
2. Connect the sample tube to a certified pure SF_6 cylinder with the regulator.
3. Set the regulator to a value lower than 10bar (1000kPa).
   SF_6 quality of 3.0 (>99.9%) is sufficient. The condensation temperature of pure SF_6 is -47.75 °C at 250kPa (2.5bar).

Fig. 67: Gas cylinder with regulator

4. In the *Measurement Control Setup*, activate the *%Vol SF_6 Measurement*

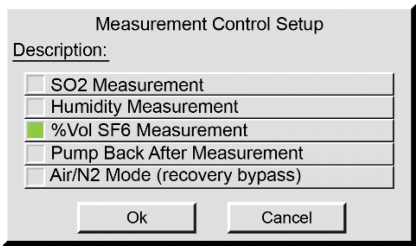


Fig. 68: Measurement control setup

5. Make sure that *Pump Back After Measurement* is deactivated; pump back through a cylinder regulator is not possible.
6. The result of the SF_6 condensation test must be within ± 0.5% for the instrument to be within specification. If the result is out of range after 3 tests, contact Process Insights GmbH or your local supplier for service support.

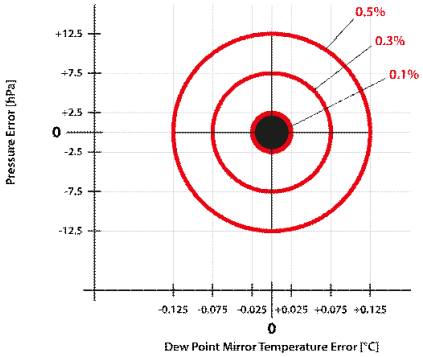


Fig. 69: Test results

7. By completing both *Ice Test* and *SF_6 Condensation Test* you have evaluated the Dew Point Mirror temperature measurement at 0 °C and -47.75 °C. Having two calibration points allows you to assume a linear Dew Point Mirror temperature error between those two points.
8. These On-Site Calibration Checks only work with Chilled Mirror Instruments using the condensation technique for SF_6 purity measurement.

7.7 Replacing the SO2 Measurement Cell (Optional)

Danger of contact with sulfur dioxide SO_2

Danger

Sulfur dioxide (SO_2) is a pressurized, poisonous gas.
If heated, the container may explode.
Gases and vapors are poisonous and must not be inhaled. Sulfur dioxide causes severe skin burns and serious eye damage.
Use a Class E respirator.
Wear protective gloves, protective clothing, eye protection or face protection.

Interval:
- *If necessary*

Replacement cell assemblies are readily available and are supplied pre-adjusted for direct in- stallation into the 973.

Proceed as follows:

1. Disconnect the analyzer from gas and electrical connections and remove the four module screws.

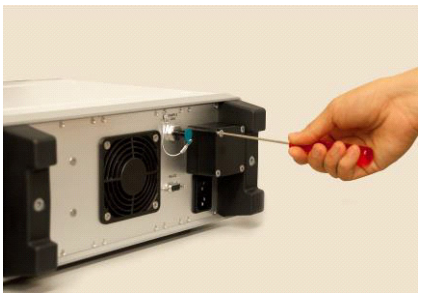


Fig. 70: Remove module screws

2. Pull straight back to remove the existing SO_2 measurement cell assembly.

Fig. 71: Remove cell assembly

3. Install the replacement assembly making sure the sealing O-ring remains correctly in place and the pins are correctly lined-up.
4. Replace the cover and screws.
5. Reconnect power and sample gas lines.

7.8 Analyzer Calibration

One of the most important attributes of the 973-SF_6 is its precision and long-term stability thanks to the chilled mirror technology used in the measurement of dew/frost point and SF_6 purity.

Calibration checks can be performed by the user, but when measurement errors are identified, or to meet the requirements of a Quality Systems, re-calibration can be peformed by Process Insights GmbH or an approved service center.

Calibration frequency is the responsibility of the user to define based on usage, user calibration check results or the user's quality procedures. Process Insights GmbH recommends a calibration frequency of 3 years.

7.8.1 Recalibration of the 973-SF_6 Analyzer

Notice

Please contact our sales department to order calibration options (Chapter 10.1, page 75).

Process Insights GmbH offers the following calibration options:

Complete Standard Calibration 973-SF_6 Analyzer, includes:
- Software update
- Evacuation of the instrument and check of the tubings
- Calibration:
- Pressure sensors P1, P2, P3
- Dew points +1 & -40 °C
- SF_6 purity in %

Complete Standard Calibration 973-SF_6 Analyzer incl. SO_2, includes:
- Software update
- Evacuation of the instrument and check of the tubings
- Calibration:
- Pressure sensors P1, P2, P3
- SO_2 module
- Dew points +1 & -40 °C
- SF_6 purity in %

7.8.2 Calibration of optional SO_2 Measurement Cell

Danger

Danger of contact with sulfur dioxide SO_2

Sulfur dioxide (SO_2) is a pressurized, poisonous gas.
If heated, the container may explode.
Gases and vapors are poisonous and must not be inhaled. Sulfur dioxide causes severe skin burns and serious eye damage.
Use a Class E respirator.
Wear protective gloves, protective clothing, eye protection or face protection.

Notice

Please contact our sales department for calibration and ordering of SO_2 measuring cells (Chapter 10.1, page 75).

Electrochemical SO_2 measurement cells have a life of 2 years, after which they must be replaced with a new calibrated sensor module. SO_2 calibration can also be performed during factory or service centre calibration. The SO_2 sensor can be supplied with a calibration certificate if required.

For information regarding replacement of the SO_2 sensor module see Chapter 7.7, page 62.

8 Technical Information

Notice

We reserve the right to make any graphic, electronic or mechanical changes that serve technical progress.

8.1 Device Specifications

Table 2: Specs

Specifications	973-SF_6
Measuring Range	
Frost/Dew Point	-50...+20 °C
Humidity content by volume	40...20'000 ppm_v
Humidity content by weight	5...2'500 ppm_w
Volume SF_6	80...100%
Inlet pressure	120...1'000 kPa abs.
Accuracy	
Frost/Dew Point	≤ ± 0.5 °C
ppm_v/ ppm_w	≤ ± 1 ppm +6% of reading
Volume SF_6	≤ ± 0.5%
Pressure	≤ ± 3 kPa

Standard Features				
Digital I/O	RS-232			
Thermoelectric mirror cooling	3-stage			
Mirror temperature sensor	RTD (Pt-100)			
Display	5.7” LCD with touch screen			
Internal gas tubes	Stainless steel 316L / FEP			
SO_2 preparation	Mechanically and electrically prepared, measurement cell cover fitted			
Gas connections	Self-sealing quick connect fitting (Swagelok® QM Series)			
Couplings	Self-sealing SF_6 coupling DN8 (VK/F-02/8) and DN20 (VK/F-02/20)			
External sample gas tube	Self-sealing 6 m stainless steel armored PTFE tubing			
ORIS	**O**ptimum **R**esponse **I**njection **S**ystem			
Transport case	Custom fit foam lined Peli 1620			
Power cable	2.5 m			
Operating instructions	English, German, French or Italian			
Calibration certificate	Pressure calibration, 2-point dew/frost point, 3-point volume %SF_6			
Optional				
Internal SO_2-Module	Measuring range:	0...100 ppm_v	or	0...500 ppm_v
	Accuracy:	< 2% of range		< 2% of range
	Sensitivity drift:	≤ 5% / year		≤ 5% / year
	Life time:	2 years in normal operation		
Additional Information				
Supply voltage	100 - 240 VAC +/- 10%, 50/60 Hz (auto switching)			
Supply voltage fluctuations	up to ± 10% of nominal voltage / Overvoltage category II Rated pollution degree 2			
Power consumption	150 Watt			
Pump back pressure max.	900 kPa			
Cooling	Air			
Operation conditions	-10 °C...+40 °C, 98 %rh, non-condensing, operating altitude max. 2000 m			
Storage conditions	-20 °C...+50 °C, 98 %rh, non-condensing			
Outdoor use	Permissible, instrument must be protected against exposure to water			
Weights & Dimensions	**Instrument**		**with Transport Case**	
Width x Height x Depth	420 x 155 x 390 mm		650 x 370 x 510 mm	
Weight	16.5 kg		32 kg	

8.2 Dimension Drawings

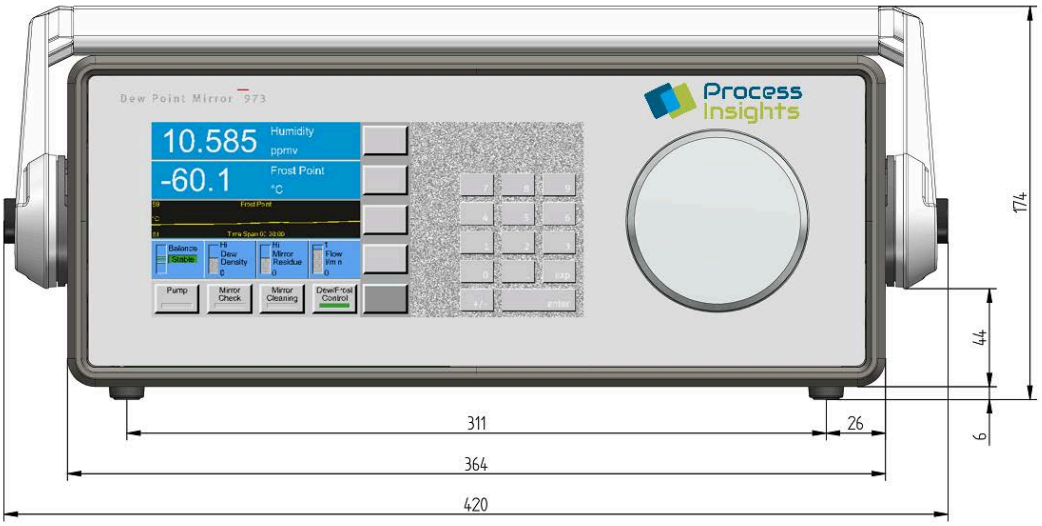


Fig. 72: Front view

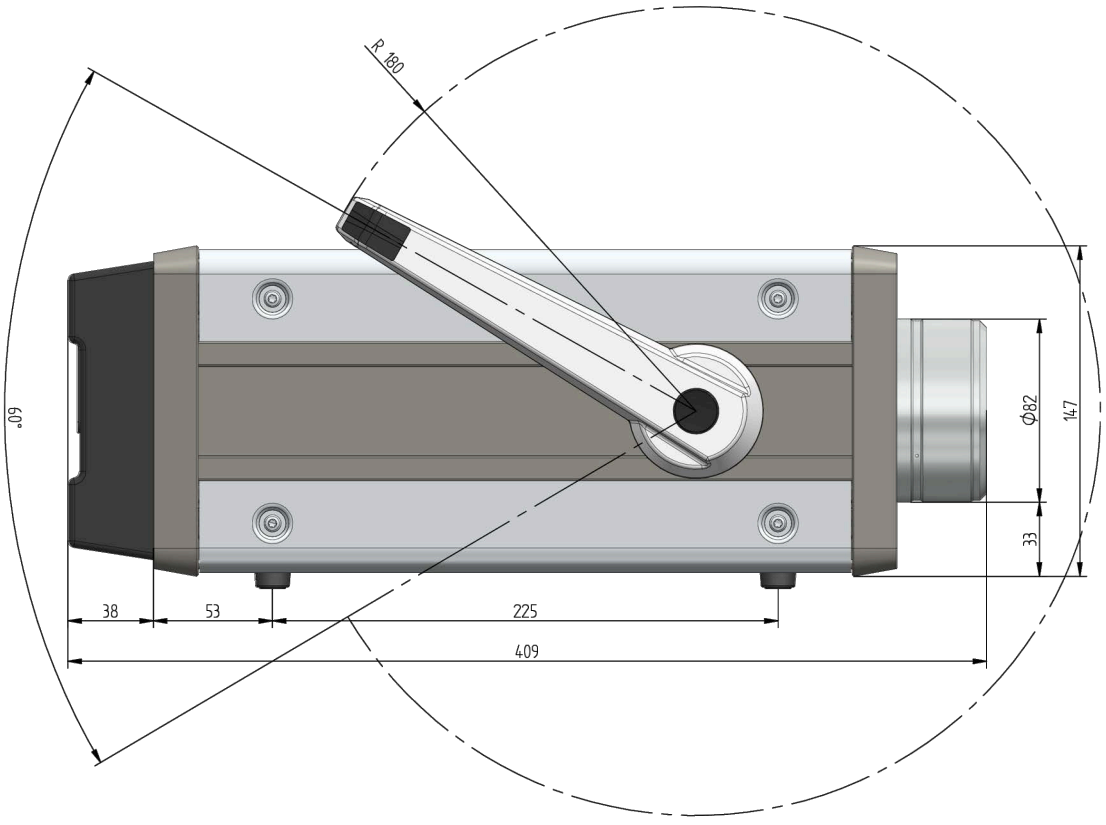


Fig. 73: Side view

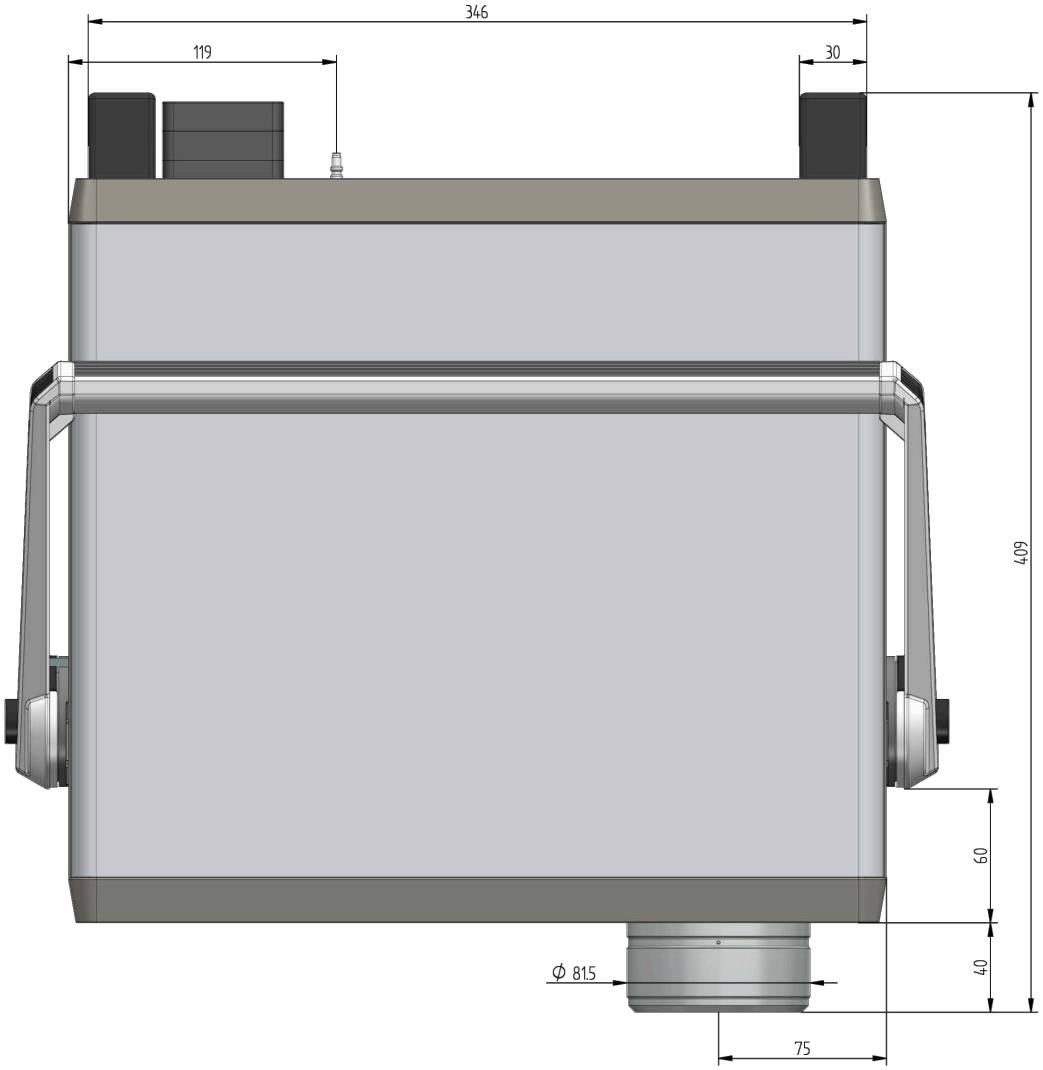


Fig. 74: Top view

9 Dew and Frost Point Measurement

9.1 Measurement of Frost and Dew Points

Since each chilled mirror is best suited for a specific dew point/freezing point temperature range, it is important to have a basic understanding of the value being measured to ensure the correct gauge is being used.

In addition to the choice of measuring device, your success depends on other factors:

- Selection and connection of the lines
- Cooling and heating needs
- Flow rate
- Cleanliness of the mirror
- Dew or frost determination

As soon as the chilled mirror is switched on, the mirror cooling is in standby mode. Temperatures, pressure and flow are measured in standby mode, but no humidity-related data is provided. Upon activation of the dew/freeze control, gas flows over the mirror. From this point on, humidity data (dew point, frost point, % RH, etc.) can be read on the device display.

If the relative humidity (% RH) needs to be measured, an external temperature sensor must also be connected.

9.2 Determination of the Condensate Layer

Due to the phenomenon of supercooled water, water can remain in the liquid phase at temperatures well below 0 °C. The fact that water can condense as either dew or frost at subzero temperatures makes it difficult to determine whether the condensate layer on the mirror is liquid or solid at temperatures below 0 °C, which is crucial for the measurement result.
The ForceFrost™ feature supercools the mirror to solidify the condensed layer. This eliminates the uncertainty as to whether the dew or frost point is being measured. Rapid cooling of the mirror below -4 °C creates frost and then quickly stabilizes the mirror again at freezing point temperature.

9.3 ORIS System

The ORIS system (Optimal Response Injection System) speeds up the measurement when measuring very low frost points. This is the case, for example, when the gas is drier than a frost point > -60 °C.
ORIS works by precisely injecting a small amount of water vapor into the dry gas stream. This accelerates the build-up of dew on the mirror, which is required for the measurement. The process allows the required dew layer to be built up in minutes, which could otherwise take hours.
ORIS is normally used for measurements below -60 °C, but the response temperature can also be set manually.

9.4 Limits of the Measurement Range

Each Dew Point Mirror has a specific measuring range. The entire range is

-95° C frost point ... +95° C dew point

To achieve this, two or more devices (with an overlap area) must be used.
The information in this chapter gives some guidelines for the range of use of your device, even if your device may differ slightly. Use the serial number of your device for the exact determination (see type plate (sticker) on the back of the device or *Chapter 7.4 on page 55*).

9.5 Differentiation between Dew and Frost

For mirror temperatures above 0 °C, water vapor always condenses on the mirror in its liquid phase (dew). A layer of condensation on a mirror above 0 °C is therefore always a dew point.

Although ice always begins to melt at exactly 0 °C, water will not necessarily freeze at 0 °C. Water can stay in the liquid phase at temperatures well below 0 °C. This phenomenon is called "supercooled water".

The fact that water can condense as either dew or frost at subzero temperatures makes it somewhat difficult to determine whether the condensate layer on the mirror is liquid or solid at temperatures below 0 °C. Various factors such as impurities, time, pressure, etc. can cause the condensate layer to remain liquid at surface temperatures of -20 °C and below.
Furthermore, it is important to understand that the difference in temperature at which the liquid or solid condensate layer stabilizes is up to 3 ˚C.

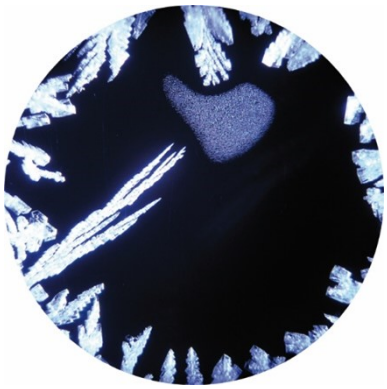


Fig. 75: Dew and frost on a mirror

As can be seen in the figure above, it is also possible for dew and frost to occur simultaneously on the mirror, causing unstable values to be read in the area between the dew and frost points.

Therefore, the phase of the condensate must be known in order to avoid significant errors in correctly calculating all humidity values, including vapor pressure, dew point, % RH, volume ratio, weight ratio, absolute humidity and specific humidity.

It would be desirable for manufacturers and users of moisture measuring devices to use the term frost point for temperatures below zero and dew point for temperatures above 0 °C. While not technically correct, it is common to use dew point for temperatures below 0 °C, although frost point is the correct term. As discussed above, a dew point below 0 °C can exist in the form of supercooled water, but differ in value from the equivalent freezing point temperature. For the same vapor pres-

sure, the frost point is approximately 10 % above the reading from the corresponding dew point (at °C). For example, a frost point of -30 °C corresponds to a dew point of -33 °C at a vapor pressure of 38 Pa. From a measurement perspective, it seems obvious that a clear and consistent distinction between dew and frost points is important.

10 Contact

10.1 Contact to Process Insights GmbH

For questions on your analyser, or for support issues, please go to

https://www.process-insights.com/contact-us/

Contact us by phone, email, or complete the form on the website.

10.2 Maintenance Plans and On-Site Support

Process Insights GmbH offers a wide variety of Service Maintenance Agreements. Depending on your needs and the kind of application you use, our service contracts range from annual preventive maintenance to weekly visits.

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