VYMPEL

Precision | Economy | Safety

Operating Manual

Hygrovision mini

Dew point analyzer

CONTENTS

Analyzer description

Purpose and areas of application

Intended use

The Hygrovision – BL-mini is a compact analyzer designed to measure the dew points of water and hydrocarbons.

It is a portable hygrometer that operates according to the principle of direct measurement and utilizes a chilled mirror to establish dew point temperature.

Areas of application

- ⇒ Spot check measurements in the field
- ⇒ Check the operational performance of permanently installed Hygrometers
- ⇒ Confirm previous measurement results
- ⇒ Regularly measure water and hydrocarbon dew points directly in locations that are not equipped with automatic through-flow hygrometers or where no such instruments can be permanently installed.
- ⇒ Control of various products and working and manufacturing processes (for example, drying and vacuuming of facilities, systems, damp presses, steamers, regenerators, evacuators, etc.)

Hygrovision analyzers can be used in a variety of sectors including the gas, oil and chemical industries, metallurgy, power generation, instrument engineering and many other fields, in order to provide quality control of production processes where water and hydrocarbon dew point values are of relevance.

Explosion Protection

The analyzer is certified “explosion-proof” as defined by EN 60079-0:2009 and it has a “flameproof enclosure” in accordance with EN 60079-1:2007. The Hygrovision mini has an “intrinsically safe power circuit” as per EN 60079-11:2007 and it carries a II 2G Exd [ib] IIB+H_2  explosion protection label according to the Russian GOST. The Hygrovision mini can be deployed in designated explosion risk areas of indoor and outdoor installations in accordance with EN 60079-14:2008, Ch. 7.3 of “Load Regulations” and other rules regulating the use of electrical equipment in explosive areas.

Measuring principle

The instrument uses the condensation method to identify the water and hydrocarbon dew points of a gaseous medium utilizing a mirror that can be heated and cooled when taking measurements.
The measurement process for establishing dew point involves noting the temperature of the mirror at the precise moment condensation forms on its surface.

Moreover, the observation process is supported by two different lighting systems for illumination of the dielectric condensation mirror.

During the measurement cycle the reflectivity of the mirror is monitored. When the dew point is reached reflectivity decreases as a condensation film forms. The temperature (T) at which this happens is the dew point.

The analyzer is equipped with an achromatic 40-power microscope for observing the surface condition of the mirror. The two illumination options are vertical and oblique.
Vertical illumination of the mirror can be used for the visual registration of water and hydrocarbon dew points.
Oblique illumination can be used for the visual registration of the dew point of water only. The low angle of illumination increases the intensity of the reflected light and the diffusion of light as water condenses, making possible earlier and clearer registration of condensation.
Switching between lighting systems during the measurement process and regulating the mirror temperature are done manually via a button pad.
The temperature at which a clear condensation film forms on the mirror's surface is fixed using this button keypad.

Construction

The Hygrovision mini analyzer has an explosion-proof design. For more information about explosion proofing see page 22.

The analyzer consists of a cold body housing, a high-pressure gas delivery system, and an optical system.

The **optical system** includes a microscope and two lighting elements: one mounted perpendicular to the mirror and one at an oblique angle.

The **housing body** of the analyzer includes an electronics unit and a measurement cell. In order to operate independent of power supply restrictions, the body of the Hygrovision mini includes a battery compartment for a specially designed onboard rechargeable battery.

The measurement cell is made up of a gas delivery system, the microscope, and the **measurement chamber**. The measurement chamber is designed to withstand a working pressure of 100 bar.

The measurement cell includes the temperature-controlled condensation mirror, which has an integrated thermal sensor, a thermoelectric battery, and a light diode for providing oblique illumination.

The **gas delivery system** guides sample gasses over the temperature-controlled mirror in the measurement chamber. This unit also includes a small observation window for monitoring the condensation process and a particle filter to protect against contamination.

The microscope is mounted directly onto the gas delivery system at a site designed for this purpose. The lighting system for the vertical illumination of the mirror's surface is integrated into the microscope.

The **electronics unit** is made up of a liquid crystal display, the replaceable power source, (battery) and a four-button control unit (button pad). The electronics unit makes it possible for the user of the Hygrovision mini to control, for example, how rapidly the condensation mirror is cooled or heated. The button pad of the control unit is also used to operate and turn the analyzer on and off as well as select the illumination system.

Information about the last measurement and system information are shown on the **Liquid Crystal Display** (LCD).

A charging unit is delivered with the analyzer for recharging the battery.

The main components and controls of the analyzer

Illustration 1

Illustration 2

1) Locking lid of the battery compartment
2) Sample gas inlet nozzle
3) Padded eyepiece
4) Mirror illumination cable
5) Sample gas outlet nozzle

6) Ventilation channel for supplemental housing cooling
7) Locking mechanism for the electronics unit cover
8) LCD screen
9) Extendable handle
10) Control unit
11) Housing body
12) Ventilation channel for supplemental mirror cooling
13) Resolution control ring
14) Battery compartment lid locking mechanism

Hygrovision mini power supply

The analyzer is equipped with an independent source of electricity: power supply unit IP-01 (battery).

Attention!
The battery should only be charged using the charging unit that is specifically designed for this purpose.

Important technical data:

- Battery type ⇒ LIR18650 (Lithium-Ion Li-Ion);
- Number of cells ⇒ 6
- Nominal voltage ⇒ 11.1 V
- Discharge current ⇒ max. 3A
- Electrical capacity ⇒ 14,400As
- Standard service life ⇒ min. of 300 charge/recharge cycles; max. 2 years
- Operating conditions ⇒ -20°C to + 60°C

Control and display elements

Illustration 3

A four-button control unit is used to operate and adjust the analyzer. The button pad is located to the right of the LCD screen (pos. 1 to 4, illus. 3)

The buttons serve different functions depending on the control mode selected.

These functions are listed in table 1.

Information about the current measurement as well as information about the system is displayed on the LCD screen (pos. 5, illus.3).

Pos.	Description	Color	Function
1	“Menu”	Red	Analyzer on/off; Return to main menu **without** saving or applying changes; Quick access to the main menu
2	“Select”	Yellow	Open the main menu; Return to the main menu (save / apply changes); Switch illumination mode
3	“Up”	Black	Scroll through menu sub-points; Increase the value of the selected parameter; Raise the mirror temperature; Mark the evaporation temperature

4	“Down”	Black	Reduce the value of the selected parameter; Lower the mirror temperature; Access cooling parameter adjustment mode; Mark the condensation temperature

Turning the Hygrovision mini on and off

Hold down the menu button (red) for a few seconds to turn the analyzer on (pos. 1, illus. 3).

After the device has been turned on, the software version is displayed on the LCD screen for 2–3 seconds.

When this message disappears the analyzer is in the dew point measurement mode and ready for operation.

To turn the analyzer off, hold down the menu (red) button until the LCD screen goes off.

Menu of the Hygrovision mini

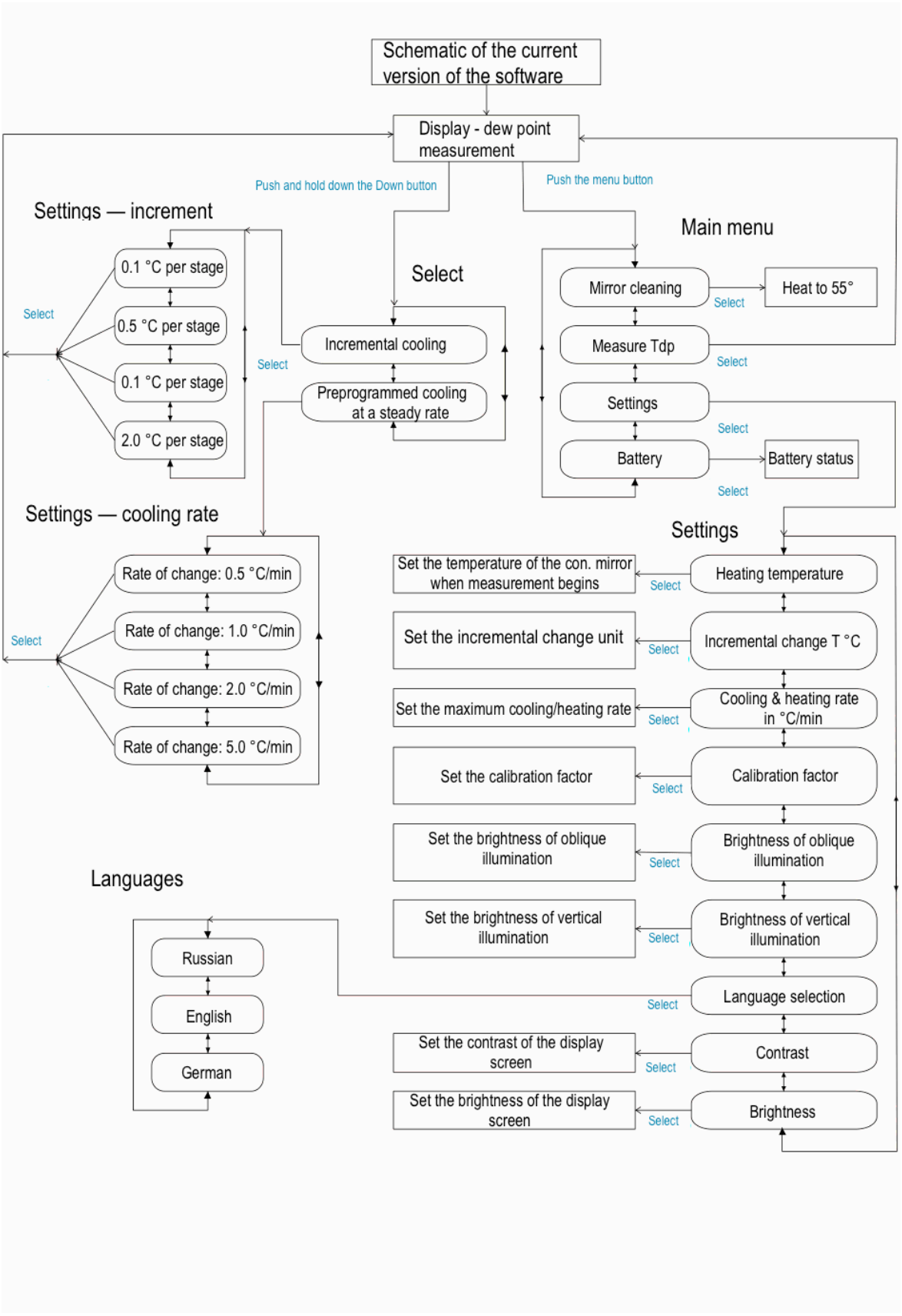


Illustration 4

Main menu

Illustration 5

Briefly push the menu button to select the main menu.
The main menu consists of the analyzers main functions, which are organized thematically under these four menu points:

- Mirror cleaning
- Dew point temperature measurement (Tdp)
- Settings
- Battery

Mirror cleaning

Illustration 6

In the “Mirror cleaning” mode, the analyzer automatically heats the surface of the condensation mirror to a predetermined temperature. This temperature will be maintained until the cleaning program is completed. The factory preset mirror-cleaning temperature is +55 °C.

In cleaning mode, the Hygrovision mini displays the following information (illus. 6):

- Program code (M10);
- Pre-programmed mirror temperature (54.9 °C — *large number in the display*);
- Current housing temperature (T_b= 24.4 °C);
- Current battery charge (100%)

After the cleaning program is complete, inspect the condition of the mirror through the eyepiece of the microscope. Should contaminants remain on the mirror after the cleaning cycle is completed, follow the instructions for manually cleaning the mirror.

To leave the cleaning mode press the menu button.

Measuring dew point temperature (T_{dp})

Illustration 7

Make sure the analyzer is turned on and select the “Dew point measurement” mode. Use the “up” and “down” buttons to scroll through the menu points and push the “select” (yellow) button to choose the measurement mode.

In the dew point measurement mode the analyzer’s LCD screen will display the following information (illus. 7):

- Program code (M20);
- Current mirror temperature (24.2 °C — *large number in the display*);
- Pre-programmed mirror temperature: T (24.2°C);
- Temperature of the housing T_b (24.2°C);
- Battery charge (100%)

When the dew point measurement mode is selected, the mirror temperature is determined by the temperature of the housing (T_b) and the parameter value M31, specified as the “heating temperature”.

During the dew point measurement process, the analyzer is controlled using the select, up, and down buttons.

Settings

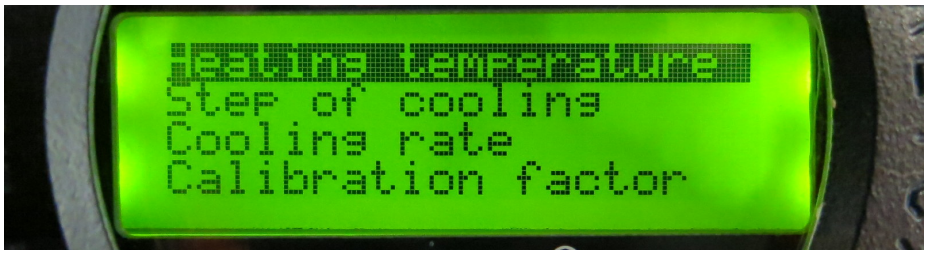


Illustration 8

The main operating parameters for the analyzers can be adjusted in the Settings mode (illus. 8). These parameters are:

- Heating temperature (M31)
- Temperature change interval for mirror cooling during the measurement cycle in °C (M32)
- Rate of heating and cooling °C/min (M33)
- Calibration factor (M34)
- Brightness of oblique illumination (M35)
- Brightness of vertical illumination (M36)
- Language (M37)
- Contrast (M38)
- Display brightness (M39)

Use the Select button to choose the corresponding sup-menu point.

Use the Up and Down buttons to make changes to the selected parameter.

Confirm the newly set value(s) by pushing the Select button.

For the factory default parameter settings see Appendix C.

Status of the battery charge

Illustration 9

Specific parameters for the battery (IP 01) can be viewed on the LCD (illus. 9).

Table 2 is a list of the most important parameters and the respective tolerable minimum and maximum value tolerances.

Table 2

Parameter	Code	Tolerance values
Voltage	U_a	9.0 – 12.6 V
Operating current	I_a	0.01 – 2.5 A
Charge status	Q_a	5 – 100 %
Temperature	T_a	-20°C – + 60°C

If a battery parameter value is outside of the range listed for that parameter in Table 2, the appropriate error message will be displayed. (Table 6).

Attention – In the first 5 seconds after this mode is selected, the maximum operating current detected during analyzer operation is determined and the voltage corresponding to the maximum power demand is displayed.

Program codes

Each of the analyzer's program points has its own code, which is shown in the upper left hand corner of the display.

Table 3 shows a list of these program codes.

Table 3

Code	Program point
M10	Mirror cleaning
M20	Measurement
M21	Measurement with incremental temperature change
M21M	Cooling parameter settings
M22	Measurement with cooling and heating rate
M23	Measurement with cooling and heating rate (when heating the mirror)
M30	Settings
M31	Heating temperature
M32	Change interval setting
M33	Maximum cooling rate setting
M34	Calibration factor setting
M35	Contrast setting (oblique illumination)
M36	Contrast setting (vertical illumination)
M37	Language selection
M38	Display contrast setting
M39	Display illumination setting
M40	Battery

Accessories and additional equipment

Accessories and additional equipment are included in the delivery of the Hygrovision mini.

Table 5, provides a list of these items.

Battery charger

In order to charge the analyzer's battery a battery charging unit (KRAY5.122.009ET) is included with delivery. Instructions for using and handling the battery charger are listed on the sticker that accompanies the charger.

Sample gas delivery system

Illustration 10

The sample gas delivery system included in delivery of the Hygrovison mini consists of: a high-pressure valve, 2.5 meters of high-pressure hose, and a quick-connect coupler.

This system provides the user with a method for steadily supplying the analyzer's measurement chamber with sample gas.

Through-flow and control system

Illustration 11

The through-flow and control system consists of a fine control valve, manometer, rotameter with protective housing, and a quick-connect coupler. This system makes it possible to control and regulate the flow of sample gas into the measurement chamber.

The system includes a 2.5-meter PVC hose to be attached to the rotameter's outlet nozzle for the safe release of the sample gas.

Particle filter

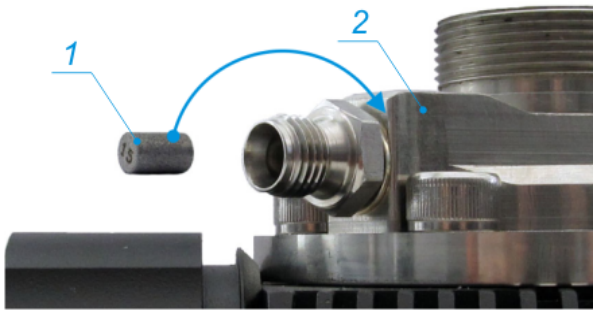


Illustration 12

Solid particulate matter and other mechanical contaminants are removed from the sample gas with the aid of a particle filter. The filter cartridge is inserted into the gas inlet nozzle of the gas delivery unit of the analyzer's housing.

The particle filter is included with the analyzer and is pre-installed for original delivery. Replacement particle filter cartridges are included in delivery as part of the additional equipment.

Detailed instructions for replacing the particle filter are listed on page 44.

The analyzer can be operated without a particle filter.

Filter for the control of glycols and heavy hydrocarbons

Illustration 13

This filter for the control of glycols and heavy hydrocarbons is included in delivery of the analyzer. It is inserted as an additional control when measuring the dew point of water, when the sample gas contains a large quantity of glycols and heavy hydrocarbons.

Sampling equipment

In order to install a fixed sampling point, a gas sampling set can be ordered separately. This set consists of sampling equipment (see Appendix D) a by-pass valve, and a membrane filter for removing liquids and particulates from the gas sample (see Appendix E).

Additional cooling system

If very low dew point values (below -40 °C) are to be measured where the pressure conditions and external temperature are high (over +35 °C), it may be necessary to purchase an additional cooling set.

The cooling system consists of a container filled with carbon dioxide, two nozzles, and a valve for regulating the coolant flow.

It is also possible to cool the housing of the analyzer using various liquids, such as water or alcohol solutions.

Technical data

Table 4

Measurement range:	Water	≥ -50 °C ($T_{housing}$)
	Hydrocarbons	≥ -50 °C ($T_{housing}$)
Absolute error	Water	±1 °C
	Hydrocarbons	±1 °C
Recommended volume of sample gas stream		0.3 – 0.5 N L/min
Power supply: voltage		9 – 12.6 V
current / power requirement		4 Ah / 15 W
Battery charge life		Min. 12 h

Operating temperature range	-10 °C – +50 °C
Ambient humidity	Max. 98% at < + 35°C
Operating pressure	< 100 bar
Sample gas temperature	-20 °C – +50 °C
Enclosure protection per IEC 60529	IP 54
Dimensions (without Microscope)	253x120x110 mm
Weight (without replacement parts and accessories)	3.8 kg
Suitable installation	In closed rooms or in open areas (explosion hazard zones)
Connection to the sample gas delivery piping	Swagelok connector for pipes (tubes) with an outer diameter of 6 mm
Service life:	
- Analyzer*	10 years
- Battery	300 charging cycles max. of two years
* - with regular maintenance and replacement of parts subject to wear	

Hygrovision mini component parts

Table 5

Designation	Description	No.	St.	Notes
Included in delivery				
VYMP2.844.011	«Hygrovision mini» dew point analyzer incl. the following equipment and accessories:		1	
KRAY3.821.003	Microscope		1	
KRAY4.853.185	Microscope cable			
VYMP4.161.001	Transportation case	–	1	
VYMP5.122. 001	Battery charger		1	
VYMP5.549.001	Rechargeable battery		1	
VYMP5.183.001	Through-flow meter	–	1	
VYMP6.450.001	High-pressure hose for sample gas supply (length 2.5 m)	–	1	
VYMP6.451.014	Filter for the removal of glycols and heavy hydrocarbons			
KRAY4.160.001	Replacement cartridge set for the VYMP6.451.014 filter (10 replacement cartridges including absorbent medium)			
VYMP6.451.013	Regulator	–	1	
	PVC pipe w/ inner diameter: D6x1.5; length: 2.48m	–	1	
	Optics cleaning solution (Eclipse 59 ml)	–	1	
	Cotton swabs for cleaning the sensors (50 ct.)	–	1	
	Adapter (12V)	–	1	
	AC adapter (220V)			
Operating documentation:				
VYMP2.844.001RE	Operating manual	–	1	
VYMP2.844.001MP	Testing documentation			
VYMP2.844.001FO	Information form			
VYMP5.122.001ET	Battery charger instruction manual			
VYMP6.451.014ET	Filter instruction manual (VYMP6.451.014 filter)			
Additional equipment (by special order) *				
VYMP5.549.001	Replacement battery IP-01			
TH-650 DV	Stand			
FE73-15	Replacement particle filter			
KRAY5.880.001	Additional mirror cooling set			
KRAY4.078.091	Gas sampling set (consists of a sampling device (KRAY6.457.013) and a membrane filter (KRAY6.457.022))			
KRAY4.078.091-01	Gas sampling set (consists of a bypass valve (KRAY6.451.013) and a membrane filter (KRAY6.457.022-01))			
130-502	Replacement membrane set for the KRAY6.457.022 (-01) membrane filter			

* The number can vary according to the order

Note:

Depending on the state of technical developments, instruments may have slight variations in construction style and delivery packaging, however these variations have no effect on the fundamental safety and functionality of the analyzer.

Explosion protection

The analyzer has a «flameproof enclosure» in accordance with EN norms 60079-1:2007 and an «intrinsically safe circuit» in accordance with EN norms 60079-11:2007. The analyzer carries the explosion protection markings:
 II 2G Ex d [ib] IIB + H_2 T5.

Ensuring the Hygrovision mini's operational safety

Safety measures

In terms of protection against electrical shock, the Hygrovision mini is a Class 0I (GOST norms 12.2.007.0 SSB) electrical device
The Hygrovision mini may not be used to take dew point measurements of aggressive media or in an aggressive environment.

When in use, the battery charger must be connected to an electrical outlet that is grounded (GOST norms 12.1.030 SSB).
Resistance in the ground circuit must not exceed 4 Ohms.

The valve of the gas sampling system must be closed and the pressure within the sampling system must be adjusted to match ambient atmospheric pressure using the needle valve before the analyzer is connected to or disconnected from the sample delivery pipe.

Visually check the installation point before mounting the analyzer. This check should include confirmation of the explosion protection markings, the integrity of the housing, and the component elements of the analyzer as well as ensuring the proper connection of the external intrinsically safe equipment (if the optical system is attached).

Friction or shocks during installation of the device that could cause sparks are to be avoided. During the installation process please attend to the following:

- ⇒ The proper alignment and order of the detachable connections
- ⇒ That all lids are screwed down fully, in other words all of the threads are covered, when the battery compartment lid and electronic unit cover are installed
- ⇒ If the channel for additional mirror cooling is not to be used, the inlet and outflow nozzles should be covered with the plastic caps provided for this purpose
- ⇒ When in operation, the device should be inspected visually on a regular basis. This inspection should include:
    - ⇒ Ensuring that all lids and caps are properly sealed
    - ⇒ Checking for any dents or other visible mechanical damage as well as dust or dirt that could interfere with the operation of the analyzer.

Using a device that is damaged or malfunctions is strictly prohibited.

Preparing the analyzer for operation

General requirements

Unpacking and visual inspection of the device

Upon delivery, please make sure that the packaging is in good condition. If it is damaged, document this in writing and contact customer service at Vympel GmbH.

Unpack the analyzer carefully. Check that the delivery includes all of the components listed on the accompanying inventory sheet.
Also check to make sure that neither the analyzer no any of its components has been damaged during transportation.

Attention!

Upon receipt of a new analyzer, fully charge the battery (IP 01) of the Hygrovision mini before switching it on for the first time.

Sampling point requirements

Please observe the following criteria when selecting a site where the analyzer will be connected to the pipeline:

- the location should offer convenient access for the mounting, installation and operation of the analyzer
- gas samples should be collected at locations that are specially designed for this purpose
- the ambient temperature and the relative humidity should lie within the tolerance range as listed in Table 4

Connecting the Hygrovision mini

Functional testing

The following points should be checked as part of function testing:

- Condition of the optical system's illumination
- Condition of the condensation mirror
- Performance of the thermoelectric battery
- Battery charge

Testing the optical illumination system

After the analyzer is switched on, it will load its operating system, which takes about 2–3 seconds. The current version of the operating system will be displayed on the LCD screen.
The vertical illumination system is active during the start up process. After the operating system has finished loading, the analyzer switches to oblique illumination and is automatically set to the dew point measurement mode.

Illustrations of various condensates under both types of illumination can be found in appendix B.

Use the select button to switch between vertical and oblique illumination.

If the start-up process proceeds without difficulty it can be assumed that both lighting systems are operating properly.

Lighting intensity can be adjusted in the "Adjustment" mode.

Check of the condensation mirror

Use the microscope to visually inspect the surface of the condensation mirror. Make sure that the microscope is properly focused.

It may be that the appearance of the surface of a clean mirror will differ from that shown in appendix B. These differences are due to the heterogeneous nature of the dielectric material and the mechanical preparation of the mirror's surface. It may therefore be the case that under oblique lighting small red points or cross-hatching may appear.

If three fourths of the entire surface of the mirror is covered in red dots, it indicates that the mirror is in need of cleaning.

Check of the thermoelectric battery (Peltier element)

Set the analyzer to “Dew point measurement” mode and push the “down” button several times (position 4; illus. 3). This will lower the temperature setting of the condensation mirror. The target value should be -15 °C to -25 °C. The cooling process should not take more than 30 seconds. You can follow the progress of this process by referring to values shown in the LC-display.
When the cooling process is complete select the “Mirror cleaning” mode. Within one minute the temperature of the condensation mirror should reach +55 °C (± 0.2 °C).
When the cooling and heating process proceeds without difficulty, it can be assumed that the thermoelectric element is functioning properly.

Check the battery charge

Select the “Battery” mode.
When the battery (IP-01) is functioning properly, the parameters displayed on the LCD screen will be within the value ranges listed in Table 2.
If the charge is below 20%, the battery should be fully recharged.

The battery should **only** be recharged using the charging unit (KRAY5.122.009), which is delivered with the analyzer.

There are two possible power sources for (re-)charging the battery (IP-01):
- 1. 220V AC power source;
- 2. 12V DC power source

The procedure for charging the battery is also illustrated on the sticker attached to the battery-charging unit (KRAY5.122.009ET).

Attention!
Charging the battery (IP-01) should only take place in explosion-proof areas. The battery should **only** be (re)charged using the recharging unit (KRAY5.122.009), which is delivered with the analyzer!

Connecting the Hygrovision mini

Place the analyzer on a level surface or affix it to a stand near the sampling point.
Attach the through-flow meter (illus. 11) to the outflow nozzle of the measurement chamber (pos. 5, illus 1). Ensure that the through-flow meter's needle valve is closed.
Connect sample-release PVC hose to the outlet nozzle of the rotameter.
After the outlet connections have been made, connect the gas delivery system to the inlet nozzle of the analyzer's measurement chamber. Ensure once again that the high-pressure valve is closed.

***Note**:*
Gas mixtures that contain early-condensing hydrocarbons can make the visual observation of water condensation difficult. In this situation, the filter for regulating heavy hydrocarbons (included in delivery) should be installed. The filter will be installed in addition to the gas delivery system.

Testing the integrity of the analyzer's seals

After the analyzer has been installed, the sampling connections must be tested for seal integrity according to the following procedure:

- Close the valve of the through-flow control system;
- Slowly open the inlet valve of the gas-sampling hose and the inlet valve of the analyzer measurement chamber;
- Apply a soapy emulsion to the connection point between the gas delivery system and the measurement chamber, and the measurement chamber and the through-flow control system — making sure that the emulsion is between the locking nut and the connection collar.

If bubbles form, it indicates that there is a leak at that location. In this situation the corresponding point must be resealed.

Using the Hygrovision mini

Preparing to make dew point measurements

Attention!

When measuring the dew point of flammable gases the measurement chamber and the sampling connection hose must be ventilated for 10 – 20 minutes before connecting the analyzer to the power supply.

When doing maintenance and servicing work on the Hygrovision mini, it should always be disconnected from the electrical supply.

Upon completion of maintenance and servicing work, the measurement chamber and the gas sampling connection should be ventilated for 10 – 20 minutes before putting the analyzer back into operation.

Switch on the Hygrovision mini portable dew point analyzer as described in the handbook above.

Slowly open the gas delivery system valve while watching the associated manometer to monitor the rise in pressure in the measurement chamber.
When the appropriate pressure is reached, open the needle valve to set the sample gas volume flow rate of 0.5 Nl/min. as indicated by the rotameter.

After the measurement chamber has been ventilated in this way for 10 minutes, reduce the volume flow to 0.2 – 0.3 Ni/min. to take dew point measurements.

After the desired measuring pressure has been reached, ensure that the microscope is optimally adjusted for observing the surface of the condensation mirror
Use the focus ring for making fine adjustments to the sharpness of the image.

When working out of doors, the intensity of the mirror surface illumination may need to be adjusted depending on environmental conditions and personal preferences.

After adjusting the illumination intensity and image sharpness, select the “Dew point measurement” mode.

Measuring the dew points of water and hydrocarbons

Visual identification of water condensation

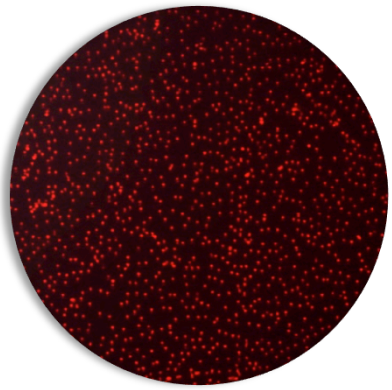


Illustration 15

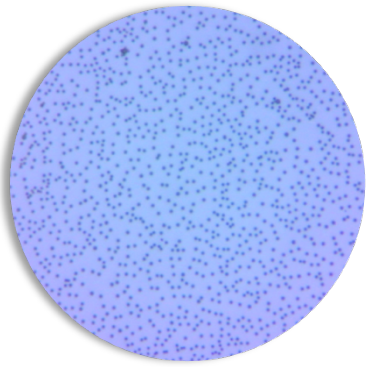


Illustration 16

Using the Hygrovision mini, the operator can observe the condensation of water vapor utilizing either oblique or vertical illumination.

When using oblique illumination, the dark surface of the mirror appears to become evenly covered with red spots as condensation forms (illustration 15).

When using vertical illumination, the light surface of the mirror appears to become evenly covered with dark spots as condensation forms (illustration 16).

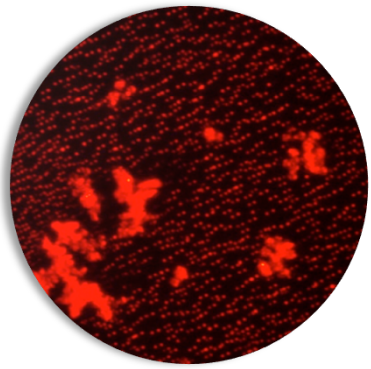


Illustration 17

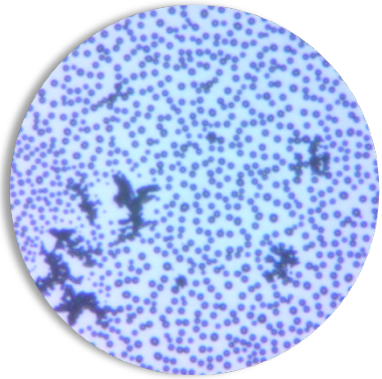


Illustration 18

In the temperature range between 0 °C and -10 °C, it may occasionally happen that condensed water vapor on the mirror surface itself, is in a super-cooled state for a certain period of time.

In the temperature range from -10°C to -50°C, when condensation occurs it can

form on the mirror's surface in both a liquid and crystalline state simultaneously (illus. 17 and 18). In this situation the dew point is also the freezing point.

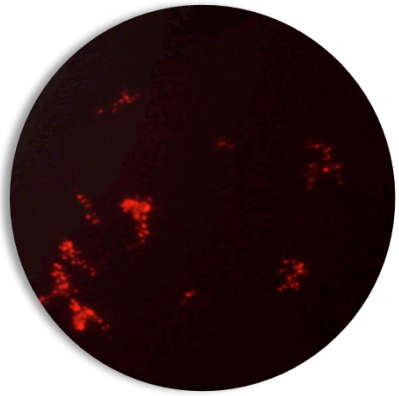


Illustration 19

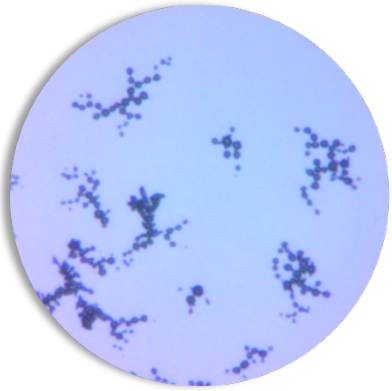


Illustration 20

Under oblique illumination, the ice crystals that form appear as clear luminous red patches when viewed through the microscope (illus. 19).
Under vertical illumination, the ice crystals that form appear as branching dark patches on a light background when viewed through the microscope (illus. 20).

Visual identification of hydrocarbon condensation

The condensation of hydrocarbons (HCs) can only be observed under vertical lighting. In contrast to the observation of the condensation of water vapor, the condensation of hydrocarbons cannot be observed under oblique lighting. Under this illumination the surface of the mirror simply remains dark during hydrocarbon condensation in the "HC Dew Point" mode (illus. 22).

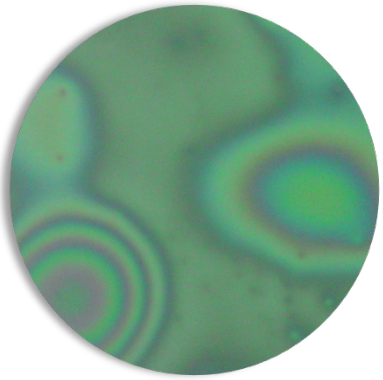


Illustration 21

Condensed hydrocarbons, ranging to include heptanes, appear as a film of rainbow-colored gradients on the surface of the condensation mirror (illus. 21). As the mirror continues to cool, this rainbow-colored film becomes a colorless

film that covers the entire surface of the mirror.

Illustration 22

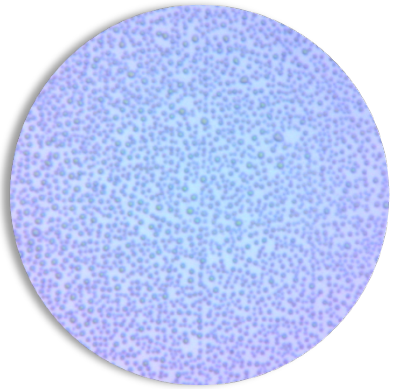


Illustration 23

Octane and higher ranked hydrocarbons condense on the surface of the mirror in the form of small, dilute dark spots. As the mirror continues to cool, these small spots slowly form into droplets (illus. 23).

As the cooling process continues, the small condensation droplets slowly collect to more completely cover the mirror's surface, until it becomes noticeably darkened. Finally, larger colorless drops form on a rainbow-colored background.

Rough dew point measurement

Rough dew point measurements serve to establish the temperature range within which the dew point is to be found.
Rough dew point measurements are made exclusively using the incremental cooling process (manual mode).

To change the cooling parameter settings select the menu point “Cooling parameters” → “Change interval”.
Each time the “Dew point measurement” mode is started, the value set for the change interval under the “Cooling parameters” menu will be used for the measurement process.

The factory default setting for the change interval in the rough dew point measurement program is 5 °C. This value can be changed as desired.

The size of the cooling interval is key to the accuracy of the rough measurement being taken.

The size of the absolute error is directly influenced by the choices made in setting the change interval parameters. For a change interval of 5 °C, the absolute error for the measurement being taken is ± 2.5 °C.

Please carry out the preliminary dew point measurements according the schedule in illustration 24.

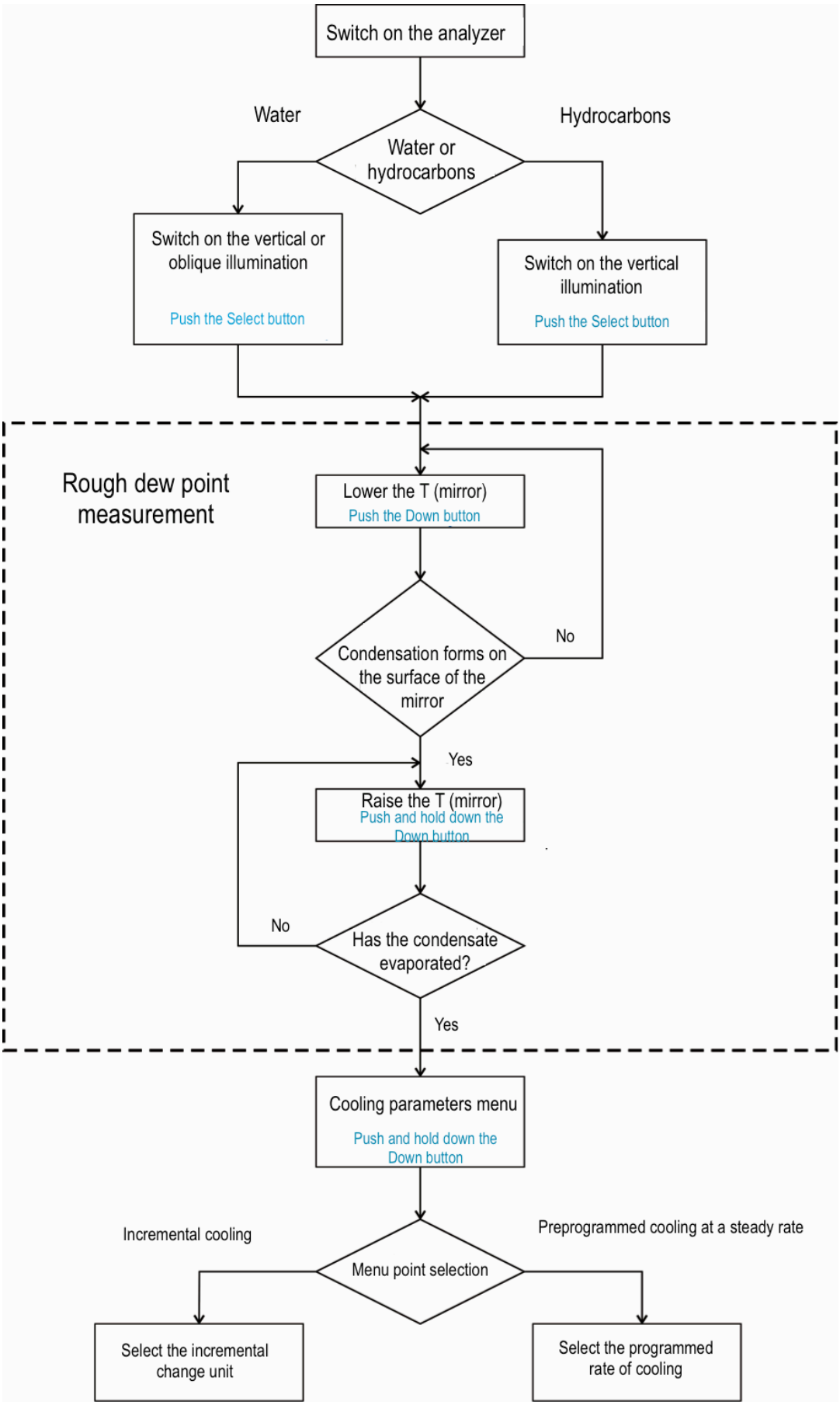


Illustration 24

When the device is switched on, all temperatures shown on the display (mirror condensation temperature; housing temperature and target temperature) may vary by up to ± 0.2 °C.
The value for the condensation mirror temperature is determined by the sum of the housing temperature value and the heating/cooling temperature value.

Illustration 25

By using the “down” button, the target temperature can be adjusted to a colder value. The current temperature of the condensation mirror should reach this value within a few seconds.

After the Down button is pushed once, a timer appears in the display showing the time that is passing as the mirror changes to the temperature that has been entered. Each time the Up or Down button is pushed the timer restarts.

Recommended duration of the cooling process

As the mirror cools, the duration of each temperature stage is not preset. Instead this length of time is determined based on the size of the temperature change between each stage, the current pressure, and the dew point temperature.

The larger the temperature difference between stages the more rapidly the condensation mirror cools.
By selecting a larger temperature difference (4°– 5°C), cooling is more intense. This creates favorable conditions for the condensation of water vapor and hydrocarbons.
Therefore, when making rough dew point measurements no more than 10 seconds should be set for the duration of each temperature stage.
When making precise dew point temperature measurements the temperature difference between stages should be ≤ 2°C and the duration of each stage should be lengthened accordingly.

For gas under higher working pressure the duration of individual temperature stages must also be lengthened.

At a working pressure of 200 bar the condensation process for water vapor and hydrocarbons slows down proportionally to the increase in pressure.

Please observe that when cooling the condensation mirror, as lower temperatures are reached it is also important to lengthen the duration of each temperature stage.

At lower temperature it takes longer for a visible condensation film to form.

Measuring water and hydrocarbon dew points

After taking a rough dew point measurement, hold down the Up button for several seconds to select the normal dew point measurement mode.
A menu will appear on the display that offers the choice of either incremental cooling or automatic cooling (illus. 27) modes.

Illustration 27

Please note: *incremental cooling set to a temperature interval of 2 °C or automatic cooling (at a rate of 1 °C per minute) will guarantee a water or hydrocarbon dew point measurement with an accuracy ±1 °C.*

A diagram of the incremental dew point measurement process is shown in illustration 28.

A diagram of the automatic dew point measurement process is shown in illustration 29.

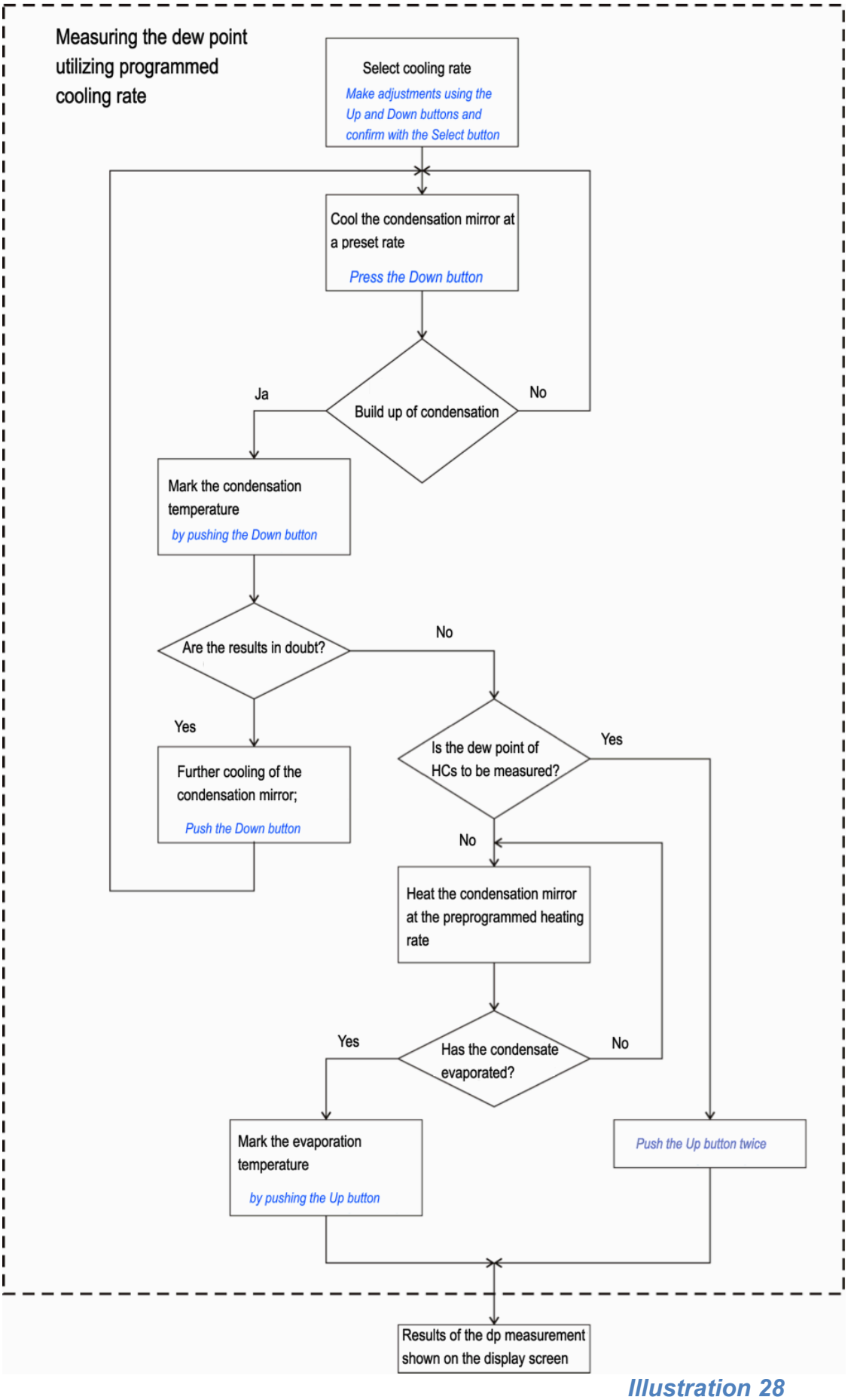


Illustration 28

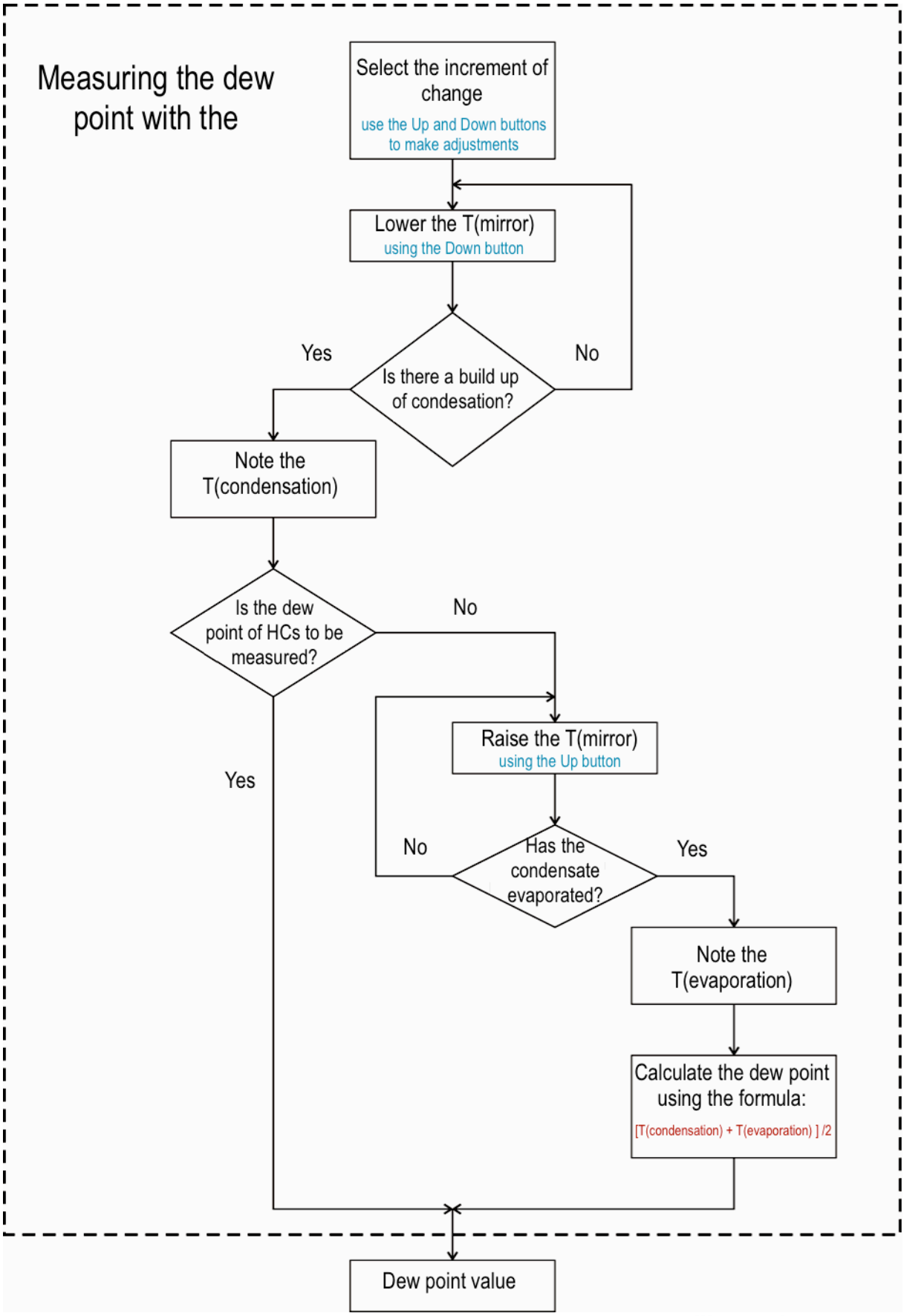


Illustration 29

When taking water dew point measurements in **automatic cooling mode**, push the Down button to fix the temperature at which condensation occurs, and to fix the temperature at which evaporation occurs push the Up button.

The dew point value will be calculated as the mean of these two temperatures (the condensation and evaporation points) in automatic cooling mode and shown on the analyzer's display.

When measuring the dew point of hydrocarbons in **automatic cooling mode** fix the condensation temperature as described above. However, unlike when measuring the dew point for water, no evaporation temperature is registered for hydrocarbons. Instead to establish the dew point of hydrocarbons push the Up button twice after fixing the condensation temperature.

In **incremental cooling mode** the condensation and evaporation temperatures are not automatically saved.
In order to calculate the dew point temperature of water and/or hydrocarbons in this mode, use the following formula:

$$TP_{Water} = (T_{C\,(W)} + T_V)/2$$

$$TP_{Hydrocarbons} = T_{C\,(HC)}$$

$\mathbf{T_C}$ =	Fixed temperature value of the condensation of water vapor (W) or hydrocarbon vapor (HC)
$\mathbf{T_V}$ =	Fixed temperature value of the evaporation of the water condensate
$\mathbf{TP}_{Hydrocarbons}$=	Hydrocarbon dew point temperature
$\mathbf{TP}_{Water}$ =	Water dew point temperature

Recommendations for determining the duration of the temperature stages in incremental cooling mode can be found under "Rough dew point measurements".

In the event that traces of condensate remain on the mirror's surface after the dew point measurement procedure has been completed, select the Mirror cleaning mode.

Additional cooling

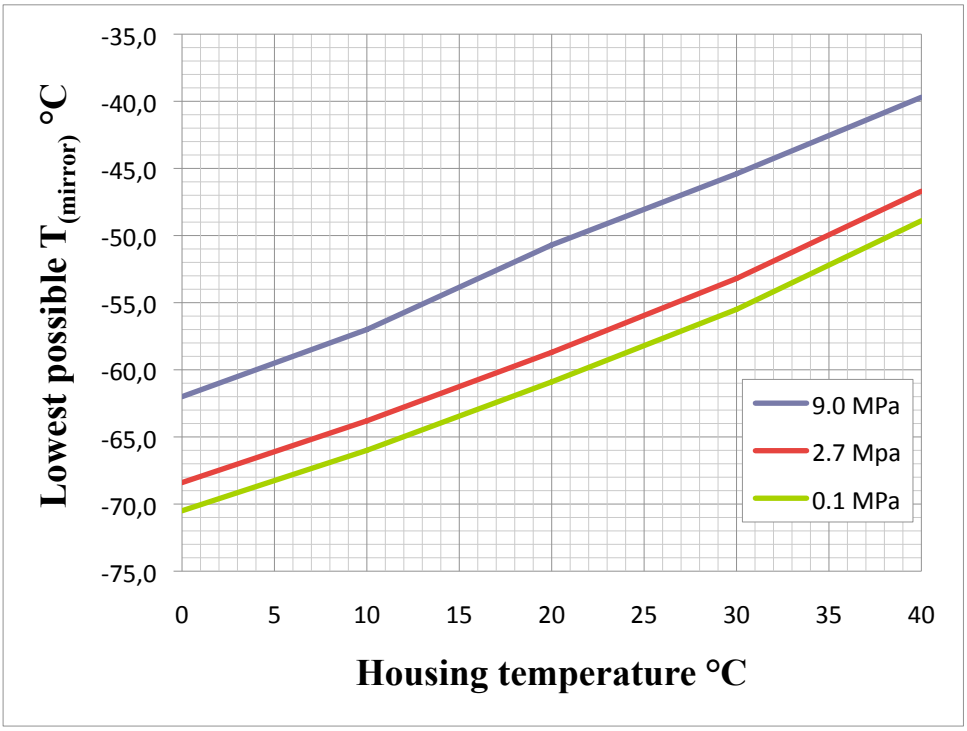


Illustration 30

The process of cooling the condensation mirror raises the temperature of the analyzers housing by 5 – 7 °C. In some situations, in order to take measurements at very low temperatures (≤ -50°C) it may be necessary to lower the temperature of the housing utilizing additional cooling.

A variety of media can be employed to cool the housing (water; propane; natural gas, etc.)

The housing has built-in cooling channels that provide for the easy and reliable circulation of liquid and gas cooling media.
The inlet and outlet ports are designed to accept pipe connectors with g1/8 threads.

The built-in cooling system can withstand pressures of up to 100 bar.

Alternatively, the measurement of very low temperature dew point values can be made under very high operating pressure. This would eliminate the need for additional cooling of the analyzer's housing.

Please note:

The analyzer's housing temperature ($T_{housing}$ / T_b) must always remain at least 5 °C above the dew point temperature being measured throughout the additional cooling process.

Deinstallation of the Hygrovision mini

Use the following procedure to uninstall the analyzer:

1) Switch off the analyzer;
2) Close the high pressure valve of the gas delivery system;
3) Using the needle valve integrated into the through-flow control system, adjust the pressure in the measurement chamber to match the level of the ambient air pressure;
4) Disconnect the sample gas delivery system and the through-flow control system from the measurement chamber.

MAINTENANCE

General information

Attention!

Analyzer maintenance consists of regular metrological recalibration, checks of the technical condition and, if necessary, cleaning the condensation mirror.

Repair work that requires opening the seals, is to be done exclusively by the manufacturer or by the relevant company.

Order of maintenance

Standard maintenance:

- Service the power supply unit (battery)
- Check the condition of the condensation mirror and clean if necessary
- Check the efficiency of mirror cooling (efficiency of the thermoelectric battery)
- Replace the particle filter
- Calibrate the analyzer
- Clear error messages

Servicing the power supply unit IP-01

Please observe the following instructions in order to ensure that the battery has a long service life:

- If the analyzer is not used for more than ten days, remove the battery to avoid unnecessary discharging.

- The charge status of all batteries held in storage should be checked at least once a month and when necessary fully recharged.

Cleaning the condensation mirror

To check the state of the surface of the condensation mirror, set the analyzer to Mirror cleaning mode.

If contamination, which could interfere with water and/or hydrocarbon dew point measurements, remains on the surface of the mirror after the automatic cleaning process is completed, the following steps can be taken before manually cleaning the mirror.

1. Select the Dew Point Measurement mode.

2. In the incremental cooling mode, press the Down button repeatedly to lower the target temperature to -25 – -30 °C. After reaching the desired target temperature select Mirror cleaning mode.

Repeat this process up to three times if necessary.

If there is no improvement in the condition of the mirror's surface after repeated cycles in the Mirror cleaning mode, it will be necessary to clean the mirror manually.

Everything required for this procedure is included with delivery.

Attention!
Manual cleaning of the condensation mirror is only to be done in an explosion proof environment!

Please follow these steps in order to manually clean the mirror:

1. Disconnect the illumination cable and remove the microscope.

2. Remove the eight bolts from the measurement chamber and open it. This should be done in a "clean" environment.

3. Dip one the cotton applicators into the cleaning fluid and gently clean the surface of the condensation mirror. Apply an absolute minimum of pressure to the mirror's surface during this procedure.

Illustration 31

In certain cases the condensation mirror can also be given a “quick” cleaning.

Using the key provided (VYMP 8.392001), turn the sleeve containing the integrated observation window counter-clockwise and remove it from the gas delivery system, see illustration 32. Clean the surface of the condensation mirror with an applicator dipped in the cleaning fluid (illus. 33).

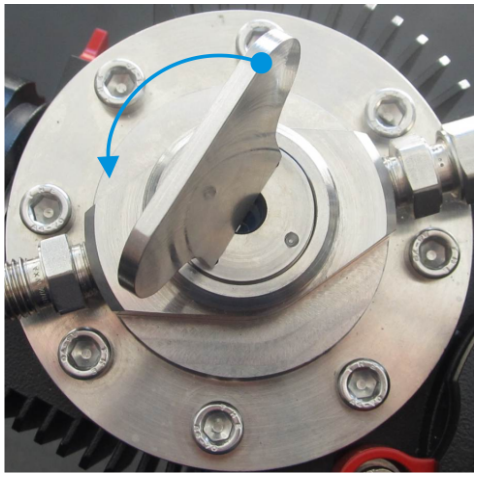


Illustration 32

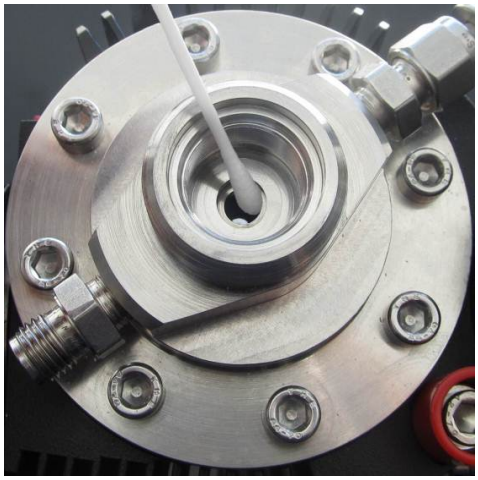


Illustration 33

Please note: *If after cleaning the mirror in the manner described above contaminants remain on the surface of the mirror, it can also be cleaned using acetone in place of the cleaning fluid delivered with the analyzer..*

Attention!

Please take the utmost care when cleaning the condensation mirror manually. Possible damage in the form of scratches or grooves will greatly reduce the performance of the analyzer. Mechanical damage to the condensation mirror caused during cleaning s not covered under the warranty.

Checking the efficiency of the thermoelectric battery (TEB)

The efficiency of the thermoelectric battery should be checked whenever the analyzer is officially calibrated and/or re-calibrated when in service and when the device has been damaged.

Follow these steps to check the thermoelectric battery:

1. switch on the analyzer
2. select the Dew Point Measurement mode and press the Down button repeatedly to set the temperature T to -60 ±1 °C
3. after three minutes have passed, note the mirror temperature T and the housing temperature T_b shown on the display. The difference between these two values must not exceed 65 °C
4. select the Mirror cleaning mode

Replacement of the particle filter

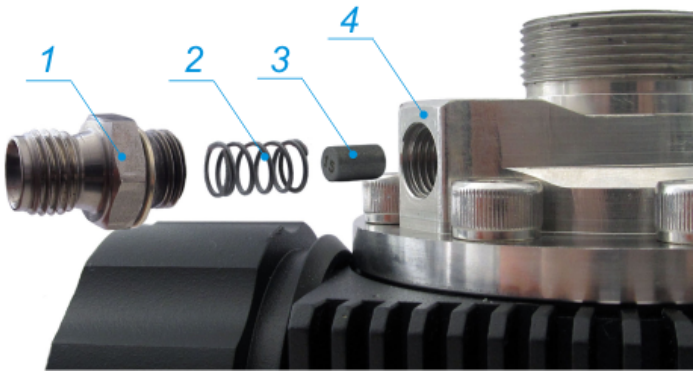


Illustration 34

Optimally, the particle filter cartridge should be replaced at least once a year. To replace the filter cartridge (illus. 34):

1. Unscrew the inlet nozzle (Pos. 1) and remove it from the sample delivery unit of the analyzer's housing
2. Carefully remove the small spring (Pos. 2)
3. Carefully remove the filter cartridge (Pos. 3)
4. Place a new cartridge in the opening (Pos. 4)
5. Carefully place the spring in the opening
6. Screw the inlet nozzle back into the sample delivery unit of the housing

Official calibration of the Hygrovision mini

The analyzer is to be officially calibrated according to “KRAY2.844.011MP”.
The analyzer should be officially calibrated every 12 months. If the absolute error values for water or hydrocarbon dew point measurements exceed the acceptable limits, the analyzer must be officially calibrated.

Calibrating the Hygrovision mini

Calibration of the device includes a shift of the analyzer’s calibration curve by a set value within the analyzer’s measurement range.

Adjust the analyzer use the calibration factors in the Settings mode:

⇒ Select the Settings mode; using the Up and Down buttons, select the calibration coefficient.
⇒ Set the coefficient to the desired value using the Up and Down buttons.
⇒ Press the Select button to confirm the set value.

The value for the calibration coefficient A is calculated as follows:

$$A = T_{calib} - T_{meas}$$

T_{calib} = defined dew point value

T_{meas} = measured dew point value

Error message codes

Possible error messages are presented in Table 6. These messages are shown on the analyzers display

Table 6

Error message	Diagnostic error message	Response
E 01	Poor battery contact! Replace the battery!	Check the battery contacts; if necessary replace the battery.
E 02	T bat ≥ + 60.1 °C Cool the battery!	In order for the analyzer to regain functionality allow the battery to cool down.
E 03	T bat ≤ – 20.1°C. Warm the battery!	In order for the analyzer to regain functionality allow the battery to warm up.
E 09	Circuit breaker tripped! Cooler!	Switch the device off and then turn it on again. If the same error message is displayed contact the manufacturer.
E 10	Circuit breaker tripped! Requires + 5V.	
E 11	Circuit breaker tripped I_a over 2500 mA	
E 12	Battery is low! Charge battery!	Recharge the battery.
E 13	T_b ≤ – 45,1 °C! Warm the device	In order to regain functionality, heat/cool the analyzer so that it is within the temperature range listed in Table 3.
E 14	T_b ≥ + 65,1 °C! Cool the device	

Possible failure messages

Table 7 presents a brief list of possible failures and a description of the appropriate action to take in response.

Table 7

	Failure	Possible cause	Response options
1.	The analyzer won't switch on in battery-powered mode.	The battery charge is too low.	(Re)charge the battery.
2.	The battery cannot be (re)charged: the charging indicator is red.	a) The battery temperature exceeds tolerable limits: 0 °C – + 45°C.	Check the appropriate parameters and elements.
		The electrical circuit between the thermometer and the temperature control unit is defective.	
		There is no electrical contact between the battery and the charging unit.	
3.	The illumination for the optical system is not functioning.	The illumination cable electrical circuit is defective.	Check the illumination cable
		The light emitting diode is defective.	Replace the cable with the LED.
4.	The sharpness of the mirror's image can't be adjusted In visual control mode.	The optical system is not properly installed.	Ensure that the optical system is properly aligned and screw it into the gas delivery unit on the housing of the analyzer until it is tight.
		The observation window lens is dirty.	Clean the optical elements using the cleaning fluid included in the set to be used for cleaning the mirror.
		Condensation has accumulated in the empty space between the observation window and the lens of the microscope.	

5.	The mirror does not reach the set temperature.	The thermoelectric battery is defective.	Replace the thermoelectric battery.
		The through-flow volume in the measurement chamber is too high.	Reduce the through-flow volume in the measurement chamber to 0.5 Nl/min.
		High operating pressure or housing temperature	Use additional external mirror cooling
6.	From time to time the analyzer switches off when operating under battery power. Led indicator flickers.	The battery is not properly (securely) installed.	Ensure that the battery lid is aligned correctly and screw it down tight.

If your analyzer fails to function in a manner that is not listed in this table, please contact the manufacturer.

Markings and labels

Markings on the analyzer's housing provide the following information:

- Trademark and name of the manufacturer
- Name of the device
- Explosion protection labeling
- Certifying Authority and Certificate Number
- Information label about protection against the effects of solids and water according to IEC 60529:1992 (IP54)
- Dew point measurement range
- Operating pressure limit
- Operating temperature of the device
- Serial number
- Country of manufacture

Packaging

The analyzer's components must be appropriately protected prior to being packaged for transportation or storage.

The device is to be packaged in a closed ventilated room with an ambient temperature of +15 °C – +40 °C and a relative humidity of up to 80%.
The ambient air must not contain any aggressive components.
Proper packaging protects the device against climatic influences and mechanical stress during loading and unloading, transportation, and storage.
The operating documentation is located under the lid of the transport case. The packing list and accompanying certification is contained in watertight packaging also located in the compartment in the lid of the case.

Storage

Analyzers are to be stored only in containers intended for that purpose from the manufacturer. These containers are designed to protect the device from mechanical damage, contamination and the effects of aggressive media.

For transportation purposes, analyzers may be held in storage (max. 6 months) in the transport packaging.

Transportation

Transportation requirements:
Analyzers are to be transported only in climate-controlled, closed containers that are and hermetically sealed.

When in service, the device must be transported in the carrying case included with delivery.

Recycling

The materials and work pieces used in the manufacture of the Hygrovision mini dew point analyzer are environmentally friendly. Both during the period the device is in service as well as after it has been decommissioned, these materials and work pieces can be classified as non-hazardous for human health as well as for production and storage spaces.
Hygrovision mini analyzers that are no longer being used may be disposed of in any way deemed appropriate by the user.
Old disused batteries are to be turned over to companies that are licensed for the disposal of these products.

Appendix A
“Hygrovision mini” dew point analyzer

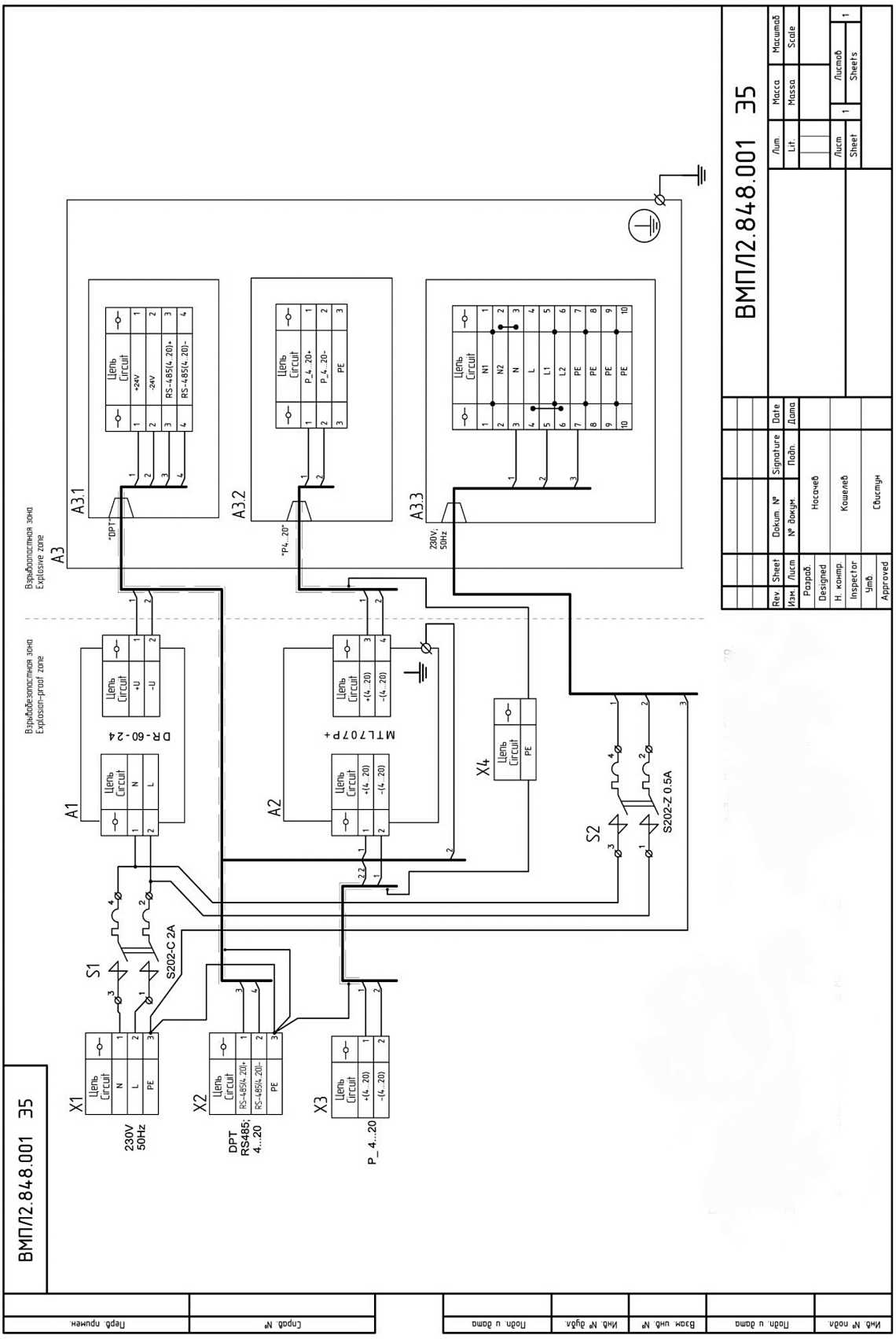


Illustration I

Appendix B

Examples of the appearance of water and hydrocarbon condensation

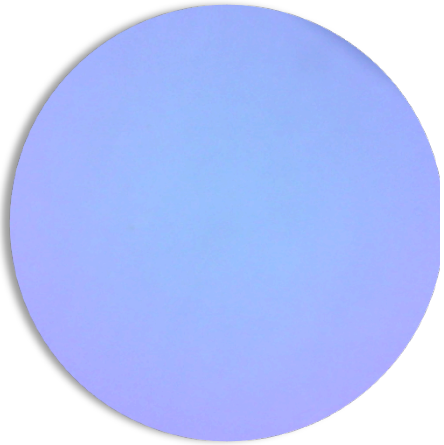
(View - optical system)

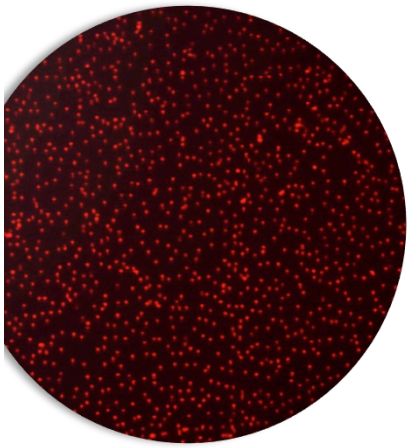
Condensation mirror under oblique illumination

Condensation mirror under vertical illumination

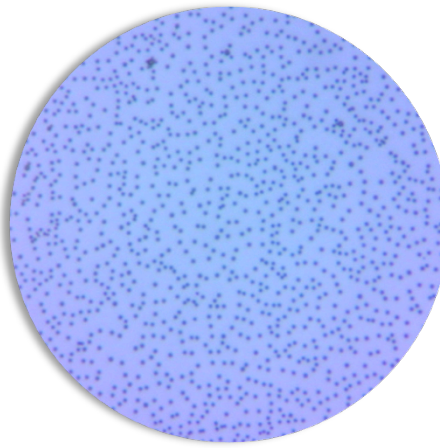
Absence of condensation

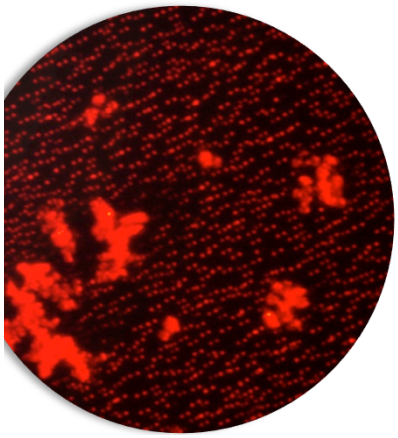
(individual red dots and scratches are acceptable)



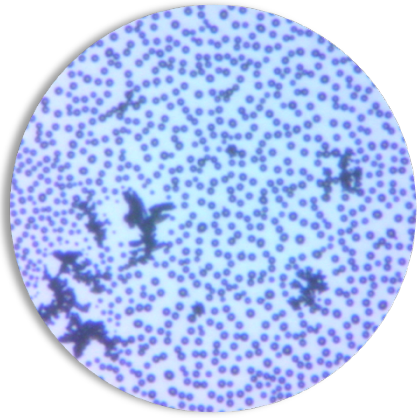


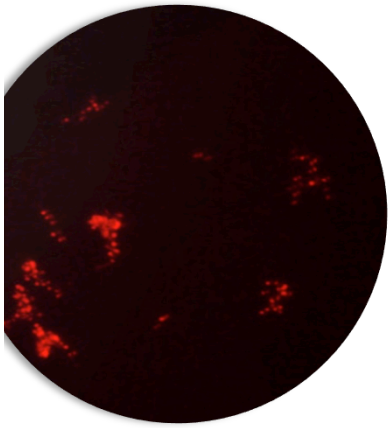
Condensation mirror showing water condensation



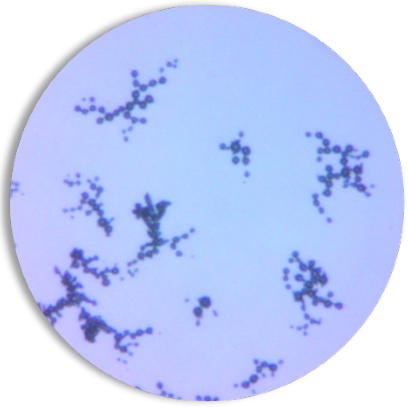


Water condensation in both liquid and crystaline phases

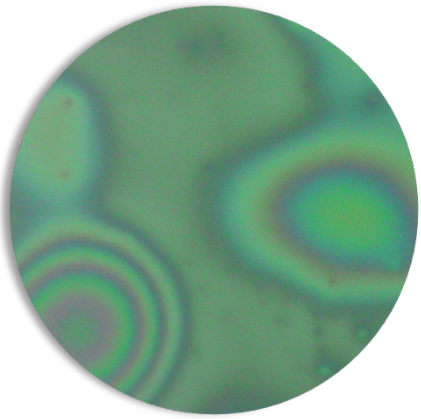




Water condensation in crystaline phase only



Hydrocarbon condensation *(inc. heptane)*



Hydrocarbon condensation *(Octane and higher ranked HCs)*

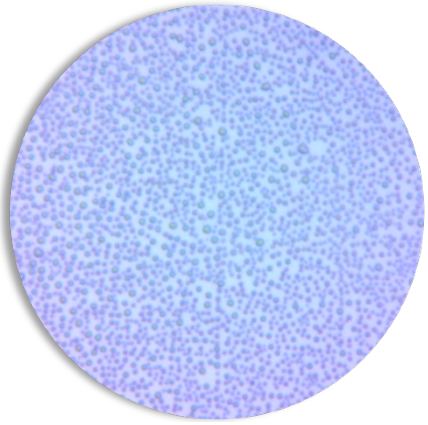


Illustration II

Appendix C

Set parameters for the Hygrovision mini

-Factory default settings-

Code	Parameter	Unit of measurement	measurement range	Value
M 31	Warming temperature	°C	0 – 60	0.0
M 32	Change interval	°C	0 – 10	5.0
M 33	Cooling rate	°C / min	0 – 10	3.0
M 34	Calibration factor	°C	-10 – 10	0.0
M 35	Oblique illumination brightness	*-preset level-*	0 – 10	10
M 36	Vertical illumination brightness	*-preset level-*	0 – 10	5
M 37	Language selection	-	Russian English German	Russian
M 38	Display: contrast	*-preset level-*	0 – 10	6
M 39	Display: brightness	*-preset level-*	0 – 10	8

Appendix D

Sample extraction system VYMP6.457.013

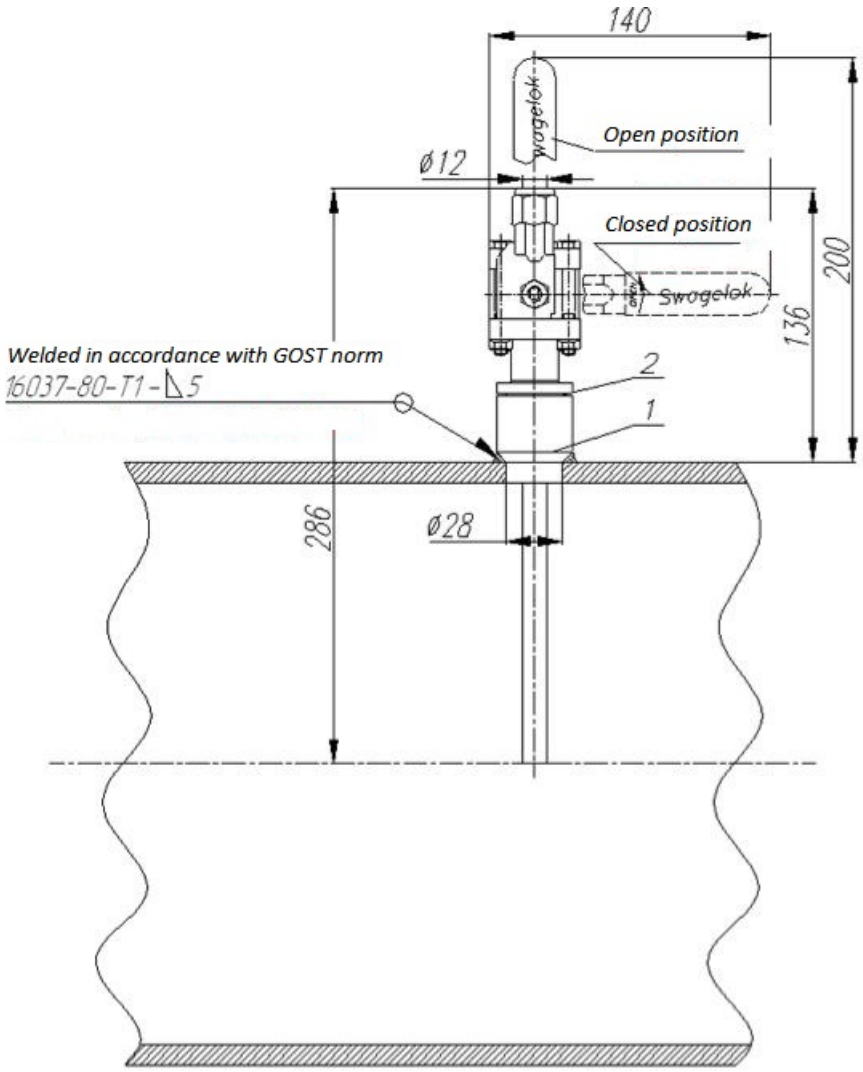


Illustration III

The sample extraction system is intended for permanent installation on the main gas line. This apparatus enables the extraction of a gas sample at the existing working pressure.

The sample extraction system is to be mounted on an installation bushing attached to the gas line at the desired sampling point. The installation bushing is made of 09G2C – steel (9MnSi5/ 13Mn6) and is included with delivery of the extraction system.

Gas flow can be controlled or stopped by opening or closing the integrated ball valve. When the valve handle is in the vertical position (parallel to the gas flow) the valve is open and gas flows into the extraction apparatus.

When the handle is in the horizontal position (perpendicular to the gas flow), the valve is closed and gas is prevented from entering the sampling system.

The connection nozzles of the sample extraction system is intended to be connected to a pipe made of stainless (Swagelok, SS-T12M-S-1,0M-6ME). No additional rolling of the pipe end is necessary in order to affix the pipe.

Appendix E

Membrane filter

The membrane filter is designed to remove liquids and particulate matter from the gas sample that could contaminate or damage the analyzer and the sampling unit.

The gas sample enters the filter housing through the inlet port, passes through the membrane, and exits through the outlet port. In this process small contaminants and even micro particles are trapped by the membrane and removed from the gas sample.

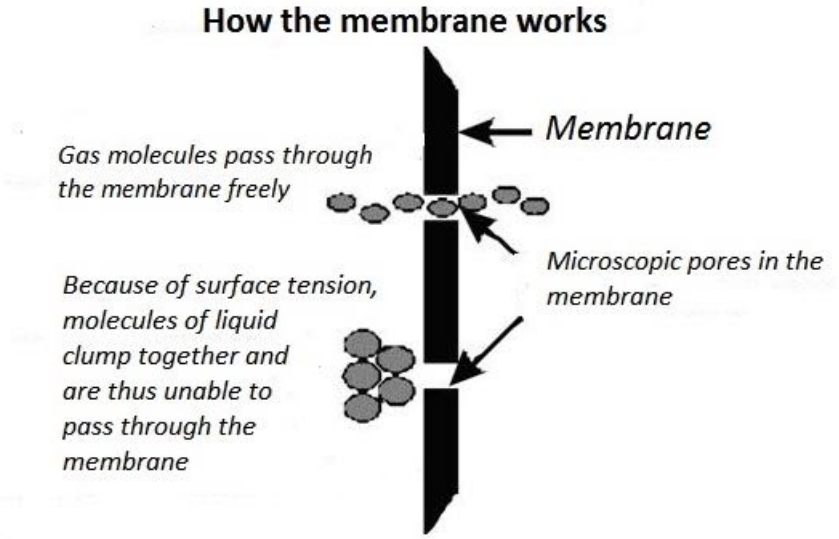


Illustration IV

The membrane is extremely elastic and is appropriate for use where a wide range of technological fluids may be present. The low adsorption properties of the membrane mean that this filter is also appropriate for systems intended to have component concentration levels in the ppm or ppb range. The membrane is also constructed to remain soft and flexible in order to be robust and guarantee a long service life.

TECHNICAL DATA

Maximum operating pressure	250 bar
Recommended maximum gas flow volume through the membrane: 130-502	72,000 cm^3 / min
Gas flow volume through the membrane: 130-502	14,400 cm^3 / min
Housing material / sealing ring material	Stainless steel / Viton
Dimensions (mm): KRAY6.457.022 KRAY6.457.022-01	see Illus. V see Illus. VI
Connection: KRAY6.457.022 (inlet, outlet) KRAY6.457.022-01 (inlet, outlet, purge)	Outer diameter ø12.0 mm Outer diameter ø 6.0 mm

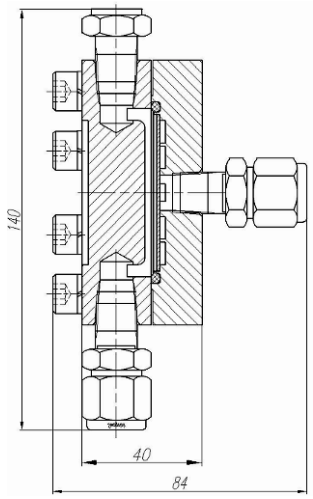


Illustration V

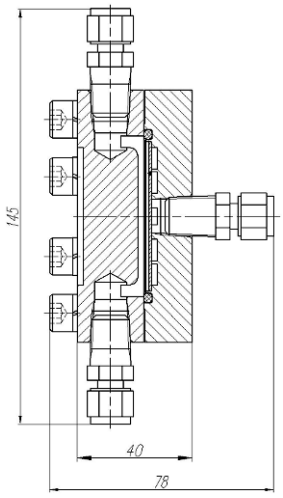


Illustration VI