G7000

Continuous Emission Monitoring System

Operation Manual

Document ID number.: 03135

Maritime

Green Instruments

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1 Introduction

1.1 About this manual

This manual contains data and instructions for the operation and maintenance of the G7000 Continuous Emission Monitoring System (**CEMS)**. For the installation of the CEMS, please refer to the installation manual.

The instructions have been made in general terms and do not take into consideration a specific installation. Therefore, this manual should be seen as a general guideline. As such, the manual is designed only for the CEMS. The instructions for the operation and maintenance of the complete monitoring system will be discussed in this manual.

The manual does not describe all possible situations but only the most common and known situations and cannot replace the necessary education of the personnel. Should situations not described in the manual occur, which cannot be solved in accordance with normal known practice and good workmanship, the operator should contact Green Instruments A/S for instructions.

Attention

Before operation read all instructions and warnings within this manual and associated documentation. Improper use may cause personal injury and/or damage of equipment and may void the warranty.

Green Instruments A/S disclaims any responsibility for damage and/or injury caused by improper installation, use or maintenance of the equipment

Green Instruments A/S reserves the right to alterations and improvements owing to developments without being obliged to enter the corresponding changes in this manual.

1.2 Inquiries and feedback

All claims and inquiries for spares shall be addressed to Green Instruments A/S or our distributors. In all correspondence or when ordering spare parts, carefully state the equipment type and serial number, which can be found on the label of the equipment.

Green Instruments A/S appreciates all feedback and suggestions for improvement. If you have any questions or find any errors in the manual, you are welcome to contact us at the following address:

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1.3 About the system

The modular design of the CEMS makes it possible to monitor different gases according to customer specifications. The G7000 can monitor the SO2 and CO2 concentrations in exhaust gas in accordance with the requirements in IMO regulations – NOx Technical Code 2008 and the requirements in MEPC.259(68).

It provides an accurate measurement of SO2 in ppm, CO2 in percent and the SO2/CO2 ratio, and presents these values on both the HMI and modbus TCP for logging and customer processing.

The system consists of a sampling and sample conditioning system and -up to two multi gas analyzers.

The unique double sample conditioning unit prepares the next sample simultaneous with measuring from the current sample and hereby ensures a fast response time. This unique feature allows the system to sample from up to 5 different sample points per system via the multiplexing device.

Furthermore, the system uses an air conditioner to maintain an optimum working temperature inside the monitoring unit. All materials are specially selected to resist the wet and acidic exhaust gas after a scrubber. The robust design is aimed for harsh marine applications and long intervals between services.

The CEMS is designed for easy calibration and maintenance. The system is arranged with automatic calibration by means of Internal Calibration Glasses together with instrument air. The system can also be verified by test gases to show compliance. To avoid damage, due to condensation it is recommended to run the system continuously.

2 Specifications

CEMS	
Function	Monitoring of SO2, CO2 and other required gases which is compliant with IMO regulations – NOx Technical Code 2008 and MEPC.259(68)
Equipment	Multi gas analyzer, multiplexer in case of multiple probes, gas cooler, gas pump, condensate pump, air conditioner, HMI, PLC, Gas filter, Condensate alarm
Power supply/ consumption	Refer to electrical drawings
Display	7.5" TFT LCD color display with touch screen
External communication	Modbus TCP/IP
Alarm outputs	4 alarm relays for "system warning", "system alarm", "level warning" and "level alarm"; NO/NC
Electrical connection	Refer to electrical drawings
Gas and fluid connections	Up to 5 probes with heated hose connected to one CEMS Refer to installation layout
Instrument air consumption	Approx. 4 l/min per probe during calibration Approx. 4 l/hour per probe during stand-by
Instrument air quality	ISO 8573-1 Class 2-2-2 Free from traces of measured gases
Sample flow	0.33…1.67 l/min
Ambient temperature	Class A. 5…45 °C (Tested to 55 °C)
Humidity	Class B. RH up to 96% at all relevant temperatures
Vibration	Class A
Emc	Class A
Material/enclosure	Painted mild steel RAL 7035 / IP55
Dimensions/weight	Refer to Installation Layout
Gas analyzer	
Measuring principle	NDIR
Measuring range	SO2: 0…200 ppm & CO2: 0…10 % Optional: SO2: 0…1000 ppm & CO2: 0…20% Monitor other gases upon request
Accuracy/linearity	≤ ±2 % of reading, or

	≤ ±0.3 % of full scale whichever is larger
Precision/repeatability	≤ ±1 % of full scale above 100 ppm or ≤ ±2 % of full scale below 100 ppm
Noise, zero drift, span drift	Each ≤ ±2 % of full scale
Auto-calibration	Zero Calibration: Automatic using compressed air. Span Calibration: Automatic using Internal Calibration Glasses and Compressed Air.
Annual calibration & validation	Connect certified gases for annual verification & calibration
Approvals & certificates	Refer to Green Instruments website
Probes and Heated Sample Lines	
Function	Extracts and filters Sample Gas. Heating elements keep temperature above dew point
Equipment	Refer to Component Overview
Number of Probes	Up to 5 pcs. Refer to Installation Layout
Sample line length	4…25m. Hose lengths > 25m upon request
Exhaust gas pressure	-50…500 mm WC dependent on material
Probe tube material & Exhaust gas temperature	316TI (max. 600°C) or Hastelloy (max. 400°C) (to be specified upon order)
Power supply	Refer to Electrical Drawings
Gas connections	Heated Hose connections (included in scope of supply) Sample Gas return line (not included in scope of supply) Refer to Installation Layout
Ambient temperature	Class A. -20 °C…45 °C (Tested to 55 °C)
Humidity	Class B. RH up to 96% at all relevant temperatures
Vibration	Class B
Emc	Class A
Enclosure	IP55
Probe dimensions/weight	Refer to Installation Layout
Approvals & certificates	Refer to Green Instruments website

Specifications are subject to changes without notice.

3 Safety aspects

Before operating the system, please study this operation manual and the technical drawings for each system in their entirety.

ATTENTION

- Please ensure correct connection of all power, signal cables and air supply before operating the CEMS.
- The multiplexer, probes and sample lines will be hot during operation. Pay attention to the risk of burn.
- Do not obstruct the circulation of supply/intake air by the air conditioner.
- The system is only suitable for installation in a safe, non-hazardous area and is not suitable for use with flammable or explosive media.
- It should be pointed out that installation and operation of this system and associated equipment must be carried out by skilled and trained personnel. Green Instruments A/S does not take any responsibility for the operation of the equipment and associated equipment whatsoever.
- If the system is used in a manner not approved by Green Instruments A/S, the function and protection provided by the equipment may be impaired.
- Successful and safe operation of this equipment depends on proper handling, installation, operation, and maintenance.

HAZARDOUS VOLTAGE!

Disconnect the power before installing or servicing the equipment. Ignoring this warning may result in severe personal injury or material damage. Read the instruction carefully to ensure correct connection of all power and signal leads.
Make sure that the correct voltage is connected to the system.

CIRCUIT BREAKER!

The installation must include a means of isolating electrical power by a clearly marked switch or circuit breaker external to the system. The external switch or circuit breaker shall be in close proximity to the system and within easy reach of the operator. The CEMS is fitted with a safety switch, placed underneath the air condition unit, and this interrupts the power to the downstream components.

OVERLOAD PROTECTION!

For compliance with the safety requirements IEC 61010-1 (2010), the installation must include a means of overcurrent protection to provide protection against excessive energy being drawn from the power supply system in case of a fault in the equipment.

PROTECTIVE EARTH!
The system must be connected to protective earth.

INSTALLATION AND FAULT FINDING!
Electrical installation and fault finding on the system should only be undertaken by a suitably trained and qualified engineer.

EMC!
For compliance with the EMC product standard IEC 60533 (1999), the connection cables for the main supply and communication signals should be shielded or provided with equivalent protection.

PROBES AND HEATED SAMPLE LINES!
To avoid risk of damage/electrical shock, the probes and heated sample lines must be installed and completely connected before powering up. When the system is powered on, the connections to the probes/sample lines must not be interrupted. The equipment must not be exposed to strong mechanical stress.

Protect the heated sample lines against overheating, sharp edges, mechanical stress, chemicals, dangling, both during the installation and when it is installed.

In case the heated sample lines must penetrate deck or bulkhead with special requirements concerning water tightness or fire protection, the penetration has to be carried out according to current rules.

BLOCKAGE OF THE GAS SAMPLING SYSTEM!
Do not block the gas sampling pipes to or from the system when the system is in operation! Damage of components can occur. Only during leakage test short periods intentional blocking is allowed.

LEAKAGE!
Components in the gas sampling lines may not be disconnected, except for troubleshooting or repair, due to the risk of leaks. Escaping exhaust gas can cause damage to the equipment and faulty measurements may occur. After reassembling any components in the gas sampling lines, a leak test must be performed.

HARMFUL COMPONENTS!
The exhaust gas is hot and may contain poisonous media that are potential harmful to humans.

Before removing any component in the gas sampling system, make sure that the gas channel is plugged to avoid exhaust gas escaping.

Condensate from gas driers may be aggressive and cause corrosion and chemical burns.

Protection must be worn whenever risk of being in contact with combustion gas and condensate occur!

RECYCLING!
Please do not dispose the equipment with regular disposal. Disposal should be in accordance with the requirements of the current statutory regulations.

Symbol identification!


Caution, risk of danger


Protective earth


Caution, risk of electrical shock


Caution, hot surface

4 Menu structure

The monitor unit uses an HMI module as a combined work and operating station.

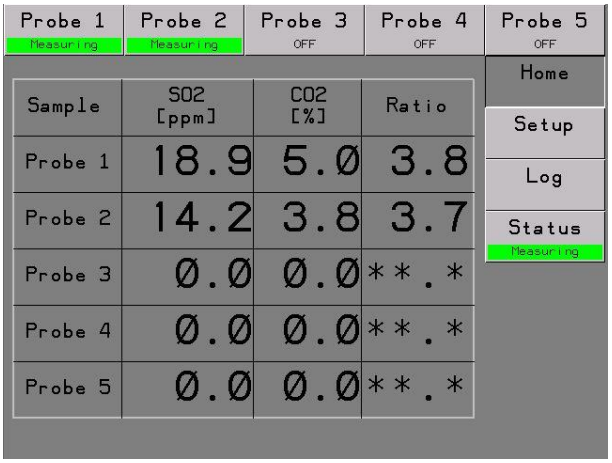


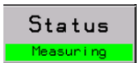
Figure 4-1: Home Menu Screen

The 5 probe buttons on top of the HMI screen with status information are common for all the views in the HMI system. Pressing one of them gives access to the relevant probe page as described in section 4.2

There are 4 function buttons: Home, Log, Status, and Setup on the right of the HMI screen.

- **Home**: to return to the Home page from any page – see section 4.1

- **Log**: to enter the Log page – see section 4.3



- **Status**: to enter the Status page with alarm log, etc. – see section 4.5

- **Setup**: to enter the Setup page – see section 4.6

4.1 Home

Home displays an overview of all current measurements. The current state of the system and the probes can also be seen as status information on the probe and status buttons.

It is always possible to go back to Home from any page or sub-menu by pressing the Home button on the right of the HMI screen.

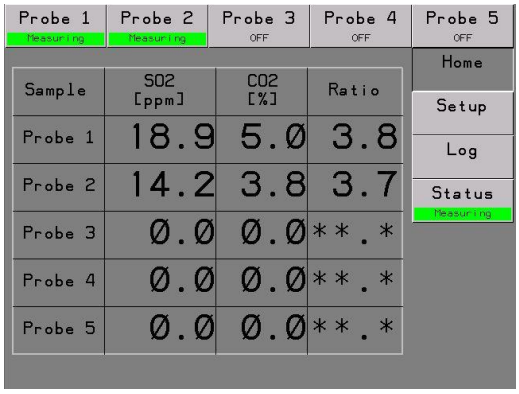


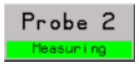
Figure 4-2: Home

4.2 Probe 1 - 5

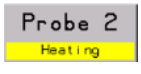
Probe 1…5 pages as shown in Figure 4-3 displays the current values and trend curves of SO2, CO2 and SO2/CO2 ratio values of the selected probe. The values are shown for the last 60 minutes.

Pressing Probe 1…5 on top of the HMI screen gives access to each probe's screen. There is an indication of probe status in each probe button:

- **OFF**: the probe is not currently in use or is not mounted on the system



- **Measuring**: the probe is in measurement mode (see Figure 4-3)



- **Heating**: the probe is in warming up period (see Figure 4-4)

- **Standby**: the probe is currently heated up to operation temperature and in standby mode, i.e. ready to sample.

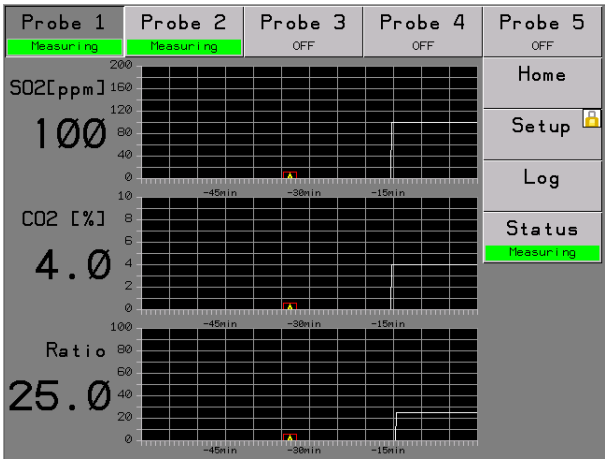


Figure 4-3: Probe 1 – Probes and analyzing cabinet in measuring state

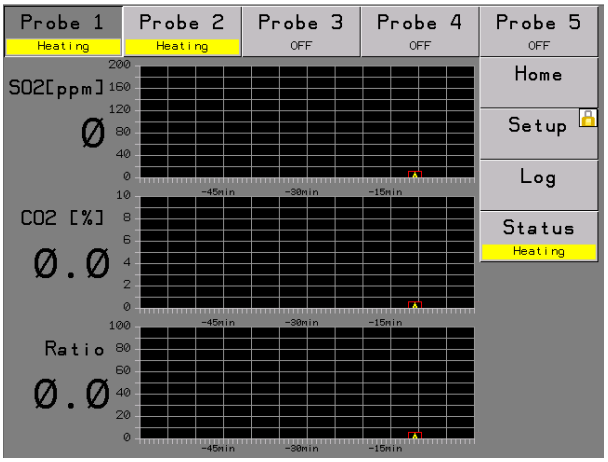


Figure 4-4: Probe 1 – Probes and analyzing cabinet in heating state

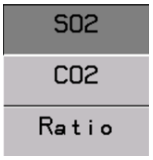
4.3 Log

Note

This logging function cannot substitute the data recording and processing device according to IMO regulations MEPC 259(68)

Pressing Log gives access to the Log screen where measurement values for all configured probes may be seen. See Figure 4-5

To access the log of SO2, CO2 or Ratio, press the relevant button in the lower right corner of the Log screen.



The coloured arrow will indicate the live trend value.

Each probe has its own colour trend curve. The colour is indicated in the probe buttons on top of the Log screen. Figure 4-5 shows that the blue trend curve is for probe 1, green for probe 2, yellow for probe 3, white for probe 4 and red for probe 5.

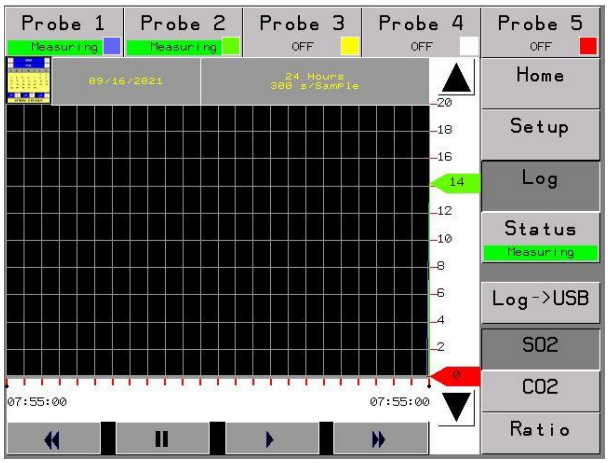


Figure 4-5: SO2 Log Screen

The time scale of the trend curve is 24 hours. There is 1 sample value every 5 minutes. The selected date is displayed on top of the graph. The period of the time is shown on the bottom of the graph. The arrow up and down on the right side of the graph is to scale up and down the log value axis.

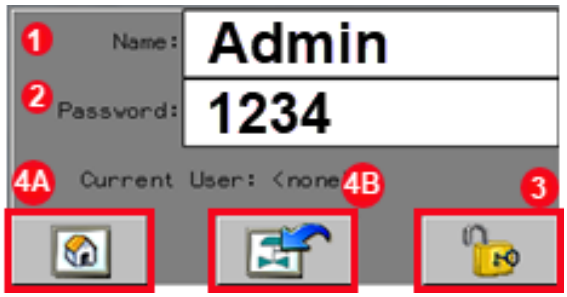
There are 4 function buttons right below the trend curve for going back and forth in the history trend. To go back to a certain date, please press the calendar button right below Probe 1 button on the top left of the screen and choose the date.

It is possible to copy the measurement log and historic alarm data to a USB memory stick which must be inserted in the HMI. After the USB memory stick is inserted in the HMI, the data can be saved by pressing the “Log -> USB” button.

Note: Do not remove the memory stick before the “Log -> USB” button changes to the normal appearance.

Historic Alarm Log can be found on the memory stick as CSV files which can be imported into a spread sheet.

4.4 Login

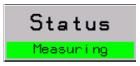


- 1. Name **Admin**
- 2. Password **1234**
- 3. Press the padlock button to log in. If the display shows **Current user: Admin** then log in is successful
- 4A. Press the **Home** button to access the Home screen
- 4B. Or press the **Return** button to return to previous screen

4.5 Status

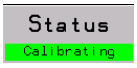
The status button selects the Status page see Figure 4-6 and has a system status indication at the bottom. There are 5 types of system status:

Heating: The system is warming up

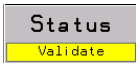


Measuring: The system is in operation mode

Error: The system has an alarm



Calibrating: The system is in calibration mode



Validate: The system is in validation mode

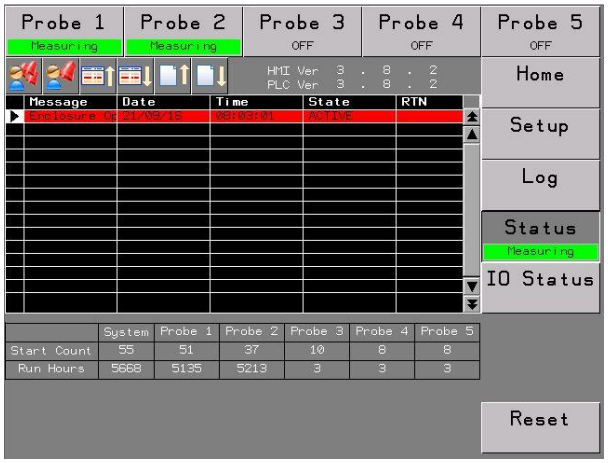


Figure 4-6 Status page in Measuring Mode

The status page displays an alarm list in a table.

- **Message**: Alarm description
- **Date**: The date when alarm starts
- **Time**: The time when alarm starts
- **State**: Status of alarm, which can be active, unacknowledged (UNACK) or acknowledged (ACK)
- **RTN**: means return to normal, which is the time when the alarm ends

Following errors can be presented in the Warning and Alarm list:

HMI Error Message	Warning	Alarm	Description
Gas Cool A		X	Gas Cooler A
Gas Cool B		X	Gas Cooler B
Analyzer		X	SO2 / CO2 Analyzer
Emg High Temp		X	Enclosure Emergency High Temperature
Enclosure H Temp		X	Enclosure High Temperature
Enclosure Temp		X	Enclosure Low Temp.
Enclosure Open	(X)		Enclosure Open. Information only. Will not trigger warning / alarm relay. Air condition unit will be switched OFF
Flow A		X	Gas Flow A too Low
Flow B		X	Gas Flow B too Low
Hose 1 Temp	X		Heating Hose 1 Temp. Low
Hose 2 Temp	X		Heating Hose 2 Temp. Low
Hose 3 Temp	X		Heating Hose 3 Temp. Low
Hose 4 Temp	X		Heating Hose 4 Temp. Low
Hose 5 Temp	X		Heating Hose 5 Temp. Low
Liquid A		X	Condensate A level too High

HMI Error Message	Warning	Alarm	Description
Liquid B		X	Condensate B level too High
No Probe 1		X	Probe 1 selected, but not mounted
No Probe 2		X	Probe 2 selected, but not mounted
No Probe 3		X	Probe 3 selected, but not mounted
No Probe 4		X	Probe 4 selected, but not mounted
No Probe 5		X	Probe 5 selected, but not mounted
Probe 1 Temp	X		Probe 1 Temperature Low
Probe 2 Temp	X		Probe 2 Temperature Low
Probe 3 Temp	X		Probe 3 Temperature Low
Probe 4 Temp	X		Probe 4 Temperature Low
Probe 5 Temp	X		Probe 5 Temperature Low
Multiplexer Temp		X	Multiplexer Temperature Low
Timeout		X	Heating timeout

Figure 4-7 Alarm List Overview

In addition to the warnings and alarm list the following general alarms and warnings are available via digital relays and Modbus/TCP:

- System Warning indicates either an error on a heating hose/probe or a system error (e.g., a system component malfunction in either the A or B sampling lines).
- System Alarm indicates an error in a system component. The system will stop monitoring.

On the top right of the alarm table, the current software version for the HMI and the PLC can be read out.

On the top left of the alarm table, there are 6 function buttons as shown in Figure 4-6

 To acknowledge all alarms

 To acknowledge the selected alarm

 To move up in the alarm list for selecting an alarm

 To move down in the alarm list for selecting an alarm

 To move to the previous alarm page

 To move to the next alarm page

There are also two sub-buttons under the Status button:

gives the information of Input and Output signals, and the manual select function to control several output signals.

Reset is to reset the system after a system error is fixed.

Besides the alarm list and SW versions, a table with runtime statistics can be seen on the status page. There are Start Count and Run Hours for the System (the monitoring cabinet) and the attached sample probes.

	System	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5
Start Count	4	4	4	3	0	0
Run Hours	3	3	3	2	0	0

- **Start Count**: will count each time the system or individual probes enter the heating state (starting the system or enabling the probes).
- **Run hours**: will keep track of the cumulative hours each part of the system has been in operation (Measuring state)

4.5.1 IO Status

IO status gives an overview of the system components status, as shown in Figure 4-8. The information on the IO status page is important to diagnose any error occurred in the system.

Green indicates that the components are powered with no alarms.

Grey indicates either those items are not configured for the system or are unpowered.

Red indicates alarm.

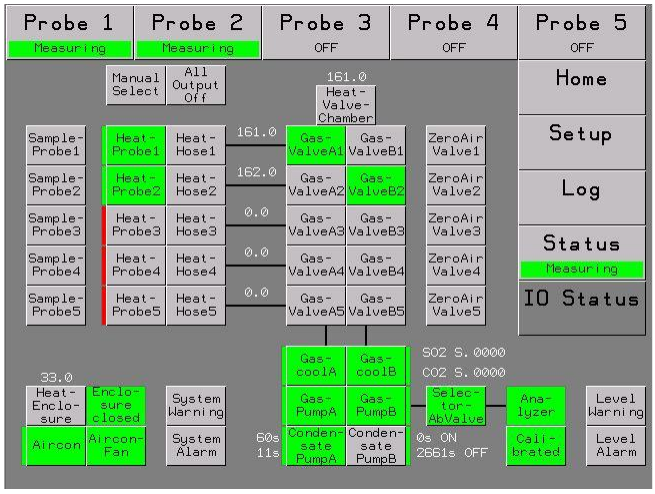


Figure 4-8: IO Status

The status of the system components can be as follows:

- **Sample Probe 1 – 5:**

  Green means that the digital input is turned ON the probe is activated.
  Grey means that the digital input is turned ON the probe is not activated.

- **Heat Probe 1 – 5**:

  Green **Heat Probe** button means that the probe is activated.
  Grey **Heat Probe** button, means the power is OFF,
  - The green line at the left side of a Heat Probe button indicates the temperature of the probe is ok with no alarms
  - Red line indicates an alarm regarding probe temperature.

- **Heat Hose 1 - 5**:

  Green means the power is ON to heat up the hose.

  Flashing green means the temperature is near the setpoint and the PID regulation has decreased the power to avoid overshoot of the operating temperature. The number on the right side of each heat hose represents the temperature of the hose.

- **Heat Valve Chamber**:

  Green indicates the **Multiplexer** temperature controller is heating
  Grey indicates the temperature controller is OFF
  - Flashing green indicates the temperature is near the setpoint and the PID regulation has decreased the power to avoid overshoot of the operating temperature. The actual temperature is shown above the button.

- **Gas Valve A-B:**

  Green or grey **Gas Valve** button indicates the valve is turned ON or OFF.

- **Gas Cool A-B:**

  Green or grey **Gas Cool** button indicates that the power is ON or OFF.
  - Red line at the edge of the button indicates the **Gas Cooler** temperature is too high.
  - Green line indicates the **Gas Cooler** temperature is within limits.

- **Gas Pump A-B:**

  Green or grey **Gas Pump** button indicates that power is ON or OFF for the relevant Gas Pump
  - Red line at the edge of the button indicates there is a low flow alarm
  - Green line indicates the flow is OK

- **Condensate Pump A-B:**

  Green or grey **Condensate Pump** button indicates that power is ON or OFF
  - Green line at the edge of the button indicates no condensate alarm
  - Red line indicates there is a condensate detection.

  There are numbers which indicates the latest ON and OFF time of the condensate pump
  - The numbers indicated at the top is the time the condensate pump is ON
  - The numbers indicated in the bottom is the time the condensate was OFF since last detection.

- **Heat Enclosure:**

  The number at the top of the **Heat Enclosure** is the temperature inside the cabinet. The temperature setpoint is 30ºC. If the enclosure temperature exceeds 45ºC, the system will be shut down. At low ambient temperature, below 5ºC the enclosure is heated by heating elements preventing the enclosure temperature dropping below 15ºC.

- **Enclosure closed:**

  Indicates whether the cabinet door is open (green) -or closed (red) If the enclosure is open the temperature control is inactive.

- **Aircon:**

  Green or grey button indicates whether the power for the Air Conditioner is ON or OFF.

- **Analyzer**:

  Green means the analyzer is ready.
  Red means the analyzer is warming up or has an error.

- **Calibrated**:

  Green means the analyzer has been calibrated. To perform calibration, press on Calibrated button, the button will turn red (Note Login is required using username and password for this operation, see section 4.4).

- **Selector AB Valve**:

  Grey if sampling is from Sample Line-A
  Green if sampling is from Sample Line-B.

- **System Warning, System Alarm, Level Warning and Level Alarm**:

  Indicates the status of the system warning, system alarm, level warning and level alarm relays.

4.5.2 Manual operating system components

Attention

This page shall only be accessed by skilled personnel. Please read the instruction carefully before carrying out any manual operation.

Manual operation can result in risk of damaging components.

The system outputs can be operated manually from the IO Status page. This is helpful when diagnosing an alarm. I.e. if there is a flow alarm, the relevant Gas pump and valves can be turned ON or OFF manually to allow adjustment of the flow. For manual operation refer to **IG-G7000-011.**

4.5.3 Reset system

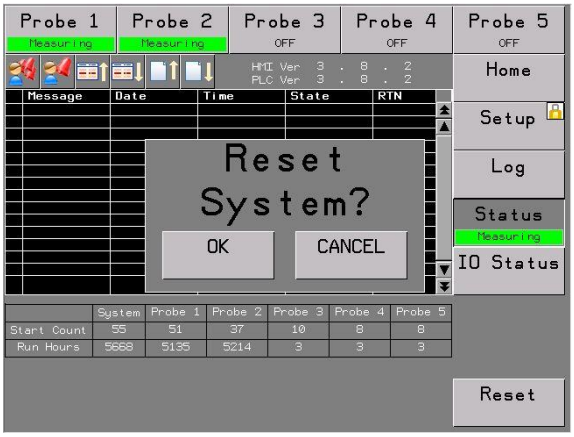


Figure 4-9 Reset the System

When an error is rectified, the system can be reset by pressing the Reset button under the Status page, and confirming to reset the system by pressing OK, shown in Figure 4-9

4.6 Setup

By pressing the Setup button, the Setup page as shown in Figure 4-10 will appear.

If the Setup page is locked, a login screen for username and password will appear. Refer to Section 4.4 for Login.

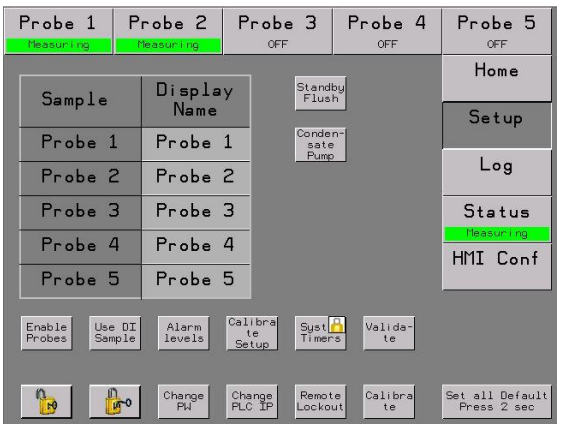


Figure 4-10: Setup Screen

The name of the probe buttons on top of the screen can be changed by editing the light grey boxes (below display name) for each probe to create better overview for the user

Sample	Display Name
Probe 1	Probe 1
Probe 2	Probe 2
Probe 3	Probe 3
Probe 4	Probe 4
Probe 5	Probe 5

Figure 4-11 Default Setup

Sample	Display Name
Probe 1	Eng-1
Probe 2	Eng-2
Probe 3	DG-1
Probe 4	DG-2
Probe 5	Inc.

Figure 4-12 Customized Example

There are setup buttons and a sub-menu button below Status button for HMI configuration. The Remote Lockout and Use DI Sample have no setting page.

: Grey indicates that the system is controlled via Modbus TCP. When Remote Lockout is selected (Green) it is not possible to control the system via Modbus TCP, but the measured values will still be provided.

: Grey indicates it is possible to use digital input to start probe sampling. Green means it is not possible to use digital input to start probe sampling.

: Is a locked button and only used for factory setting. Only Green Instruments has access to this function.

4.6.1 Probe setting

: This button, opens the Probe settings page

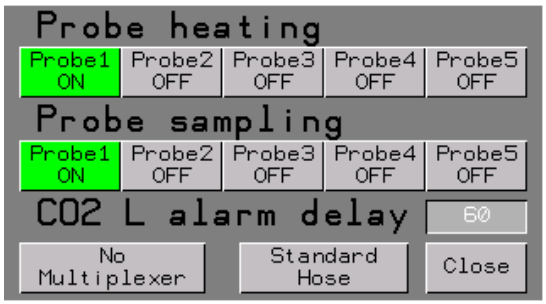


Figure 4-13 Probe Setup

- **Probe heating:** Enable the probes to be active. The button will turn green with the text **ON**. The selected probes will start heating.
- **Probe sampling:** Used for manual control of sampling. When a probe is heated up to its operating temperature, the CEMS will start to sample from this probe.
- Deselecting **Probe sampling** will keep the probe heated but not measuring
- Deselecting **Probe heating** will switch OFF the probe heat and sampling, this could be used in cases of repair or prolonged engine shut down.

4.6.2 CO2 low alarm

If the CO2 level has been below 0.5% for a defined period. This can indicate a potential leak in the gas path, and Ratio will be set to 100. This can be delayed up to 360 minutes, default setting is 60 minutes.

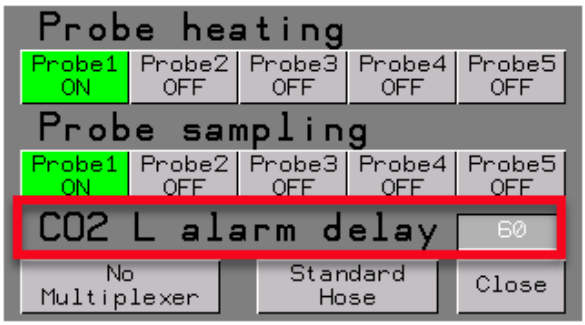


Figure 4-14 CO2 Level Alarm

4.6.3 Alarm setting

: can be configured to application requirements.

- **Warning levels:** SO2/CO2 ratio, SO2 High, CO2 Low, CO2 High
- **Alarm levels:** SO2/CO2 ratio, SO2 High, CO2 Low, CO2 High

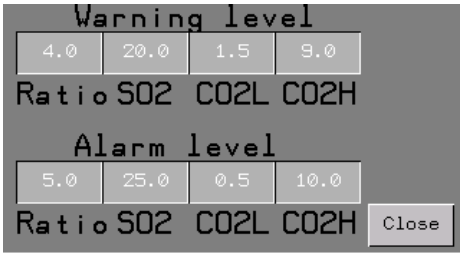


Figure 4-15 Alarm Setup

4.6.4 Auto calibration settings

- **Calibrate Setup**: Calibration Setting page will appear
- **Interval [h]**: Interval between two automatic calibrations. The analyzer use the internal optic filters for Span calibration and instrument air for Zero calibration
- **Zero check [h]**: Interval between Zero check. The analyzer will use instrument air
- **Zero offset max**: If the analyzer zero point has drifted over this value, the analyzer will carry out an automatic calibration regardless of the automatic calibration interval

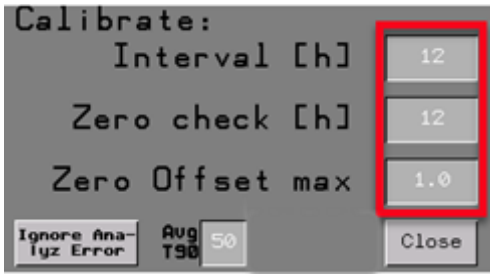


Figure 4-16 Auto Calibration Setup

- **Ignore Analyz Error:** if the button is active, it will change to Green. It will ignore all errors from the GAS Analyzer.

Attention

Ignoring the Analyzer Error can end up causing material damage.

- Deactivate Grey **Ignore Analyz Error** to return to normal condition.

4.6.5 Average settings

To reduce fluctuating analyzer values, it is possible to alter the **Avg T90** time see Figure 4-17.

Recommended default settings for 1-Stack systems: T90 time = 50 sec.

For CEMS with multiplexers installed, the T90 time must not be above 25 sec.

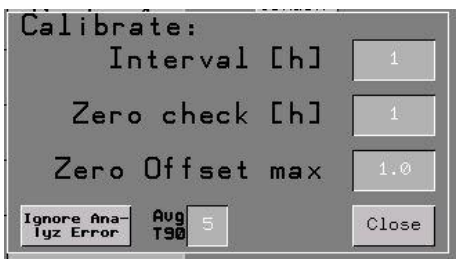


Figure 4-17 AVG Settings

With T90 set to 25 sec. the sample will reach within 2 % of max test gas value during the 50 seconds of measuring sequence used in multiprobe systems, see Figure 4-18:

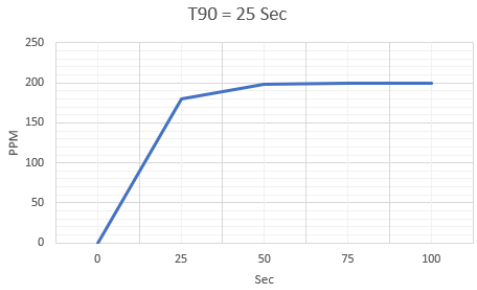


Figure 4-18: T90 Graph for 200 ppm SO_2 gas

4.6.6 Change password

- **Change PW**: Press this and the page for changing password will appear

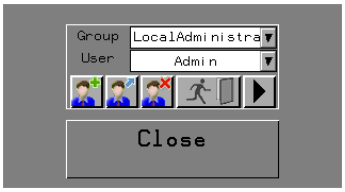


Figure 4-19 Change Password

Press  at the screen for entering the new Password and confirming the new password by pressing  and then Close.

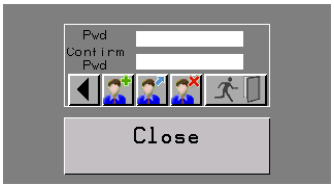


Figure 4-20 Confirm Password

4.6.7 Change PLC IP address

- **Change PLC IP**: The PLC IP Address page will appear – see figure 4-21

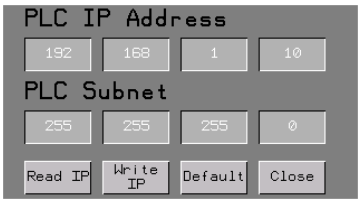


Figure 4-21 Change PLC IP Address

The factory default PLC IP Address is **192 168 1 10** with PLC sub net **255 255 255 0.** The PLC IP Address can be changed according to the user's system. To change the IP address, key in the new IP address and press Write IP.

There are 4 function buttons:

- **Read IP**: To read the current IP address

- **Write IP**: To confirm the new IP address after it is entered

- **Default**: To reset to the factory default IP address

- **Close**: To close **PLC IP Address** setup page

- **Standby Flush**: The Probe Standby Flush setup page will appear. It is possible to adjust the Probe standby flush time interval. As per default the sysem will flush 1 minute every hour – see figure 4-22.

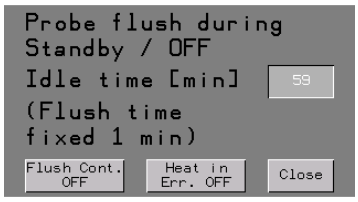


Figure 4-22: Standby flush

- **Flush Continuous OFF:** Grey indicates that the Probe Flush is controlled by the timer. When "Flush Cont. OFF" is Green, the Probes are flushed continuously while system is in standby. **Note**: continuous flush will consume approx. 240 l/h instrument air per probe.

- **Heat in Error state OFF:** If the button is grey, the system will deactivate heating on Probes, Heated Hoses and Multiplexer (*if installed)*. If the button **Heat in Err. OFF** is active (Green), the system components will remain heated even though the system is in Error State. **Note:** The system does not identify if an error is caused by i.e., a probe and will in this case continue heating the probe.

- **Condensate Pump:** This button opens the condensate pump control page.

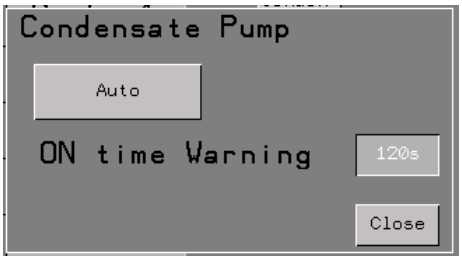


Figure 4-23: Condensate pump

When the condensate pump control is set to Auto mode, it is possible to set a timer to provide a service message on the HMI which indicates if the condensate pump has been running for a prolonged time. The warning is shown as a Pop-Up – see figure 4-24. If condensate is detected for more than five minutes, the system will go into error mode.

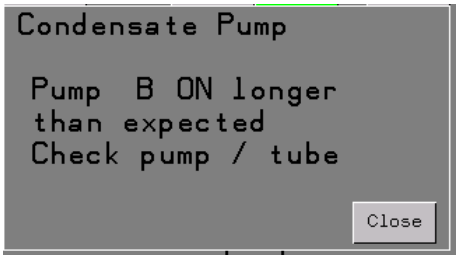
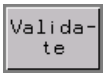


Figure 4-24: Condensate pump – pop up

- **Auto:** When the Auto Button shows "*Auto",* the condensate pump will activate using the condensate level switch. If the button shows *Always On,* the pump will run continuously.



- **Validate:** Pressing the Validate button opens the page for annual validation – see figure 4-25.

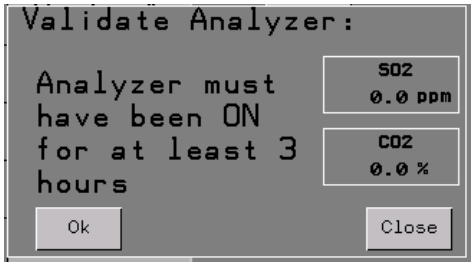
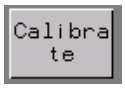


Figure 4-25: Annual validation



- **Calibrate:** Pressing the Calibrate button opens the page for annual calibration – see figure 4-26.

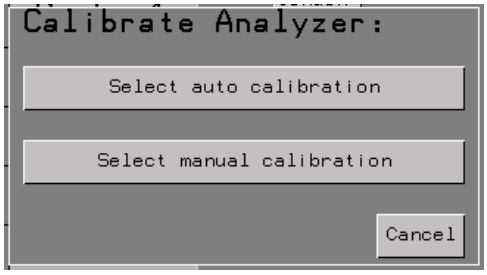


Figure 4-26: Annual calibration

4.6.8 HMI screen setting

The HMI Screen can be configured by pressing the **HMI Conf** button. The most relevant settings are Date/Time and Brightness. Press the relevant button, then follow the instruction on the screen.

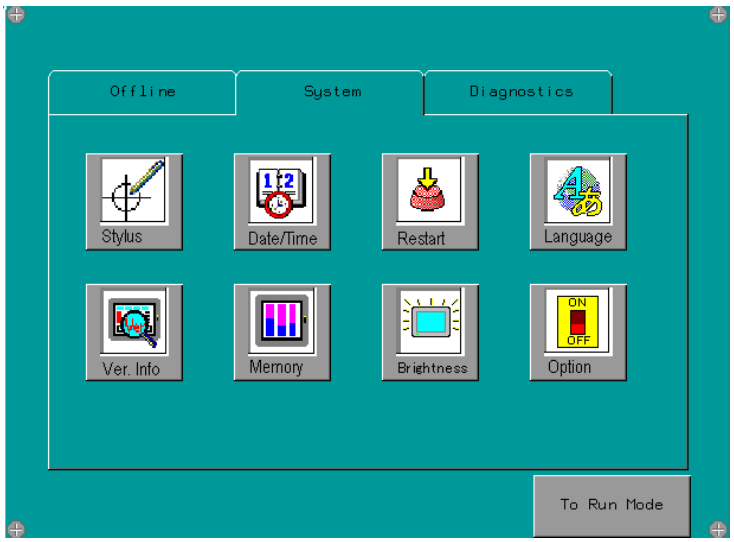


Figure 4-27 HMI Screen Setting

5 Commissioning

Before starting the CEMS for the first measuring sequence after completing the installation, perform the leak test. Before the leak test, check and control that all connections are installed in accordance with the installation instruction.

After completing the installation, a verification of the installation and setup is required. Refer to the section that represents the unit to be verified.

5.1 Probes

- The probes with the seal plugs have been installed according to the instructions.
- The electrical connector of the heated hose at the probe end have been connected.
- The sample gas hose (centre hose) from the heated hose is connected at the probe end.
- The calibration gas hose (PVDF fitting) from the heated hose is connected at the probe end.

5.2 Heated sample lines

- The heated sample line has been installed according to the instructions.
- The electrical connector of the heated hose at the cabinet end has been connected to the terminals inside the top right corner of the monitoring cabinet.
- The sample gas hose from the heated hose is connected to the multiplexer at the monitoring cabinet end. For one probe system, the sample hose is connected to a Tee-piece inside the cabinet.
- The calibration gas hose from the heated hose is connected to the calibration valves at the monitoring cabinet end.

5.3 Monitoring cabinet

Attention

After the installation of the monitoring cabinet, the unit shall stay unpowered at least 1 day in the mounting position. This is to ensure correct function of the air conditioner.

Damage of the components can occur if the instructions are not followed.

- The monitoring cabinet has been installed according to the instructions.
- The monitoring cabinet has been installed in a location where the ambient temperature is always between 5…45 ºC.
- Condensate Outlet hose has been installed and secure to the proper drain.
- The electrical connections are connected according to the instructions.
- Protective earth is connected.
- The communication connection is according to the instructions and the signal has been tested.
- A single separate return gas hose **Yard/Customer Supply** has been connected to the elbow fitting for Sample Gas Return on top of the monitoring cabinet to a suitable location e.g. the return gas connection on the probe flange socket.
- Air supply has been installed to the monitoring cabinet. The air quality is in accordance with ISO 8573-1 Class 2-2-2. Free from traces of measured gases.
- Associated systems are ready for operation.
- Power up the system by switching ON the automatic fuse placed at the bottom left corner inside of the cabinet and switched ON the lock safety-switch, placed outside left of the enclosure. Check the start-up of the system. After the heating period, the system performs the automatic calibration. Once the calibration has finished the system is ready for the initial leak test.

5.4 Initial leak test before operation

It is essential to perform a leak test during commissioning of the system. The leak test must be performed using the Instruction Guide: **IG-G7000-022** for **External Leak Test.**

If the leak is above the permitted limit, the gas hose from the Multiplexers/Tee-piece to the probes and the calibrating hose from probes to calibrating valves connections must be checked. The internal gas connections are checked before delivery, but, if necessary, check as described in: **IG-G7000-021** for **Internal Leak Test.**

5.5 Mounting the probe tubes

Attention

Probes and sample lines are hot. Pay attention to the risk of burn.

After performed leak test, the probe tubes shall be mounted on the probe by the following steps:

- Set the switch to OFF and remove the probe from the flange socket, then remove the sealed plug.
- Mount the probe tube on the probe. Then remount the probe on the flange socket. Set the switch to ON. From cold condition to normal working temperature, the estimated time is 0.5…1.5 hour.

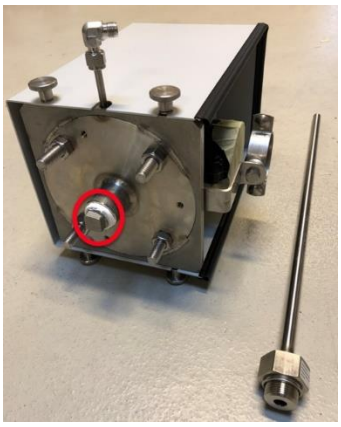


Figure 5-1 Remove the sealed plug

5.6 Gas flow adjustment

Adjustment of the gas flow is done by the following steps – see figure 5-2:

- Open the flowmeter valve completely
- Adjust the flow to 100 l/hour on the gas pump
- Decrease the flow by using the needle valve on the flowmeter to 80 l/hour
- Increase the flow again to 100 l/hour on the gas pump
- Decrease the flow to 60 l/hour on the flowmeter

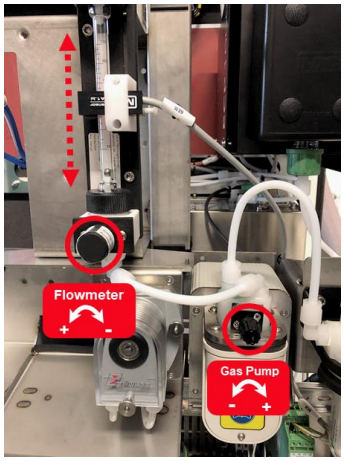


Figure 5-2: Gas flow adjusting

6 Calibration & validation

How to perform a Calibration and annual Validation & Calibration

Attention

The system requires compressed instrument air for automatic calibration.

Compressed air must not contain oil, water, or any constituents of the sample component, except from atmospheric CO2 content.

The presence of sample components in the analyzer during calibration will cause faulty measurements and/or calibration error.

Negative readings can occur if missing or insufficient compressed air is present during the self-calibration.

Negative readings can also occur if traces of sample components are present in the compressed air.

6.1 Auto and manual calibration with internal calibration cells

The system is setup with automatic calibration by means of internal calibration cells together with instrument air. The interval of automatic calibrations can be configured upon the application requirement. Please refer to section 4.6.4 for auto calibration settings.

The system can also be manually calibrated by the same means. Manual calibration can be carried out whenever wanted or required e.g. after repair. To carry out a manual calibration refer to **IG-G7000-006** for **Calibration of Internal Optical Glasses**.

If the analyzer indicates an error i.e. due to lack of instrument air during calibration, the analyzer must be recalibrated. Before re-calibration, press the **Ignore Analyzer Error** button in Calibration settings menu - see section 4.6.4 and make sure that sufficient instrument air is provided to the system.

6.2 Annual calibration & validation

Note

The G7000 analyzer is calibrated at factory. Please refer to the analyzer certificate. The validation of the calibration is to be performed in accordance with section 6 of Appendix 4 of the NOx Technical Code 2008, in which the calibration shall be checked.

- Using a zero gas and a span gas whose nominal value shall be more than 80% of full scale of the measuring range.
- And if for the two points considered, the value found must not differ by more than +/- 4% of full scale from the reference gas.

After the validation is performed, run the calibration routine and the analyzer is calibrated.

6.2.1 Auto and manual calibration & validation

Validation with certified test gases:

- **Zero gas**: 100% N2 (alternative other gases without SO2/CO2 can be used)
- **Mixed Span gas**: 200ppm SO2 + 10% CO2

To access auto or manual gas calibration & validation, logging in to the system is required - see section 4.4.

Attention: Some safety features will be disabled during operation in manual mode.

Before validation and calibration, the analyzer must be **ON** for at least 3 hours.

Performing a calibration is only possible if a validation with both SO2 and CO2 is completed successfully.

If the validation is carried out using separate SPAN gases, SO2 or CO2, then 2 separate validation tests must be performed. The value of the gas used for testing shall be accepted. I.e. if only CO2 is applied then only the CO2 value must be accepted.

VALIDATION AND CALIBRATION REQUIRED STEPS PROCEDURE

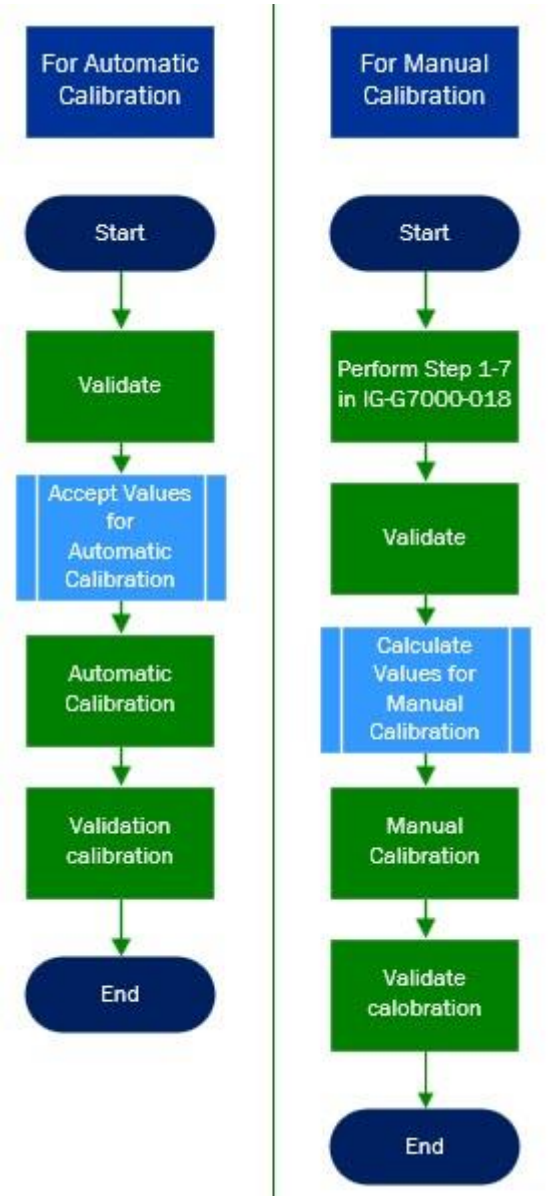


Figure 6-1: Validation and Calibration required steps procedure

The flow chart shows the required steps for Validation and Calibration

To carry out a validation and auto - or manual calibration, follow the relevant guides:

- **IG-G7000-017** for **Validation**
- **IG-G7000-018** for **Calibration**

7 Operation

7.1 Operating the CEMS

- The operating temperature of the CEMS is achieved in approximately 0.5…1.5 hour after powering up the system depending on the ambient temperature and air flow around the probes. When all components reach the operating temperature, sampling from the active probes starts and the measured values are displayed at the **Home** screen. After a few minutes, the system will automatically calibrate.
- **IO Status page:** The system status can be observed, see section 4.5.1. The temperatures of the gas hoses, the valve chamber, multiplexer, and the enclosure are shown. Abnormal operating conditions, temperature/flow are indicated by a red line at the left side of the relevant buttons.
- **Setup menu**: All relevant probes must be selected in **Probe heating** and **Probe sampling,** see section 4.6. By default, all installed probes are selected, remote control is allowed via Modbus TCP.
- Recommended gas flow is 60 l/h. The gas flow is supervised by an optical alarm sensor fitted on the two flow meters, which is adjusted to detect if the flow is dropping to less than 40 l/h. Insufficient gas flow will trigger the flow alarm and the gas pump will stop. If it is not possible to achieve sufficient flow, the basic flow adjustment must be performed see section 5.6 Gas Flow adjustment.
- Temperature control of the enclosure is suspended if the door is open. This feature is implemented to avoid overload of the air conditioner and proper operation of CEMS, in case of high ambient temperature.

Note

Never tamper or alter the door switch, it must be always effective to avoid material damage.

- Keep the door closed during operation as high temperature in the enclosure may cause malfunction of the system.
- If the ambient temperature is below 15 °C, the installed heating system is activated. This will avoid formation of condensation in the enclosure.

7.1.1 Air conditioner

- The air conditioner will lower the temperature inside the enclosure to ensure proper operational temperature. The cooling is provided automatically and controlled by the air condition temperature controller.
- Contact Green Instruments if you encounter excess water coming from the air conditioner bottom drain. For more information see section 8.3 Air-conditioner.

7.2 Leak test

If the system cannot be verified by a certified gas, the system may be leaking, thus a leak test must be performed. It is recommended to test for internal leaks prior to testing for external leaks. A leak test can be performed using the Instruction Guides:

IG-G7000-021 for **Internal Leak Test**

IG-G7000-022 for **External Leak test**

8 Routine maintenance

ATTENTION

Do not use sharp or hard tools to clean the system. Use a tissue soaked with water to remove salt and fouling deposits!

The multiplexer, probes and sample lines are hot during operation. Pay attention to the risk of burn.

8.2 Planned maintenance program

Attention

The intervals stated below are only general guidelines and must be adjusted based on specific system experiences. The intervals are based on optimum conditions and failure to comply with system specifications can impact intervals.

Factors which can reduce maintenance intervals could be:

- If sample flow is above the recommended setpoint
- If soot blowing occurs frequently
- If system, spares, and components are handled in an unintended manor

If a high amount of water droplets and salts is present at the sampling point. e.g. defective demister

The Instruction Guides from the Planned Maintenance program are in section 12

Planned Maintenance Program											
Description	**If necessary**	**Weekly**	**Monthly**	**Every 2 month**	**Every 3 month**	**Every 6 month**	**Every 9 month**	**Every 12 month**	**Every 2 years**	**Every 2 years or less**	**Instruction Guide Number (IG)**
Analyzer											
Analyzer – Annual Gas calibration.								**x**			IG-G7000-**017** IG-G7000-**018**
Air conditioner											
Visual check of aircon filter and clean If necessary		**x**									Refer to Section 8.2 Air Conditioner and IG-G7000-**020**
Replacement of aircon. Filter (03385)								**x**			IG-G7000-**020**
Probe											
Visual check of probe to see if cleaning/repair is needed			**x**								
Replacing filter and O-rings of probe (03370+03231)						**x**					IG-G7000-**004**
Heated hoses											
Visual check of heated hoses	**x**		**x**								
Leaking gas line											
Check if CO2 level drops below expected level.		**x**									
Condensate switch											
Visual check of condensate switch					**x**						IG-G7000-**013**
Replacement of condensate Alarm (03182)										**x**	IG-G7000-**015**
Condensate pump											

Planned Maintenance Program											
Description	**If necessary**	**Weekly**	**Monthly**	**Every 2 month**	**Every 3 month**	**Every 6 month**	**Every 9 month**	**Every 12 month**	**Every 2 years**	**Every 2 years or less**	**Instruction Guide Number (IG)**
Visual check of condensate pump			x								IG-G7000-**014**
Hose replacement of condensate pump (03386)						x					IG-G7000-**014**
Gas pump											
Replacement of Bellow & by-pass valve f. gas-pump (03387 & 03234)								x			IG-G7000-**023**
Gas filter											
Replacement of Internal gas-filter (03235)				x							IG-G7000-**003**
Water trap											
Water trap replacement (103830)								x			IG-G7000-**042**
3-way solenoid valves											
Replacement of 3-way selector valves (02391)										x	IG-G7000-**024**
Multiplexer											
Replacement of heating elements in multiplexer (03044)										x	IG-G7000-**025**
Calibrating air											
Test of calibration air supply.								x			IG-G7000-**029**

Figure 8-1: Planned Maintenance Program for the G7000 CEMS System

8.3 Air conditioner

8.3.1 Preventative maintenance

- The air conditioner requires regular cleaning of the condenser air inlet filter. Wash the filter whenever it appears physically dirty. Restriction to the flow of air over the condenser coil will degrade the performance of the equipment, causing it to overheat, reduce cooling and can damage the compressor. The overload switch in the compressor may cause the compressor to cycle if the condensing coil pressure becomes too high due to air restriction.
- A further safety feature is the refrigerant high pressure cut OFF switch which will stop the compressor if the condensing pressure becomes too high due restricted condenser air flow or some other causes. Restricted air flow due to neglecting a dirty filter will cause the unit to repeatedly turn OFF and then turn back ON after it cools OFF. An operation in this safety cycling mode will eventually damage the equipment and void the warranty.

Attention

Do not operate the air conditioner without the air filter.

8.3.2 Air filter service

- Remove the air conditioner filter and clean it properly using proper cleaning compound and back flush the dirt out. Dry thoroughly before replacing. air filter treatment spray in aerosol cans or spray bottle is recommended to enhance air filter efficiency
- Operation without filter will allow the condenser coil to become dirty and loose efficiency, causing overheating and diminished cooling capacity. Dirty condensing coils must be back-flush cleaned using proper commercial coil cleaning compounds and thorough back-flush rinsing. Refer to directions on the cleaning compounds selected. Acid wash is not recommended as it reduces the life of the coil
- Condenser and Evaporator Fans use high efficiency, long life, sealed ball bearing fans engineered for optimum performance that require no maintenance. Keep fan blades clean for optimal performance

9 Spare parts

Spare parts are not included in the standard delivery. Spare parts can be ordered when necessary. When ordering spare parts, please mention the serial number of the system.

Part No.	Part Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
03227	7.5” Color touch panel (Configuration needed)	
03450	SD Card 16GB	
03272	Aircon for enclosures	
03165	SO2/CO2 Analyzer	
03270	Solid state relay – 12A	
103950	Solid state relay – 20A	

Part No.	Part Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
00350	Heating element – 230V – 100W	
03217	PLC f. analyzer 24VDC (Configuration needed)	
03218	DI/DO Modul – relay	
03219	AI modul (Temp)	
03220	DO modul - PNP	
03221	DO modul – relay	
03236	Gas cooler	
03012	Sample gas pump	
03011	Flow meter	

Part No.	Part Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
103830	Water trap with fittings	
103690	Level switch complete	
03014	Condensate pump	
03205	Optical flow – detector	
03077	Multiplexer block – for 3…5 stacks	
03029	Multiplexer block –for 2 stacks	
03210	Safety switch	
03276	Door switch	

Part No.	Part Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
03121	Alarm relay	
00556	Interface relay (G2R -2- SN 24DC	
00557	Interface relay socket	
03342	Calbr.Valve – 5	
03343	Calbr.Valve – 2	
03183	Interface module for Ethernet RJ 45	
03204	Flow alarm – Controller	
03206	Fuse base	

Part No.	Part Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
02198	Fuse Automatic 10A	
02197	Fuse Automatic 6A	
04072	Fuses - 4A - pack of 10 pcs	
04073	Fuses - 6.3A - pack of 10 pcs	
03085	24VDC power supply	
03013	Sample Gas Filter	
03235	Filter Insert-Pack of 5 pcs	
00657	Filter Regulator 1/8, 0-2 bar	
03136	Temperature Sensor Ø3x30mm	

Part No.	Part Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
03388	Compl.Probe Head without Probe Tube	
03372	Probe Tube - Hastelloy	
03881	Testgas SO2/CO2 and N2 Kit	
03373	Probe Tube – 316 TI	
03385	AC – Filter Insert	
03386	Tube f. Condensate Pump	
03387	Bellow f. Gas Pump	
03234	Bypass v/v f.gas pump	
03044	Heating element	
02391	Solenoid valve – 3 way	

Part No.	Part Description	The specific appearance of the spare parts is subject change without notice; the function however will not change
03182	Condensate - Alarm	
03098	Heated Hose Line 6m	
03099	Heated Hose Line 9m	
03268	Heated Hose Line 12m	
03664	Heated Hose Line 15m	
03711	Heated Hose Line 25m	
03370	Probe filter - ceramic -Incl O-ring	
03231	O-ring set – Viton	
102724	Glass tube for Gas Cooler	
102784	Fitting-Elbow $^{6}/_{4}$ mm - $^{1}/_{4}''$ BSP PVDF	

Recommended Spare Parts

ONE YEAR OPERATION - RECOMMENDED SPARE PARTS		
03848	Maintenance Kit 1-year G7000 for each probe	2 x Ceramic filter w. O-rings 2 x Set of O-rings - Viton
03662	Maintenance Kit 1-year G7000 1 stack system	2 x Tube for Condensate pump 1 x Bellow f. gas pump 1 x By-pass v/v f. gas pump 1 x Filter insert-pack of 5 pcs 1 x Air condition – Filter insert
03663	Maintenance Kit 1-year G7000 2-5 stacks system	4 x Tube for Condensate pump 2 x Bellow f. gas pump 2 x By-pass v/v f. gas pump 2 x Filter insert-pack of 5 pcs 1 x Air Condition – Filter insert

No Of Probe	The recommended spare parts for 1 year operation depend on the number of probes. The table below can be used based on number of probes.
1	1 x 03848 Maintenance Kit 1-year G7000 for each probe 1 x 03662 Maintenance Kit 1-year G7000 1 stack system
2	2 x 03848 Maintenance Kit 1-year G7000 for each probe 1 x 03663 Maintenance Kit 1-year G7000 2…5 stacks system
3	3 x 03848 Maintenance Kit 1-year G7000 for each probe 1 x 03663 Maintenance Kit 1-year G7000 2…5 stacks system
4	4 x 03848 Maintenance Kit 1-year G7000 for each probe 1 x 03663 Maintenance Kit 1-year G7000 2…5 stacks system
5	5 x 03848 Maintenance Kit 1-year G7000 for each probe 1 x 03663 Maintenance Kit 1-year G7000 2…5 stacks system

10 Packing of gas analyzer

10.1 Packing

- Before disconnection: Flush the Analyzer refer to **IG-G7000-029** to perform flushing of the Analyzer
- Unmount the gas hose **(1)** and **(2)** from the fittings and tightly seal the gas ports. See Figure 10-1

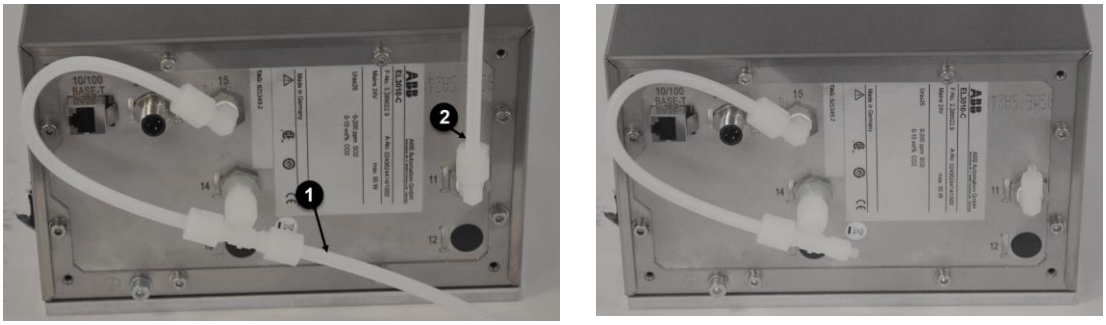


Figure 10-1 Analyzer hose connections

- It is vital that the return analyser must be packed in the original packing for optimal protection during transportation.
- Mark the box as **Fragile Goods**
- Ambient temperature during storage and transport: -25… +65ºC

11 Appendix

11.1 Technical documentation list

No.	Document name	
1	G7000 – Installation Layout – CEMS	Delivered with system
2	G7000 – Installation Layout – Multigas probe	Delivered with system
3	G7000 – Installation Layout – Heated Hose	Delivered with system
4	G7000 – Component Overview – CEMS	Delivered with system
5	G7000 – Component Overview – Multigas probe	Delivered with system
6	G7000 – P&I Diagram	Delivered with system
7	Electrical documentation	Delivered with system
8	Test and Configuration Sheet	Delivered with system

12 Maintenance & troubleshooting

In order to maintain the system, it is necessary to follow the instruction guides.
These guides can also be used in case of troubleshooting.

Note

For troubleshooting the CEMS, refer to the P&ID drawing.

Troubleshooting should always be carried out by skilled personnel. The CEMS is connected to hazardous electric voltages, which can cause personal injury or mechanical damage if not handled correctly and in accordance with normal safety regulations.

Trouble	Points of interest	Guide
Activate the components manually	→ If a component needs to be activated	IG-G7000-**011**
Flow alarm	→ Follow the flow alarm flowchart	IG-G7000-**001** IG-G7000-**002** IG-G7000-**003** IG-G7000-**004** IG-G7000-**005** IG-G7000-**012** IG-G7000-**023**
Temperature alarm	→ Check the air conditioner automatic fuse → Check the electrical connections → Check the air condition unit → Check/control air con temperature → Check enclosure heating elements	 IG-G7000-**019** IG-G7000-**020**
Incorrect indication of SO2/CO2 value	→ Check if there is any leakage → Manually calibrate the analyzer → Check the calibration air supply	IG-G7000-**006** IG-G7000-**021** IG-G7000-**022** IG-G7000-**029**
Condensate alarm	→ Check the condensate alarm → Check the condensate pump	IG-G7000-**013** IG-G7000-**014**

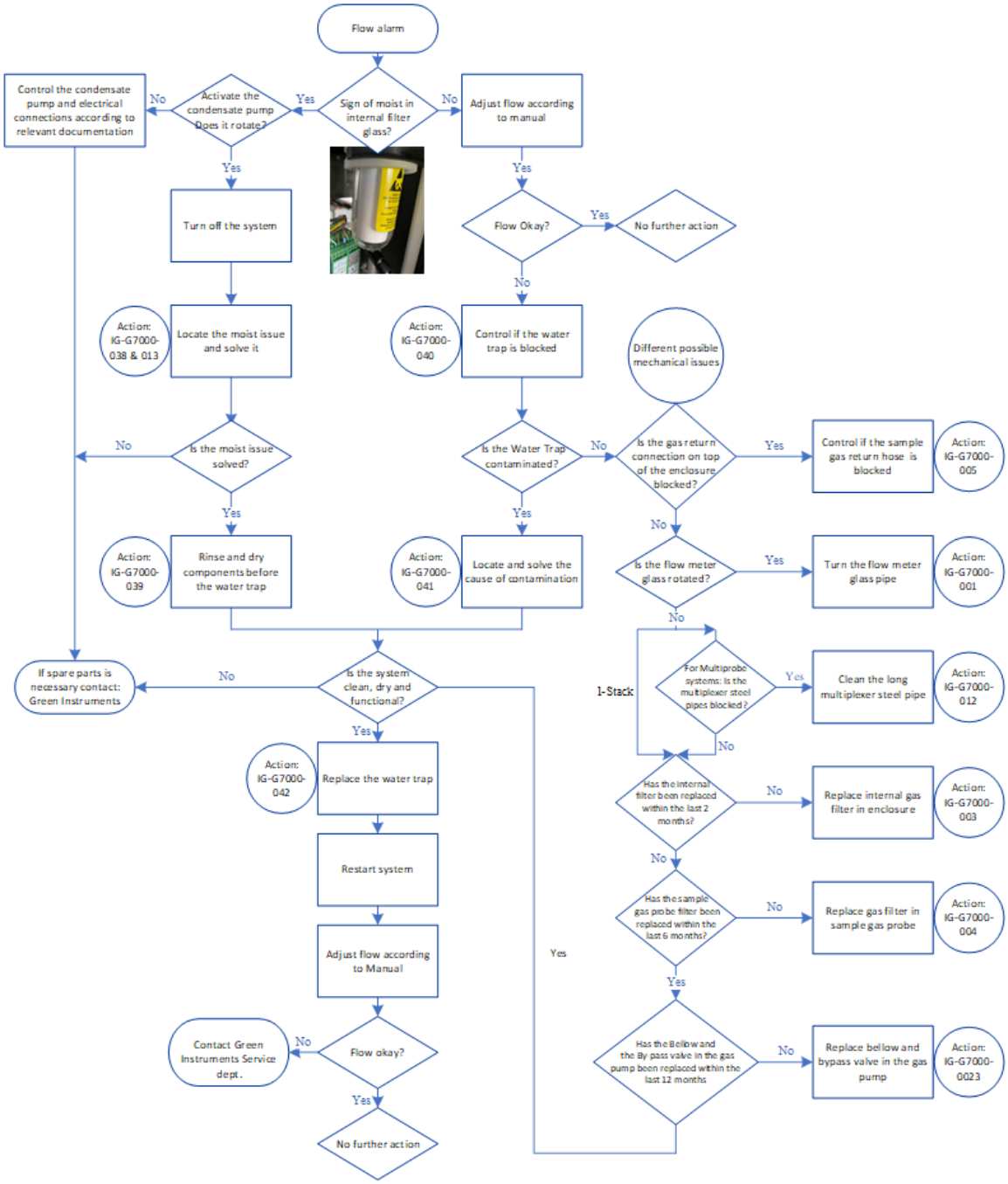
Trouble	Points of interest	Guide
No Heat in multiplexer	→ Check the wiring → Change the heating elements	IG-G7000-**025**
Broken Condensate Alarm	→ Replace the condensate alarm	IG-G7000-**015**
Broken Condensate Pump	→ Replace the condensate pump	IG-G7000-**016**
Broken 3-Way Valve	→ Replace 3-Way valve	IG-G7000-**024**

Flow Alarm Flowchart

In case of a flow alarm, it is possible to use the flowchart to help locate the problem. Some of the Instruction Guides require an active gas pump and to activate the gas pump follow the instruction in section 4.5.2 Make sure the gas pump can be activated before starting troubleshooting.

Note

It is recommended to carry out flow adjustment before any components are replaced – see the **IG-G7000-002.**


Flow alarm
Sign of moist in internal filter glass?
Activate the condensate pump Does it rotate?
Control the condensate pump and electrical connections according to relevant documentation
Adjust flow according to manual
Turn off the system
Flow Okay?
No further action
Action: IG-G7000-038 & 013
Locate the moist issue and solve it
Is the moist issue solved?
Action: IG-G7000-039
Rinse and dry components before the water trap
Action: IG-G7000-040
Control if the water trap is blocked
Is the Water Trap contaminated?
Action: IG-G7000-041
Locate and solve the cause of contamination
Different possible mechanical issues
Is the gas return connection on top of the enclosure blocked?
Control if the sample gas return hose is blocked
Action: IG-G7000-005
Is the flow meter glass rotated?
Turn the flow meter glass pipe
Action: IG-G7000-001
1-Stack
For Multiprobe systems: Is the multiplexer steel pipes blocked?
Clean the long multiplexer steel pipe
Action: IG-G7000-012
Has the internal filter been replaced within the last 2 months?
Replace internal gas filter in enclosure
Action: IG-G7000-003
Has the sample gas probe filter been replaced within the last 6 months?
Replace gas filter in sample gas probe
Action: IG-G7000-004
Has the Bellow and the By pass valve in the gas pump been replaced within the last 12 months
Replace bellow and bypass valve in the gas pump
Action: IG-G7000-0023
Is the system clean, dry and functional?
If spare parts is necessary contact: Green Instruments
Action: IG-G7000-042
Replace the water trap
Restart system
Adjust flow according to Manual
Flow okay?
Contact Green Instruments Service dept.
No further action
Yes
No

Instruction guide table			
Number	**Name**	**In OM**	**On request**
IG-G7000-001	Turn the flow meter glass pipe	X	
IG-G7000-002	Adjust the flow for the gas pump	X	
IG-G7000-003	Replace internal gas filter	X	
IG-G7000-004	Replace probe filter	X	
IG-G7000-005	Blocked gas return	X	
IG-G7000-006	Calibration with internal calibration cells	X	
IG-G7000-007	Replacement of analyzer		X
IG-G7000-008	No data log		X
IG-G7000-009	No remote log		X
IG-G7000-010	No display		X
IG-G7000-011	Operate the system in manual mode	X	
IG-G7000-012	Clean/replace the multiplexer steel pipe		X
IG-G7000-013	Check the condensate alarm and condensate pump	X	
IG-G7000-014	Check or replace the hose in the condensate pump	X	
IG-G7000-015	Replace condensate alarm		X
IG-G7000-016	Replace the condensate pump		X
IG-G7000-017	Guide for manual validation	X	
IG-G7000-018	Guide for calibration	X	
IG-G7000-019	Temperature alarm	X	
IG-G7000-020	Clean or replace the air condition filter	X	
IG-G7000-021	Internal leak test	X	
IG-G7000-022	External leak test	X	
IG-G7000-023	Replacement of bellow and by-pass valve in gas pump	X	
IG-G7000-024	Replacement of 3-way valve		X
IG-G7000-025	Replacement of heating elements in multiplexer		X
IG-G7000-029	Test of calibration air supply	X	
IG-G7000-030	Replace sample gas hose		X
IG-G7000-038	Problem location and solving guide	X	
IG-G7000-039	System cleaning guide	X	
IG-G7000-040	Water trap control guide	X	
IG-G7000-041	Contamination location and solving guide	X	
IG-G7000-042	Water trap replacement guide	X	

IG-G7000-001

System Type	G7000 Multi gas system	IG-G7000-001
Task:	Control of incorrect mounted flow meter glass	
Task description:	This instruction identifies how to adjust the flow meter glass if it is mounted incorrect and cause a Flow alarm.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧🔧		10 min

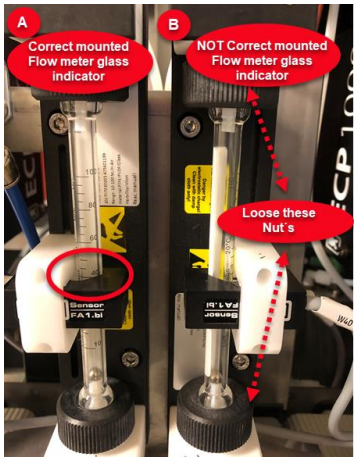
Note: This operation must only be carried out by a trained technician

Instructions	Photos

Tools:

- Multi grip pliers

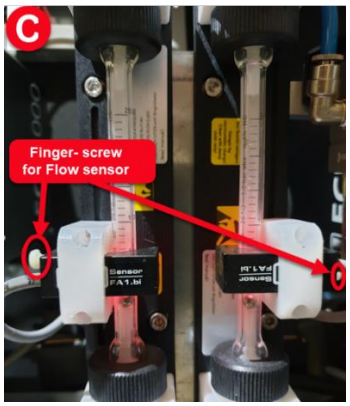
1. Power **"OFF"** the relevant Gas pump
   Refer to IG-G7000-011-Operate the system in manual mode
2. Loose the "big black nut" in the top and the bottom of the flow meter. See picture "B", and loose the finger screw on the flow sensor, see picture "C". Rotate the glass to the correct position, make sure the white color forms the background as seen in picture "A"
3. Make sure the Flow meter sensor is mounted at the Alarm level at 40 l/h. See the red circle on picture "A".
4. Hold the glass in correct position with the hand and tighten up the "big black nuts" -top/bottom, first with the hand, then with the multi grip pliers.
5. Tighten up the finger screw for the flowmeter sensor, see picture "C"
6. Reset the system from the "Status Page"



Sensitivity adjustment of the electronic controller.

Note

This procedure is necessary if the flow meter glass has been turned.

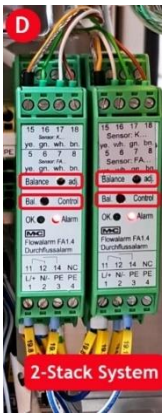


Tools:

- Ball point pen
- Screwdriver

1. Power "**OFF**" the Gas pump.
2. Gently Press the **Bal. Control** button using a ball point pen, and carefully turn the **Balance adj.** screw simultaneously. Be aware not to overturn the adjustment screw.

   Turn the adjustment screw right or left a few revolutions at a time to find the switch point where the LED indicator changes from Red to Green or Green to Red See picture "D"
3. The exact adjustment is where the **OK/Alarm** shift from green to red.
4. Reset the system from the "Status Page"



Refer to IG-G7000-011-Operate the system in manual mode.

IG-G7000-002

System Type	G7000 Multi gas system	IG-G7000-002
Task:	Adjust the Gas Flow for the Gas Pump	
Task description:	This instruction identifies how to adjust the flow at the Gas pump and flow meter, to avoid a flow alarm.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧		20 min

Note: This operation must only be carried out by a skilled technician

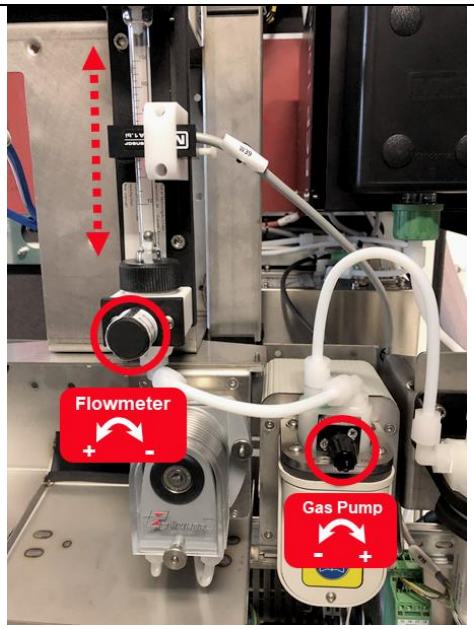
Instructions	Photos

Note: The gas pump must be active. *Refer to IG-G7000-011-Operate the system in manual mode*

Steps to adjust the Flow:

1. Open the flowmeter valve completely. By turning the valve to the left +.
2. Adjust the flow to **100 l/h*** on the gas pump needle valve.
3. Decrease the flow by the needle valve on the flowmeter to **80 l/h**.
4. Increase the flow again to **100 l/h** on the gas pump needle valve.
5. Decrease it to **60 l/h** on the flowmeter.
6. Manually Stop the gas pump

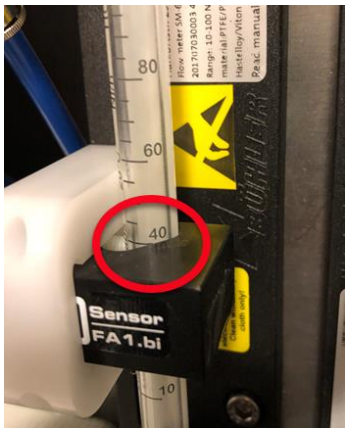
   Refer to IG-G7000-011-Operate the system in manual mode.
7. Then reset the system from the Status Page to remove the alarm at the display.



*If it is not possible to adjust the flow to **100 l/h**, then see the instruction guide on how to change the sample gas probe filter.

Alarm level setting.

Check if the sensor is correctly mounted at the flowmeter glass, the top edge should be set at 40 l/h. See picture beside.



IG-G7000-003

System Type	G7000 Multi gas system	IG-G7000-003
Task:	Replace internal gas filter	
Task description:	This instruction identifies how to replace the internal gas filter	
Difficulty 1-5	Spare parts	Estimated Time Consumption
🔧	**#03235** Filter insert-pack	10 min

Note: This operation must only be carried out by a trained technician

Turn off safety switch. The system will be out of service during the operation

Instructions	Photos
1. Pull the locking ring off 2. Gently pull the filter-glass down to release it 3. Pull down the used filter 4. Remount the new filter 5. Remount the filter glass 6. Plug-in the locking ring *** The filter must be changed according to the Planned Maintenance Program in this manual.**	 

IG-G7000-004

System Type	G7000 Multi gas system	IG-G7000-004
Task:	Control of incorrect mounted flow meter glass	
Task description:	This instruction identifies how to adjust the flow meter glass if it is mounted incorrect and cause a Flow alarm.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧🔧		10 min

Note: This operation must only be carried out by a trained technician

Instructions	Photos

It is strictly prohibited to reuse or clean the filter and O-ring at any time!

- When it is not possible to reach a gas flow of 100 l/h, a sample gas probe filter change could be necessary
- The filter should be changed according to the Planned Maintenance Program
- There are, no reason to remove the filter for inspection, because it does not give
- any indication of the filter condition or filter clogging.
- If the filter is removed for any reason the O-ring and the filter must be replaced
- During a filter change it is important to have a new set of filter and O-ring at hand
- It is preferred to have the CEMS, scrubber and engine shut down during a filter change to avoid unfiltered exhaust gas in the CEMS and the surroundings
- If the scrubber and engine are active the following steps must be carried out to protect the CEMS
- Stop the sample gas pump. For manual operation refer to IG-G7000-011-Operate the system in manual mode
    - Open the calibrating air valve using "Sample Probe" button. For manual operation refer to IG-G7000-011-Operate the system in manual mode
    - The probe heat must remain active
    - Replace the filter and O-ring using the following instructions
    - After replacing the filter and O-ring the system must be set back in AUTO mode

Attention

Probes and sample lines will be hot during operation.
Pay attention to the risk of burn.

Note: Make sure to have a new O-ring set for the handle before replacing the sample gas filter!

The filter collects dust particles inside, which makes it difficult to see the amount of contamination outside.

The Used filter on the picture shows the particles in the center.

The filter on the picture is totally blocked.

In a worst-case scenario, a blocked filter may cause damage to other parts of the system.

The filter must be changed according to the Planned Maintenance Program in the Operation Manual.

The following page shows how to change the filter in the probe.

A. Follow the instructions above
B. Loos the 4 thumb nuts to gain access to the probe handle and filter
C. Loose the handle by rotating it 90° and pull out the handle to grant access to the probe filter
D. Remove the old filter and O-ring from the handle.
E. Change the O-Ring on the handle, and remember to put the silicon grease on the O-ring
F. Put the silicone grease on the O-rings inside the filter
G. Remount the filter to the Probe handle
H. Put the probe handle with the N**ew Filter** back in the probe and turn the handle 90°
I. Remount the Probe housing using the 4 thumb nuts
J. Start or reset the system

Note

Do not reuse O-ring and probe filter.

IG-G7000-005

System Type	G7000 Multi gas system	IG-G7000-005
Task:	Check for blocked Sample Gas return hose	
Task description:	This instruction identifies how to check if the sample gas return hose is blocked.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧		30 min

Note: This operation must only be carried out by a trained technician

Instructions	Photos
1. Unmount the Sample gas return hose from the sample gas return connection, on top of the enclosure Check if there are any sharp bends on the Sample Gas Return Hose 2. Check if it is blocked by blowing air through the Sample gas return hose. **Attention: To avoid damaging the Analyzer do not blow compressed air backwards into the Sample Gas Return Fitting** 3. If the Sample Gas Return Hose is blocked remove the object or replace the Sample gas return hose.	

IG-G7000-006

System Type	G7000 Multi gas system	IG-G7000-006
Task:	Calibration of Internal Calibration Glasses	
Task description:	This instruction identifies how to calibrate the built-in Calibration Glasses	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧🔧		15 min

Note: This operation must only be carried out by a trained technician

Instructions	Photos

Note: A log in is required for this operation
Refer to IG-G7000-011-Operate the system in manual mode.

Make sure there is sufficient instrument air flushed through the system for this process.

The system will Calibrate the built-in Cells automatic after the system is turned ON.

A calibration with the Built-in Cells can be performed using the "IO Status" page see picture "A"

1. Press **"**Manual Select" (1)
2. Press "Calibrated" button (2)
3. The "Calibrated" button will turn red see. Picture "B"
4. The Calibration of the internal Calibrations glass will be performed

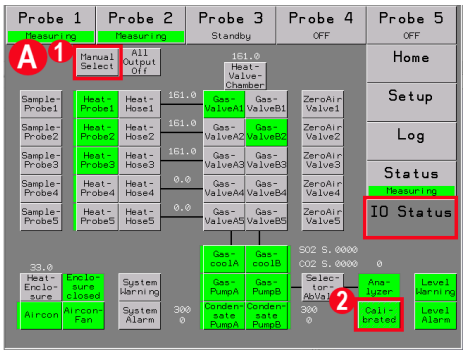
The calibration is finished when the **Calibrate** button turns **GREEN**

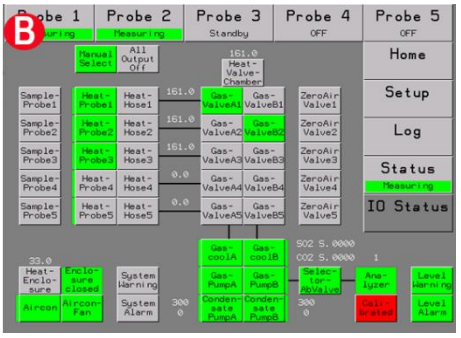
If the Analyzer has an Error given by the numbers i.e xxx as in picture "C" the following steps should be followed prior to a Calibration of the built in Cells:

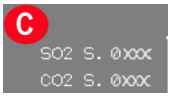
Ignore Analyzer Error

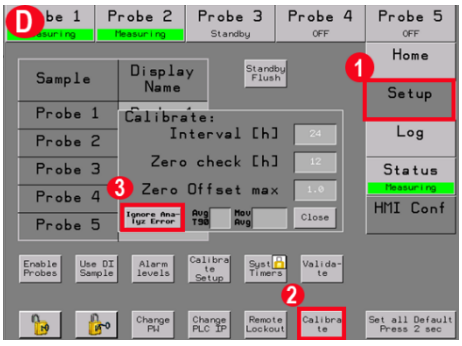
a) Press the **Setup (1)** button
   See Picture "D"
b) Press the **Calibrated (2)** button
c) Press the "**Ignore Analyz. Error" (3)** button and Close
d) **Restart Calibration from pkt. 1**

ATTENTION: It is important to deselect the "Ignore Analyz. Error" button again after end calibration





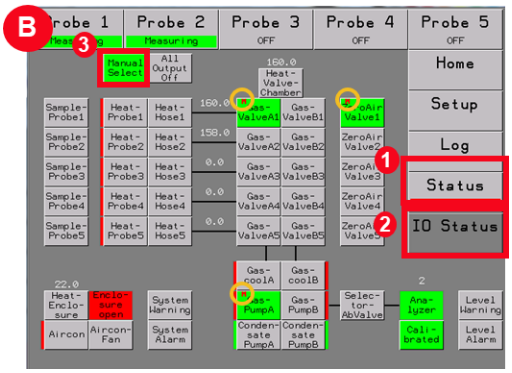




IG-G7000-011

System Type	G7000 Multi gas system	IG-G7000-011
Task:	How to set the system in manual mode	
Task description:	This instruction identifies how the system outputs can be operated manually from the IO Status Page. **Attention:** Some safety features will be disabled during operation in manual mode.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧		5 min

Note: This operation must only be carried out by a trained technician

Instructions	Photos
Lgin is required to operate in manual mode: Refer to Operation Manual section 4.4 **Activate Manual Mode:** 1. Press the **Status (1)** button 2. Press the **IO Status (2)** button 3. Press the **Manual Select (3)** button will turn **Green** 4. Now press any button intended for manual operation 5. The selected buttons will show a red **M** letter which indicates Manual Operation. 6. Press the Manual Select again, it will turn grey. 7. Any button with red **M** letter can be turned "**ON**" or "**OFF**" manually 8. When the button is turned "ON", there will be an "ON" indication on that button. **Deactivate Manual Mode:** 9. To deactivate Manual Operating mode, press "Manual Select" so it turns green 10. Press the buttons with red **M** 11. Press the Manual select button again and it will turn grey Press the buttons with "ON" written to deactivate the manual operation	 **Component activation list:** • Gas Pump • Condensate Pump • Gas Cooler • Enclosure Heating Elements • Valves • Multiplexer Heating • Hose Heating • Probe Heating **Remember to turn off activated components after end use!**

IG-G7000-013

System Type	G7000 Multi gas system	IG-G7000-013
Task:	Check the Condensate alarm and Condensate Pump	
Task description:	This instruction identifies how to check the Condensate alarm and the Condensate Pump.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧		20 min

Note: This operation must only be carried out by a trained technician

Instructions	Photos

Inspection of the 2 types of Level Switch:

> **Note**
>
> Spill during replacement or control of the Limit Switch can damage the electronics.
> Cover all components below before start.

Before controlling the condensate alarm verify the **Condensate OUTLET** is intact and not blocked – see illustration 1.

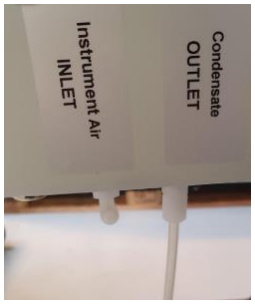


Illustration 1

Illustration 2

Condensate Alarm type with a level float sensor:

The Level Switch is located behind the Gas filter

Check if:

- the glass is filled with condensate.
- the level switch is installed correct, with the magnet in the bottom of the glass.
- the level switch hoses are intact and not blocked.
- the wires to the Level Switch are connected correct.
- the level switch glass is undamaged
- the Limit Switch venting is not blocked - see illustration 3.
- the drain holes inside the Limit Switch is not blocked – illustration 4.

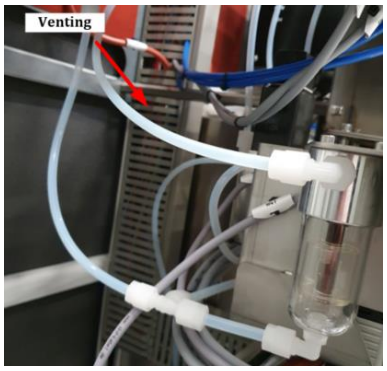


Illustration 3

Illustration 4

Note: For electrical wiring, check the Electrical Diagram for correct connection! Refer to the Documentation.

If the Level Switch is blocked and cannot be cleaned or if it is defect, it must be replaced according to the operation manual.

Condensate Alarm type with capacitive sensor:

Inspection of the Level Switch Sensor

The Level Switch is located below the Gas cooler

Check if:

- the level switch sensor is active. It will emit orange and/or green light when energized – see illustration 5.
- If there is no light on the level switch sensor, it is not energized control the wiring. - see illustration 6.
- the level switch hoses are intact and not blocked or bend.

Note

- Operation of the limit switch sensor - SW V. 3.8.2 or greater.
- The condensate pump will only run when there is condensate in the limit switch housing

With Active Limit Switch Sensor

No Condensate in the Limit Switch Housing => Orange and green light =>Condensate pump stops – see illustration 7.

Condensate in the Limit Switch Housing => Green Light => Condensate pump run – see illustration 7.

The minimum activation time for the condensate pump is 60 seconds.

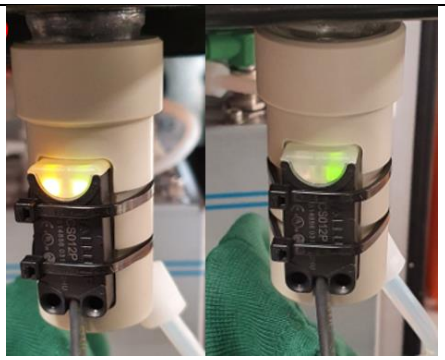


Illustration 5

Illustration 6

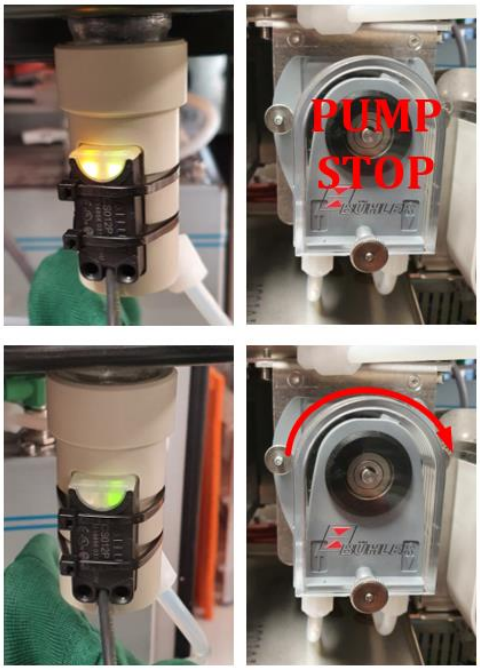


Illustration 7

IG-G7000-014

System Type	G7000 Multi gas system	IG-G7000-014
Task:	Check or replace the hose in the condensate pump	
Task description:	This instruction identifies how to check and replace the hose in the condensate pump.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧		20 min

Note: This operation must only be carried out by a skilled technician

Turn OFF safety switch. The system will be out of service during the operation

Instructions	Photos

The hose in the condensate pump will become deformed over time and reduce the ability to pump condensate.

Note:

- Stop the Condensate Pump if necessary
- Refer to IG-G7000-011-Operate the System in manual mode.

The hose needs to be changed according to the planned maintenance program in the Operational Manual if the pump shall remain functional.

- Check the state of the condensate hose – see illustration 1.
- The hose must not be bent, folded or teared – see illustration 2.
- It can be necessary to unmount the hose for inspection, to be sure it is intact and not damaged.
- Illustration 3 shows the difference between a new hose and a deformed hose.
- Illustration 4 shows an example of a damaged hose which must be replaced.

To unmount the hose from the pump, follow the instructions on the following page.

Attention

Protective gloves and glass are required.

Note: Spill during replacement of the Pump hose can damage the electronics.

Cover all components below before start.

Stop the Condensate Pump

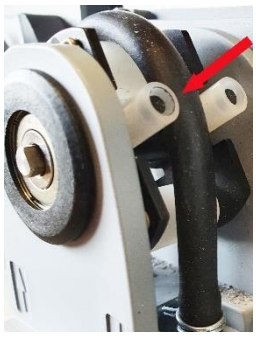


Illustration 1

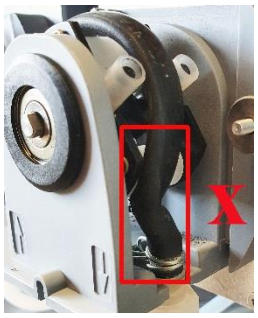


Illustration 2

Illustration 3

Illustration 4

Refer to IG-G7000-011-Operate the System in manual mode.

1. Loose the thumb nut on the Condensate Pump. See picture “A”
2. Pull of the cover
3. Loosen the two PVDF hoses (Inlet & Outlet) on the finger nuts
4. Unmount the pump hose in both sides of the Condensate pump. See picture “B and C”
5. Connect the new pump hose back in the fittings in both sides of the Pump
6. Mount the cover and make sure to **thoroughly** tighten the thumb nut at the front of the Condensate Pump.
7. Retighten the two PVDF hoses (Inlet & Outlet) on the finger nuts
8. Restart the Condensate Pump by Deactivating Manual Mode

Refer to IG-G7000-011-Operate the System in manual mode

IG-G7000-017

System Type	G7000 Multi gas system	IG-G7000-017
Task:	Manual Validation Routine	
Task description:	This instruction identifies how to perform a Manual Validation	
Difficulty 1-5	Spare parts	Estimated Time Consumption
🔧🔧	**#03881** Test gas kit	30 min

Note: To perform this operation, logging in is required.
See Guide IG-G7000-011-Operate the system in manual mode

Attention: This instruction requires Software greater then: V3.4.0
This operation must only be carried out by a skilled technician

Perform Calibration and Validation using certified test gases i.e.:
Zero gas bottle:100% N2
Span gas bottle: 200ppm SO2 + 10% CO2

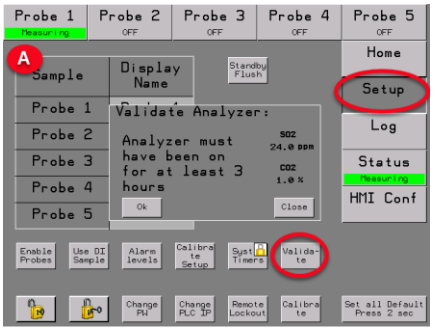
Instructions	Photos

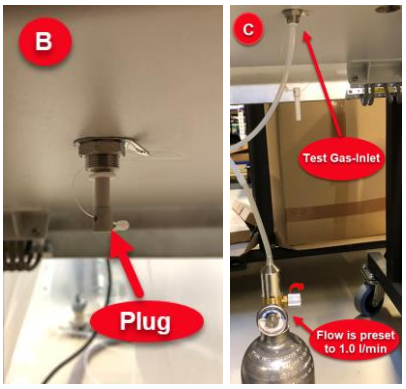
Important: The analyzer must be turned, "ON" for at least 3 hours prior to the operation.

1. After log-in press "Setup" button and then "Validate" button
   See picture "A"
2. Remove the plug to the "Test Gas Inlet" at the bottom of the enclosure. See picture "B"

<u>Zero Gas Validation:</u>

3. Apply certified test gas. N2 100% by the 6/4 mm hose to the
   "Test Gas Inlet" (Push to connect)
4. The flow regulator in the certified **#03810** test gas bottle is preset to 1 L/min. See picture "C"
   Make sure the hose is intact, clean, and not bent/broken.
5. Press "OK" to confirm that the hose is connected. See picture "A" – illustration 1
6. An info screen appears with the note: "Wait 5 minute for stable readings for *SO2 ppm and CO2 %* ", then press "OK". See picture "B" – illustration 1.
7. When pressing "OK", the analyzer performs an internal adjusting of the inbuild calibration glasses. See picture "C" – illustration 2.
8. After approx 5 minutes the Analyzer performs an internal calibration with the inbuild optical calibration glasses, and the results of the Zero validation can be observed. See picture "D" – illustration 2.





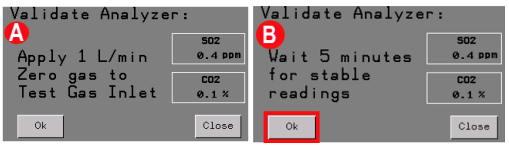


Illustration 1

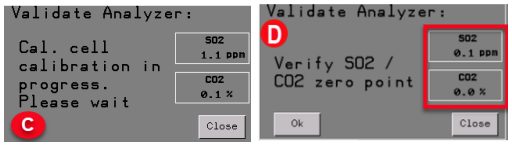


Illustration 2

For manual calibration note and save this value in a logbook for further reference, these are used for calculating the manual calibrations "Factor and Offsets"

Accepted tolerance of the Zero Validation:

Press "OK". *Remember to close the zero-gas bottle after end test.*

Zero GAS example	Accepted tolerance	Min example	Max example
SO2 ppm	+/- 8 ppm	- 8 ppm	+ 8 ppm
CO2 %	+/- 0,40 %	- 0,40 %	+ 0,4 %

SPAN Gas Validation:

9. Apply the certified mixed Span gas to the "Test Gas Inlet" (Refer to the span test gas bottle i.e.: SO2 = 200 ppm and CO2 = 10 %). The flow regulator in the **#03881** test gas bottles is preset to 1 L/min – see picture "A" – illustration 3
10. Wait approx. 5 min until the SO2 ppm and CO2% gas value is stable. Then press "OK". See picture "B" – illustration 3
11. The SPAN Gas Validation result can be observed. See picture "C" – illustration 4

    If a calibration is to be performed, the following steps must be done

- ***For manual calibration*** *note and save this value in a logbook for further reference See picture "C" - illustration 4*
- ***For Auto Calibration*** *press the SO2 and/or CO2 values on the screen. When the button turns* ***GREEN*** *the value is accepted. See picture "D" – illustration 5*

Note: *Only press the value corresponding to the applied type of gas*

Accepted tolerance of the SPAN Validation:

SPAN GAS example	Accepted tolerance	Min example	Max example
SO2 200ppm	+/- 8 ppm	192,0 ppm	208,0 ppm
CO2 10 %	+/- 0,40 %	9,6 %	+/- 10,4 %

12. When validation is done press "Close". *Remember to close the bottle of the mixed span gas after end test.*

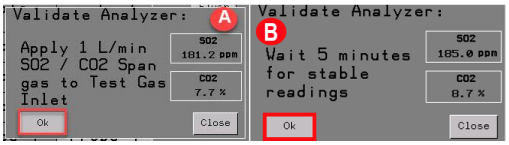


Illustration 3

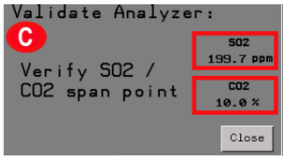
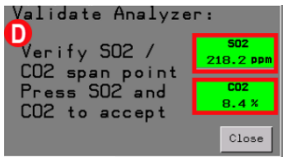


Illustration 4



Auto calibration Illustration 5

Notice

It is required to Validate with both SO2 and CO2 to complete a validation.

Notice

Min/Max. in the table is the calculated test gasses: 200ppm SO2 and 10% CO2

See the exact gas certification value on the test gas bottle certificate.

IG-G7000-018

System Type	G7000 Multi gas system	IG-G7000-018
Task:	Auto and Manual Calibration Guide	
Task description:	This instruction identifies how to perform an Auto- or Manual Calibration	
Difficulty 1-5	Spare part	Estimated Time Consumption
🔧🔧🔧	**#03881** Certified Test gas kit	60 min

Note: To perform this operation, log in is required.
See Guide for manual operation: *IG-G7000-011-Operate the system in manual mode*

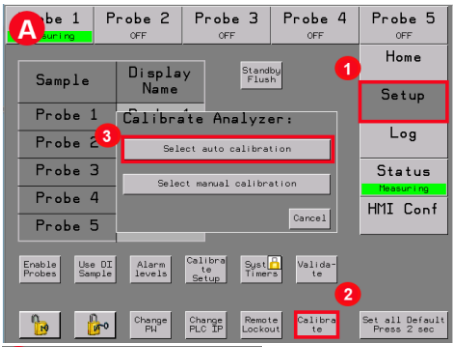
Attention: This instruction requiers Software greater than Version 3.4.0

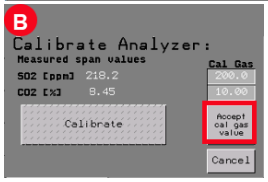
Perform Calibration and Validation using certified test gases i.e: Zero gas bottle:100% N2 and Span gas bottle: 200ppm SO2 + 10% CO2

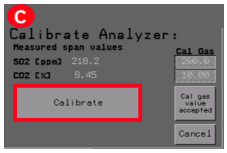
Instructions	Photos

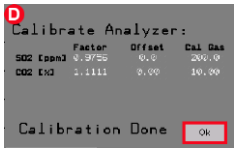
Perform Auto Calibration:

1. After log in press the “Setup” button (**1**), and then the “Calibration” button (**2**). Now press “Select auto calibration” button (**3**) See picture “A”
2. The accepted value from the validation are now present. To continue the auto calibration, press the “Accept cal gas value” button. See picture “B”
3. Press the “Calibrate” Button to start the auto calibration with the accepted validation values. See picture “C”
4. The calibration is done, and the screen shows the new calculated Factor and Offset values for SO2 and CO2, press “OK” See picture “D”





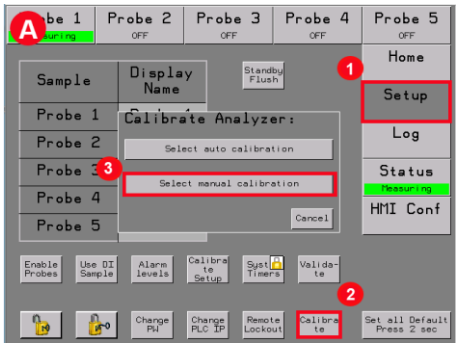




Note:
To verify the new Factors and Offset values for SO2 and CO2 a validation must be performed. Refer to **IG-G7000-017** guide for Manual Validation.

Perform Manual Calibration:

1. After log in Press “Setup” button **(1)** then Calibrate button **(2)**. Now press the “Select Manual Calibration” button **(3)**. See picture “A”
2. To enable editing of numeric value, press the “Edit Value Unlocked” button. See picture “B”
3. -And write 1.0000 in both SO2 and CO2 Factor fields. See picture “B”
4. Write 0.0 in both SO2 and CO2 Offset fields.
5. Write Cal Gas values from the certificate of the span gas.
6. Press “OK”



7. Run Validation as described in Guide: IG-G7000-**017** Guide for manual validation
   and **note** both zero and span values for SO2 and CO2. Old values are overwritten; thus it is recommended to note these values manually in a logbook for future reference.

Use the equations below to calculate the Factor and Offset for SO2 and CO2

1. Calculate Factor for SO2

$$\textbf{Example: SO2 factor} = \frac{\mathbf{0 - SO2_{Bottle\ Gas}}}{\mathbf{SO2_{Zero} - SO2_{Span}}}$$

$$= \frac{\mathbf{0-200}}{\mathbf{6.3-202{,}3}} = \mathbf{1{,}02}$$

   Write it in **SO2 Factor** See picture "C"

2. Calculate Offset for SO2
   (can normally be set to 0)

   Example: SO2 offset:

   $\mathbf{0 - 1{,}02 * 6{,}3 = -6{,}4}$

   Write it in **SO2 Offset** See picture "C"

3. Calculate Factor for CO2

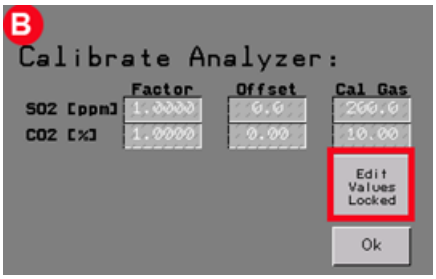
$$\textbf{Example: CO2 factor} = \frac{\mathbf{0 - CO2_{Bottle\ Gas}}}{\mathbf{CO2_{Zero} - CO2_{Span}}}$$

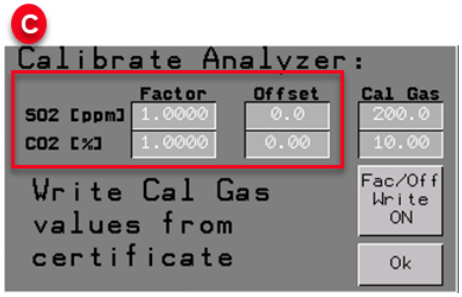
$$= \frac{\mathbf{0-10}}{\mathbf{0.4-9.6}} = \mathbf{1{,}0869}$$

   Write it in **CO2 Factor** See picture "C"

4. Calculate Offset for CO2 (can normally be set to 0)
   Example: CO2 offset:

   $\boldsymbol{CO2_{Offset} = 0 - CO2_{Factor}\ x\ CO2_{Zero} = 0 - 1{,}0869x0{,}4 = -0{,}434}$





Note

For verifying the calibration, it is recommended to run a Validation: Refer to **IG-G7000-017** Guide for manual validation

Write it in **CO2 Offset** - see picture "C"

Press "OK" after entering the new factor and offset values.

IG-G7000-019

System Type	G7000 Multi gas system	IG-G7000-019
Task:	What to be checked in Case of Enclosure temperature alarm	
Task description:	This instruction identifies what equipment to check in case of enclosure temperature alarm.	
Difficulty 1-5	Spare part	Estimated Time Consumption
🔧🔧	**# 03136** Temperature sensor ø3x30mm	45 min

Note: This operation must only be carried out by a skilled technician

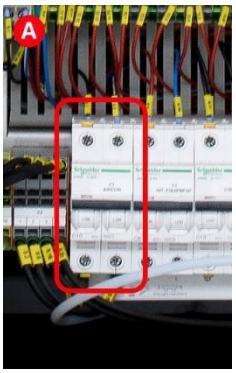
Instructions	Photos

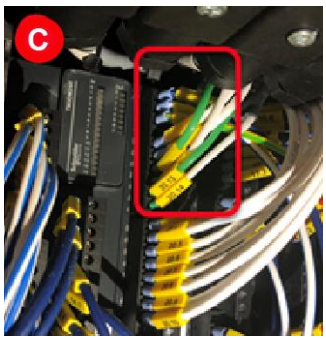
Be aware: When the enclosure door is open the temperature control will be deactivated.

1. Check that the door switch is functional
2. Check if the F1 automatic fuse **"AIR CON"** is activated. See picture "A" to activate the automatic fuse the lever must be as shown upwards.
3. Check that the Air Con is switched **ON,** see picture "B"
4. Check the connection to the Thermo-Couples, placed on the PLC inside the enclosure, for checking pull *gently* in the white/green cables. see picture "C"

   Note: See the electrical diagrams in the documentation folder for correct connection and reconnection of wires and electrical components
5. Check if the air condition display is "ON"
6. Check if the Set-Point is correctly adjusted to the right temperature at the air Condition by following the steps below:
7. Press "SET" **1** to view the Set-Point, it is specified to **30°C**
8. Make sure that the Air Condition filter is clean or see the Instruction guide: *IG-G7000-020*

for cleaning or change of the air condition filter.





How to adjust the "Set-Point" If not correct adjusted.
Default Setting = 30°C

1. Press and hold "SET" 1 for 2 sec see picture "C". The icon **"°C"** will start *flashing* and it is possible to adjust Set Point by using the Up/Down button 2

   See picture "D"
2. Check the connection for the heating element inside the enclosure. See picture "E"
3. Check the enclosure temperature at the HMI screen. See picture "F" If the temperature is below 5°C the system will automatic shutdown.

   (Normally working temperature is between 5-45°C the system is able to start at temperatures below 5°C)
4. Set the "Heat Enclosure" to "ON" and check for rising temperatures on the heating elements.

   Refer to: IG-G7000-011-Operate the system in manual mode

The Heating elements can be warm pay attention to the risk of burn.

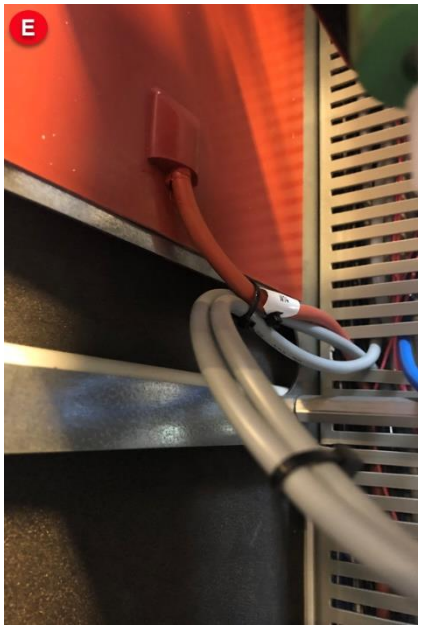
Note: To avoid overheating of the heating elements, **Turn "OFF"** the heating elements after testing.

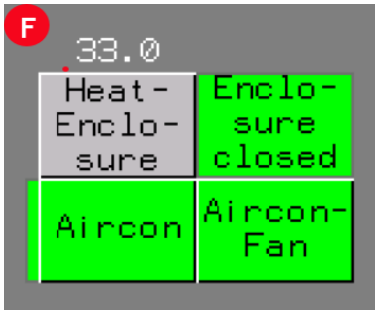
When in manual mode the temperature control is OFF.

5. Check for damage on the wiring for the Thermo-Couples/temperature Sensor
6. Check Thermo-Couples resisters with a multi meter

Note

See the electrical diagrams in the documentation folder for correct connection and reconnection of wires and electrical components

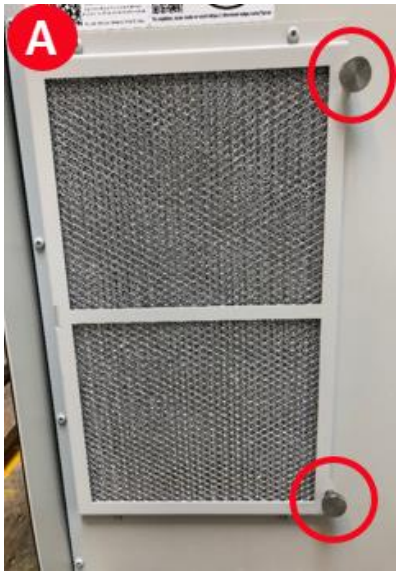




IG-G7000-020

System Type	G7000 Multi gas system	IG-G7000-020
Task:	Replace or Clean the Air Condition Filter	
Task description:	This instruction identifies how to clean and replace the air condition filter	
Difficulty 1-5	Spare part	Estimated Time Consumption
🔧	**#03385** AC-Filter Insert	15 min

Note: This operation must only be carried out by a skilled technician

Instructions	Photos
The Air condition filter requires regular cleaning. 1. Loosen the two thumb bolts at the side of the Air Condition unit “see picture A” 2. Push the filter with a screwdriver in the slot end and pull it sideways out of the rail. 3. Do NOT use acid wash as it reduces the life of the filter. Only clean the filter with mild soap and water. Dry thoroughly before replacing. 4. If the filter is damaged or not possible to clean, then replace the Air condition filter. 5. After cleaning or replacing the filter, mount it back in the slot and lock it with the two thumb bolts.	 

IG-G7000-021

System Type	G7000 Multi gas system	IG-G7000-021
Task:	How to perform internal leak test	
Task description:	This instruction identifies how to perform an internal leak test.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧🔧	**# 02366** Elbow Fitting 6/4mm – ¼" PVDF	60 min

Note: This operation must only be carried out by a skilled technician

Instructions	Photos

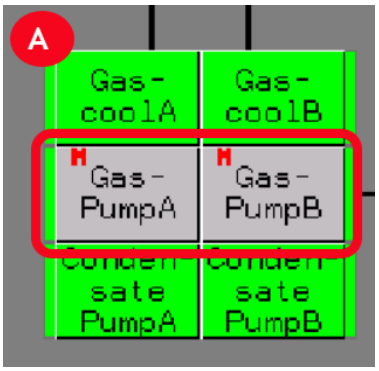
An internal leak test needs to be performed if:

- A commissioning is being performed
- The Analyzer has to be calibrated
- The Analyzer has been replaced
- Any hoses, components or fittings has been damaged or dismantled
- SO2 and CO2 values are lower than expected

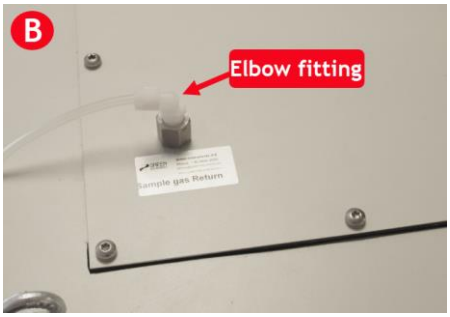
Tools to be used for internal leak test.

- PVDF Elbow fitting 6/4mm - ¼" *
- Silicon hose 6/4mm
- "Glass" of water
- Spanner 12mm
- Stopwatch.

*If not already connected



Blockage of the gas sampling system!
Do not block the gas sampling pipes to or from the system when the system is in operation! Damage of components can occur. Only during leakage test (short periods) blocking is allowed.



To perform this operation, a log in is required. See: *IG-G7000-011-Operate the system in manual mode*

1. Turn off (grey) all gas pumps using the "IO Status" and manual select button. See picture "A"
2. Disconnect the return gas connection on top of the enclosure and connect a soft 6/4mm silicon hose to the if not already connected then mount a PVDF Elbow fitting 6/4mm - ¼" to the ¼" NPT connection. See picture "B"

3. Close the bypass valve on the gas pump. See picture "D"

Open/close
Bypass valve

For 1-stack system without multiplexer installed – illustration 1:

4. *For 1-stack systems* (Only B-side installed) disconnect the sample gas inlet hose at the tee-piece connector in the top right corner of the enclosure
5. On the tee-piece connector (1 probe system) block the gas inlet with your thumb.

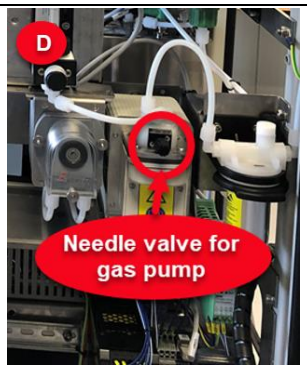
For 2-5 stack System with multiplexer installed:

6. *For systems with multiplexer installed* make sure all gas valves are closed (grey) via IO Status Manual Select screen
7. Turn off *all* the "gas Valve" using the "IO Status" and manual select button.
8. **For systems with multiplexer installed:** Start the gas pump A via "IO Status Manual Select" See picture "A"
   For One-Stack systems: Start gas pump B (Only B-side installed) via "IO Status Manual Select"
9. Wait until the flowmeter ball lays still at the bottom of the flow meter glass see picture "B"
10. If not possible to achieve a steady ball, a leak is present!
11. Squeeze the silicone hose flat before submerging it into the water See picture "C"

    WARNING: Risk of water entering the system backwards. *Loosen the grip slowly and make sure* ***NO*** *water is entering the hose.*

    If water enters the hose, squeeze quickly and remove the hose from the water!

    Remove any water droplets in the hose and try again from **step "11"**



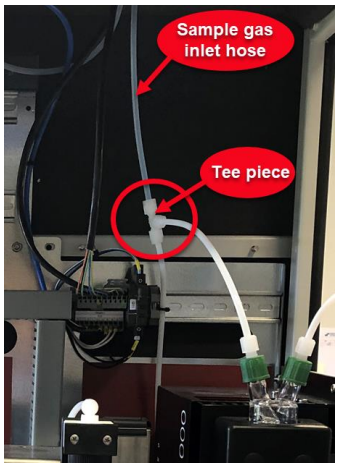
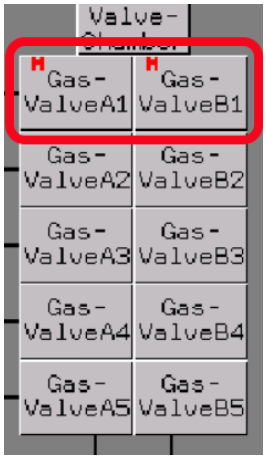
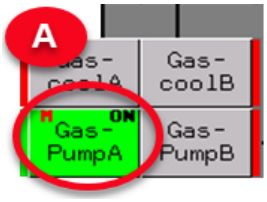


Illustration 1



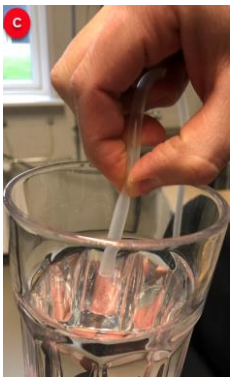


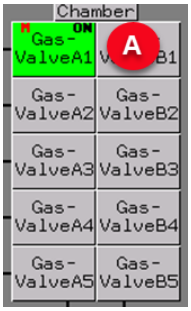
12. Count the amount of bubbles in the water: Up to 40 bubbles /minute is allowed*
13. If the amount of bubbles is < 40 pcs/minut, the system is air-tight, and leak test is passed.

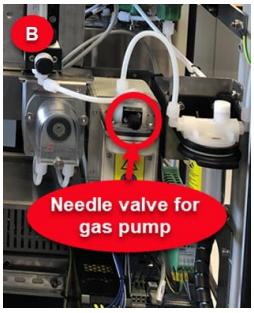
    To avoid water in the Analyzer!
    Remove the silicone hose from the glass of water, immediately after the test is completed.
14. Turn off the active gas pump via "IO status manual select"

    **(If the amount of bubbles exceeds*

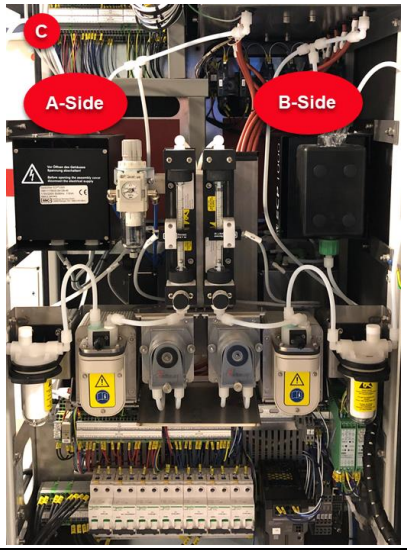
    40 bubbles/minute then search for a leak somewhere inside the cabinet and perform a leak test again)
15. **For systems with multiplexer installed:** Repeat step 8-13 with Pump B for the B-side
16. ***For 1 stack system***. Remove the thumb from the Sample gas inlet connection. Reinstall the hose to the fittings
17. ***System with multiplexer installed.*** Open the gas valve through the "IO status Manual select" A or B. See picture "A"
18. Start the gas pump shortly (1-2 minutes) to normalize the pressure in the system. See picture "B"
19. ***For system with multiplexer installed.*** The internal leak test procedure needs to be performed for both "A-side and B-side" See picture "C"
20. All manual functions shown on the "IO Status screen" must be de-selected for the system to resume in auto-mode.







Gas Pump:
Adjust Flow



IG-G7000-022

System Type	G7000 Multi gas system	IG-G7000-022
Task:	How to perform external leak test	
Task description:	This instruction identifies how to perform an External leak test.	
Difficulty 1-5	Spare part	Estimated Time Consumption
🔧🔧	**# 02366** Elbow Fitting	30 min

Note: This operation must only be carried out by a trained technician

The system will be out of service during this operation. -Leaks causes faulty measurements

Instructions

An External leak test needs to be performed if:

- performing commissioning on a new system
  To secure no leak at the heated hose and the probe
- a leak is suspected, and an internal leak test has been performed with success
- any heated hose, probe or fittings has been dismantled
- SO2 and CO2 values are lower than expected

Tools to be used for External leak test.

- PVDF Elbow fitting 6/4mm - ¼”
- Silicon hose 6/4mm
- “Glass” of water
- Spanner 12mm
- Stopwatch

Blockage of the gas sampling system!

Do not block the gas sampling pipes to or from the system when the system is in operation! Damage of components can occur. Only during leakage test (short periods) blocking is allowed.

<u>Commissioning</u>

Initial leak test before operation

As a part of commissioning, a leak test must be performed to ensure no leakage in the system, heated hose or probe.

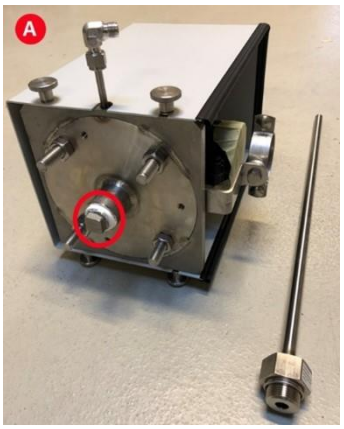
Attention

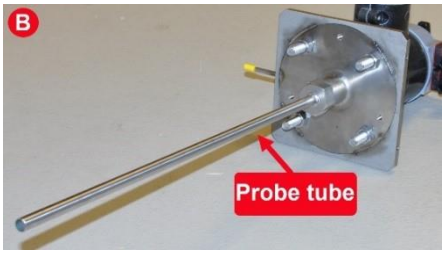
The sealed plug must be mounted during the commissioning process, see picture “A”

Photos

WARNING!

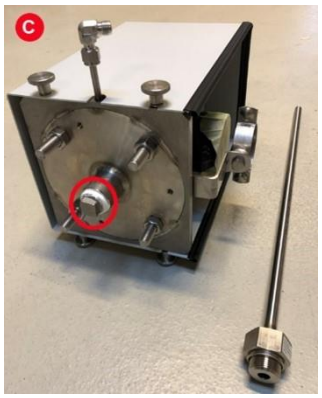
Probes, sample line and multiplexer are hot, pay attention to the risk of burn.





For system in operation

Dismount all the probes from the stacks, remove the probe tubes see picture “B” and seal the probes with ¾” sealed plug See picture “C”



To perform this operation, a log in is required. See: *IG-G7000-011-Operate the system in manual mode*

External leak test can only be performed when the probe is sealed with a sealed plug.

1. Turn OFF (grey) all Gas Pumps using the “IO Status” and manual select button. See illustration 1 “A”
2. Disconnect the return gas connection on top of the enclosure and connect a soft 6/4mm silicon hose to the if not already connected then mount a PVDF Elbow fitting 6/4mm - ¼” to the ¼” NPT connection. See illustration 1 “B”
3. Close the bypass valve on the gas pump. See illustration 1 “D”

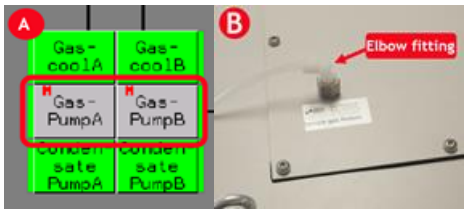


Illustration 1

Open/close
Bypass valve

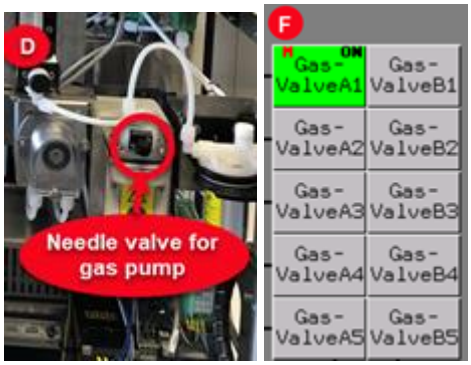
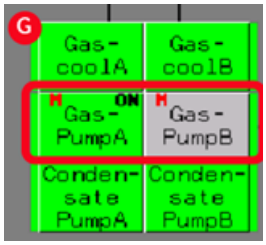


Illustration 1

For Systems with Multiplexer installed. Leak test must be performed for one hose at the time!

4. The external leak test can be performed for “Gas Valve” [A1,2,3,4,5] *or* [B1,2,3,4,5]
5. To open (green) or close (grey) the “Gas Valves” use the “IO Status” page. See illustration 1 “F”
6. Start the corresponding gas pump (A or B) See illustration 1 “G”
7. Wait until the flowmeter ball lays still at the bottom of the flow meter glass see illustration 1 “H”.
   If it is not possible to achieve a steady ball, a leak at the system is presented.
8. Squeeze the silicone hose flat before submerging it into the water See picture “I”



WARNING: Risk of water entering the system backwards. *Loosen the grip slowly and make sure **NO** water is entering the hose.*

If water enters the hose, squeeze quickly, and remove the hose from the water!

Remove any water droplets in the hose and try again from step "8"

9. Count the amount of bubbles in the water: Up to 40 bubbles /minute is allowed*
10. If the amount of bubbles is < 40 pcs/minute, the system is airtight, and leak test is passed

    To avoid water in the Analyzer!
    Remove the silicone hose from the glass of water, immediately after the test is completed
    Turn OFF the gas pump via "IO Status" immediately after ended leak test, to avoid damage on the system See picture "J"
11. Remove the sealed plug from the tested streams.

    Remount all dismantled components after finished test.
12. All manual functions shown on the "IO Status screen" must be de-selected for the system to resume in auto-mode or reset the system to resume to normal operation.
13. After end test, the flow needs to be re-adjusted: Refer to: *IG-G7000-002-Adjust the Flow for The Gas Pump*

Attention

If the number of bubbles exceeds 40 bubbles/minute then search for a leak on the corresponding heated hose and probe, and perform the leak test again)

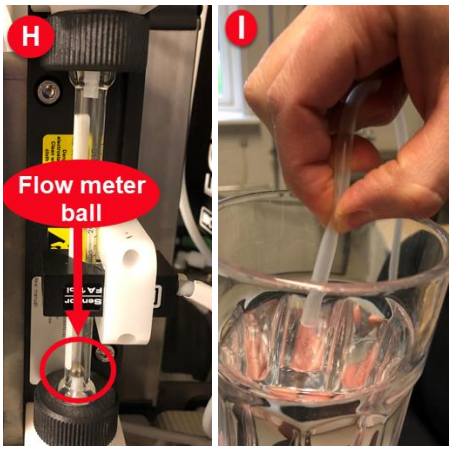
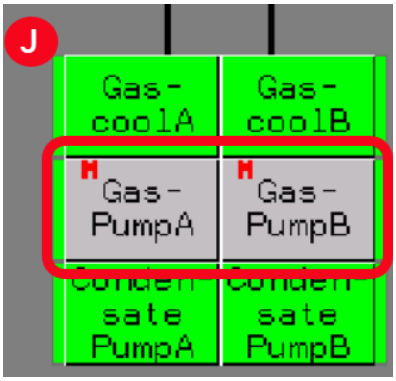


Illustration 1



WARNING!

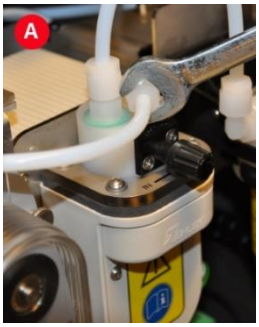
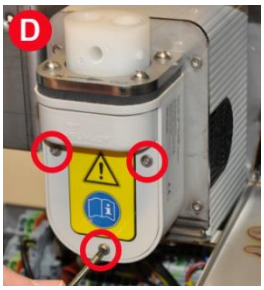
Probes, sample line and multiplexer are hot, pay attention to the risk of burn.

IG-G7000-023

System Type	G7000 Multi gas system	IG-G7000-023
Task:	Replacement of bellow and bypass valve in gas pump	
Task description:	This instruction identifies cleaning or replacement of the bellow and bypass valve in gas pump	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧🔧	#03387 Bellow f. Gas Pump #03234 By-pass v/v f. gas pump	45 min

Note: This operation must only be carried out by a trained technician

Turn OFF safety switch. The system will be out of service during the operation

Instructions	Photos
Tool to be use: • 1 x Torx 10 Screwdriver • 1 x Torx 20 Screwdriver • 1 x PH 1 Screwdriver • 1 x Spanner 12mm • 1 x Spanner 13mm • 1 x Spanner 14mm 1. Dismount the 2 hoses, on the Gas Pump using the 12mm spanner See picture "A" 2. Dismount the straight fittings using the 13mm spanner and then the elbow fittings using the 14mm spanner. see picture "B" Mark the fittings and hoses for correct mounting position after the replacement! (Remove old Teflon tape from the Elbow fittings and wrap it with new Teflon tape see picture "H") 3. Dismount the selector on the bypass valve with the PH 1 screwdriver, see picture "C" 4. Dismount the front of the Gas Pump using the Torx 10 Screwdriver, see picture "D" 5. Dismount the top of the Gas Pump using the Torx 20 Screwdriver see picture "E"	    

6. Remove the bypass valve from the Gas Pump see picture “F”

   Note: Pay attention the gasket is fragile!
7. Remove the bellow by turning it counterclockwise. See Picture “G”
8. Now the Bellow is unmounted and can be replaced with the new bellow
9. When the bellow is installed the new bypass valve can be mounted and the screws can be fitted
10. Remount the gasket carefully and make sure the orientation is correct
11. Remount the new bypass valve, make sure the orientation is correct
12. Mount the bypass valve at top of the Pump using the Torx 20 Screwdriver
13. Remount the selector on the bypass valve using the PH 1 screwdriver
14. Mount the cover for the gas pump using the Torx 10 Screwdriver
15. Mount the PVDF fittings and the hoses back on the bypass valve, see the instruction below for correct handling of the fittings

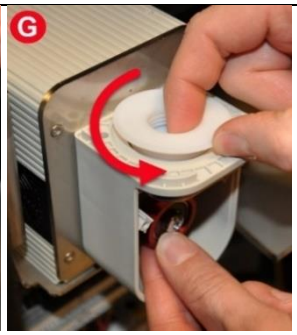
Technical information:

Reinstallation instructions for PVDF fittings:

PVDF

Tighten the union nut by hand until perceptible resistance.

Tighten down the union nut **1 rotation** using a wrench.

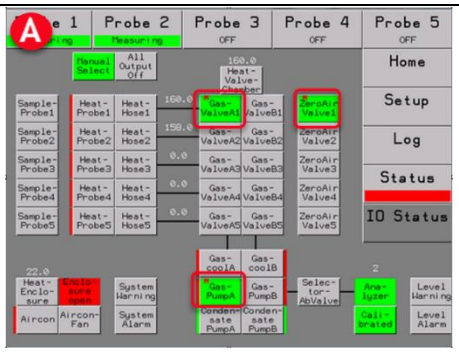
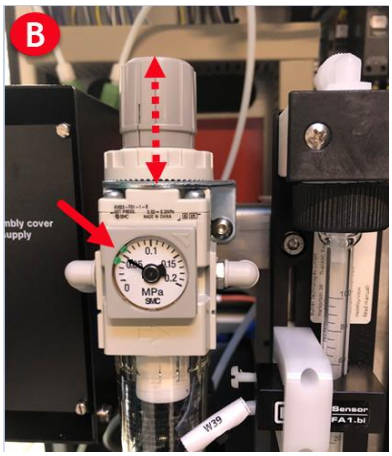
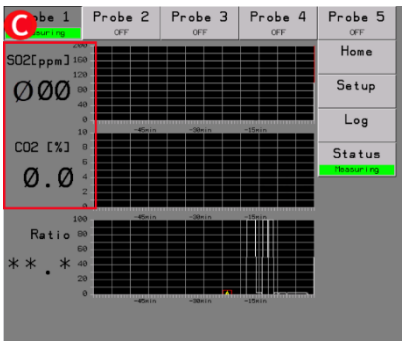


Wrap the Elbow fittings with new Teflon tape

IG-G7000-029

System Type	G7000 Multi gas system	IG-G7000-029
Task:	Control of Calibration Air Supply	
Task description:	This instruction identifies that sufficient calibration air is present for the calibration.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧		10 min

Note: This operation must only be carried out by a skilled technician

Instructions	Photos
Note: For this Instruction, the system must be operated in manual mode. *Refer to IG-G7000-011-Operate the system in manual mode.* 1. Activate the **Gas ValveA1, Zero Valve1** and the **Gas PumpA**, see picture "**A**" 2. Check the Air flow at the filter regulator when the gas pump is active. Correct pressure = 0,03 to 0,05 MPa. If the pressure is wrong, then pull up the button of the filter regulator and adjust the Air flow. see picture "**B**" 3. Wait approx. 2 min, and read out the measurement for the P**robe1** the value should reach 0% - CO2 and 0 ppm-SO2 4. Deactivate the Gas pump, close the valves and deactivate Manual Mode *Refer to IG-G7000-011-Operate the System in manual mode*	  

IG-G7000-038

System Type	G7000 Multi gas system	IG-G7000-038
Task:	Moist location and solving guide	
Task description:	This guide identifies how to locate signs of moist and how to solve the issue causing it.	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧		20 min

Note: This operation must only be carried out by a skilled technician
For a thorough explanation regarding filter change etc. consult the CEMS operation manual

Instructions

- Turn off system
- Water location in gas cooler

In the gas cooler glass, it is possible to see small droplets or mist, this is caused by the condensation of the hot exhaust gas and is not a sign of a fault in the system – see picture A.

Condensate with air bubbles must not be present.

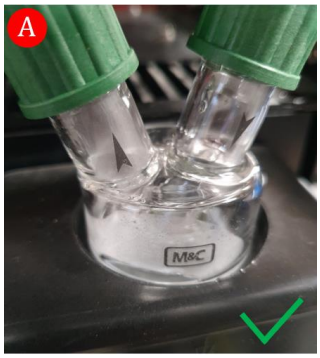
Attention

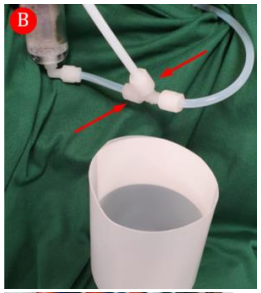
Condensate from gas driers may be aggressive and cause corrosion and chemical burns.
PPE must be worn whenever risk of being in contact with combustion gas and condensate occur.

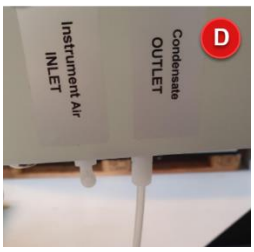
- When controlling the gas cooler, place a cloth and container below to pick up potential condensate. *See picture **B.***
- Control the amount of water in the gas cooler glass by demounting the condensate hose from the cooler and the hose from the limit switch at the T-Piece and put the hose ends in a container. *See picture **B***
- If necessary, loosen a gas fitting on the gas cooler top to help evacuate water. See picture C
- Check the "Condensate OUTLET" is intact and not blocked – see picture D.

If water is present in the gas cooler follow the instruction guide **IG-G7000-013** to solve the issue.

Photos







IG-G7000-039

System Type	G7000 Multi gas system	IG-G7000-039
Task:	System cleaning guide	
Task description:	This guide identifies how to clean components and hoses if moist has entered the system	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧🔧		30 min

Note: This operation must only be carried out by a skilled technician

Instructions	Photos

Attention

Condensate from gas driers may be aggressive and cause corrosion and chemical burns.

PPE must be worn whenever risk of being in contact with combustion gas and condensate occur.

Note

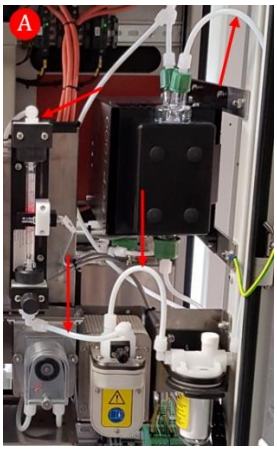
Before restarting the system, all components need to be clean.
Cleaning must be carried out using mild soap.

Cleaning the gas hoses

- Demount all hoses in gas path from cooler outlet to water trap inlet - *see picture **A.***
- Wash the loose hoses in mild soap and water - see picture B.
- Dry the hoses with compressed air - see picture C.

Cleaning the gas filter housing and glass

- Demount the gas filter glass and discard the gas filter - see picture D.
- Clean the filter housing and glass with mild soap and water
- Dry the glass with a cloth - see picture E.
- Dry the housing with compressed air - see picture F.



When moist has entered the system, the gas filter must be changed after ended system cleaning.

Cleaning the gas pump

- Loosen the 4 screws to demount the top of the gas pump - see picture G
- Carefully clean the bellow using a cloth, water, and mild soap - see picture H
- Carefully dry the bellow with compressed air see picture I

Note

Be careful not to dismount the bellow when cleaning

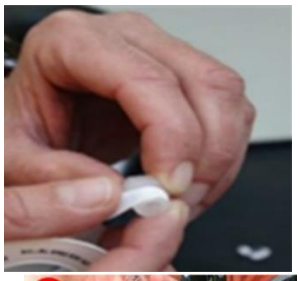
Cleaning the flow meter

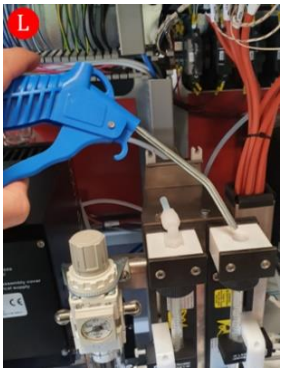
- Demount the fitting on top of the flow meter - see picture J
- Remember teflon tape when reinstalling fittings
- Slowly rinse the flow meter glass using water and mild soap.

  Place a container below the flow meter inlet to collect the water - see picture K
- Dry the pipe with compressed air blown carefully through the top - see picture L

When the cleaning is complete, reassemble the system with the dry and clean components.

- Mount the top of the gas pump
- Reconnect fittings and hoses
- Use teflon tape and do not overtighten fittings
- Reinstall the new gas filter and filter glass



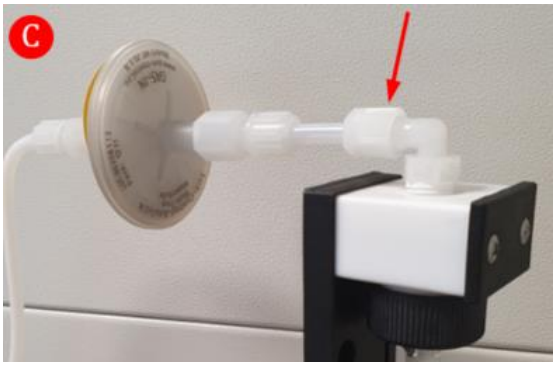


IG-G7000-040

System Type	G7000 Multi gas system	IG-G7000-040
Task:	**Water trap control guide**	
Task description:	This guide identifies how to check if the water trap is contaminated when there is no sign of moist in the gas filter housing	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧		20 min

Note: This operation must only be carried out by a skilled technician

For a thorough explanation regarding filter change etc. consult the CEMS operation manual

Instructions	Photos
During normal operation the flow will lower over time because the filters are getting contaminated. The water trap can become dark on the gas-inside if it is contaminated. See picture A **Section #1 Check contamination and flow through the water trap** • Loosen the fitting on the gas filter outlet See picture B • Manually activate the gas pump and adjust the flow to 100 l/h • If 100 l/h cannot be reached - Go to Section #2 • If 100 l/h can be reached when the hose is disconnected the water trap is not contaminated – **go to flow alarm flowchart in operation manual** **Section #2 Direct control of water trap contamination and flow** • Loosen the fitting on the flow meter outlet - see picture B • Manually activate the Gas pump and adjust the flow to 100 l/h • If 100 l/h can be reached when the Water Trap is disconnected, the Water Trap needs to be changed. • If 100 l/h cannot be reached when the Water trap is disconnected –**go to flow alarm flowchart in operation manual**.	  

IG-G7000-041

System Type	G7000 Multi gas system	IG-G7000-041
Task:	Contamination Location and solving guide	
Task description:	This guide identifies possible solution on how to locate the source of contamination and solve the issue	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧		15 min

Note: This operation must only be carried out by a skilled technician

Instructions	Photos
The Water trap will clog over time because of contamination of the small pores. This is not necessary an issue but if the water trap is contaminated, the system needs to be checked. **Gas filter** Check if the gas filter is installed and mounted correct The filter must be placed in top of the housing - *See picture **A*** Check if the gas filter is damaged or collapsed - *See picture **B*** <u>Change the gas filter if it is damaged or collapsed</u> Check the system if there are any disconnected hoses If it is necessary to check the probe filter for any damage, it is important follow the instruction guide in CEMS operation manual.	 

IG-G7000-042

System Type	G7000 Multi gas system	IG-G7000-042
Task:	Replace the Water Trap	
Task description:	This guide identifies how to replace the water Trap when a change is necessary	
Difficulty 1-5	Overhaul Interval	Estimated Time Consumption
🔧		15 min

Note: This operation must only be carried out by a skilled technician

Instructions	Photos

Attention

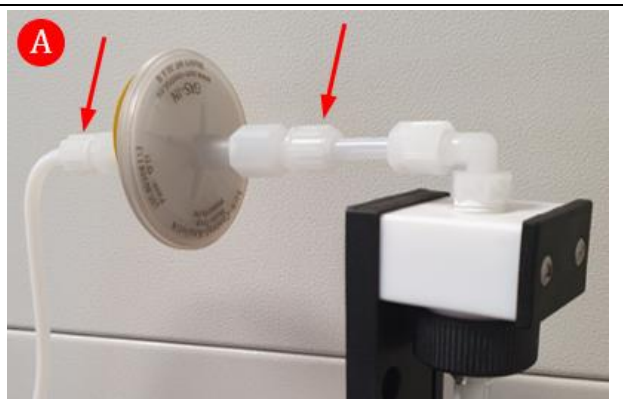
Replacement of a Water Trap, which has clogged due to moist or dirt, should only be carried out when the system components and hoses are clean and dry.
Be aware of "GAS IN" direction.

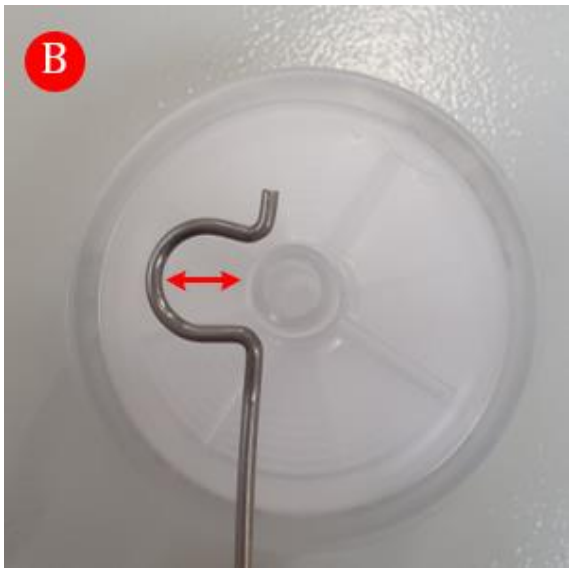
Changing the water trap

- Loosen the fittings on the water trap - *see picture **A***
- Pull the water trap sideways out of the Spring holder - s*ee picture **B***
- Install the new water trap in the spring holder
- Tighten the fittings on the water trap
  DO NOT OVERTIGHTEN

Important: If the water trap fittings are overtight, the flow can be obstructed.

Restart the system and adjust the flow according to the operation manual.





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