

# G7200

# Multi Gas Monitoring System

## User Manual



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# Maritime

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Instruments**

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For safe and proper use of the G7200 Multi Gas Monitoring System, read this user manual carefully and keep it for future reference.

For spare parts information, refer to the G7200 Spare Parts Catalog.

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# 1. Introduction

## 1.1 About the System

The G7200 Multi Gas Monitoring System (MGMS) from Green Instruments is a continuous emission monitoring system. The modular design of the system enables customers to monitor different gases according to their specific requirements and application.

For scrubber applications the G7200 can monitor the SO<sub>2</sub> and CO<sub>2</sub> concentrations in exhaust gas according to the requirements in Appendix 3 of the NO<sub>x</sub> Technical Code 2008 and the requirements in MEPC. 340(77) – 2021 Guidelines for exhaust gas cleaning systems. It provides an accurate measurement of SO<sub>2</sub> in ppm, CO<sub>2</sub> in percent, and presents the SO<sub>2</sub>/CO<sub>2</sub> ratio.

For other applications such as emissions from MGO, LNG, and biofuels the modular system configuration comes into force. By fitting the G7200 MGMS with gas analyzers based on both non-dispersive infrared (NDIR) principle and non-dispersive Ultraviolet (NDUV) principle, the system can detect a wide range of gasses among others SO<sub>2</sub>, CO<sub>2</sub>, NO<sub>2</sub>, NO, CH<sub>4</sub>, CO, N<sub>2</sub>O and H<sub>2</sub>O. All measurements are compensated for variations in temperature and pressure.

The double sample conditioning unit prepares the next sample while simultaneously measuring from the current sample. This ensures a fast response time when the system is configured to measure from 2 different sample points.

The system has a unique 5-step filtration system that can be configured for different applications. The low sample gas flow of only 0,5L/min maximizes the lifetime of filters and introduces a minimum of contaminants from the exhaust to the system. Diagnostic features help the user carry out maintenance only when required.

The system components include heated probe(s) and heated hose(s) to maintain the extractive exhaust gas sample at a sufficient temperature to avoid condensed water and loss of SO<sub>2</sub> as required in section 6 of the MEPC. 340(77). A gas cooler cools down the gas and lowers the dew point of the gas making it a dry cool gas. A level switch activates the condensate pump that drains the produced condensate from the system. The sample gas pump modulates its speed to keep the gas flow constant, while selector valves make it possible to handle two samples in one system. The air treatment system helps to ensure the air quality used for zero calibration and purging/flushing periodically in between exhaust gas samples. A flow transmitter monitors flow for each relevant operational mode from sampling to flushing and calibration. It also acts as feedback for maintenance of filters and sample gas pumps and ensures flow is stable during measurements and calibration. Heaters and ventilators operate automatically to maintain required temperatures in different areas of the system.

## 1.2 Proposed Field of Application

The device is intended to be used for exhaust monitoring as well as other applications onboard vessels where continuous monitoring of gasses is relevant.

It can be installed as CEMS on SO<sub>2</sub> scrubbers according to MEPC.340(77). The system can also be applied as a generic gas monitor for exhaust emissions from combustion of various fuels such as MGO, LNG and biofuels. For these applications, the mentioned relevant sections of NTC 2008, appendix 3 have been demonstrated.

## 1.3 Technical Specifications

**NOTE:** Specifications are subject to change without notice.

<b>G7200 MGMS</b>	
Type	G7200
Function	Monitoring of CO <sub>2</sub> , SO <sub>2</sub> , NO <sub>2</sub> , NO, CH <sub>4</sub> , CO, N <sub>2</sub> O, H <sub>2</sub> O, and other relevant gasses.
Equipment including	Analyzer modules, gas cooler, gas pump (s), condensate pump(s), gas filtration system, flow transmitter, solenoid valves, air filter regulator and oil/particle separator, air dryer, HMI, PLC.
Certification	DNV, Rina, LR, CCS, KR, ClassNK, ABS, BV
Number of Gas Analyzer Modules	1-3 depending on configuration
Power Supply	230 VAC – 50/60 Hz
Power Consumption	16 A - 40 A dependent on system configuration – refer to the electrical drawings of each system.
Display	7" TFT LCD color display with touch screen
External Communication	Modbus TCP/IP (RJ45) Optional Modbus RTU
Electrical connection	Refer to the electrical documentation
Gas and fluid connections	Refer to the drawing Installation Layout
Air supply	ISO 8573-1 Class 3-3-3 Free from traces of measured gasses. Approx 1 L/min. 4-10 bar.
Sample flow	0.33 – 1.67 l/min. Default 0,5L/min.
Ambient temperature	Class A From 5°C to 55 °C
Humidity	RH up to 96% at all relevant temperatures
Vibration	Class A
EMC	Class A
Material/Enclosure Class	Painted mild steel RAL 7035, IP54
Dimensions/Weight	1200 x 800 x 300 mm (H x W x D) Approx. 125 kg depending on configuration
<b>Probes and Heated Sample Lines</b>	
Number of probes	Up to 2, refer to Installation Layout
Sample line length	4 – 25 m; dependent on system configuration
Exhaust gas temperature	From 0°C to 500 °C (Dew point ≤ 60 °C)
Exhaust gas pressure	-50 – 500 mm WC
Material	Hastelloy max 400 °C 316TI max 600 °C Optional 316TI and other materials on request.
Flange dimensions	DN65/PN6
Inserting length	500 mm from mounting flange
Power supply	Supplied from the monitoring cabinet



Electrical connection probe end	2 pre-configured plugs for temp. alarm and power
Electrical connection monitoring cabinet	2 pre-configured connectors on the hose
Ambient temperature Probe	5°C to 55 °C (optional outdoor probe available on request.)
Ambient temperature Hose	-20°C to 55 °C
Humidity	RH up to 96% at all relevant temperatures
Vibration	Class B
EMC	Class A
Enclosure Class	IP55
Probe Dimensions/Weight	175 x 180 x 795 mm (H x W x D)/12 kg
Hose diameter/ bend radius	At system end Ø53mm. Hose diameter Ø45 mm. Bend radius min. 250mm.
<b>Analyzer Modules</b>	
Type G7010	
Gas analyzer measuring principle	NDIR
Measuring gasses and typical ranges	CO <sub>2</sub> : 0 – 10 % SO <sub>2</sub> : 0 – 200 ppm Other ranges upon request
Accuracy/linearity	≤ ±2 % of reading or ≤ 0.3 % of full scale whichever is larger (except zero)
Precision/repeatability	≤ ±1 % of full scale above 100 ppm or ≤ ±2 % of full scale below 100 ppm
Noise	≤ ±2 % of full scale
Zero drift	< ±2 % of full scale
Span drift	< ±2 % of full scale
Calibration	Zero Calibration: Automatic using compressed air Span Calibration: Automatic using inbuilt cuvette which hold span gas and the possibility to connect mixed test gases for verification

## 1.4 Storage and Handling

### 1.4.1 Storage

The ambient temperature must be 0–60 °C, and the relative humidity must be 20–90% RH. Keep the equipment stored in its original packaging. Store indoors in a dry room where the equipment will not be exposed to vibration or dust.

### 1.4.2 Handling

Refer to the relevant technical specifications for the weight of each component when unpacking, moving, and installing the components.

The system enclosure is equipped with 4 eyebolts for lifting. Use appropriate lifting equipment that can lift the system enclosure securely and safely.

## 1.5 Delivery Check

Check the equipment upon arrival to ensure that the equipment has been transported properly.

Check for any damage. If any damage is found, immediately make a note on the delivery document. Remove the packing and check for intrusive water or signs of humidity.

Check for missing parts against the packing list. Any discrepancies or damage should be reported to Green Instruments A/S immediately.

## 1.6 Terms and Abbreviations

The following table lists terms and abbreviations used in this user manual.

Description	Abbreviation
Multi Gas Monitoring System	MGMS
Continuous Emission Monitoring System	CEMS
Human Machine Interface	HMI
International Maritime Organization	IMO
Marine Environment Protection Committee	MEPC
Non-Dispersive Infrared	NDIR
Non-Dispersive Ultraviolet	NDUV
Programmable Logic Controller	PLC






## 2. Safety

### 2.1 Safety

Read and understand the contents of the entire user manual before operating the system.

#### 2.1.1 Symbols and Warning Labels

This manual uses the following symbols to identify essential information related to the correct and safe operation of the G7200 MGMS. Follow the safety warnings to minimize the risk of electrical shock, burns and equipment damage when operating the system.

Symbol identification			
	General warnings sign		Hot surface hazard
	Electric shock hazard		Protective earth
	Chemical hazard		

#### **WARNING**

- Failure to follow the instructions can lead to serious injury or death. Follow the instructions:
- Do not install the system in hazardous and explosive environments such as EX-zones. It is not safe.
- Do not use the system for sampling and measurements of media that is explosive. It is not safe.
- Install equipment on a robust structure that minimizes vibration and is strong enough to support the load.
- Ensure all power and signal cable connections are correct before operating the G7200 Multi Gas Monitoring System.
- Hot surface hazard: The gas analyzer modules and enclosures, probes, sample lines, gas cooler, and heater elements become hot during operation and can cause burns. Avoid contact with hot components and allow components to cool down before performing work on these.
- Wear personal protective equipment. The system must only be installed in a safe, non-hazardous area. It must not be used with flammable media. This manual describes the most common and known situations. It does not describe every possible situation or circumstance relating to the installation of the system. This manual does not replace the specific training and education of personnel who will be installing the system.

Should a situation arise that is not described in this manual, and which cannot be resolved by normal known practice and good workmanship, then contact Green Instruments A/S.

#### **WARNING**

##### **Electric shock hazard**

Disconnect the power before installing or servicing the equipment. Failure to do so can cause damage to materials. Read the installation instructions carefully to ensure all power and signal leads have been correctly connected.

Ensure that the correct supply voltage is connected to the system.

## Circuit Breaker

The installation must include a means of isolating electrical power by a clearly marked external switch or circuit breaker. The external switch or circuit breaker must be located near the system and within easy reach of the operator.

The G7200 MGMS is equipped with a safety switch located on the top left side of the system. This switch disconnects power to downstream components.

## Overload and Short Circuit Protection

In accordance with the safety requirements in IEC 61010-1 (2010), the installation must include a means of overcurrent and short circuit protection to provide protection against excessive energy being drawn from the system power supply if the equipment has a fault. Refer to the electrical documentation for more information.



### Protective Earth

The system must be connected to protective earth.

## Installation and Fault Finding



### Electric shock hazard

Electrical installation and system fault finding may only be carried out by a suitably trained and qualified engineer.

## EMC

In accordance with the EMC product standard IEC 60533 (2015), connection cables for communication signals must be shielded or have equivalent protection.

## Probes and Heated Sample Lines



### WARNING

Risk of damage/electrical shock. The probes and heated samples must be installed and connected before powering up the system. When the system is powered on, the connections to the probes and sample lines must not be disconnected. The equipment must not be exposed to strong mechanical shocks.

Sample lines must be protected from overheating, sharp edges, mechanical stress, chemicals, and from hanging loosely both during and after installation. For more information, see the Hose Handling and Installation Guide.

If sample lines must penetrate a deck or bulkhead or if there are special requirements relating to water tightness or fire protection, always follow the applicable safety regulations.



### ATTENTION

Pressurized system. Never shut-off the pipeline to or from the system when the system is operating, as this may damage components. De-pressurize the system before removing any wetted components. Do not block bypass, outlet or drain lines from the instrument air system.

**ATTENTION**

Gas sampling system. Never block the gas sampling lines to/from the system when the system is operating, as this may damage components. Intentional blockage is only permitted for short periods when carrying out a leakage test in accordance with our instructions.

**WARNING**

Harmful components: toxic gas hazard.

Avoid leaks of toxic gas. Only disconnect sampling line components when carrying out troubleshooting or repairs. Escaped exhaust gas can damage equipment or result in faulty measurements. After carrying out troubleshooting or repairs or after reassembling components in the gas sampling lines, perform a leakage test.

**WARNING**

Harmful components: toxic gas and chemical burns hazard.

The exhaust gas is hot and contains toxic media. Before removing a component ensure that the gas channel is plugged to prevent exhaust gas escaping.

Condensate from exhaust gas can be corrosive and cause chemical burns. Wear personal protective equipment whenever there is a risk of contact with exhaust gas or condensate e.g., from the gas cooler.

**Equipment Disposal**

Do not dispose of the equipment with normal waste. Disposal must be carried out in accordance with the requirements of the applicable statutory regulations.

### 3. HMI Structure

The HMI (Human Machine Interface) structure is designed to ease the setup, operation, and maintenance of the G7200 system.



Figure 3-1 Navigation Bar

You can use the navigation bar at the top of the screen to navigate to the home page, measurements page, alarm page, settings page, and status page. You can also use it to change access levels and perform a safe shutdown of the system.

#### 3.1 Security and Login

The G7200 supports the following user access levels:

Level	Access	Username	Password
1	Standard access on power up	Guest	
2	Service access	Service	1234
3	Admin access	Admin	Generated one-time password

- **Level 1 – Guest** : Guest users can view system status, measurement values, active alarms, and alarm history.
- **Level 2 – Service**: Service personnel can access system settings, sample line setup, calibration, software update, and manual activation of components during trouble shooting. This is for trained personnel only. The system automatically logs off Service level access after 20 minutes inactivity.
- **Level 3 – Admin**: Admins can modify system parameters, configure the number of sample points, and the number of analyzer modules. They can also modify certain internal parameters.

**NOTE:** The system is case-sensitive and distinguishes between lower- and upper-case letters.

#### ATTENTION

Access to Level 3 requires consent and a password from Green Instruments. The admin must contact Green Instruments and share the information shown on the login screen. Green Instruments can then generate a one-time password that will be active for 30 minutes after login.

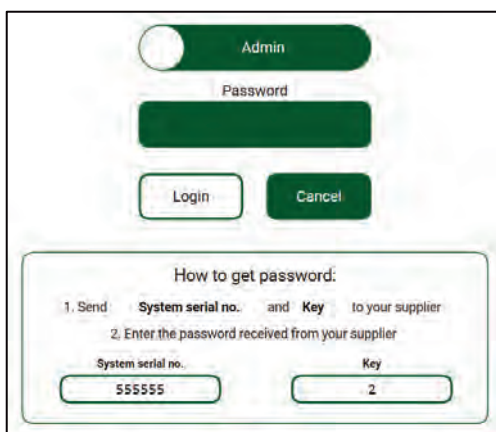


Figure 3-2 Level 3 Password

Press **Yes** to log out.

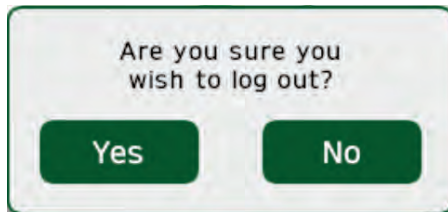


Figure 3-3 Log Out

## 3.2 Home Page

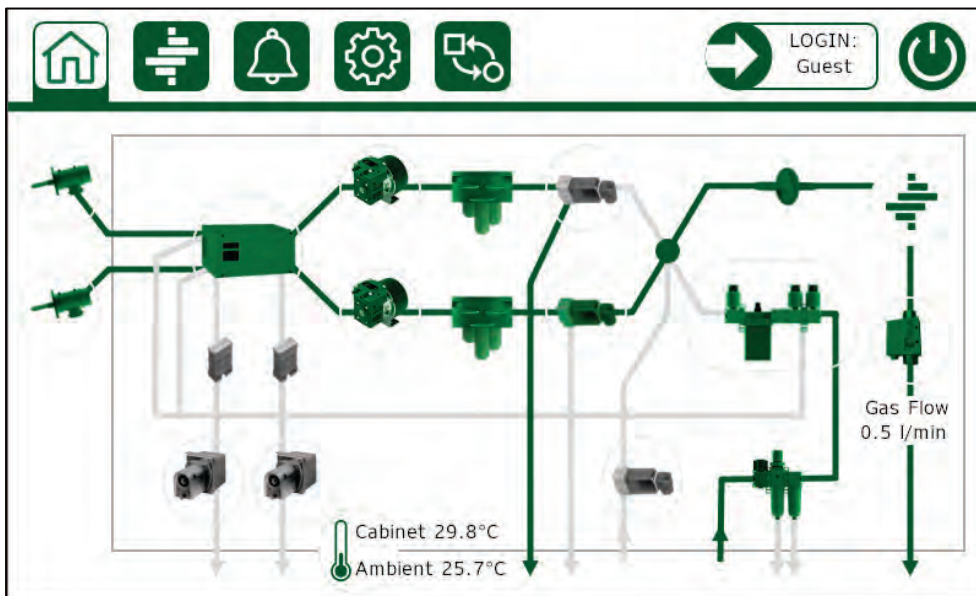


Figure 3-4 Home Page

On the **Home** page you can do the following:

- Get an overview of the system layout and components.
- View live operational status of components, gas flow, and temperature.
- Control relevant components manually in relation to trouble shooting.
- View component parameterization such as limits and setpoint settings

### Indicators:

- A circle around a component indicates that an operator with Level 2 Service Access can control the component.
- No circle around a component indicates that control is not possible. However, information about the component is available when it is pressed.
- A red "M" on the rim of a circle indicates that a component is being operated manually by the operator. When the M is not visible, it means that the component is automatically controlled.
- ON or OFF on the rim of a circle indicates whether a component is on or off while it's being operated manually.
- A green line indicates that this section of the gas path is open. It does not necessarily mean gas is flowing through this gas path.
- An orange color indicates that the component is heating up.
- A green color component indicates that the component is ready for operation or active.
- A grey color means the component or gas path is inactive.

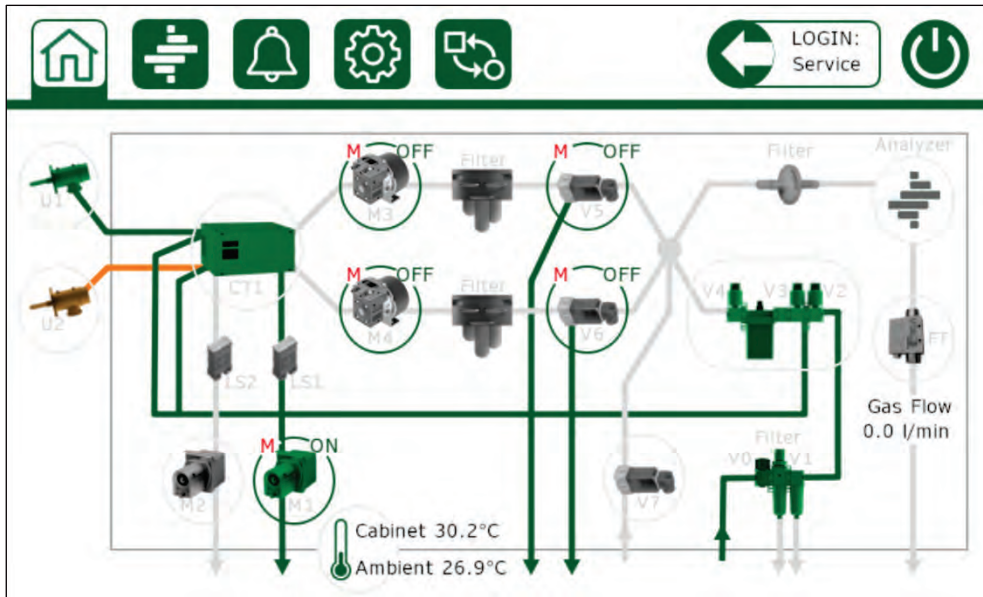


Figure 3-5 Home Page Example

M3 Gas Pump 1	
Manual	
Auto	On
	Off
Process Value	30.7 %
Manual Setpoint Value	80.0 %
Auto Warning High Value	80.0 %
Close	

Figure 3-6 Component Popup Example



### 3.3 Measurements Page

The **Measurements** page displays live measurements for each parameter and sample point.

	Sample 1	Sample 2	
SO2	21.0	18.0	ppm
CO2	6.30	5.80	%
Ratio SO2/CO2	3.3	3.1	-

Figure 3-7 Measurements Page

### 3.4 Alarm Page

Date	Time	Status	Category	Message
01/10/2024	10:26:17	Active	Alarm	Gas cooler temperature high alarm1
01/10/2024	10:26:17	Active	Alarm	Gas cooler temperature high alarm 2
01/10/2024	10:26:17	Active	Alarm	Gas cooler temperature signal alarm 1
01/10/2024	10:26:17	Active	Alarm	Gas cooler temperature signal alarm 2
01/10/2024	10:23:39	Active	Warning	Controller Cabinet door open warning

Figure 3-8 Alarm Page

On the **Alarm** page you can view both historic alarms and active alarms.

- Red indicates an active alarm/warning.
- Green indicates that the criterion for an alarm or warning is not being met anymore.
- To switch between the Active and Historic view, use the button in the top left corner.
- To perform a system reset for active alarms or warnings, press the **Reset Alarms** button in the top right corner for 3 seconds.
- To sort and filter alarms, press the black arrow on the header of the relevant column.

### 3.5 Settings Page

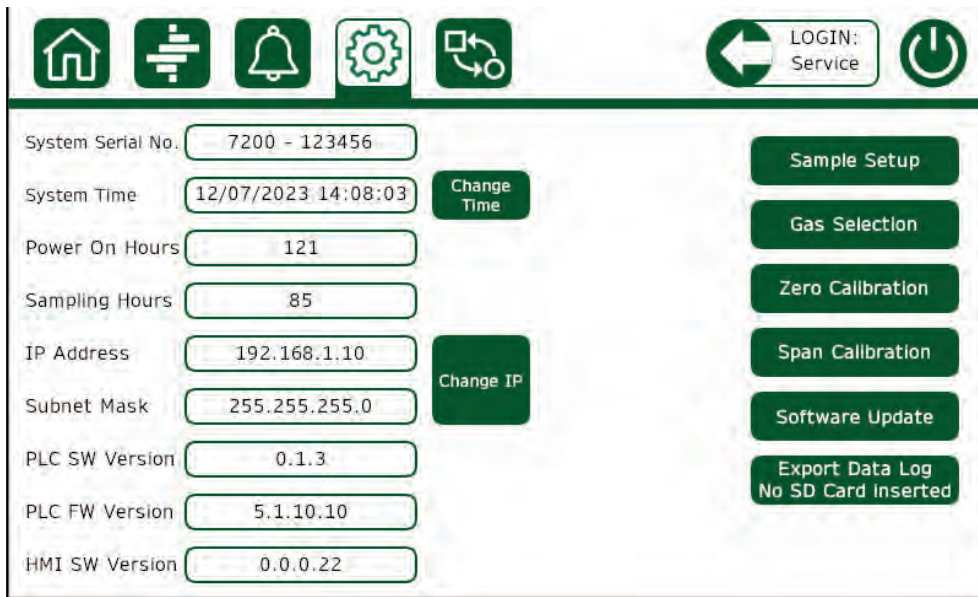


Figure 3-9 Settings Page

Only users with service security access level have access to the **Settings** page. The page displays relevant system information and enables you to edit system settings and perform zero and span calibration. On the system settings page, you can do the following:

- View system serial number and system time.
- Monitor how many hours the system has been powered on and total hours of sampling.
- Configure the system IP address.
- View and update PLC and HMI software
- Enable or disable sample points and edit sample point alias.
- Enable or disable available gas measuring channels.
- Initiate and configure span calibration of analyzer modules.

#### 3.5.1 Sample Setup Page

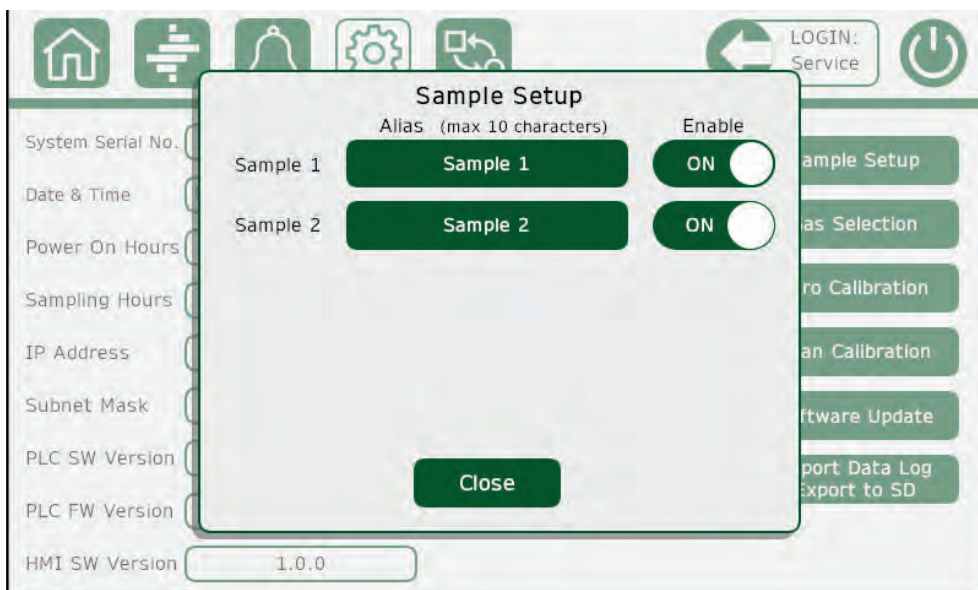


Figure 3-10 Sample Setup Page

On the sample setup page, you can do the following:

- Enable or disable a sample point. That is, you can disable sampling via stream 2 for a longer period if measurements from stream 2 are not needed or if stream 2 has a known error that has not yet been fixed.  
**NOTE:** A disabled sample stream will still be visible on the Measurements Page, but the probe, heated hose, and gas pump will not be active, and measurements will not be updated. Likewise, associated warnings and alarms will be disabled.
- Assign a name alias to each sample such as “ME 1” or “DG 2”.

### 3.5.2 Gas Selection Page

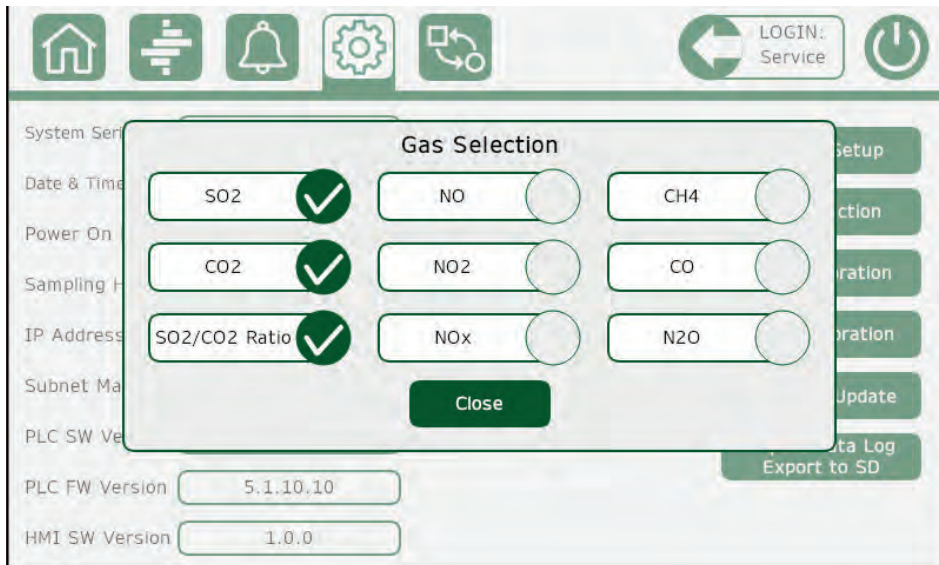


Figure 3-11 Gas Selection Page

On the gas selection page, you can do the following:

- Select and deselect gasses you want to monitor by setting a check mark. Only the selected gasses will be shown on the Measurements Page, and you can only calibrate selected gasses. All gasses that are supported by the MGMS are shown in the selection menu. However, depending on the gas analyzer configuration, you can only select gasses with a full colored green circle.

### 3.5.3 Software Update

Before updating the software, make a note of any changes to the system settings and system running hours for future reference. The settings can be overwritten by default values.

1. Copy the HMI software files received from Green Instruments onto an empty and formatted USB stick.
2. Copy PLC software files received from Green Instruments onto an empty and formatted SD memory card.

- Go to system **Settings Page**, press the **Software Update** button, and then follow the instructions in the pop-up window.

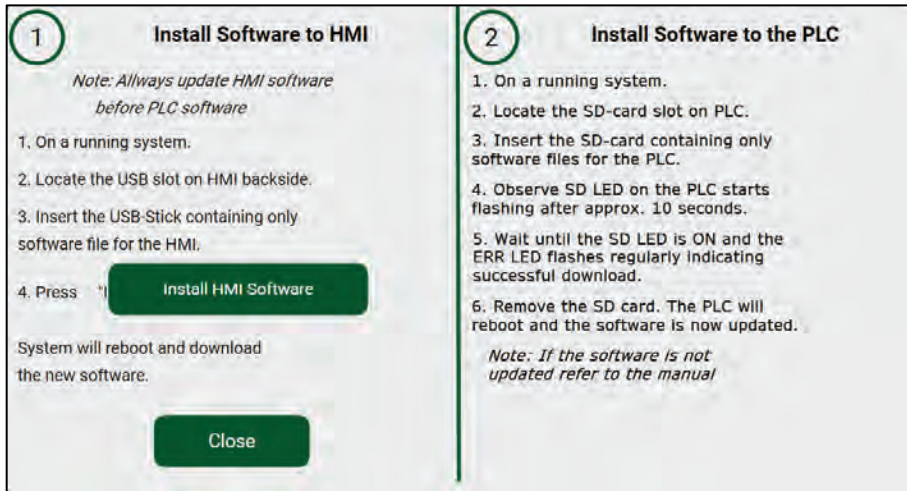


Figure 3-12 Software Update

### 3.5.4 Log and Data Export

**NOTE:** IMO resolution MEPC.259(68) and 340(77) stipulates that the logging function must not substitute data recording and processing. Logged data is typically sent to the manufacturer for diagnostic purposes.

All measurement data and relevant system data is being logged and saved on an SD card located on the PLC, every 24 hours. You can export the latest data to the SD card at any time by pressing the **Data Log Export** button on the **Settings** page on the HMI. The data on the SD card is saved in a csv format.

### 3.6 Status Page

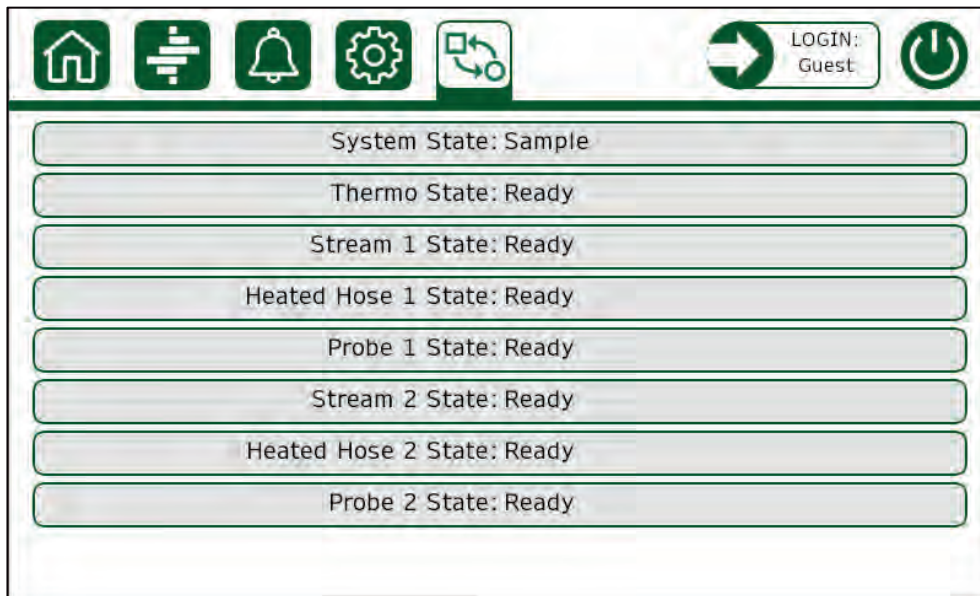


Figure 3-13 Status Page

On the **Status** page, you get an overview of the different states and operating statuses of the system or components.

- Operating statuses:** When the system is powered on, it can have the following operating statuses: **Check, Preparing, Heating, Ready, Sample, Purge, Calibration, OFF, Not mounted** and **Hibernation**.

- **System state:** includes the gas analyzers and components that are not included in the sub-systems such as the flow transmitter and ambient temperature sensor. The system state also controls sampling, flushing, calibration, and shutdown scenarios.
- **Thermo State:** covers heating and cooling of the sampling cabinet and heating of the gas analyzer compartment. If any of the cabinet doors are open, Thermo State is OFF.
- **Stream State:** consists of the gas cooler, heated hose, and probe. A stream can only be ready if the gas cooler, heated hose, and probe is ready. At least one stream must be ready for the system state to start sampling.
- **Heated Hose state:** reflects the status of the heated hose.
- **Probe state:** reflects the status of the probe.

## 4. Installation

### 4.1 Mechanical System Installation



#### **WARNING/ATTENTION**

Faulty operation/system failure hazard

This section provides critical information regarding the installation of the system enclosure and must be read carefully. Incorrect or improper installation may result in system failure or faulty operation. Failure to comply with the installation requirements may result in personal injury and/or damage to equipment and will render the warranty void.

Follow the instructions and comply with the requirements stated in Chapter 3 and throughout this manual and consult the relevant technical documentation to ensure correct installation.

- Ensure that the installation always complies with system enclosure specifications and technical drawings.
- Ensure the correct connection of power, signal cables, fluid, and air connections before operating the system enclosure.



#### **ATTENTION**

The following installation instructions are for general use only and apply to a complete MGMS and are not concerned with specific installations.

Every MGMS is configured at the factory in accordance with the specific system configuration for the system in question.



#### **WARNING**

Electric shock hazard

Refer to the electrical drawings for each system enclosure before carrying out the electrical installation.

#### 4.1.1 System Enclosure



#### **ATTENTION**

The G7200 MGMS is designed, developed, and rigorously tested to function efficiently and safely in demanding maritime applications under ambient temperature conditions between 5-55°C. Failure to comply with recommended maintenance program, service letters and usage instructions can affect the function, lifetime and warranty.

Special attention and extended testing have been carried out to secure function and compliance at high ambient temperatures between 45-55°C, which is an enhancement to the DNV Class A normal operating temperature. The system monitors both ambient, enclosure and single component temperatures to control and maintain ideal operating and lifetime conditions during gas sampling, conditioning and measurement. Thermal dynamic properties and software features facilitate that the continuous emission monitoring is conducted reliable and without interruptions up to 55° ambient temperature following applicable guidelines and regulations.

Cautious high or low temperature warnings will indicate if operating conditions get close to limitation, and safeguarded system shutdown will prompt if ambient temperature gets below 0°C or higher than 55°C. Refer to section 5.2 Safe System Shutdown.



## ATTENTION

Refer to the G7200 MGMS installation layout drawing and to the P&ID for detailed instructions before installing the system enclosure.

To ensure satisfactory and faultless operation with minimal maintenance be aware of the following:

- The system enclosure must be installed indoors and protected from direct contact from salt, mist, water, dust, soot, and oil spills. Avoid high humidity levels (see the max. permitted ambient RH in the technical specifications section).
- The system enclosure must be mounted in location and at height that is easily accessible for operation and service.
- The ambient temperature outside the system enclosure must comply with the specification limits. The ambient location must be well-ventilated and not be near sources of radiant heating.
- The system enclosure must be mounted vertically.
- The system enclosure must be mounted mechanically to structural beams, pillars, or other similar main structures to ensure minimal vibrations. It must not be mounted onto a thin-plated structure such as casing plates or similar because of the risk of vibrations.
- The system enclosure must be mounted using the mounting brackets bolted to the system enclosure.
- There must be sufficient free space for access to the system enclosure. The system enclosure must be mounted in a location with correct circulation of air. Refer to the G7200 MGMS installation layout in the technical drawings for more information and for the dimensions of the system enclosure.
- The length of heated hoses must be taken into consideration when determining the mounting location of the system enclosure and probes.
- The system enclosure must be connected to a compressed air supply. The air must be free from significant traces of measured gases. For information regarding pressure, consumption, and air quality refer to the specification.
- For some applications, the G7200 MGMS can produce acidic condensate. Therefore, ensure that the connection(s) marked as **Condensate outlet** are connected to a suitable hose such as PTFE, and that this is led securely to a suitable pressure less drain located below the system enclosure.

### 4.1.2 Probes



## ATTENTION

Refer to the probe installation layout drawing for detailed instructions before installing the probes.

### Choose a Sampling Point

Install the probe in a suitable location where it will extract the gas that is going to be monitored. It is important that the exhaust gas is homogeneous/well mixed in order to extract a representable sample. Ideally, the probe must be installed at a distance equivalent to of at least 10 x the pipe diameter after the outlet of the engine, turbocharger, or the last post-processing device (whichever is furthest downstream). If this is not possible, then the probe must be installed in the best possible location where it is expected that the exhaust gas has been uniformly mixed.

Ideally the probe must also be positioned at least 0.5 m or a distance equivalent to 3 x the pipe diameter upstream from the exit of the exhaust gas system (whichever is greater). This is to avoid ambient air from unintentionally entering the probe. If this is not possible, then the probe must be installed in the best possible location where it is expected that ambient air will not enter the probe during normal operation.

Refer to the probe installation layout drawing for detailed installation instructions.

The sampling probe is intended for use in enclosed areas in order to provide adequate protection from the weather. If used outdoors a special type of probe must be ordered. In all cases the specifications for the probe must be respected. The probe must be installed where it is protected against mechanical damage and vibration. The flue gas temperature must not exceed the given temperature limit of the probe tube.

### Fit a Probe

The probe is designed to be fitted to a JIS B2220 5K 65A (DIN DN65/PN6) flange socket by means of four bolts. Refer to the drawing **Flange Socket f. Probe** for more information about the flange socket. The 3/8" threaded socket on the flange pipe must be plugged using a suitable 3/8" BSP male plug.

When welding the mounting socket JIS B2220 5K 65A (DIN DN65/PN6) to the stack, ensure that the bolt holes are aligned, so that the probe can be fitted with the sampling hose connection facing downwards.

The probe tube must be self-draining by tilting downward at 15°. Note that the entering of droplets and aerosols in the probe must be avoided.

Also ensure that the insert length of the probe is greater than 10 % of the duct diameter. Refer to the probe installation layout drawing for detailed probe installation instructions.

**NOTE:** Any holes or leaks in the gas ducting system upstream or near to the probe might affect the accuracy of the measurement.

## 4.2 Electrical Connections for System Enclosure and Probe

### 4.2.1 Probe Connections

The electrical connectors for power and alarms are included in the heated hose and must be connected to the probe. These are clearly marked **Power** and **Alarm** as shown in the following figure:

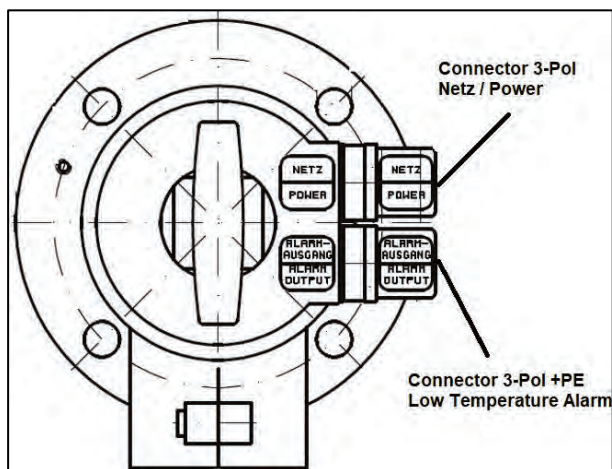


Figure 4-1 Probe Electrical Connections

### 4.2.2 System Enclosure Power Supply

Before connecting the external power supply to the system enclosure, make sure that it complies with the power supply rating for the G7200 MGMS. Refer to the electrical drawings that are relevant for the installation.

### 4.2.3 Install Cables

Cable types for each system are clearly defined in the electrical drawings. Make sure that you comply with the specification and best practice for installation of cables.



#### 4.2.4 Terminals, Cables, and Wires Marking

All terminals, cables and wires are marked with a unique number in accordance with the electrical documentation.

### 4.3 Heated Hose



#### ATTENTION

Before installation, see the Hose Handling and Installation Guide for information about the positioning and protection of the heated sample lines. Failure to comply with the instructions might result in damaged components.

- The heated hose can be delivered in different lengths to meet customer specification upon order.
- The heated hose is intended for use in enclosed areas. If used outdoors, adequate protection from the weather must be provided. In all cases the specifications for the heated hose must be respected.
- The heated hose must be protected from overheating, sharp edges, mechanical stress, chemicals, and from hanging loosely both during and after installation.
- The hose must have adequate ventilation. If penetrating deck or bulkhead with a heated hose, do not fill with foam or insulation around the heated hose. Use bulkhead plates mounted with glands with a minimum internal diameter range of Ø38–Ø46mm. Do not over tighten the gland as it might damage the hose.

**NOTE:** This connection method might be insufficient for deck or bulkhead penetrations that have special requirements relating to water tightness or fire protection.

#### 4.3.1 Connect Heated Hose

After installation of the heated hose, it must be fitted and secured in accordance with the instructions in the heated hose installation layout drawing.

##### Connect the heated hose at the system end

1. Insert the heated hose from **Sample Line 1** through **Sample Inlet 1** in the cabinet top and connect the PTFE hose named **Sample gas** to **Gas Cooler Sample 1**. Repeat for heated hose number 2 for 2 stack systems.
2. Connect the PTFE hose named **Calibration Gas** to the fitting named **Test Gas**. Repeat for heated hose number 2 for 2 stack systems.
3. The heated hose and the system enclosure are connected electrically using two pre-configured plugs. Refer to the electrical diagram for further information.

##### Connect the heated hose at the probe

1. Remove the probe enclosure, the insulating cover, and loosen half of the hose clamp.
2. Connect the **sample gas hose** to the probe using the pre-fitted hose fitting underneath the probe insulation cover. Do not overtighten the hose clamp and bolts. Pay special attention not to damage the bolt of the insulation cover since this type of heat resistant material is fragile.
3. Connect the **calibration gas hose** to the stainless-steel pipe on the side of the probe using the pre-fitted fitting.
4. The heated hose and the probe are connected electrically via plugs, located under the probe enclosure. Refer to the electrical diagram for further information.

### 4.4 Communication

System communication is available via a Modbus TCP/IP communication line, where it acts as a client device.

- The IP address can be configured from the settings page on the HMI.
- The default system IP address is: 192.168.10.1

### 4.4.1 Modbus Map

The G7200 MGMS communicates via Modbus TCP/IP or optional Modbus RTU. The following table shows details, values, and which Modbus addresses to access for specific parameters.

Note the following:

- Only Modbus holding registers are used. The first holding register is address 0.
- Type: *Bit arrays* holds registers where individual bits are named with a function description. When a bit is 1 (true), the function is active.
- Type: *Real* uses two Modbus holding registers. Format is little-endian byte swap.

Address (Holding register Function code 03)	Name	Function Description	Type (Read/Write)	Range or Unit
<b>System</b>				
0-5	Reserved			
6	SYSTEM_STATUS	0 = System Ready, sampling or calibrating 1 = System Error, preparing or check 2 = Reserved 3 = Reserved 4 = Reserved 5 = Hibernate or shutdown 6- 15 = Reserved	Bit array. Active high (Read)	
7	PROBE_COUNT	Attached probes in the system	uint16 (Read)	1-5
8	REMOTE (R/W)	Enable local or remote control 0 = Local on G7200 HMI 1 = Remote via Modbus TCP/IP	uint16 (Read/Write)	0 -1
9	PROBES_ON (R/W)	Probes ON. In Local control it shows enabled probes. In Remote control it enables probes 0 = Probe 1 1 = Probe 2 2 = Probe 3 3 = Probe 4 4 = Probe 5 5 - 15 = Reserved	Bit array. Active high (Read/Write)	
10	Reserved			

Address (Holding register Function code 03)	Name	Function Description	Type (Read/Write)	Range or Unit
11	CALIBRATE_STATUS	Calibrate Status 0 = Calibration done 1 = Reserved 2 = Calibrate in progress 3 = Calibrate error	uint16 (Read)	0 - 3
12-56	Reserved			
57	SYSTEM_HIBERNATE	0 = Hibernate	Bit array. Active high (Read/Write)	
<b>Probe 1</b>				
100	PROBE_STATUS_1	0 = Off, hibernate or check 1 = Preparing 2 = Ready 3 = Measure 4 = Error 5 = Reserved 6 = Reserved 7 - 15 = Reserved	Bit array. Active high (Read)	
102	SO2	According to measuring range in ppm	real (Read)	ppm
104	CO2	According to measuring range in %	real (Read)	%
106	Ratio	Note: 100 indicates an error shown if the CO2 level is below 0.5 % for a prolonged period of time.	real (Read)	0-100
108	NOX	According to measuring range in ppm	uint16 (Read)	ppm
110	NO2	According to measuring range in ppm	uint16 (Read)	ppm
112	CH4	According to measuring range in ppm	uint16 (Read)	ppm
114	NO	According to measuring range in ppm	uint16 (Read)	ppm
116	N2O	According to measuring range in ppm	uint16 (Read)	ppm
118	H2O	According to measuring range in ppm	uint16 (Read)	ppm
120	CO	According to measuring range in ppm	uint16 (Read)	ppm
<b>Probe x</b>				
X00	PROBE_STATUS_X	0 = Off, hibernate or check 1 = Preparing 2 = Ready 3 = Measure 4 = Error 5 = Reserved	Bit array. Active high (Read)	

Address (Holding register Function code 03)	Name	Function Description	Type (Read/Write)	Range or Unit
		6 = Reserved 7 - 15 = Reserved		
X02	SO2	According to measuring range in ppm	real (Read)	ppm
X04	CO2	According to measuring range in %	real (Read)	%
X06	Ratio	Value 100 indicates an error caused by the CO2 level being below 0.5 %, which makes the ratio calculation invalid.	real (Read)	0–100
X08	NOX	According to measuring range in ppm	uint16 (Read)	ppm
X10	NO2	According to measuring range in ppm	uint16 (Read)	ppm
X12	CH4	According to measuring range in ppm	uint16 (Read)	ppm
X14	NO	According to measuring range in ppm	uint16 (Read)	ppm
X16	N2O	According to measuring range in ppm	uint16 (Read)	ppm
X18	H2O	According to measuring range in ppm	uint16 (Read)	ppm
X20	CO	According to measuring range in ppm	uint16 (Read)	ppm
<b>Probe 5</b>				
500	PROBE_STATUS_5	0 = Off, hibernate or check 1 = Preparing 2 = Ready 3 = Measure 4 = Error 5 = Reserved 6 = Reserved 7 - 15 = Reserved	Bit array. Active high (Read)	
502	SO2	According to measuring range in ppm	real (Read)	ppm
504	CO2	According to measuring range in %	real (Read)	%
506	Ratio	<b>NOTE:</b> 100 indicates an error shown if the CO2 level is below 0.5 % for a prolonged period of time.	real (Read)	0–100
508	NOX	According to measuring range in ppm	uint16 (Read)	ppm
510	NO2	According to measuring range in ppm	uint16 (Read)	ppm
512	CH4	According to measuring range in ppm	uint16 (Read)	ppm

Address (Holding register Function code 03)	Name	Function Description	Type (Read/Write)	Range or Unit
514	NO	According to measuring range in ppm	uint16 (Read)	ppm
516	N2O	According to measuring range in ppm	uint16 (Read)	ppm
518	H2O	According to measuring range in ppm	uint16 (Read)	ppm
520	CO	According to measuring range in ppm	uint16 (Read)	ppm

## Communication Implementation

The following flowchart shows the minimum required implementation for remote control of the G7200 MGMS via the Modbus communication line. The flow chart can be used as a visual aid when implementing the system communication between the G7200 MGMS and the customer control system.

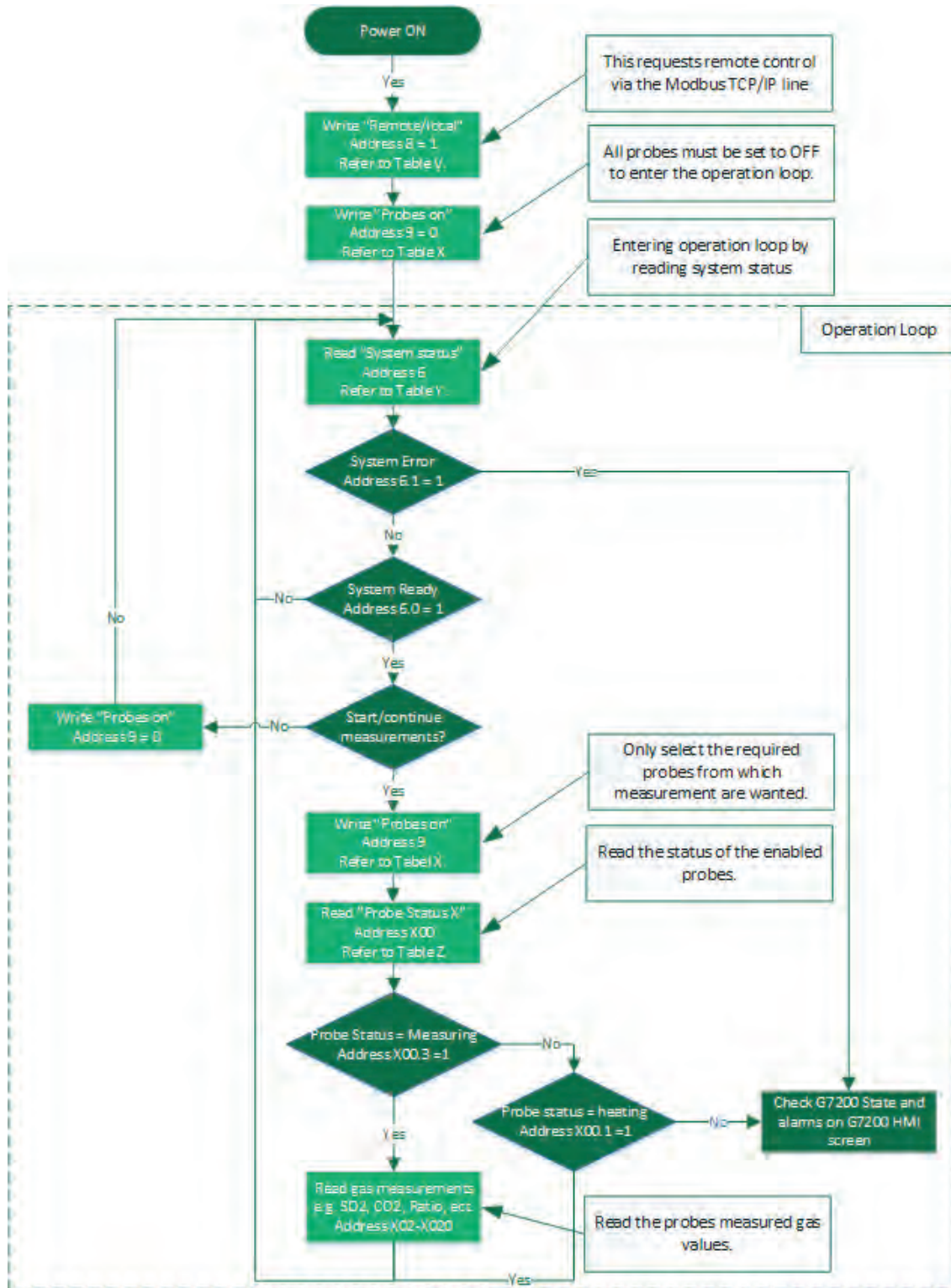


Figure 4-2 Modbus Control Flowchart

### Table V: Remote (R/W)

“REMOTE (R/W)” must be used to determine whether to control the system locally on the HMI or remotely via Modbus TCP/IP. If the user login level is >1 (≠ guest), then the value is automatically forced to 0.

REMOTE (R/W)	Value
Local operation on HMI	0
Remote control via Modbus TCP/IP	1

### Table X: Probes on (R/W)

When the system is in local mode, PROBES\_ON (R/W) shows actual enabled probes. When the system is in remote mode, it enables probes. “x” Indicates irrelevant bits

PROBES_ON (R/W)	Value
All Probes OFF	xxxx xxxx xxx0 0000
Probe 1 ON	xxxx xxxx xxxx xxx1
Probe 2 ON	xxxx xxxx xxxx xx1x
Probe 3 ON	xxxx xxxx xxxx x1xx
Probe 4 ON	xxxx xxxx xxxx 1xxx
Probe 5 ON	xxxx xxxx xxx1 xxxx
All Probes ON	xxxx xxxx xxx1 1111

To enter the operation loop, all probes must be disabled/OFF using “PROBES\_ON (R/W)”.

The system enters the operation loop when “SYSTEM\_STATUS” bit “0” is 1.

The system exits operation loop if no probes are enabled or if the system or all enabled probes have an error. If multiple probes are enabled and not all have an error, then the system remains in operation loop and reports measurement values from the remaining enabled probes that have no errors.

To stop measurements, disable probes using “PROBES\_ON (R/W)”. When no probes are enabled, the system remains in ready/standby mode and is ready when probes are enabled again.

### Table Y: System Status (R)

“x” Indicates irrelevant bits.

SYSTEM_STATUS	Value
System Ready, Sampling or Calibrating	xxxx xxxx xxxx xxx1
System Error, preparing or check	xxxx xxxx xxxx xx1x
Reserved	xxxx xxxx xxxx x1xx
Reserved	xxxx xxxx xxxx 1xxx
Reserved	xxxx xxxx xxx1 xxxx
System Hibernate or Shutdown	xxxx xxxx xx1x xxxx

To start measurements, there must be no system alarms and the system must be ready.

“PROBES\_ON (R/W)” selects the probes from which measuring is required. Read the status of the probes using “PROBE\_STATUS\_X” for the enabled probes.

“x” Indicates irrelevant bits.

**Table Z: Probe Status (R)**

PROBE_STATUS_X	Value
Off, Hibernate or Check	xxxx xxxx xxxx xxx1
Preparing	xxxx xxxx xxxx xx1x
Standby/Ready	xxxx xxxx xxxx x1xx
Measure	xxxx xxxx xxxx 1xxx
Error	xxxx xxxx xxx1 xxxx

The system reads the status of activated probes. If the probes are in measuring mode, the system will report measurement values.

#### 4.4.2 Web Viewer (VNC)

The web viewer function is available by default and makes it possible to access and control the HMI via a web browser when you are on the same network.

**ATTENTION:** For some actions you must be located physically in front of the system. When using remote control, always proceed with caution.

To use the web viewer, connect a network to the **remote connection** port. Refer to the electrical documentation to see the location of the port.

1. Using two fingers, alternately tap on opposite corners of the HMI to access a hidden HMI setting pop-up menu.
2. Scroll down to Ethernet 2 and enter the IP address and subnet mask you want to access.
3. Press Save and reboot.
4. Enter the following in the address bar in a web browser:  
Ethernet 2 HMI IP-address + port number + "Webviewer/index.html"  
Example: 192.168.50.10:8082/webviewer/index.html
5. When the connection is successful, a login window appears. Use the same username and password as used on the HMI.

#### 4.4.3 Remote Connection

The G7200 MGMS allows remote support via an internet connection. The internet connection must be established in accordance with the electrical documentation.

To enable this function, contact Green Instruments for further information.

When established, this connection allows Green Instruments technicians and programmers to remotely monitor, diagnose, control, and program the MGMS if needed. Remote access to the device is achieved by means of a private, point-to-point connection. Access to this connection is strictly controlled and all data that is sent and received on the connection is encrypted.

The following outbound rules must be granted to the remote connection:

- TLS through Web proxy (TLS to remote IP address and port of Web proxy)
- HTTPS (HTTP over TLS) to remote IP address of GateManager, remote port 443
- TLS over HTTP to remote IP address of GateManager, remote port 80

### 4.5 Commissioning



#### ATTENTION

After completing the system installation and before bringing the G7200 MGMS into operation, verify the setup by ensuring all connections are made according to the installation instructions. You must also carry out a required leak test. Refer to the relevant section in the following for the unit you need to verify. Note that the commissioning checklist is not exhaustive as it only lists the typical acceptance criteria.



### 4.5.1 Check Probes

Check the following:

- Probes with the seal plugs have been installed in accordance with the instructions.
- The electrical connector of the heated hose at the probe end is connected.
- The sample gas hose (center hose) from the heated hose is connected at the probe end.

### 4.5.2 Check Heated Sample Lines

Check the following:

- The heated sample line has been installed in accordance with the instructions. Inspect installation for damages to the hoses.
- The electrical connector of the heated hose at the enclosure end has been connected to the terminals inside the top right corner of the system enclosure.
- The sample gas hose (center hose) from the heated hose is connected to the gas cooler at the system enclosure end.
- The hose extruding from the outer side of the heated hose (named calibration gas hose) must be connected to the plugged fitting named "Test gas" located on the top of the gas cooler. Refer to instructions in the heated hose installation layout drawing.

### 4.5.3 Check System Enclosure



#### ATTENTION

Check the following:

- The system enclosure has been installed in accordance with the instructions. There is sufficient space for operation, maintenance, door opening and air flow to ventilators are free.
- The system enclosure has been installed in a location where the ambient temperature is always between 5–55 °C.
- The condensate outlet hose(s) has been installed and is securely connected to a proper drain.
- The electrical connections have been made in accordance with the instructions.
- Protective earth is connected.
- The communication connection has been made in accordance with the instructions and the functions have been tested.
- The air supply for the system enclosure is installed and the air quality is in accordance with ISO 8573-1 Class 3-3-3 or better. The air is free from traces of measured gases.
- Associated systems are ready for operation.
- The system powers up and starts properly: Power up the system by switching ON the automatic fuses located inside the enclosure and switch ON the main safety-switch, positioned on the outside left of the enclosure.
- Check the start-up of the system and that heating is in progress. When heating has completed, the system is ready for the initial leak test.

### 4.5.4 Initial Leak Test Prior to Operation

It is essential to carry out a leak test when commissioning the system. The leak test must be performed in accordance with MI7200-022: Executing an external leak test.

If a leak exceeds the permitted limit, check the gas hose connecting to the probes. The internal gas connections are checked before delivery.

### 4.5.5 Fit the Probe Tubes



#### WARNING

Hot surface hazard. Probes and sample lines are hot. Avoid contact with hot components.

Once the leak test has been completed, use the following procedure to fit the probes:

1. Use the safe shutdown function and then set the safety switch to **OFF**.
2. Remove the probe from the flange socket, and then remove the sealed plug.
3. Fit the probe tube to the probe and re-fit the probe on the flange socket.
4. Set the switch to **ON**. It takes 0.5–1.5 hours for the probe to reach its temperature.

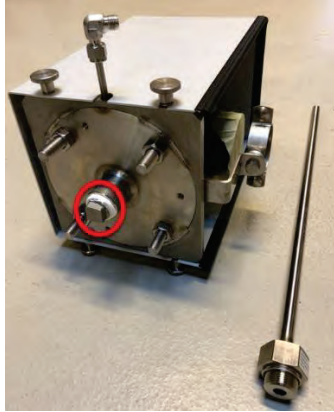


Figure 4-3 Removal of the Sealed Plug

#### 4.5.6 Commissioning Checklist

**Signature by Installation Contractor:** The installation contractor must sign the commissioning checklist once all the checks have been completed.

#### Submission to Green Instruments A/S

A scanned copy of the commissioning checklist along with the results and any remarks must be sent to Green Instruments A/S.

**NOTE:** The commissioning checklist is also included in the documentation package so that you can easily copy and scan it.

- Send the scanned document to: [service@greeninstruments.com](mailto:service@greeninstruments.com)
- Add the following information in the subject field: *G7200 checklist, IMO no., System Serial no.*

Action	Observed criteria	Evaluation	Note
Install cabinet.	<ul style="list-style-type: none"> <li>■ Stable/no vibrations.</li> <li>■ Ambient temp. is OK.</li> <li>■ Well-ventilated area.</li> <li>■ Free space for operator, door opening, and ventilation flow.</li> <li>■ Installation layout drawing has been consulted.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 4 Installation
Connect air supply to cabinet.	<ul style="list-style-type: none"> <li>■ Pay special attention to oil, water, and particle content.</li> <li>■ Air quality must be according to specifications.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 4 Installation
Connect hose(s) to drain away condensate.	<ul style="list-style-type: none"> <li>■ Drain is suitable, pressure less and positioned below cabinet e.g., small tank/vessel.</li> <li>■ Drain led directly to the floor is not acceptable.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 4 Installation.

Action	Observed criteria	Evaluation	Note
Connect power cable to cabinet (X51).	<ul style="list-style-type: none"> <li>■ Power voltage has been verified with multimeter.</li> <li>■ Power is ready to be switched on.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 4 Installation.
Connect ethernet cable to cabinet (X52).	<ul style="list-style-type: none"> <li>■ IP address has been configured.</li> <li>■ Connection has been tested with a cable tester or by “pinging” system.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 4 Installation.
Connect ethernet cable to cabinet for remote connection. Failing to do so will result in loss of system functions.	<ul style="list-style-type: none"> <li>■ IP address has been configured.</li> <li>■ Connection has been tested with a cable tester or by “pinging” system.</li> <li>■ Internet connection is available and relevant outbound rules are granted for remote connection.</li> <li>■ For service reasons it mandatory to establish this communication line.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to section 4.4 Communication
Check sample gas outlet, bypass gas outlet, and instrument air condensate drains.	Must not be blocked in any way.	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 4 Installation.
Probe installation	<ul style="list-style-type: none"> <li>■ Stable/no vibrations.</li> <li>■ Heated hose connection is orientated downwards.</li> <li>■ Probe tip has downward slope.</li> <li>■ Location is chosen to avoid mist into the probe.</li> <li>■ Access for service is OK.</li> <li>■ Probe tube is not mounted, and probe is plugged and ready for leak test.</li> <li>■ Probe filter is mounted.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to section 4.1.2 Probes
Heated hose installation	<ul style="list-style-type: none"> <li>■ Hose guide has been carefully respected.</li> <li>■ Outmost caution has been shown during handling of the hose.</li> <li>■ Connections at probe end has been established.</li> <li>■ Connections at system end has been established.</li> <li>■ Calibration gas hose is connected to test gas connector.</li> <li>■ Check that sample 1 and 2 is not</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to the Hose Handling and Installation Guide

Action	Observed criteria	Evaluation	Note
	switched around.		
Perform leak test.	MI7200-022 has been followed.	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to MI7200-022
Implement communication protocol via MODBUS TCP/IP.	Verify that all functions have been implemented by performing a test.	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to section 4.4 Communication
Configure HMI	<ul style="list-style-type: none"> <li>■ Gasses to be monitored are selected.</li> <li>■ Alias for samples are defined.</li> <li>■ Check that date and time corresponds to UTC.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 3 HMI Structure
Calibration and gas bottle	<ul style="list-style-type: none"> <li>■ Zero and span calibration of relevant gasses have been performed with success.</li> <li>■ Relevant test gas bottles are found onboard.</li> </ul>	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	Refer to chapter 6 Calibration
Inform if relevant systems onboard are ready for operation e.g., scrubber, pumps, control system etc.	Necessary systems must be operational if relevant to the MGMS.	<input type="checkbox"/> Accepted <input type="checkbox"/> Not accepted <input type="checkbox"/> Not done	
MGMS serial number.			
Installation contractor			
Ship name / hull no./ IMO no.			
Ship owner			
Checks performed by (date / sign)			
Checks verified by (date / sign)			

## 5. Operation

### 5.1 System Startup

After being turned on, the G7200 MGMS typically reaches its operating temperature within 2 hours, depending on the ambient temperature and cooling of the system and probes. Once all the components have reached their operating temperature, sampling from the probes is activated via Modbus and the measured values are displayed on the **Measurements Page** and send via Modbus to the customer system.

- **Flow adjustment:** The sample gas pump keeps the gas flow constant and ensures that the sample gas flow is adjusted automatically, even when the sample gas filters, and water traps gradually get blocked.
- **Sampling:** The system automatically handles sampling, flushing, and daily zero calibration.
- **Temperature control:** Temperature control inside the system enclosure is automatically maintained. The temperature control is suspended if any enclosure door is open. If the ambient temperature is low, the integrated heating system will be activated. If the ambient temperature is high, the ventilators will start automatically.

### 5.2 Safe System Shutdown

Use the safe shutdown function whenever the system needs to be powered off, for example, when performing certain maintenance tasks. It is vital that you use the safe shutdown function since it prepares the software for shutdown and flushes the system from exhaust gasses that could otherwise harm the system when powered OFF.

#### 5.2.1 Perform a Safe Shutdown

1. Press the shutdown button in the upper right corner.



Figure 5-1 Safe Shutdown Button

2. Press **Yes** when asked if you want to shut down the system.



Figure 5-2 Accept Safe Shutdown

3. The system starts a flushing sequence, during which the following popup appears.

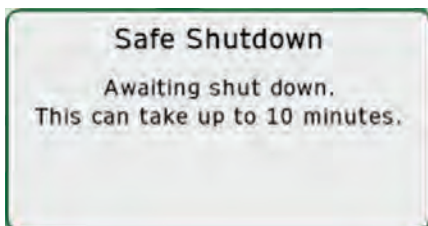
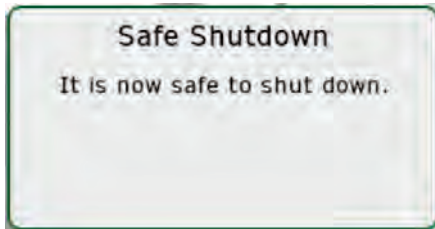


Figure 5-3 Perform Safe Shutdown

4. When the flushing is completed, the following popup appears.



*Figure 5-4 Safe Shut Down*

5. Shut down the system by turning the safety switch on the side of the system.

## 6. Calibration

### **ATTENTION**

The system requires instrument air for automatic zero calibration. The instrument air must conform to the specification in relation to content of oil, water, or traces of the sample gas components to be monitored except from atmospheric CO<sub>2</sub> content.

- Any presence of sample components in the analyzer during calibration will cause faulty measurements and/or a calibration error.
- Negative readings can occur if there is no compressed air or insufficient compressed air during the self-calibration.
- Negative readings can also occur if traces of sample components are present in the compressed air.
- Calibration is only possible when the ambient temperature is below 50°C and when the system state is either **Ready** or **Sample**.

### 6.1 Auto Calibration

The G7200 MGMS automatically performs a zero calibration of all available analyzers every 24 hours using instrument air as reference. The G7010 analyzer module can automatically perform both a zero and span calibration by means of built-in calibration cells together with instrument air every 24 hour.

### 6.2 Manual Calibration Procedure

#### **ATTENTION:**

All analyzers are calibrated from factory. According to *section 6 of Appendix 4 of the NOx Technical Code 2008* Analyzer type G7010 must be calibrated every 12 months.

- Regardless of the type of analyzer module, all analyzers can also be calibrated manually with a mix of certified reference gases.
- The analyzer must be switched **ON** for at least 3 hours before carrying out validation and calibration of the analyzer.
- The term “Span” is used to describe the upper part of the measuring range. You must always calibrate with zero gas before carrying out the span gas calibration. A full calibration procedure takes around 15 minutes.
- A maximum of 2 hours must pass from the completion of the zero-gas calibration to the completion of the span gas calibration.
- Use a span gas with a nominal value of more than 80% of full scale of the measuring range.

#### 6.2.1 Perform Zero Calibration

1. On the HMI, go to the **Settings Page -> Login**, and then press the **Zero Calibration** button.
2. Select the gas you want to zero calibrate, and then press the **Calibrate** button.

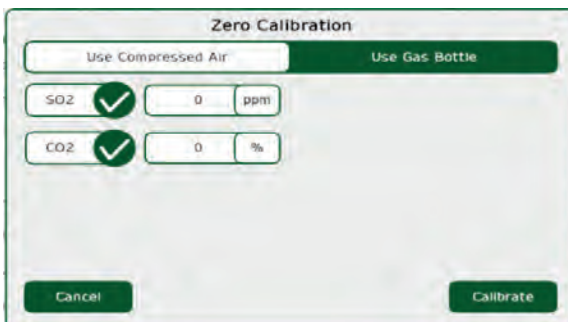


Figure 6-1 Zero Calibration

**NOTE:** Bottled zero reference gas is used for troubleshooting purposes only.

3. Zero calibration starts and the following popup appears.

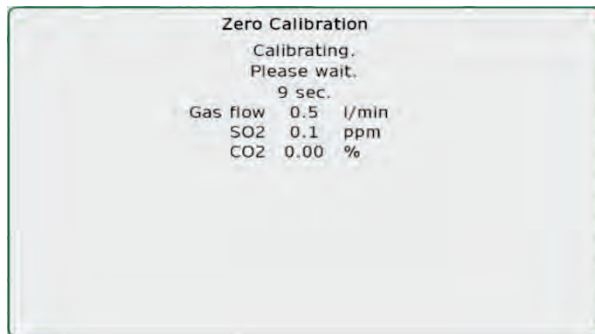


Figure 6-2 Zero Calibration Start

4. When the zero calibration is complete, you can perform the span gas calibration.

## 6.2.2 Perform Span Gas Calibration

1. When the zero calibration has successfully completed, press the **Span calibration** button on the **Settings** page.
2. In the pop-up window, select the gas or gases you want to span calibrate.

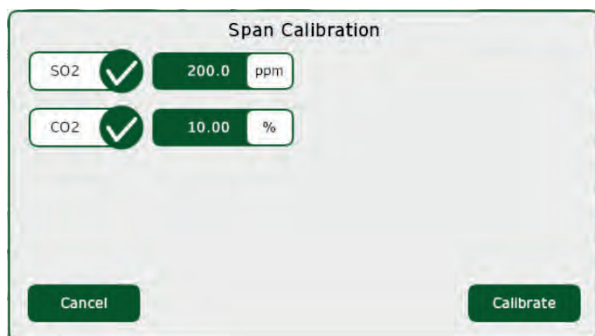


Figure 6-3 Span Calibration

3. Find the span reference gas value or values on the reference gas bottle, and then enter the value or values for each gas in the numeric field next to the selected gas or gasses. Double check to confirm that the entered values correspond to the certified gas concentration on the gas bottle. You must enter all gas components that are part of the gas mix except N2.
4. **NOTE:** The many test gas bottles contain a mix of span gasses, which makes it possible to calibrate more gasses at the same time. If more than one gas bottle is needed to calibrate all required gasses, repeat the zero and span procedure for the next series of gasses contained in the next gas bottle.

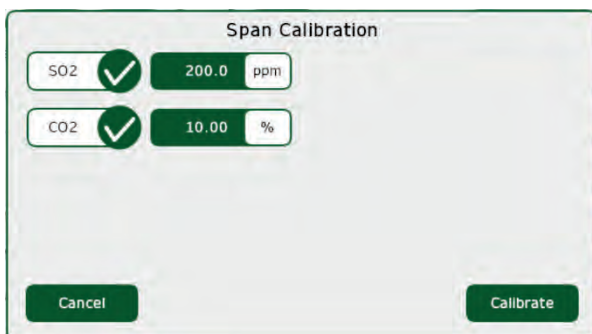


Figure 6-4 Span Calibration Enter Values

5. Press the **Calibrate** button to go to the next step.



- When the following popup appears, use a hose to connect the span gas bottle to the calibration gas inlet port found on the bottom of the cabinet, and then open the valve on the bottle.



Figure 6-5 Span Calibration Connect Gas Bottle



Figure 6-6 Gas Bottle

- NOTE:** The gas bottle and regulator must be of a type that provides a constant flow of approximately 1L/min and maximum 1 bar. Otherwise, you must use an external flow meter to ensure correct flow. Press **OK** soon after the gas bottle has been opened to avoid loss of gas.
- The calibration procedure starts, and the following popup appears.

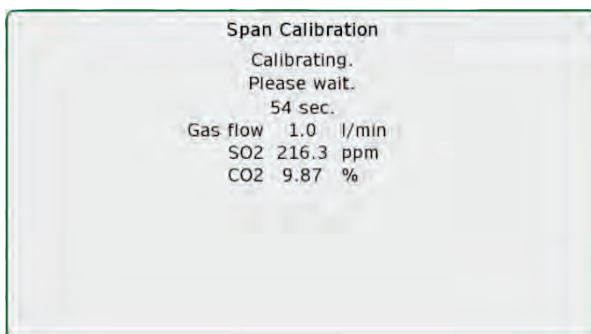
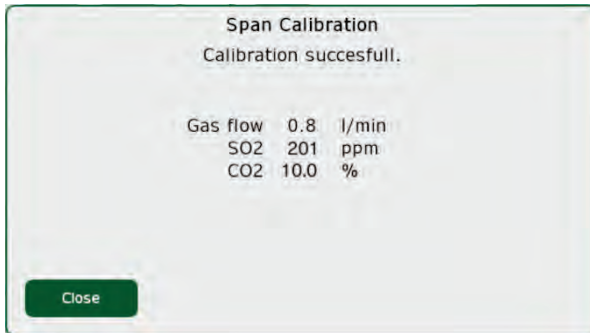


Figure 6-7 Span Calibration Starting

9. The span calibration is complete when the **Calibration successful** message appears.



*Figure 6-8 Span Calibration Complete*

**NOTE:** If zero or span calibration has not been successfully after 3 attempts, then consult the trouble shooting section of this manual. If calibration is still unsuccessful, then extract the data log file, and send the file and any relevant test gas certificates to the supplier for trouble shooting.

## 7. Maintenance

### 7.1 Planned Maintenance Program



#### ATTENTION

Specific conditions can affect how often maintenance must be carried out. For example:

- The sample flow is above the recommended setpoint.
- Soot blowing occurs frequently.
- The system, spares, or components are not handled properly.
- A high amount of water droplets and salts are present in the exhaust gas.
- A high amount of soot and particles are present in the exhaust gas.
- Operation outside and near the system specification limits.

Action	When necessary	Weekly	Monthly	Every 2 months	Every 3 months	Every 6 months	Every 9 months	Every 12 months	Every 2 years	Every 2 years or less	Maintenance Instruction
Gas analyzer G7010											
Manual calibration								X			Refer to section 6.2
Gas analyzer replacement	X										MI7200-007
Probe											
Probe filter replacement						X					MI7200-004
Condensate Pump											
Condensate pump hose replacement								X			MI7200-014
Condensate pump replacement								X			MI7200-016
Gas Pump											
Gas pump replacement								X			MI7200-023
Gas Filter											
Gas-filter replacement						X					MI7200-002
Adsorber filter and glass balls replacement	X										MI7200-002
Water Traps											
Water trap filter replacement								X			

Action	When necessary	Weekly	Monthly	Every 2 months	Every 3 months	Every 6 months	Every 9 months	Every 12 months	Every 2 years	Every 2 years or less	Maintenance Instruction
Secondary water trap replacement (for analyzer type G7010)								X			MI7200-001
Instrument Air											
Instrument air filter elements replacement								X			MI7200-003
Cabinet											
Ventilation filter replacement	X					X					
Heated Hose											
Heated Hose replacement	X										Refer to the installation drawing
Gas cooler											
Gas cooler replacement	X										
Sample line											
Leak test	X										MI7200-022
Sample gas hose replacement	X										MI7200-030

## 7.2 Lifetime Considerations

In every application, the following items are considered consumable parts.

Parts with an expected replacement interval less than 2 years:

- Gaskets
- Filters, adsorbents, and absorbers.
- Condensate pumps excluding the motor unit but including all other mechanical parts and parts in contact with media.
- Sample gas pumps including all mechanical parts and parts in contact with media.
- Water traps
- Sensors incl. all mechanical parts and parts in contact with media.
- Glass fuses

A limited warranty applies for the following items with an expected replacement interval more than 2 years:

- The gas analyzer(s): In all cases, any warranty is conditioned on no evident signs of soot or liquids having entered the device.
- The heated hose(s): In all cases, the warranty is conditioned on no evident signs of soot or liquids having entered from the outside of the device, and no signs of overheating, mechanical stress, or damage caused by changes in voltage (undervoltage, overvoltage and voltage peaks).
- The gas cooler.

Regardless of application, the lifetime will be reduced by various operational factors of which the most common are:

- Excessive sampling flow.
- Exposure to liquids such as condensate, aerosols, acids, or similar.
- All mechanical forces including vibration, shock, drop, impact, and bends.
- Exposure to substances with content of organics with low boiling point, unburned fuel, lead, phosphorus, silicon, or halogens.
- Contaminants such as soot, dust, salts, ash, or similar deposits.
- Pressure including over- and under pressure and pulsations.
- Thermal stress due to temperature variations including power on/off cycles.

Furthermore, installation, operation, and maintenance must follow best practices and the latest version of the user manual and must respect the limitations of the product type approval. Failure to comply with service letters can also affect lifetime and warranty.

The provided information about the lifetime of the product shall in no case be interpreted as a guarantee of the product's condition or quality.

## 8. Services

With assistance from our global service network, we offer a wide range of customer services and support. To find out more about our service offerings, contact our service department at [service@greeninstruments.com](mailto:service@greeninstruments.com).

### 8.1 Spare Parts

Place your original spare parts order directly with Green Instruments. Our dedicated spare parts team ensures effective handling of your order, and we offer fast worldwide delivery to stock or directly to vessel. Contact [spares@greeninstruments.com](mailto:spares@greeninstruments.com).

### 8.2 Commissioning

Our service team offers supervision of your Green Instruments equipment installation. We offer startup assistance, checkpoint functionality as well as surveyor assistance, sea trial support, and training of onboard crew before final delivery.

### 8.3 Field Service

Our skilled and certified service engineers offer the best service onboard and provide authorized service for installed Green Instruments equipment. Services include calibration, troubleshooting, inspections, technical advice, and maintenance.

### 8.4 Support

- Our skilled instructors facilitate training both online and in-person. Training is product specific and ensures that end users and onboard crew become familiar with system operation and maintenance in a controlled environment.
- We offer full technical support of all our products throughout their entire lifetime. Our dedicated experts provide 24-hour service support to ensure timely assistance.
- Our remote services are designed to assist you quickly and accurately with basic requests and to prepare technicians for on-site visits.

### 8.5 Service Agreements

Our transparent service agreements are tailored to the needs of your organization and offer a predictable yearly cost. A service agreement includes relevant spare parts, training, as well as remote and onsite assistance.

### 8.6 Return of Equipment

You must contact Green Instruments to coordinate equipment return. You will then receive a **Return Form** that you must fill out and return along with the equipment.

Use a secure transport container suitable for the equipment that you are returning. Carefully clean the equipment prior to return to ensure that it is free of any hazardous substances (acids, alkalis, solvents, etc.).

**IMPORTANT:** Clearly mark the equipment with the system serial number and return confirmation number.

## 9. Troubleshooting

For troubleshooting of the system, refer to the PI diagram of each system. Troubleshooting must always be carried out by trained professional personnel. Carry out the suggested actions for each issue in the listed prioritized order.

Issue	Possible Causes	Action
Gas cooler temperature high warning/alarm	Ambient temperature is high.	Replace ventilation filters and allow gas cooler time to cool down before starting sampling.
	Exhaust gas sample is too wet.	Inspect root cause e.g., function of demister in exhaust pipe or probe location.
	Defective gas cooler.	Replace gas cooler.
Gas cooler temperature low alarm	Ambient temperature is too low	Wait until ambient temperature is within specification.
	Defective gas cooler	Replace gas cooler.
Condensate alarm	Condensate drain is blocked.	Inspect/clean drain line.
	Condensate pump needs maintenance.	Replace condensate pump hose. Refer to MI7200-014.
	Liquid alarm is defective.	Check function of liquid alarm sensor. Sensor color indication on HMI should be green if filled with water and grey when there is no water. If color indication is not like this, then sensor needs replacement. LED indication on sensor should be green when filled with water and green+orange when empty of water.
	Condensate pump needs replacement.	Replace condensate pump.
<ul style="list-style-type: none"> <li>■ Gas pump capacity warning</li> <li>■ Flow low warning/alarm</li> <li>■ Fluctuating flow</li> </ul>	Filters need replacement	<ul style="list-style-type: none"> <li>■ Replace the sample gas probe filter, (MI7200-004).</li> <li>■ Replace the internal gas filter (MI7200-002).</li> <li>■ Replace water trap filter.</li> </ul>
	Gas pump needs replacement	Replace sample gas pump (MI7200-023).
	Blockage in system/heated hose.	Troubleshoot by disconnecting hoses upstream of gas pump.
	Defective flow transmitter	Replace flow transmitter.
	Wrong position/leak through selector valve V5 or V6.	Inspect or replace valve V5 or V6.
	Leak in system downstream of sample gas pump.	Look for leaks from hoses, fittings, and O-ring seals e.g., in filter bowls.
Compressed air flow low alarm	Insufficient supply of compressed air	Adjust/monitor pressure. If pressure is low, then reestablish supply of instrument air.
	Instrument air filters need replacement.	Adjust/ monitor pressure – if pressure is OK, then replace instrument air filter elements.

Issue	Possible Causes	Action
	Malfunction in solenoid valve V3, V4, V5, or V6.	If pressure and filters are OK, then troubleshoot on solenoid valve V3, V4, V5, or V6.
	Broken or leaking hose or fitting.	Inspect gas path.
Compressed air flow low/high alarm	Throttle valve is adjusted incorrectly.	Manually close V5 & V6 and open V3 & V4. Adjust the throttle valve downstream of V4 until flow transmitter measures 0,8L/min. Lock throttle valve in its setting and put valves in Auto mode again.
	Defective flow transmitter	Replace flow transmitter
Any type of signal alarm	Broken cable/wire/connection.	Inspect cable/wire/connector
	Component defective.	Replace defective component
	I/O card defective.	Check light/status on I/O card. Replace if necessary.
Sample gas wetness alarm	Temperature around gas cooler is high.	Refer to section related to temperature high alarms.
	High amount of moisture in sample gas or in instrument air.	<ul style="list-style-type: none"> <li>■ Empty secondary water trap.</li> <li>■ Inspect/replace water trap</li> <li>■ Check dryer system for supplied instrument air.</li> <li>■ Inspect sample gas probe/location.</li> <li>■ Replace air dryer module if moisture indicator has changed color</li> </ul>
	H2O measurement needs calibration.	Calibrate H2O measurement (specialist required).
	Gas cooler defect.	Check/replace gas cooler.
<ul style="list-style-type: none"> <li>■ Ambient temperature low alarm</li> <li>■ Sampling cabinet temperature low alarm</li> </ul>	It is too cold.	<ul style="list-style-type: none"> <li>■ Do not start system if it is too cold. Wait until it is warmer.</li> <li>■ Test heater element.</li> </ul>
<ul style="list-style-type: none"> <li>■ Ambient temperature high alarm</li> <li>■ Controller temperature high alarm</li> <li>■ Analyzer temperature high alarm</li> <li>■ Sampling cabinet high alarm</li> </ul>	<ul style="list-style-type: none"> <li>■ It is too hot.</li> <li>■ Ventilator filters are blocked.</li> <li>■ Ventilators are not working, blocked/restricted.</li> </ul>	<ul style="list-style-type: none"> <li>■ Do not start system if it is too hot. Wait until it is colder.</li> <li>■ Replace ventilation filters.</li> <li>■ Inspect/replace ventilators.</li> </ul>
<ul style="list-style-type: none"> <li>■ Sampling cabinet door open warning.</li> <li>■ Controller cabinet door open warning</li> </ul>	Door not closed	Close door
	<ul style="list-style-type: none"> <li>■ Broken cable/wire/connection</li> <li>■ I/O card defective</li> <li>■ Defective door switch.</li> </ul>	<ul style="list-style-type: none"> <li>■ Inspect cable/wire/connector.</li> <li>■ Check light/status on I/O card.</li> <li>■ Check switching point or replace defective door switch.</li> </ul>
Heated probe temperature low alarm	<ul style="list-style-type: none"> <li>■ Probe fuse is blown.</li> <li>■ Ambient is too cold at probe mounting location.</li> <li>■ Probe has excessive heat</li> </ul>	<ul style="list-style-type: none"> <li>■ Inspect/replace fuse.</li> <li>■ Check ambient temperature at probe.</li> <li>■ Inspect cable/wire/connector.</li> <li>■ Check light/status on I/O card and relay.</li> </ul>

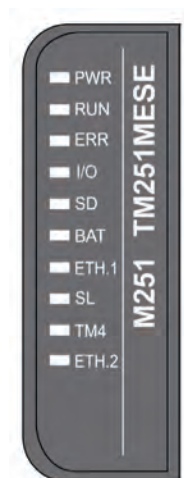


Issue	Possible Causes	Action
	loss to exhaust gas pipe or insulation is missing. ■ Broken cable/wire/connection ■ Defective relay or probe.	■ Reduce probe heat loss to exhaust gas pipe. ■ Check/improve insulation. ■ Replace defective probe.
Heated hose temperature low alarm	■ Fuse is tripped. ■ Solid state relay malfunction. ■ Ambient is too cold around hose. ■ Hose has excessive heat loss or insulation is missing. ■ Broken cable/wire/connection. ■ Defective hose.	■ Check fuse. ■ Check ambient temperature along hose. ■ Inspect cable/wire/connector ■ Check light/status on I/O card and relay. ■ Replace defective hose.
Unsafe shutdown warning	■ Power interrupt or tripped fuse. ■ System has been shut off without the use of the safe shutdown function.	■ Reset warning. ■ Always use the safe shutdown function when powering off the system.
Analyzer invalid warning	■ Broken cable, wire, connection for power or communication. ■ Defective analyzer.	■ Inspect cable/wire/connector ■ Reboot system. ■ Replace gas analyzer.
■ Gas XXX measurement invalid warning (e.g., CO <sub>2</sub> measurement invalid warning) ■ Fluctuating measurements. ■ Incorrect indication of measured gas value.	■ The analyzer self-diagnostic function has discovered an irregularity. ■ The measured gas is being erratic, fluctuating, unstable. ■ Ambient air leaking into system. ■ Calibration needed. ■ Defective analyzer module.	■ Check and empty secondary water trap. ■ Calibrate the gas analyzer. ■ Perform leak test/inspect for possible leaks (MI7200-022). ■ Trouble shoot by applying test gas to test gas connection above gas cooler. ■ Replace defective gas analyzer.
■ PLC does not power on. ■ HMI does not power on. ■ No light in any I/O cards.	■ No power. ■ Broken cable/wire/connection.	■ Inspect fuse, safety switch and DC power. ■ Inspect cable/wire/connector. ■ Replace defective component.
■ HMI shows error code format APPxxxxx or format SYSxxxxx.	Multiple reasons could be the cause.	Consult supplier and inform specific error code.
■ HMI shows pink graphical elements that are not depicted in this manual.	Communication error or communication configuration is wrong.	■ Check communication cable. ■ Check/update HMI + PLC software.
I/O card error	■ Indicates device errors on the serial line, SD card, internal TM3 communication bus or	■ Could be caused by overtemperature. If the temperature is high, then let it cool down and restart system. ■ Replace the I/O card if defective.

Issue	Possible Causes	Action
	Ethernet port(s). <ul style="list-style-type: none"> <li>■ High temperature can cause I/O card error.</li> <li>■ Defective I/O card.</li> </ul>	
PLC errors	Multiple reasons could be the cause.	Refer to section below.
DC consumers are all inactive.	<ul style="list-style-type: none"> <li>■ AC mains supply is missing.</li> <li>■ DC power supply is defective.</li> </ul>	<ul style="list-style-type: none"> <li>■ Measure AC supply voltage.</li> <li>■ Check fuses.</li> <li>■ Measure DC voltage. Check/replace DC power supply.</li> </ul>
No communication. System does not respond to command send via Modbus TCP/IP line.	<ul style="list-style-type: none"> <li>■ IP-address not configured correctly.</li> <li>■ Missing cable/broken wire/connector.</li> <li>■ System is in Local mode.</li> <li>■ Modbus not implemented correctly.</li> </ul>	<ul style="list-style-type: none"> <li>■ Confirm/edit IP-address.</li> <li>■ Test cable with cable tester and/or “ping” system.</li> <li>■ Put system in Remote mode or log out on HMI.</li> <li>■ Verify implementation of Modbus protocol.</li> </ul>
SD card error Log will not be exported	PLC does not recognize SD-card.	<ul style="list-style-type: none"> <li>■ Check/insert SD-card.</li> <li>■ Check SD-card lock function.</li> <li>■ Check SD-card format (FAT 32).</li> <li>■ Replace SD-card.</li> <li>■ Allow the system time to export data to the SD-card.</li> </ul>
HMI display seems stuck and displays “Initializing”	No connection between PLC and HMI.	<ul style="list-style-type: none"> <li>■ Give the system time to reboot.</li> <li>■ Check internal ethernet cables.</li> <li>■ Restart system.</li> <li>■ Load PLC and HMI software to system again.</li> </ul>
Air dew point indicator changes color.	<ul style="list-style-type: none"> <li>■ Color changes if dew point changes.</li> <li>■ Green/blue color indicates that dew point is relatively dry.</li> <li>■ Pink/yellow color indicates air dew point is too wet.</li> <li>■ Color can also change due to contamination by particles, oil and likewise.</li> </ul>	<ul style="list-style-type: none"> <li>■ Inspect quality of instrument air supply. Best practice is to verify water content with a dew point meter.</li> <li>■ Replace instrument air filters, dew point indicator and air dryer.</li> </ul>

## 9.2 PLC error codes

The following figure shows the status LEDs. These indicators show the current status of the system.



The following table describes the system status LEDs:

Label	Function Type	Color	Status	Description
PWR	Power	Green	On	Power is applied.
			Off	Power is removed.
RUN	Machine status	Green	On	The controller is running a valid application.
			Flashing	The controller has a valid application that is stopped.
			1 flash	The controller has paused at BREAKPOINT.
			Off	The controller is not programmed
ERR	Internal Error	Red	On	An operating system error has been detected
			Fast flashing	The controller has detected an internal error
			Slow flashing	A minor error has been detected if <b>RUN</b> is ON or that no application has been detected
I/O	I/O error	Red	On	Device errors on the serial line, SD card, TM4 bus, TM3 bus, Ethernet port(s) or CANopen port.
SD	SD card access	Green	On	The SD card is being accessed
BAT	Battery	Red	On	The battery needs to be replaced.
			Flashing	The battery charge is low.
ETH.1 ETH.2	Ethernet port status	Green	On	The Ethernet port is connected, and the IP address is defined.
			3 flashes	The Ethernet port is not connected.

Label	Function Type	Color	Status	Description
			4 flashes	The IP address is already in use.
			5 flashes	The module is waiting for BOOTP or DHCP sequence.
			6 flashes	The configured IP address is not valid.
SL	Serial line	Green	On	Indicates the status of serial line.
			Off	No serial communication
TM4	Error on TM4 bus	Red	On	An error has been detected on the TM4 bus
			Off	No error has been detected on the TM4 bus

## 10. System Hibernation

To ensure optimal system performance, you must enable the hibernation function via the external Modbus TCP/IP interface if the system is taken out of operation for extended periods (>30 days). Using the hibernation function benefits system lifetime and minimizes electrical power consumption during the out-of-operation period.




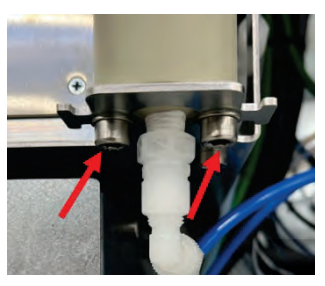
**NOTE:** We recommend that you keep the following spare parts in stock for when the system is restarted after an extended period of inactivity (>30 days):


- System filters including probe filters
- Water trap
- Sample gas pump(s)
- Condensate pump spares

## 11. Maintenance Instructions

The following is a list of G7200 Maintenance Instructions (MI) available. For more information about the spare parts listed in the maintenance instructions, refer to the Spare Parts Catalog.

Number	Description
MI7200-001	Replacing the Secondary Water Trap
MI7200-002	Replacing the Filter Element and Glass Balls in the Filter Block
MI7200-003	Replacing Instrument Air Filters
MI7200-004	Replacing the Gas Filter in the Sample Probe
MI7200-007	Replacing the Gas Analyzer
MI7200-014	Checking or Replacing the Hose in the Condensate Pump
MI7200-016	Replacing the Condensate Pump
MI7200-022	Performing an External Leak Test
MI7200-023	Replacing the Gas Pump
MI7200-030	Replacing the Sample Gas Hose

System type	<b>G7200 Multi Gas Monitoring System</b>	<b>MI-7200-001: Replacement of the Secondary Water Trap</b>
Description	This procedure describes how to replace the Secondary Water Trap. The operation must be carried out by a skilled technician.	
	Chemical hazard. Wear personal protective equipment.	
Difficulty 1-5	Overhaul interval	Estimated time
	Every 12 months	15 min.
Spare parts		
<ul style="list-style-type: none"> <li>■ Part no. GI-G7200-104778 Maintenance Kit 1-year G7200 (1-stack)</li> <li>■ Part no. GI-G7200-104779 Maintenance Kit 1-year G7200 (2-stack)</li> <li>■ Part no. GI-G7200-104678 Secondary Water Trap ver. 2</li> </ul>		
Procedure		
<p>1. Disconnect the inlet and outlet from the Secondary Water Trap.</p>		
<p>2. Disconnect the Secondary Water Trap from the bracket using a 5mm Allen key to unscrew the two bolts.</p>		
<p>3. Install the new Secondary Water Trap on the bracket, and then connect the inlet and outlet.</p>		

<b>System type</b>	<b>G7200 Multi Gas Monitoring System</b>	<b>MI-7200-002: Replacing the Filter Element and Glass Balls in the Filter Block</b>
Description	This procedure describes how to replace the filter element and glass balls in the Filter Block. The operation must be carried out by a skilled technician.	
	Chemical hazard. Wear personal protective equipment.	

Difficulty 1-5	Overhaul interval	Estimated time
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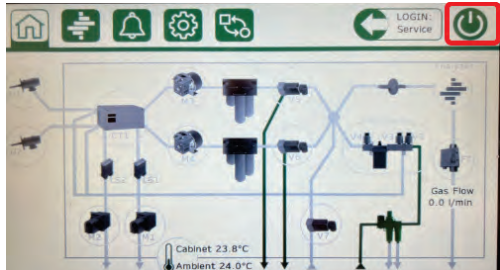
	Every 6 months	20 min.
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Spare parts

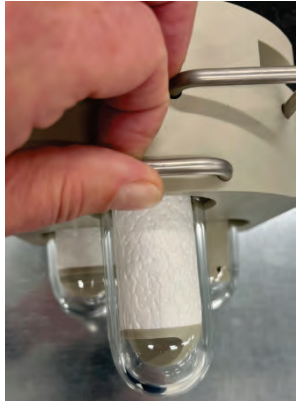
- Part no. GI-G7200-104778 Maintenance Kit 1-year G7200 (1-stack)
- Part no. GI-G7200-104779 Maintenance Kit 1-year G7200 (2-stack)
- Part no. GI-G7200-104591 Filter Element Kit 0.1 my
- Part no. GI-G7200-104763 Gas Adsorber Set

**Procedure**

1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.

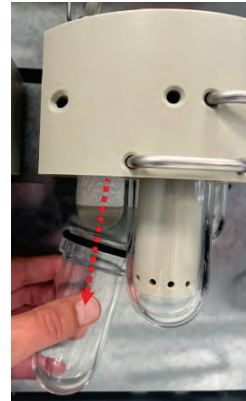


2. Pull out the locking ring on the filter block.

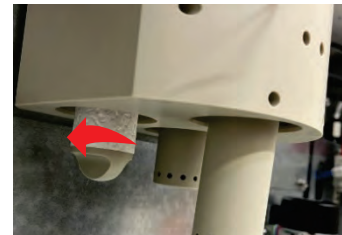




3. Pull down the filter glass carefully to release it, and then replace the O-ring on the filter glass.



4. Unscrew the filter screw counterclockwise.



5. Carefully insert a new filter element.



6. Refit the filter glass, and then reinsert the locking ring.
7. Repeat the procedure for the second filter.

**Attention:** If the glass balls appear unclean because they have been contaminated, for example, by aerosols, you must replace the container and filter glass as described in the following procedure.

1. Pull out the locking ring on the filter block.



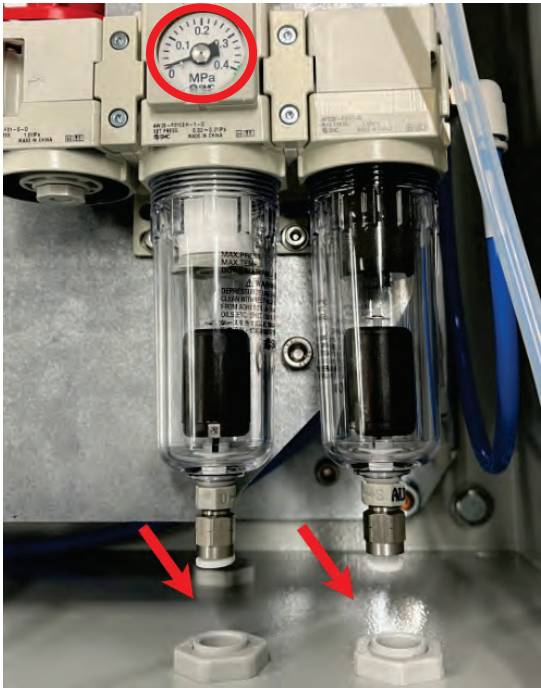
2. Pull down the filter glass carefully to release it, and then pull down the container to release it.

3. Replace the container (with glass balls) and filter glass and then reinsert them.



System type	G7200 Multi Gas Monitoring System	MI-7200-003: Replacing Instrument Air Filters
Description	This procedure describes how to replace the filter element in the instrument air treatment unit. The operation must be carried out by a skilled technician.	
	Chemical hazard. Wear personal protective equipment.	
Difficulty 1-5    Overhaul interval    Estimated time		
	Every 12 months	20 min.
Spare parts		
<ul style="list-style-type: none"> <li>■ Part no. GI-G7200-104778 Maintenance Kit 1-year G7200 (1-stack)</li> <li>■ Part no. GI-G7200-104779 Maintenance Kit 1-year G7200 (2-stack)</li> <li>■ Part no. GI-G7200-104978 Filter Elements Particle/Oil Separator</li> </ul>		
Procedure		
<p>1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.</p>		
<p>2. Turn off the Air Treatment Unit switch by turning it to EXH.</p>		

- 3. Confirm that the unit is pressureless, and then disconnect the two hoses for the Instruments condensate drain.



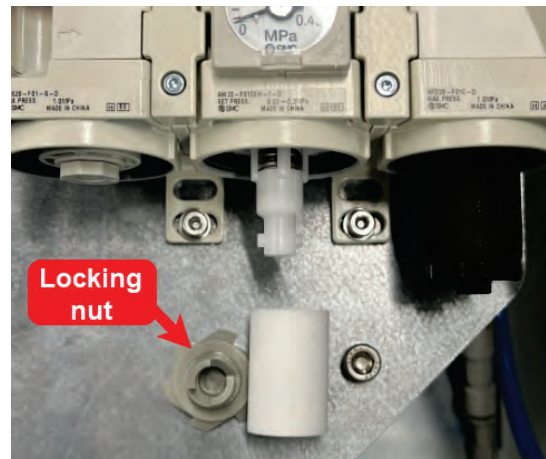
- 4. Unscrew the filter glasses.





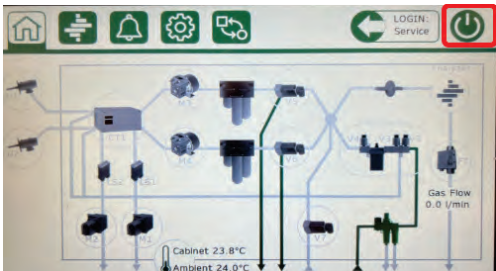
5. Unscrew and replace the filter element for the oil separator.



6. Loosen the locking nut by half a turn and replace the filter element for the Water Particle Separator.



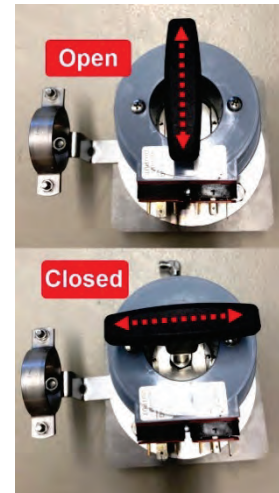
7. Remount the filter glasses
8. Turn on the Air Treatment Unit switch by turning it to SUP, and verify that the pressure is high.
9. Power ON the G7200 System

System type	G7200 Multi Gas Monitoring System		MI-7200-004: Replacing the Gas Filter in the Sample Probe
Description	This procedure describes how to replace the probe filter and the O ring in the sample probe. The operation must be carried out by a skilled technician.		
	<ul style="list-style-type: none"> <li>■ Chemical hazard. Wear personal protective equipment.</li> <li>■ Hot surface hazard. Probe and sample lines will be hot during this operation.</li> <li>■ Warning. Reusing or cleaning the filter and the O-ring is not allowed under any circumstances.</li> </ul>		
Difficulty 1-5		Overhaul interval	Estimated time
	<ul style="list-style-type: none"> <li>■ Filter and O-rings every 6 months</li> </ul>	45 min.	
Spare parts			
<ul style="list-style-type: none"> <li>■ Part no. GI-G7200-03848 Maintenance Kit 1-year for 1 probe</li> </ul>			
Procedure			
<p>When the system reports flow warning or flow alarm on one of the current sample probes, you might have to change the sample gas probe filter and the filter element in the filter block.</p> <ul style="list-style-type: none"> <li>■ Do not remove the filter to inspect it. The filter doesn't give any visual indication of the filter condition or filter clogging.</li> <li>■ Replace the filter and the O-ring if they have been removed regardless of the reason.</li> <li>■ Shut down the MGMS, scrubber and engine during filter change to avoid unfiltered exhaust gas in the MGMS and the surroundings.</li> </ul>			
<p>1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.</p>			

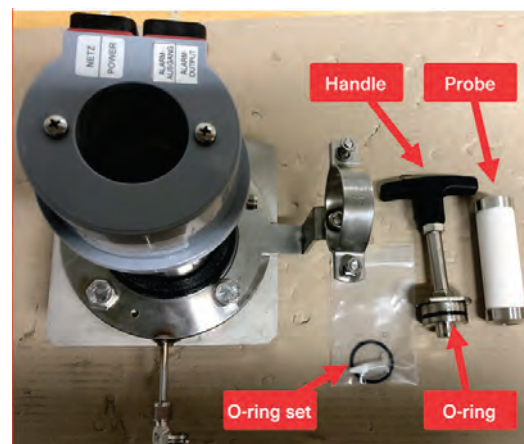
2. Loosen the 2 bottom thumb screws. You can then pivot the probe cover up to gain access to the probe handle and filter.




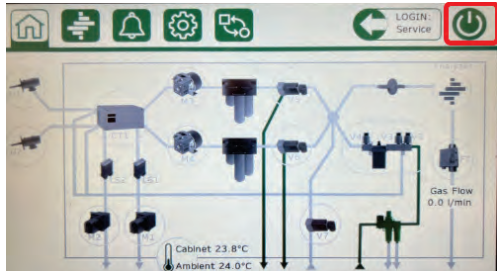
3. Loosen the handle by rotating it 90° and then pull out the handle.



4. Remove the old filter and O-ring from the handle.
5. Change the O-Ring on the handle, and grease it with silicon grease.
6. Grease the O-rings inside the filter silicone grease.
7. Attach the new filter to the handle.

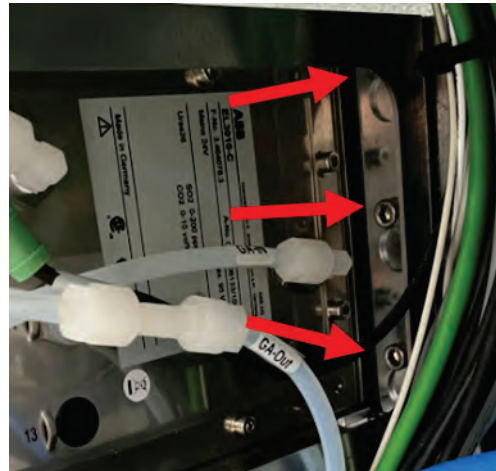


8. Insert the probe handle with the new filter in the probe, and then turn the handle 90°.
9. Reinstall the probe housing using the 4 thumb screws.
10. Start or reset the system.

<b>System type</b>	<b>G7200 Multi Gas Monitoring System</b>	<b>MI-7200-007: Replacing the Gas Analyzer G7010</b>
Description	This procedure describes how to replace the Gas Analyzer in the G7200 MGMS The operation must be carried out by a skilled technician.	
	<b>Chemical hazard.</b> Wear personal protective equipment.	
<b>Difficulty 1-5</b>	<b>Overhaul interval</b>	<b>Estimated time</b>
	When necessary	30 min.
Spare parts		
Part no. GI-G7200-104500 G7010 Analyzer Module for SO2/CO2		
<b>Procedure</b>		
1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.		
2. Loosen the PVDF fittings on the union nut, and then pull back the hose to release it.		





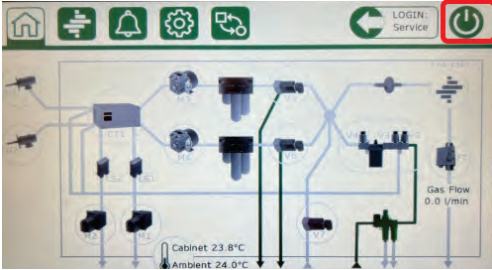
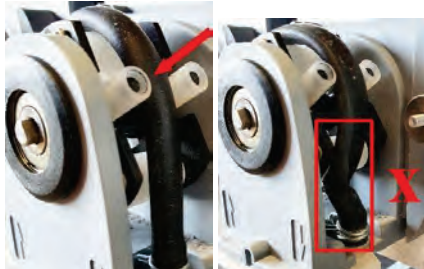
3. Loosen the three Allen bolts on both sides of the analyzer bracket (you don't have to unmount them completely.) Lift and remove the analyzer bracket from the backplate.






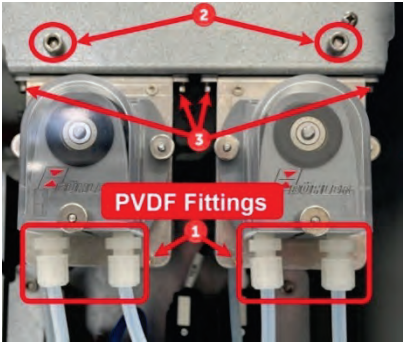
4. Loosen the two Allen bolts on both sides of the analyzer bracket and remove the analyzer.



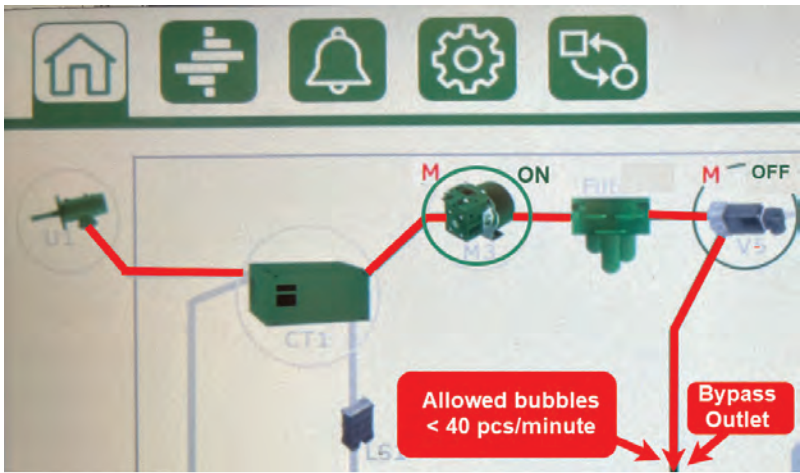


5. Assemble the new analyzer by performing the above steps in reverse order.

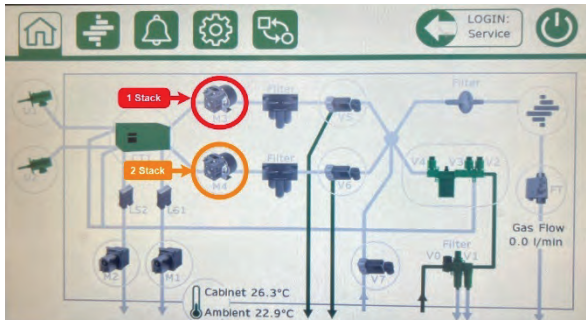
System type	G7200 Multi Gas Monitoring System	MI-7200-014: Checking and Replacing the Condensate Pump Hose
Description	This procedure describes how to check and replace the hose in the condensate pump. The operation must be carried out by a skilled technician.	
	<p><b>Chemical hazard.</b> Wear personal protective equipment.</p> <p><b>Warning.</b> Spillage during replacement of the pump hose can damage the electronic components. Cover all components below before starting.</p>	
Difficulty 1-5	Overhaul interval	Estimated time
	Every 12 months.	30 min.
Spare parts		
<ul style="list-style-type: none"> <li>■ Part no. GI-G7200-104778 Maintenance Kit 1-year G7200 (1-stack)</li> <li>■ Part no. GI-G7200-104779 Maintenance Kit 1-year G7200 (2-stack)</li> <li>■ Part no. GI-G7200-03386 Tube for Condensate Pump</li> </ul>		
Procedure		
<p>1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.</p>		
<p>2. Check the state of the condensate hose. Ensure that the hose is not bent, folded, or ruptured. You might have to disconnect the hose to inspect it properly.</p> <p>3. The images show the difference between a new hose and a damaged hose.</p> <p>4. If the hose has been damaged, you must replace it.</p>		
<p>5. Loosen the thumb screw on the condensate pump.</p> <p>6. Pull off the cover.</p> <p>7. Loosen the two PVDF hoses (inlet and outlet) on the finger nuts.</p> <p>8. Disconnect the pump hose from both sides of the condensate pump.</p> <p>9. Connect the new pump hose on both sides of the pump.</p> <p>10. Fit the cover and tighten the thumb screw on the front of the condensate pump.</p> <p>11. Retighten the two PVDF hoses using the finger screws.</p> <p>12. Power up the G7200 MGMS again.</p>		

10.

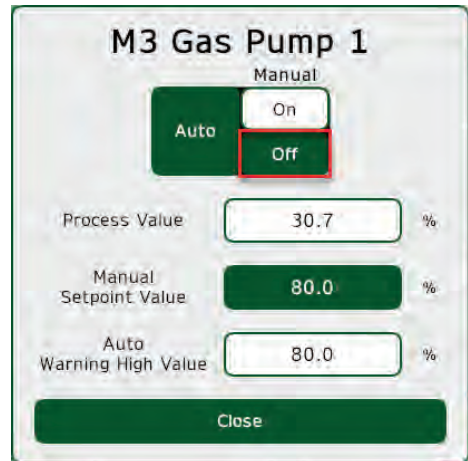
System type	G7200 Multi Gas Monitoring System	MI-7200-016: Replacing the Condensate Pump
Description	This procedure describes how to replace the condensate pump. The operation must be carried out by a skilled technician.	
	<p><b>Chemical hazard.</b> Wear personal protective equipment.</p> <p><b>Warning.</b> Spillage during replacement of the pump hose can damage the electronic components. Cover all components below before starting.</p>	
Difficulty 1-5		Overhaul interval
	When necessary	Estimated time
Spare parts		45 min.
Part no. GI-G7200-104637 Condensate Pump w. Connector		
Procedure		
<p>1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.</p>		
<p>2. Disconnect the cable of the condensate pump. To identify the correct cable and connector, refer to the electric drawing.</p>		
<p>3. Loosen the two PVDF fittings (inlet and outlet) on the union nuts and then pull down the hoses to release them. (1)</p>		
<p>5. Unscrew the two Allen bolts to release the bracket from the gas cooler. (2)</p>		
<p>6. Unscrew the two Allen bolts from the condensate pump bracket to release the condensate pump. (3)</p>		
<p>4.</p>		
<p>7. Install the new pump by performing the above steps in reverse order.</p>		
<p>8. Power up the G7200 MGMS again.</p>		

System type	G7200 Multi Gas Monitoring System	MI-7200-022: Performing a Leak Test
Description	This procedure describes how to perform a leak test. The operation must be carried out by a skilled technician.	
	<p><b>Chemical hazard:</b> Wear personal protective equipment.</p> <p><b>Warning:</b> Don't block the gas sampling pipes to or from the system when the system is in operation to avoid damaging the system. Blocking is allowed for short periods only during leak test.</p> <p><b>Hot surface hazard:</b> The gas analyzer modules and enclosures, probes, sample lines, gas cooler, and heater elements become hot during operation and can cause burns. Avoid contact with hot components and allow components to cool down before performing work on these.</p>	
Difficulty 1-5	Overhaul interval	Estimated time
	When necessary	45 min.
Spare parts		
Leak Test Kit delivered with Cabinet		
Procedure		
<p>Perform an external leak test in the following situations:</p> <ul style="list-style-type: none"> <li>■ When commissioning a new system.</li> <li>■ When a heated hose, probe, or fittings have been dismantled.</li> <li>■ When SO<sub>2</sub> and CO<sub>2</sub> values are lower than expected.</li> </ul> <p>The following image shows the leak test string:</p>		
		
Apart from the leak test kit, you need glass filled with water and a stopwatch to perform the test.		
<ol style="list-style-type: none"> <li>1. Log in to the system. If it's a two-stack system, turn off both gas pumps M3 and M4 before blocking the sampling system for vacuum suction.</li> </ol>		

- Click the **M3 pump** icon on the HMI display.

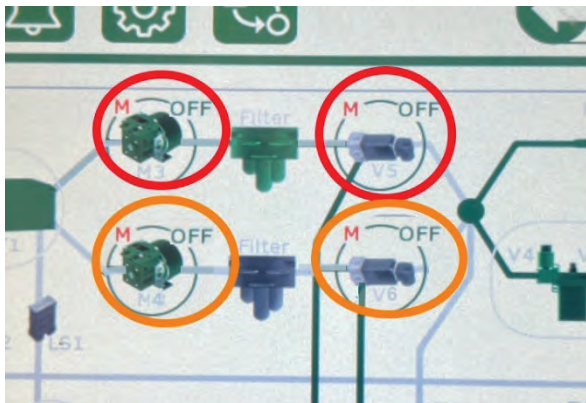


- In the pop-up window, click the **Off** button, and then click **Close**. For two-stack systems do this for both gas pumps.

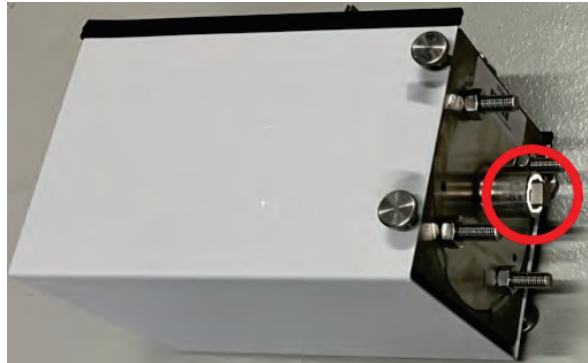


- Click the **Selector valve** icon on the HMI display. In the pop-up window, click the **Off** button, and then click **Close**. For two-stack systems do this for both selector valves. The selector valve is now in bypass mode.

- When the system is in manual mode, the letter M in red and OFF is displayed.

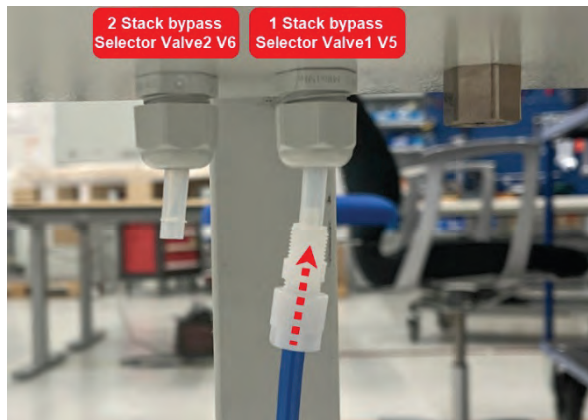


- Ensure that the plug is fitted during the leak test.

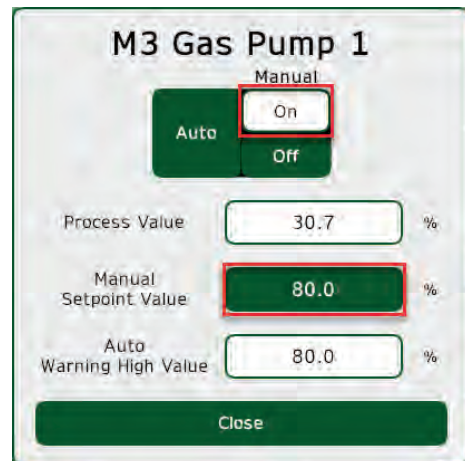


- NOTE:** The following steps describe the leak test for one-stack systems. For two-stack systems repeat steps 7-14 for the second probe and heated hose.

- Mount the blue air hose included in the leak test kit to the bypass connection for selector valve V5. The connection is located at the outside bottom of the cabinet.



- Click the **M3 pump** icon on the HMI display. In the popup window set the **Manual Setpoint Value** to 80%, and then click the **On** button followed by the **Close** button.




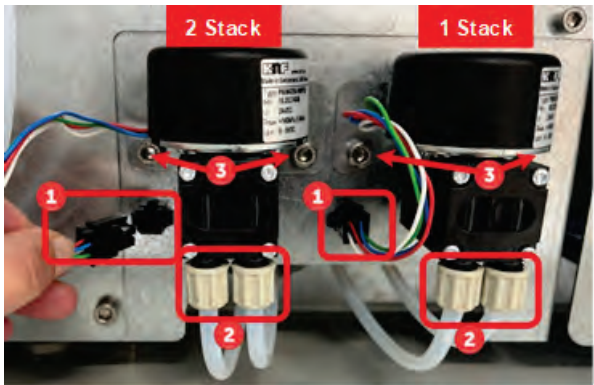


10. Wait 10-20 sec, and then submerge the air hose into the glass of water. Count the number of bubbles in the water. Up to 40 bubbles/minute is allowed.
11. If the number of bubbles is less than 40 pcs/minute, the system is airtight and the system has passed the leak test.
12. **Attention:** If the number of bubbles exceeds 40 bubbles/minute, you must search for a leak on the corresponding heated hose and probe, and then perform the leak test again.




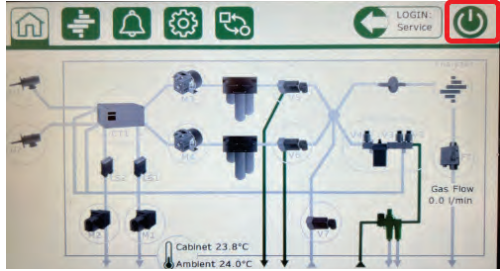
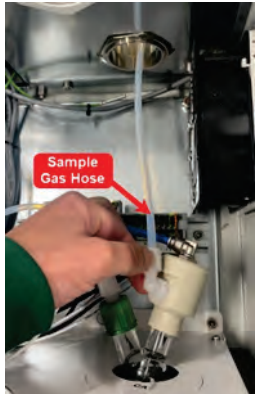


13. Turn off the gas pumps.

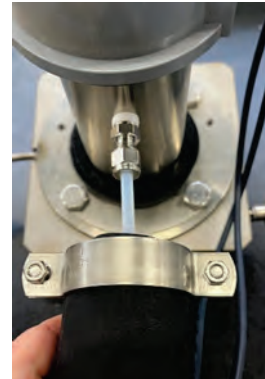
For two-stack systems repeat steps 7-14 for the second probe and heated hose.

<b>System type</b>	<b>G7200 Multi Gas Monitoring System</b>	<b>MI-7200-023: Replacing the Gas Pump</b>
Description	This procedure describes how to replace the gas pump. The operation must be carried out by a skilled technician.	
	<b>Chemical hazard:</b> Wear personal protective equipment.	
<b>Difficulty 1-5</b>	<b>Overhaul interval</b>	<b>Estimated time</b>
	Every 12 months	15 min.
Spare parts		
<ul style="list-style-type: none"> <li>Part no. GI-G7200-104778 Maintenance Kit 1-year G7200 (1-stack)</li> <li>Part no. GI-G7200-104779 Maintenance Kit 1-year G7200 (2-stack)</li> <li>Part no. GI-G7200-104585 Gas Pump 24V w. Connector</li> </ul>		
<b>Procedure</b>		
1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.		
2. Disconnect the wire connector (1). 3. The hoses are labeled, however, you can also not down the connection point of each hose for future reference. 4. Loosen the union nuts, and then disconnect the hoses (2). 5. Unscrew the two Allen bolts (3) and remove the old pump.		
6. Install the new gas pump by performing the above steps in reverse order.		



System type	<b>G7200 Multi Gas Monitoring System</b>	<b>MI-7200-030: Replacing the Sample Gas Hose</b>
Description	This procedure describes how to replace the sample gas hose. The operation must be carried out by a skilled technician.	
 	<p><b>Chemical hazard:</b> Wear personal protective equipment.</p> <p><b>Hot surface hazard:</b> The gas analyzer modules and enclosures, probes, sample lines, gas cooler, and heater elements become hot during operation and can cause burns. Avoid contact with hot components and allow components to cool down before performing work on these.</p>	
Difficulty 1-5	Overhaul interval	Estimated time
	When necessary	15 min.
Spare parts		
<ul style="list-style-type: none"> <li>■ GI-G7200-102744 Sample Gas Hose Service Set 20 m</li> <li>■ GI-G7200-102745 Sample Gas Hose Service Set 40 m</li> </ul>		
Procedure		
<p>1. Perform a safe shutdown of the G7200 system. Press the ON/OFF button in the right corner of the HMI, and then follow the instructions on the screen.</p>		
<p>2. Disconnect the sample gas hose from the connector inside the cabinet.</p>		

3. Remove the sample gas hose from the probe.



4. Unplug the power and alarm connectors from the probe.



5. Remove the heated hose from the probe bracket.

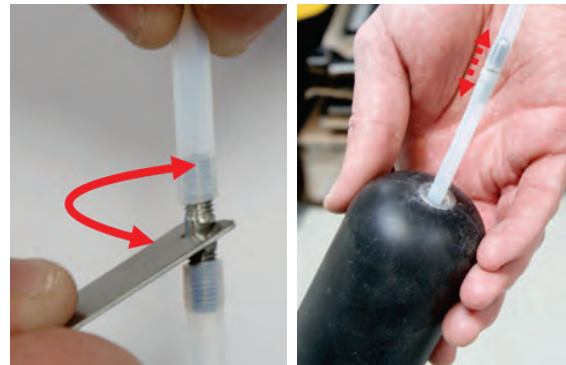


6. While holding the sample gas hose end with one hand, use your other hand to cut off the stainless-steel fittings at the end of the hose. If you don't hold onto the hose, it can slip inside the heated hose.



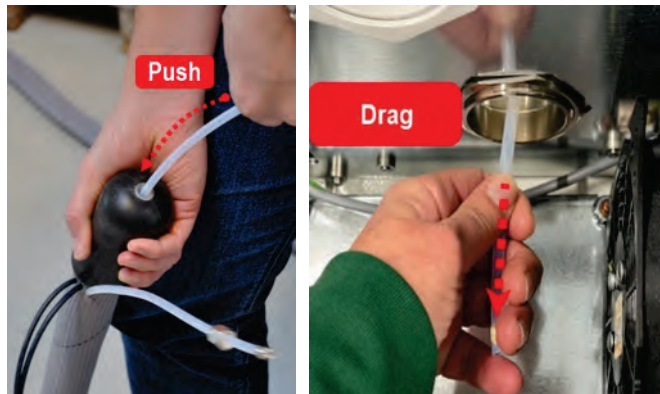
7. Use the hose connector to join the new hose and the old hose. The part of the connector that is fitted inside the hoses must be of the same length. First, use your hands to insert the hose connector, and then use the spanner.

Ensure that the two hoses are firmly and tightly connected.



8. **Note:** the following step requires two people, one to feed the sample gas hose into the probe and one to pull it out at the other end.

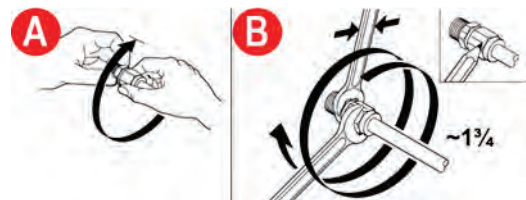
9. Feed the sample gas hose into the probe, while your partner slowly pulls the sample gas hose through the heated hose and out from the enclosure.



10. Remove the hose connector and the old hose.

11. Adjust the length of the new sample gas hose. Make sure that there's room for the new fittings.

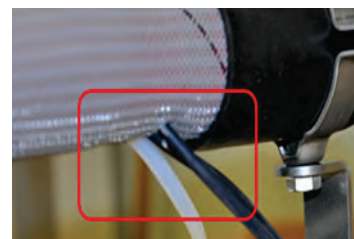
12. Connect the new stainless fittings to the sample gas hose, First tighten the union nut by hand until perceptible resistance (A), and then tighten down the union nut 1 3/4 rotation using 2 wrenches (B).



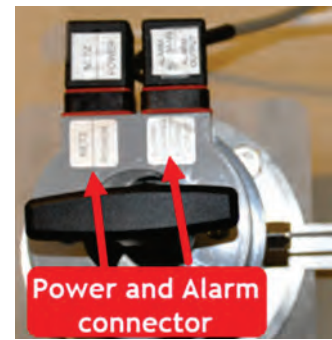
13. Attach the hose to the probe.



14. Make sure that the heated hose is connected properly to the prob bracket. The unused air hose and the Power/Alarm and Sensor cable must be placed underneath the bracket.



15. Reconnect the power and alarm connector.



16. Connect the sample hose with the gas cooler adapter.



17. Connect the PTFE hose named **Calibration Gas** to the fitting named **Test Gas**.

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