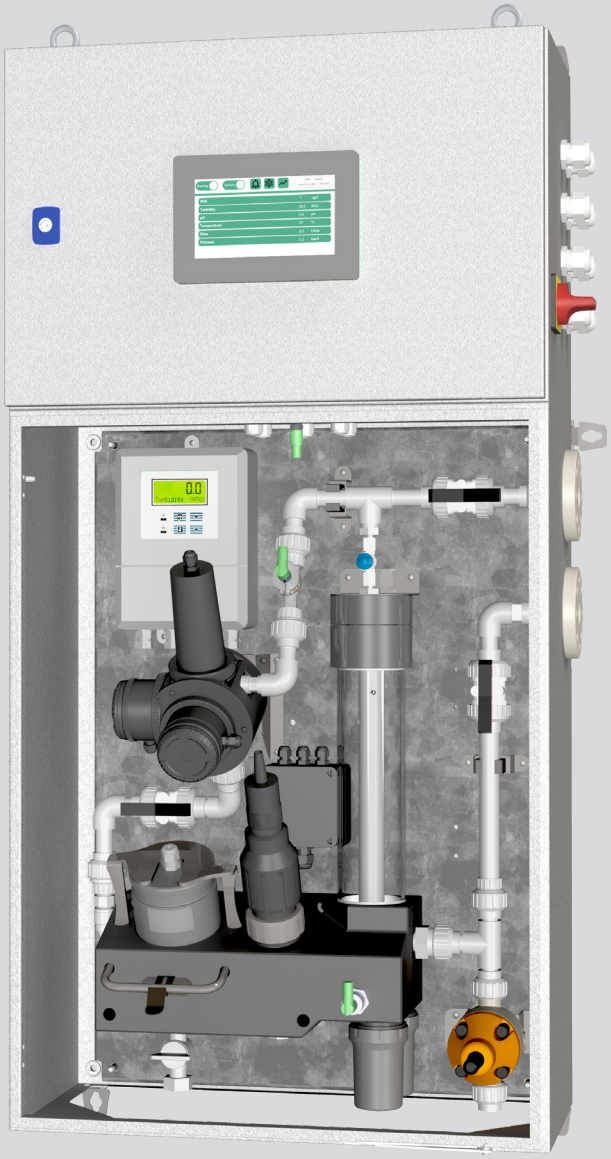
G6200

Water Monitoring System

User Manual



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Maritime

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This user manual must be read carefully and must be kept for future use with the system.

For safe and proper use, read and follow all instructions in this manual.

For spare parts, refer to the separate respective spare parts catalogue.

Green Instruments A/S reserves the right to make adjustments and improvements to its products and systems. This means that documentation is subject to change without notice.

Green Instruments A/S has taken all measures to ensure the information in this user manual is accurate and comprehensive. Green Instruments A/S reserves the right to make corrections and cannot be held liable for any errors or omissions in this manual.

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

Green Instruments A/S appreciates all feedback and suggestions for improvement. If you have any questions relating to the user manual or there are discrepancies in this user manual, contact Green Instruments A/S.

Language: English

Content

List of Figures

1. Terms & abbreviations

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

When a term is first used, it will be written out in full and include its abbreviation for the sake of clarity.

Description	Abbreviation
Exhaust Gas Cleaning System	EGCS
Marine Environment Protection Committee	MEPC
Polycyclic Aromatic Hydrocarbons	PAH
Water Monitoring System	WMS
Firmware	FW
Software	SW

2. Introduction

2.1 About the system

The G6200 water monitoring system is a modular system that continuously monitors scrubber water. With its robust and durable design, the system can be used in both open, closed, and hybrid systems and includes a de-bubbler, which avoids interference due to sample degassing.

Compared to our G6100 version, the G6200 WMS is simpler, with no need for a pump cabinet unit or a pressure reduction unit. The G6200 WMS only requires water from scrubber pumps or a free-standing supply pump.

The G6200 WMS has a wide water pressure and flow range, making it suitable for both the inlet and outlet of the scrubber. The ranges are highly flexible, meaning different pumps such as impeller pumps or hose pumps can be connected to the system. Having a WMS on board is an extremely effective way of ensuring compliance with international regulations. The G6200 WMS is fully compliant with MEPC.259(68) & MEPC.340(77).

The system design and choice of materials used are based on more than one thousand systems installed on various vessel types. The system is easy to service, includes on-board verification and does not include a costly sensor servicing program.

2.1.1 PAH

The polycyclic aromatic hydrocarbons module measures the content of PAH in water as specified by MEPC.259(68) & MEPC. 340(77). The module uses a UV technique and detects PAH concentration in µg/l (ppb) in water. A special measuring arrangement ensures a reliable and repeatable measurement while keeping the need for cleaning at an absolute minimum. A unique feature is local validation which ensures a reliable measurement of PAH.

The PAH measurement is compensated for the effects of turbidity by means of a turbidity compensation formula and input from the turbidity sensor module G6120.

2.1.2 Turbidity

The Turbidity measures the turbidity of water in accordance with MEPC.259(68) & MEPC.340(77). The module used a 90° IR technique in accordance with ISO 7027. The Turbidity module can detect soot, particles, and suspended soil in the water. Special precaution is taken to avoid interference from dissolved gasses and bubbles and an integrated wiper keeps optical fouling at a minimum. Certified calibration solutions are used to perform local calibration.

2.1.3 pH & Temperature

The pH/Temperature measures the pH value and temperature of the water. Temperature compensation ensures accurate and reliable measurements. Calibration is simple and fast.

Download product certificates at https://greeninstruments.com/.

2.2 Technical specifications

G6200 Water Monitoring System			
Function	Monitoring EGCS discharge water in accordance with IMO resolution MEPC.259(68) & MEPC.340(77)		
Power supply	400-440VAC 50-60 Hz 3 phased		
Display	7" TFT LCD color display		
External communication	■ Standard: Modbus TCP/IP ■ Optional: Modbus RTU (RS-485) via converter To be specified upon order		
Sample connections	Flange Standard DIN20/JIS3/4" 10K PN10		
Sample pressure	**Inlet:**	With pressure reduction valve	Max 10 bar (g)
		Without pressure reduction valve	Max 2.5 bar (g)
	Outlet:		Max 1.8 bar (g)
Sample temperature	0–50 °C		
Sample flow	Max. 10 l/min, flow warning 2.5 l/min, flow alarm 1.5 l/min		
Sample purity	Particle size of max. 2 mm		
Sample condition	The system is designed for maritime SO2 scrubber wash water containing seawater, polluted seawater, freshwater with NaOH, residue particles from HFO combustion, and salts (Na2SO4 etc.). Chemical capability and material lifetime depend on a combination of local factors such as temperature, acidity, oxygen, and oil among others. Therefore, always consult a chemical compatibility database with reference to each of the materials.		
Wetted materials (In weighted order)	PVC – PP / PPGF – PC – PET – POM – PVDF – PPS – PE – PTFE – NBR – EPDM – FKM – PA6T/6I – 316L – Al2O3 – ETFE – Quartz glass – Glass – Epoxy preform (cured) – polyamide 6.		
Max ambient temperature	Class A 45 °C (Tested to 55 °C)		
Humidity	Class B		
Vibration	Class A		
Emc	Class A		
Enclosure & material	Class B (IP65) AISI 1008 Painted		
Dimensions	600 x 1200 x 300 mm		

Weight	85 kg

Sensor Modules	
PAH Module – Type G6111	
Compliance	Complies with MEPC.259(68) & MEPC.340(77)
Certificates	Download at https://greeninstruments.com/
Measurement technology	UV induced fluorescence Excitation wavelength: 254 +/-10 nm Detection wavelength: 360 +/- 50 nm The PAH measurement is compensated for the effects of turbidity by means of a turbidity compensation formula and input from the turbidity sensor module G6120.
Measurement range	Low range: 0-100 µg/l phenanthrene equivalence, or High range: 0-800 µg/l phenanthrene equivalence or Dual range: 0-100/800 µg/l phenanthrene equivalence Must be specified in the order.
Power supply	Refer to Electrical Drawings
Wetted materials	PVC, fused silica glass, AISI 316, PVDF and NBR
Signal	RS-232 and Analog 0/4-20 mA (Active)
Accuracy	Max. ±5% of sensor range or Max. ±5% of the nominal standard test concentration, which value is no less than 80% of the sensor range.
Turbidity Module – Type G6120	
Compliance	Complies with MEPC.259(68) & MEPC.340(77)
Certificates	Download at https://greeninstruments.com/
Measurement technology	According to ISO 7027
Measurement range	0-400 NTU
Power supply	Refer to Electrical Drawings
Wetted materials	Acetal, polycarbonate, PVC, AISI 316, NBR, EPDM, fused silica glass, polyamide 6, Epoxy preform (cured).
Signal	Analog 4-20 mA (Active)
Accuracy	0-40 NTU max ± 2 NTU 0-400 NTU max ± 5%
pH/Temperature Module – Type G6130	
Compliance	Complies with MEPC.259(68) & MEPC.340(77)

Certificates	Download at https://greeninstruments.com/
Measurement technology	According to BS EN ISO 60746-1 & BS EN ISO 60746-2:2003
Measurement range	0-14 pH units; 0-50 °C
Power supply	Refer to Electrical Drawings
Wetted materials	AISI 316 or PPS, glass, PVDF & PVC
Signals	2 Analog 4-20 mA (Passive)
Accuracy	Max. ±0.2 pH unit

Specifications are subject to changes without notice.

2.3 Storage and handling

2.3.1 Storage

The ambient temperature must be 0-45 °C, and the relative humidity must be 20-90% RH.

The pH/Temperature sensor uses an electrode which is stored inside the system in a separate container to maximize electrode lifetime. The electrode is packed in a sealed bag and delivered with a safety cap on to ensure the electrode is kept moist. The electrode will be damaged if it dries out. Refer to section 6.5 for additional information.

2.3.2 Calibration kit

Calibration solutions come with expiry dates. The calibration kit has an expiry date of approximately 12 months from the date of delivery. Store calibration kits at 5-25 °C.

Calibration solutions can become damaged at temperatures below 0 °C and temperatures above 25 °C may reduce their accuracy and lifetimes. However, storage temperatures of up to 35 °C for calibration liquids are permitted during transport but only for a period of seven days.

When using the calibration liquids, ensure their temperature is about 20 °C for the highest accuracy.

2.4 Control of delivery

Please check the equipment upon arrival, ensuring 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 discrepancy or damage should be reported to Green Instruments A/S immediately.

3. Safety

Before operating the system, read and understand the entire user manual.

WARNING

Failure to follow the instructions can lead to serious injury or death.

Follow the instructions:

- Ensure all power and signal cables connections are correct before operating the water monitoring system.
- The PAH sensor module and turbidity sensor modules use UV and IR light that can damage eyes. Do not look directly into the lenses.
- Avoid air in the sampling system to prevent the risk of air locks occurring, which can trigger a flow alarm.
- Always ensure there is positive suction pressure and keep discharge pressure as low as possible in order to maximize pump lifetime.
- Do not block a safety valve's drain or outlet connection, as this will damage components.
- Check the safety valve to ensure it functions correctly. Follow the planned maintenance program.
- The system may only be installed in a safe, non-hazardous area. It must not be used with flammable sample liquids. Non-wetted components such as enclosures must be kept dry and clean.

WARNING

Use of unqualified, unskilled, and untrained personnel can lead to serious injury or death.

The installation and operation of this system and associated equipment must be carried out by skilled, and trained personnel. Green Instruments A/S bears no responsibility for the operation of the system and associated equipment. The correct and safe operation of this equipment depends on proper handling, installation, operation, and maintenance.

The equipment must only be used as described in this user manual. If the system is used in any other way not specified by Green Instruments A/S, equipment safety may become impaired. Green Instruments A/S cannot be held liable for any resulting damage or injury.

Hazardous voltage

Disconnect power before installing or servicing the equipment. Failure to disconnect power can result in severe personal injury or 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 in close proximity to the system and within easy reach of the operator.

Overload protection

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

Protective earth

The system must be connected to protective earth.

Installation and fault finding

Risk of electrocution

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 (1999), connection cables for the main power supply and communication signals must be shielded or have equivalent protection.

ATTENTION

Sensors can become damaged. The sensor modules must be connected to the WMS before powering up otherwise they can become avoid damaged. When the system is powered on, the connection to the sensor modules must not be disconnected. If a sensor is to be connected or disconnected, switch off the power first. The equipment must not be exposed to strong mechanical shocks.

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.

WARNING

Harmful components: poisoning and chemical burns hazard.

The water can contain poisonous components that are potential harmful to humans and animals. Some calibration solutions contain high concentrations of harmful components. There is a risk of chemical burns. Wear personal protective equipment whenever there is a risk of coming into contact with the water or calibration liquids.

Recycling

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

Symbol identification!			
	General warning sign		Protective earth
	Electric shock hazard	CE	The CE mark indicates the product meets EU safety, health and environmental protection requirements
	Chemical hazard		Hot surface hazard

4. Menu structure

The WMS HMI home screen layout, menu structure and different user options are shown in Figure 4.1. Figure 4.2 shows the trend screen and Figure 4.3 shows the alarm screen.

The illustrations use yellow lines and yellow boxes to show the relationships between screens and different user options, and to explain button functions.

HMI settings and system settings page are explained in detail in section 4.2 and 4.3.

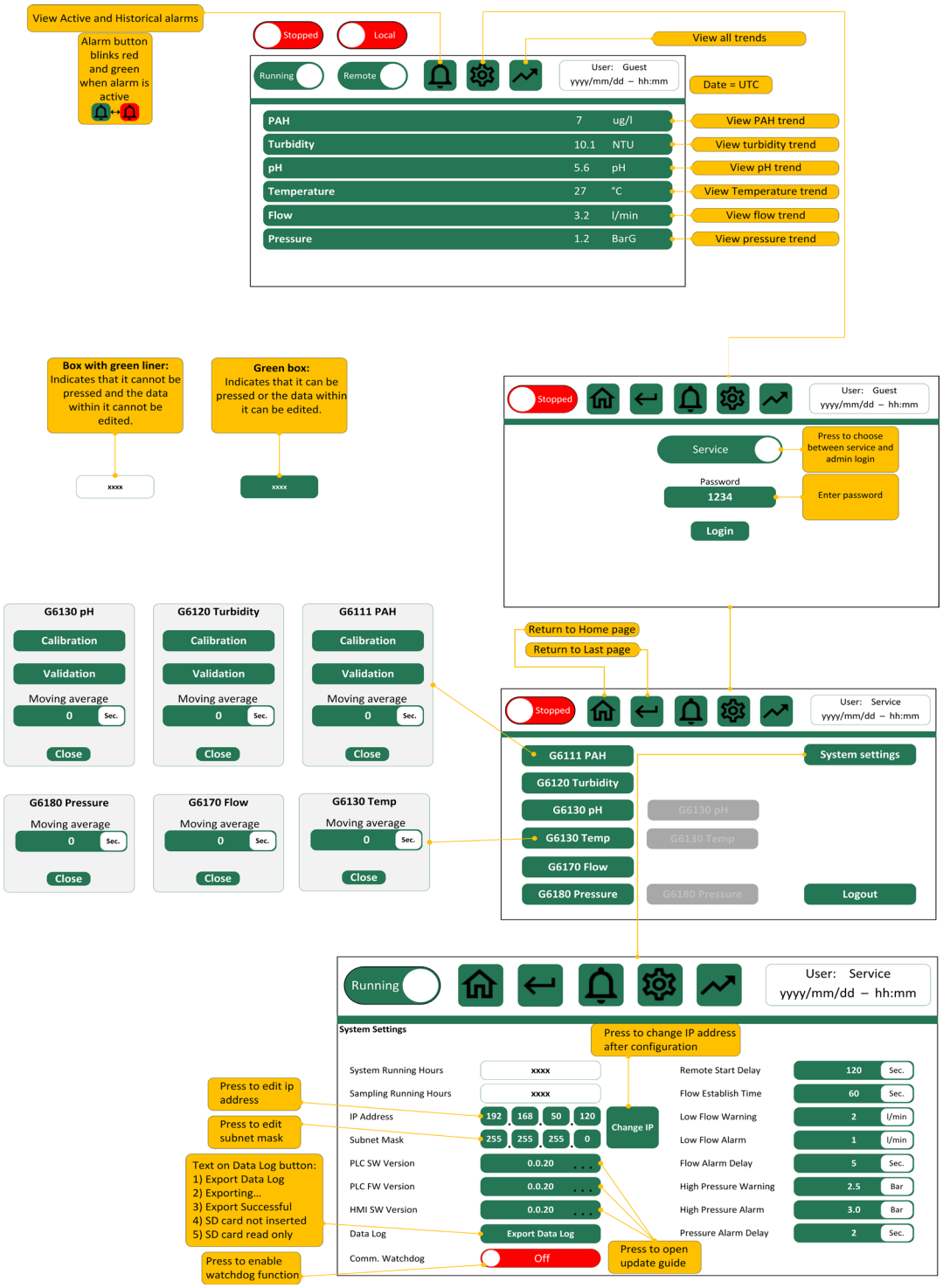


Figure 4.1: HMI home screen layout, menu structure and settings options

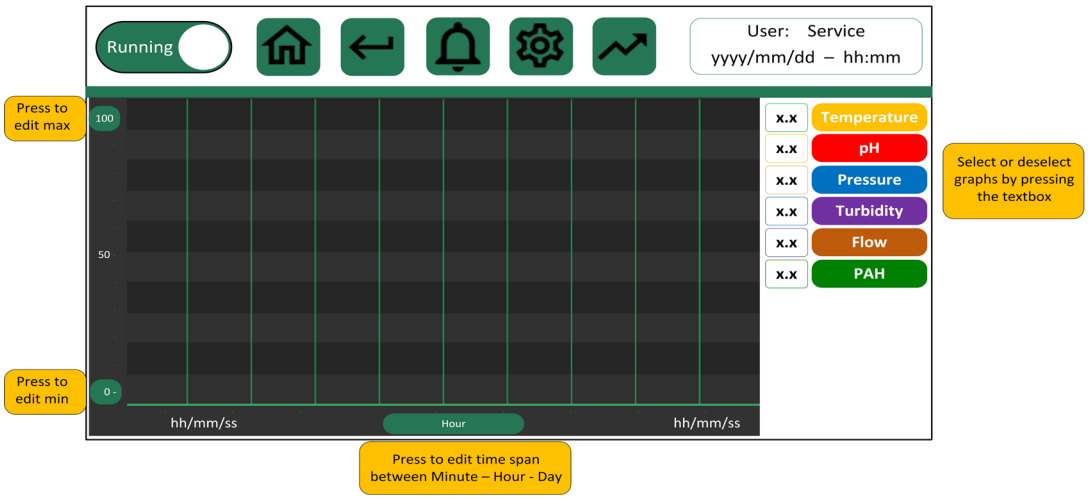


Figure 4.2: Trend screen

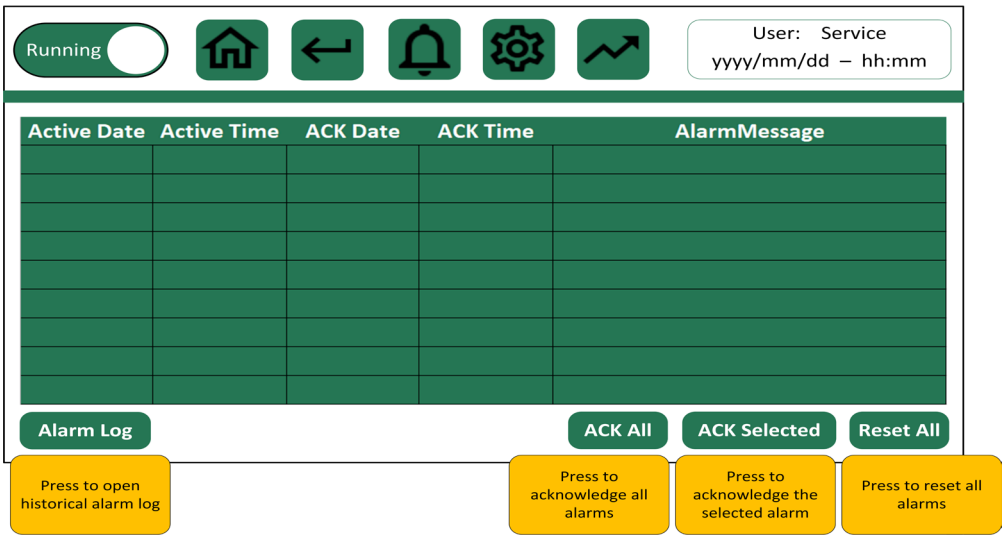


Figure 4.3: Alarm screen

4.1 Security and login

The WMS is equipped with three 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

Figure 4.4: User access levels

Level 1 – Guest

The user can view trends, active alarms, alarm history, activate start/stop and local/remote functions.

Level 2 – Service

Only for trained personnel.

The user can access system settings, calibration, validation and moving average functions.

Level 3 – Admin

ATTENTION

The following may only carried out in collaboration with Green Instruments.

The user can change calibration set-points, sensor communication, sensor setup and sensor signal scaling.

To access this level, the user must contact Green Instruments with 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.

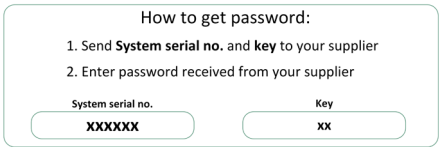


Figure 4.5: Admin login

4.2 Settings

The user can calibrate and validate the sensors using the settings screen. For sensors that do not require calibration, it is only possible to edit the moving average (refer to Figure 4.6). The settings screen also contains greyed out buttons. To enable these, contact Green Instruments.

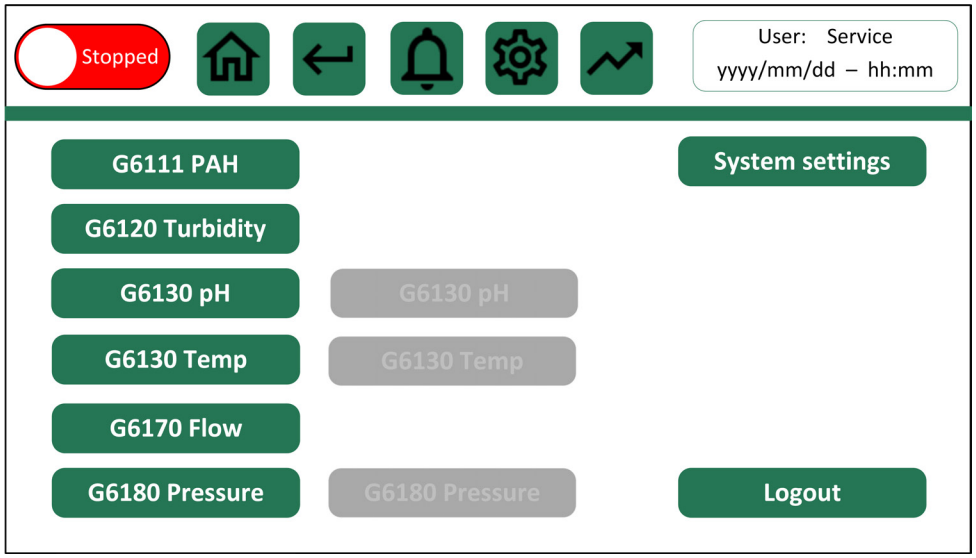


Figure 4.6: Settings screen

Pressing the pH, Turbidity or PAH button will generate a pop-up window, as shown in Figure 4.6. Here it is possible to edit the moving average applied on the signal. It is also possible to perform a calibration or a validation of the specific sensor.

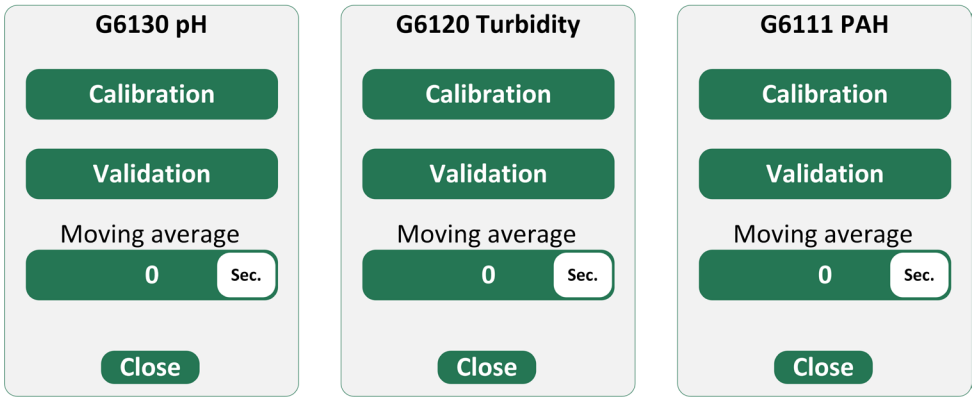


Figure 4.7: Sensor pop-up

When pressing the Calibration or Validation buttons the user will be instructed in how to perform the selected function (refer to section 7).

4.3 System settings

The system settings screen can be accessed from the settings screen (see Figure 4.6). Any functions that are not explained in Figure 4.1 will be described in this section.

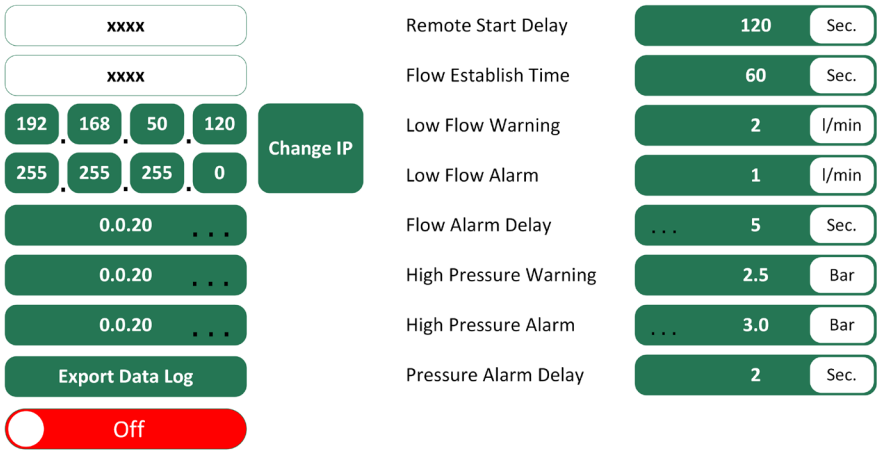


Figure 4.8: System settings

Remote start delay

Air might be present in the scrubber piping system at start-up. This sampling delay ensures that air does not enter the system during the start-up phase. The On/Off valve or the pump will turn on after the Remote Start Delay period has expired. This function is **only** active in remote operation.

Remote Start Delay also ensures a degree of protection of the pump against dry running. Therefore, changing the timer setting should be considered carefully.

Default setting: 120 seconds Range: 0–240 seconds

Flow establish time

The WMS starts sampling when the On/Off valve or the pump is activated. Flow Establish Time allows for sufficient time for the water to travel from the On/Off valve or the pump to the flow sensor. If the flow sensor is triggered within the time set by the Flow Establish Time, the WMS will continue sampling.

But if the flow sensor is not triggered (because there is no flow) within the set time, then the Flow Alarm will trigger.

Default setting: 60 seconds Range: 5–240 seconds

Low flow warning/alarm

During sampling water flow can decrease. If the water flow falls below the low flow warning set-point, this will trigger a low flow warning. If the water flow rises above the set-point again, the warning will be cancelled.

If the water flow continues to decrease and falls below the low flow alarm set-point, this will trigger a low flow alarm once the flow alarm delay period has expired. If the water flow rises above the low flow alarm set-point during this time, the alarm will be cancelled. If the pump continues to operate when the water flow is low, it may become damaged.

Warning default setting: 2.5 l/minute Range: 2–10 l/minute

Alarm default setting: 1.5 l/minute Range: 1.5–10 l/minute

Flow alarm delay

The flow alarm delay allows for small flow fluctuations without trigging the flow alarm. When the WMS is sampling, flow alarm delay controls for how long the flow may be missing before the Flow Alarm is triggered because of low flow.

Default setting: 3 seconds Range: 3–10 seconds

High pressure warning/alarm

During sampling it is possible that the pressure can rise due to i.e., clogging, closed valve or increased back pressure. If the pressure increases above the high-pressure warning set-point, a high-pressure warning will be set.

If the pressure decreases below the set-point, the warning will be cancelled. If the pressure continues to increase and moves above the high-pressure alarm set-point, a high-pressure alarm will be set after the pressure alarm delay period has expired.

If the pressure in this period decreases below the high-pressure alarm set-point, the alarm is cancelled.

Warning Default: 2.3 bar Range: 0-2.5 bar

Alarm Default: 2.5 bar Range: 0-3 bar

Pressure alarm delay

This pressure alarm delay allows for small pressure fluctuations without trigging the high pressure alarm. When the WMS is sampling, the pressure alarm delay sets the length of time that can expire before the high-pressure alarm is triggered because of high pressure.

Default setting: 0 seconds Range: 0–4 seconds

ATTENTION

Changing the high pressure warning/alarm/delay set-points can cause system failure and will void the system warranty.

4.4 Alarm action

Some of the system alarms have the ability to stop the sampling process e.g. stop pump or close motor valve if the alarms are activated. Figure 4.9 shows the flow and pressure alarm settings. Moving the slider to "ON" will activate flow and pressure alarms. To access these functions, press the three dots located next to the alarm on the system settings page Figure 4.8.

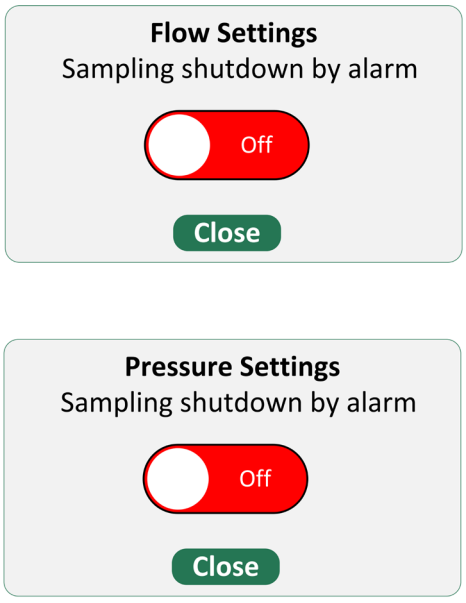


Figure 4.9: Alarm action

5. Installation

5.1 Mechanical

5.1.1 System installation

WARNING/ATTENTION

Faulty operation/system failure hazard

This section provides critical information regarding the installation of the system 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.

The manufacturer cannot be held liable for damage or injury resulting from the incorrect or improper installation, maintenance, or misuse of the equipment.

Keep the equipment safe from exposure to water, dust, and fire. Welding near the equipment is not recommended but if welding near the equipment cannot be avoided, make the equipment safe from welding/grinding sparks, heat, electric current and electromagnetic effects.

Consult all relevant technical documentation to ensure correct installation.

ATTENTION

The following requirements must always be met:

- Observe and ensure that the installation always complies with system specifications.
- Ensure that the requirements on the installation layout drawing in the technical documentation are followed. We recommend installing a drainpipe below the system to collect water drained from the system.
- The equipment must be installed in an area protected from direct contact with water or oil. High levels of moisture should also be avoided.
- Make sure to remove plugs and flange protection that were to protect the system during transport.
- The pipework must include means of isolation e.g. shut off valves.
- The pipework must be properly aligned with the cabinet connection points to avoid stress on the connection points.
- Cabinet dimensions are stated in the installation layout. Cabinets can be

mounted using the six brackets designed for 8 mm bolts.

- Cabinets must be lifted in the eyebolts placed on the top cabinets.
- Ensure that there is sufficient space for the safe operation and servicing of the equipment. Avoid placing electrical components below the system due to water drain off.

5.1.2 Sampling point

- Refer to drawing Sample Point Connection Example.
- Always choose a sampling point where water will be present at all times.
- Consider any special requirements of the sampling pump that you are using, e.g., suction pressure, risk of cavitation, pipe dimension, lifting heights, etc.. Refer to the pump manual for additional information.

ATTENTION

Air locks and system failure hazard

- Take the presence or accumulation of air at the sample point into consideration. Choose a sample point with the least amount of air and avoid U-bends and goosenecks in the sample line. It is strongly advisable that measures are taken to prevent air from entering the sampling system, otherwise this will increase the risk of air locks and system failure.
- Take the presence or accumulation of particles at the sample point into consideration. Choosing the right connection angle/orientation helps to avoid particles occurring or accumulating. Consider executing sampling from a position inside the main scrubber piping rather than in the periphery piping.

5.1.3 Legislation and piping

According to section 10.4.1 of MEPC.340(77), the data recording system must have a logging frequency of no less than 0.0111 Hz. For this reason, the volume of water inside the WMS must be replaced approximately every 90 seconds. The internal volume of water in the WMS is 2.2 liters.

When designing pipework length and diameter as well as sampling pump capacity, the installer must ensure that the MEPC guideline is complied with. Furthermore, the installation must comply with good practice regarding the size and length of the pump suction pipe, transfer piping, and flow velocity. For additional information please consult the pump manual.

For further assistance, please contact Green Instruments.

5.2 Electrical

WARNING

Risk of electrocution

Before starting the fully installed WMS for the first time, check and ensure that all electrical connections have been correctly wired in accordance with the electrical documentation.

5.2.1 Electrical documentation

The electrical documentation is delivered separately and covers all versions and options. Carefully read the electrical documentation and determine which options are relevant for the system(s) delivered.

If the electrical documentation is lost, new documentation can be obtained on request. Please state the system serial number to ensure that you receive the relevant version of the electronic documentation from Green Instruments. The power supply for the WMS must be in accordance with the power supply specified in the electrical documentation.

5.2.2 Power

The characteristics of the WMS power supply must be as specified in the electrical documentation.

ATTENTION

Failure to use the specified power supply can result in system failure.

5.2.3 Communication

The system uses Modbus TCP/IP communication or an optional Modbus RTU line. The Modbus mapping is specified in section 5.3.2 and the correct ethernet port is identified in the electrical documentation. The Modbus communication must be tested to ensure correct use before bringing the system into operation.

To set the System Modbus IP address - see section 5.3.1 & 5.3.2.

The WMS also supports Web Viewer (VNC) - see section 5.3.3.

The WMS also supports optional remote connectivity for servicing and troubleshooting purposes - see section 5.3.4.

5.2.4 Optional converter

If Modbus RTU is required, the system can be installed with a converter, part no: 03558.

To communicate via the converter, use the following details:

Function	Value
Serial	RS485
Slave ID:	4
Baudrate	19200
Parity	Even
Stop bits	1

NOTICE

Ensure the system ethernet 2 IP address is set to 192.168.50.100 when using a converter.

Nr.	Slave ID	IP address TCP	Slave ID TCP	Reserved sock	Errors sock	UDP	Broadcast	Mnemonic
1	1	192.168.50.121	1	☐		☐	☐	WM00
2	2	192.168.50.125	1	☐		☐	☐	WM20
3	3	192.168.50.129	1	☐		☐	☐	WM30
4	4	192.168.50.100	1	☐		☐	☐	G6200

Table 5.1: Converter table

5.3 Commissioning

This section describes the commissioning process of the WMS. To operate the system successfully, it is important that the user reads this section in detail and becomes familiarized with the functions and features available in the system.

5.3.1 Check ethernet settings

IP address setting

The WMS will be delivered with a default Modbus IP address.

To configure this IP address, the user must change to Level 2 and navigate to System Settings. Here it is possible to change the PLC Ethernet 2 address which is used for Modbus communication with external systems.

To change the IP address and subnet mask, press the green boxes on Figure 4.8 and enter a valid address.

When done, press the button “Change IP” and wait for the text “Done” to indicate a successful configuration.

5.3.2 Modbus map

The WMS communicates with external systems via MODBUS TCP/IP or optional MODBUS RTU. Figure 5.1 shows details, values, and which addresses to access for specific parameters.

Variable name	Data type	Range	R Security Level	W Security Level	Modbus	Function
Stop / Start	Boolean	0 - 1	0	0	400000,0	0 = Stop, 1 = Start
Reserved					400000.1-11	Reserved
Remote / Local	Boolean	0 - 1	0	-	400001,0	0 = Remote, 1 = Local
Running / Stopped	Boolean	0 - 1	0	-	400001,1	0= Stopped, 1 = Running
Reserved					400001.2-11	Reserved
Low Flow Alarm	Boolean	0 - 1	0	-	400002,0	0 = All OK, 1 = Alarm
Low Flow Warning	Boolean	0 - 1	0	-	400002,1	0 = All OK, 1 = Alarm
PAH Signal Alarm	Boolean	0 - 1	0	-	400002,2	0 = All OK, 1 = Alarm
Turbidity Signal Alarm	Boolean	0 - 1	0	-	400002,3	0 = All OK, 1 = Alarm
pH Signal Alarm	Boolean	0 - 1	0	-	400002,4	0 = All OK, 1 = Alarm
Temperature Signal Alarm	Boolean	0 - 1	0	-	400002,5	0 = All OK, 1 = Alarm
Reserved	Boolean				400002,6	Reserved
Flow Signal Alarm	Boolean	0 - 1	0	-	400002,7	0 = All OK, 1 = Alarm
PAH Warning	Boolean	0 - 1	0	-	400002,8	0 = All OK, 1 = Alarm
Pressure Signal Alarm	Boolean	0 - 1	0	-	400002,9	0 = All OK, 1 = Alarm
General Warning	Boolean	0 - 1	0	-	400002,10	0 = All OK, 1 = Alarm
General Alarm	Boolean	0 - 1	0	-	400002,11	0 = All OK, 1 = Alarm
High Pressure Alarm	Boolean	0 - 1	0	-	400002,12	0 = All OK, 1 = Alarm
High Pressure Warning	Boolean	0 - 1	0	-	400002,13	0 = All OK, 1 = Alarm
Motor unit tripped	Boolean	0 - 1	0	-	400002,14	0 = All OK, 1 = Alarm
Reserved	Boolean				400002,15	Reserved
PAH value	Float	0 - 800	0	-	400003-400004	REAL value with measured PAH
Turbidity value	Float	0 - 400	0	-	400005- 400006	REAL value with measured Turbidity
pH value	Float	0 - 14	0	-	400007-400008	REAL value with measured pH
Temperature value	Float	0 - 50	0	-	400009-400010	REAL value with measured temperature
Reserved	Float	0 - 10	0	-	400011-400012	Reserved
WM Communication Watchdog_1	UINT		0 - 65535	0	400013	With 1 sec. interval, the client should read an new value.
WM Communication Watchdog_1	UINT		0 - 65535	-	400015	With 5 sec. interval, the WM expects to read an new value.
Flow value	Float	0 - 10	0	-	400017-400018	REAL value with measured flow
Pressure value	Float	0 - 10	0	-	400019-400020	REAL value with measure pressure
Reserved					400016-30	Reserved
Watchdog (optional)	UINT	0 - 65535	0	-	400032	With 1 sec. interval, the client should read an new value.
Watchdog (optional)	UINT	0 - 65535	-	0	400034	With 5 sec. interval, the WM expects to read an new value.

Figure 5.1: MODBUS Map

5.3.3 Web viewer (VNC)

The WMS can be connected with an external display, monitor, or PC.

This function is available per default and can be accessed from a browser on a PC connected to the system.

Please note that even though this function supports all functions on the HMI, it is not advisable to control all functions remotely, for example, validation procedures and most service/maintenance tasks should not be carried out remotely. When using remote control, always proceed with caution.

To use the web viewer, a network must be connected to the “remote connection” port (refer to the electrical documentation to see the location of the port). After connecting the network, the IP address of the HMI must be configured. To do this the user must access the HMI menu. This is done by pressing screen corner 1 and then pressing the diagonally opposite screen corner 2. Repeat this until the menu opens. Figure 5.2 shows which screen corners to press.

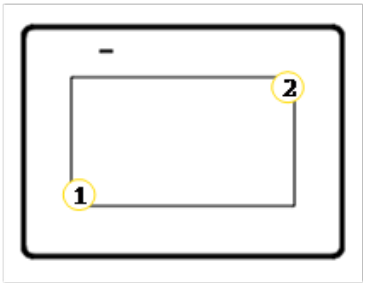


Figure 5.2: HMI

When the menu opens, scroll down to ethernet 2 and enter a suitable IP address and subnet mask. When finished, press “save and reboot”. The user can now open a browser on a PC connected to this network. Enter the following into the URL line:

“HMI IP-address” + “port number” + “Webviewer/index.html”

Example: 192.168.50.10:8082/webviewer/index.html

If the connection is successful, a screen will appear and you will be required to enter a user name and password to log in to the Web Viewer. The Web Viewer requires that the user has Level 2 access. Refer to Figure 4.4.

5.3.4 Remote connection

The WMS allows remote support via an internet connection (see Figure 5.3). The internet connection must be established in accordance with the electrical documentation.

This connection allows Green Instruments technicians and programmers to remotely monitor, diagnose, control, and program the WMS 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 sent and received on the connection are encrypted.

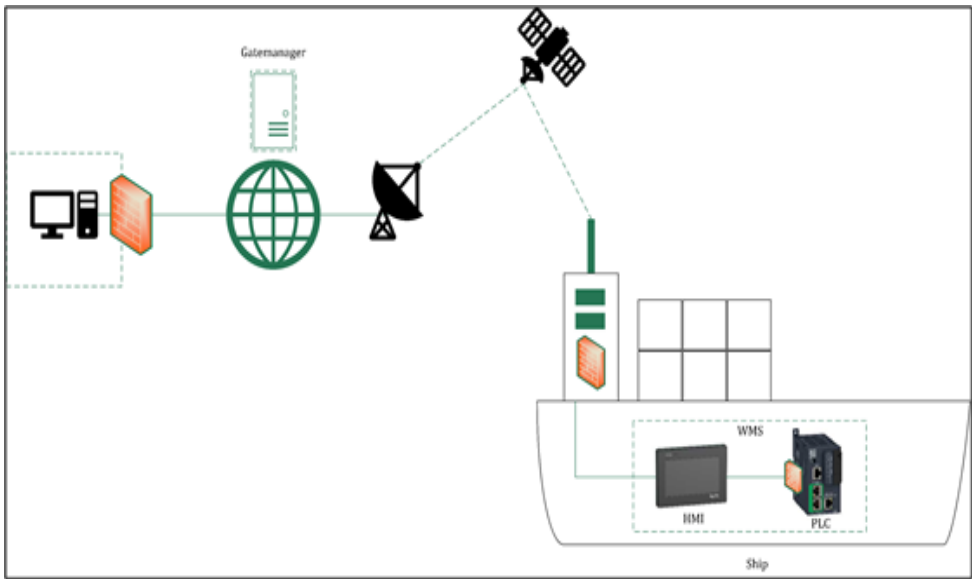


Figure 5.3: Remote connection

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

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

5.3.5 Commissioning checklist

After completing the installation, verification of the installation and setup is required.

To verify that the installation and setup is correct, carry out the following:

- Ensure that the inlet and outlet connections are connected as specified with reference to the installation layout drawing.
- Ensure that drainage from the system is established.
- Ensure that the flow paths to and from the system are not blocked.
- Ensure that the power supply connection and power supply rating comply with the electrical documentation.
- For systems with a motor protection unit (K1): Adjust the tripping current to match the motor current on the motor tag plate. After carrying out the adjustment, switch the handle on the motor protection unit from the OFF position to the ON position.
- Ensure that the protective earth is connected.
- Ensure that the communication connection (MODBUS and remote connection) complies with the electrical documentation.
- Verify that the pH electrode is installed correctly and submerged into water.
- Ensure that the pH/temperature sensor rotary switch ring is set to position “M”.
- Verify that internal valves “Inlet”, “Outlet” and “Calibration” are open, and the “Drain” valve is closed.
- Verify that the PAH locking bracket and pin is in place.
- Verify that the turbidity wiper is mounted correctly.
- Verify that the pH sensor flat gasket is in place.
- Power up the system by switching on at the main switch to "I" position. Observe the start-up of the WMS and the sensor modules.
- Verify that the IP Address is correct.
- Verify that all functions described in the communication protocol are tested and working.

- Verify that the phase sequence of the power supply is correct, and that the rotation direction of the motor corresponds to the inlet/outlet connection on the pump. Carefully read and follow the instructions in the pump manual before starting the pump for the first time.

6. Operation

This section explains how to operate, calibrate, and validate the WMS. It also explains how to adjust valves, handle alarms/warning, logs, and software updates.

6.1 Sampling

The WMS can operate in either remote or local.

6.1.1 Remote operating mode

When the WMS is in remote mode, it is possible to start the sampling via MODBUS.

Example: Send 1 to Modbus Address: 40000.0

The system will start when the remote start delay period has expired.

Example: Send 0 to Modbus Address: 40000.0

The system will stop sampling by turning off the pump or motor valve

Follow the MODBUS map in section 5.3.2 to identify relevant functions.

6.1.2 Local operating mode

When the WMS is in local mode, it is possible to operate the system manually. This mode can also be used to block remote start signals when performing some types of work on the system. To test the system, it is possible to start the pump or open the motor valve by pressing the “running/stopped” slider in the upper left corner.

When operating the system manually, it is important to pay attention to valve positions, open sensors/unmounted sensors, pressure, and flows.

ATTENTION

If the web viewer is activated and in use, it is important to turn off the web viewer before carrying out work on the system or pump, otherwise there is a risk that the system can be started from the web viewer.

6.2 Pressure reduction and safety valve adjustment

6.2.1 Pressure reduction valve

If the WMS is equipped with a pressure reduction valve, this valve can be used to adjust the pressure and flow within the system. The system pressure limits can be found in the system specifications section 2.2. Make sure that the system is running, and water is flowing before any adjustments.

To increase system pressure and flow, turn the adjustment screw on the top of the pressure reduction valve clockwise. To decrease pressure and flow, turn the adjustment screw counter-clockwise.

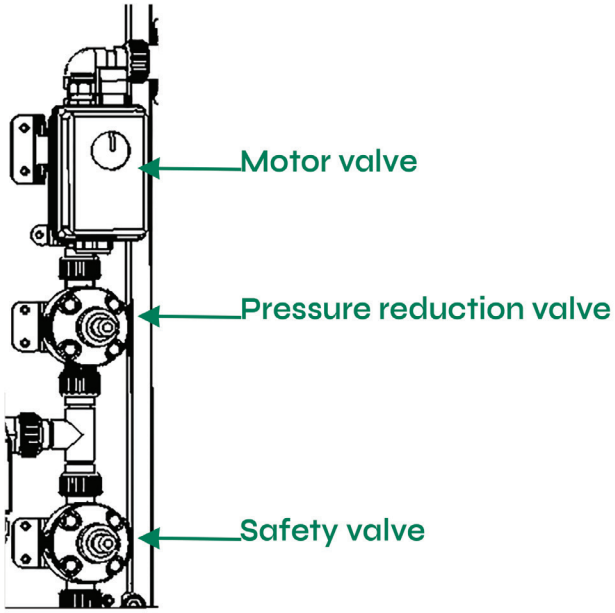


Figure 6.1: Inlet valve arrangement

6.2.2 Safety valve

All WMSs are equipped with a safety valve to reduce the risk of pressure damage. The safety valve is located on the inlet valve arrangement and can be seen on Figure 6.1. The safety valve has a set-point of 3 bars. If required, the safety valve can be adjusted. Follow Maintenance Instruction MI6200-0010 to adjust the safety valve.

ATTENTION

If the safety valve pressure set-point is set higher than the max. pressure allowed by the system, this may lead to the system failing and the warranty will be void.

6.3 Adjustment of needle valve

The white needle valve located above the de-bubbler controls the ratio of water/air mix flowing from the top of the de-bubbler and the flow of bubble-free water that flows from the bottom of the de-bubbler to the sensors. The valve must never be fully closed, otherwise it will stop the de-bubbler from functioning. Turning the handle clockwise will increase the flow to the sensors.

The valve is typically set to 30% open, which corresponds to approximately 2.5 turns made counterclockwise from the fully closed position. If the valve is closed more, there is a greater risk of it becoming blocked with sediments. This should be avoided. If the measured flow [l/minute] is unaffected by valve adjustments, then the valve is probably blocked or broken. If this is the case, either clean the valve or replace the valve.

6.4 Adjustment of flow

The flow of water through the WMS is determined by the system inlet pressure, cleanliness of the strainers, the needle valve setting, the backpressure at the outlet flange, and the pipework's dimensions and length. For systems equipped with a pressure reduction valve, the setpoint pressure of the pressure reduction valve will also affect the flow of water through the WMS.

In general, water flow through the WMS should be kept as low as possible so that the strainers will be required to be cleaned less regularly. However, the water flow must also be high enough to avoid tripping the low flow warning too often. This means that the optimum flow setting will vary with each installation and thus the user must make fine adjustments based on experience with the system.

Recommendation for systems with pump

Choosing the correct pump type and pressure/flow characteristics are essential for optimal operating conditions. Carefully study section 2.2 and 5.1.3 to choose the correct pump.

6.5 pH/temperature electrode

The pH/temperature sensor uses an electrode which is stored inside the

system in a separate container to maximize electrode lifetime. The electrode is packed in a sealed bag and delivered with a safety cap on to ensure the electrode is kept moist.

The electrode will be damaged if it dries out. The cap must be removed prior to start-up of the system. The pH/temperature sensor is also fitted with a plug to prevent moisture from entering the electrical connection. The plug must be removed, and the electrode fitted prior to start-up.

When fitting the new electrode, be sure to retract the safety cap enough to allow thread engagement. The safety cap may have pushed the gasket upwards, and this will cause the thread not to engage properly. Ensure that there is water inside the measuring chamber before the electrode cap is removed and before the sensor is mounted into its measuring chamber.

Figure 6.2: pH electrode installation

6.6 Moving average

A moving average strainer function is applied to all sensor signals to remove sudden peaks. The filter function calculates the mean value of the signal over a given time. Maximum mean time is 20 seconds. To deactivate this function, enter a 0 in the moving average input area, refer to Figure 4.7.

6.7 Alarms & warnings

Alarms and warnings and their associated messages are displayed in a list. Refer to Figure 6.3. The alarm screen displays the active alarm time, date and alarm acknowledged time and date. Alarms that have been reset or automatically removed can be viewed in the historical alarm log.

Alarm messages contain information regarding specific alarms. Refer to section 10 regarding troubleshooting if the alarm is not automatically removed.

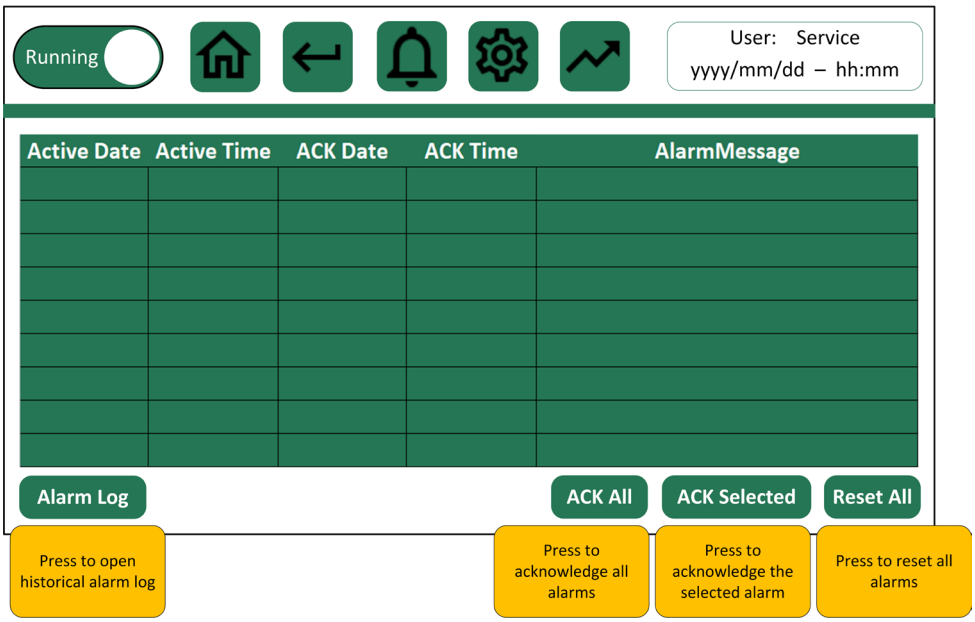


Figure 6.3: Alarm screen

6.8 Log & data export

NOTICE

IMO resolution MEPC.259(68) & 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 most relevant system data is logged and saved. It can be exported in an editable format to the SD card located in the PLC. The SD card can then be inserted into a PC and the files copied to a folder on the PC. The data can then be used or sent to Green Instruments on request.

Login and open the System Settings screen. Refer to Figure 5.2. Press the system settings button and then press the Export Data Log button and wait for the display message “Export Successful”.

Note: Always remember to reinsert the SD card in the PLC after you have copied the files to the PC.

6.9 Software update

1. Remember to note down the system serial number and system running hours prior to carrying out any updates.

2. Login and open the System Settings screen. Refer to Figure 5.2. Press the system settings button in the System Settings screen.

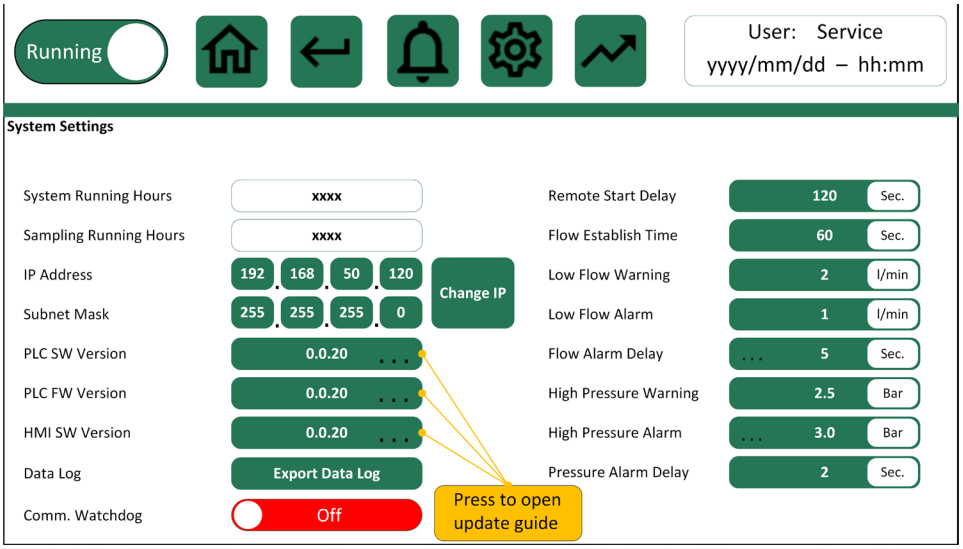


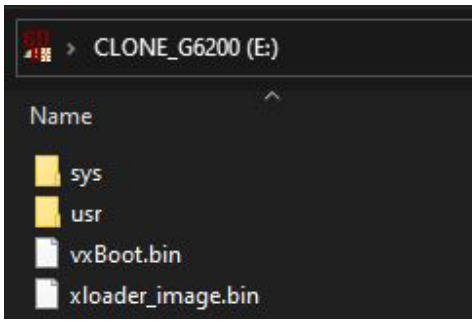
Figure 6.4: Software update

Note: Both PLC and HMI updates must be executed in the correct order to ensure that the system will function as intended. Updates must be executed in this order:

3. Software update files must be saved in a SD card and in a USB memory stick.

Updating PLC firmware and software

1. The files relevant for PLC updates must be transferred to a formatted SD-card that does not contain any other files. The SD-card name must be CLONE_G6200. This update package contains both FW and SW. The file structure should look like this:

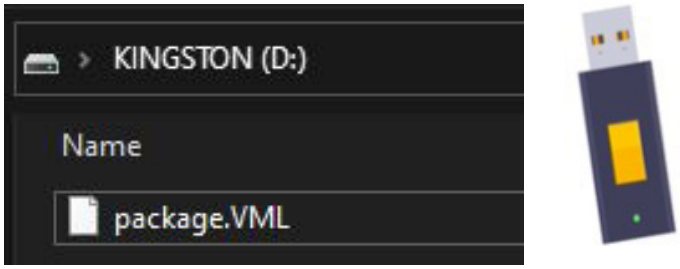


2. Remove the existing SD card from the SD slot in the PLC and store it while carrying out the software updates.
3. Press the three dots (...) on the green PLC FW button.
4. Follow the instructions on the HMI

PLC FW and SW updates are now completed.

Updating HMI software

1. Format a USB memory-stick.
2. Transfer the software files relevant for HMI updates onto the formatted USB memory stick that does not contain any other files. The file structure should look like this:



3. Remove the existing USB memory stick from the back of the HMI and store it while updating.
4. Press the three dots (...) on the green HMI SW button.
5. Follow the instructions on the HMI.
6. After successful update, remove the USB memory stick again.
7. Remember to reinsert the existing USB memory stick in the USB slot on the back of the HMI.

After two updates have been carried out, perform a power off/on cycle (power off for 10 seconds and power up again) and check that the versions on the system settings page have all been updated.

7. Validation & Calibration

7.1 Introduction

PH, Turbidity and PAH sensor modules can all be validated and calibrated using certified calibration standard liquids supplied by Green Instruments. The calibration kit includes all calibration materials necessary to perform a validation and/or calibration.

Validation is a normal part of WMS maintenance. Sensor validation must comply with the WMS planned maintenance program found in section 8.

Calibration will only be required if the sensor validation result deviates by a value that is greater than the accuracy stated for the given module in section 2.2. The system will notify the user of the result of the validation with either a “Validation Passed” or “Validation Failed” message.

If the validation is passed, the user can return the system to normal operation. If the validation fails, the user is required to perform a system calibration following the on-screen guides and this manual.

Before manually operating the sensors, set the system to “STOPPED” and “LOCAL” mode. This is done by moving the slider buttons as shown in Figure 7.1.

Once the system is in “STOPPED” and “LOCAL” mode, it is safe to operate and/or maintain the system.

ATTENTION

You must check and ensure that the web viewer is not activated and in use before performing validation/calibration procedures to avoid risk of unintentional disturbance during these procedures.

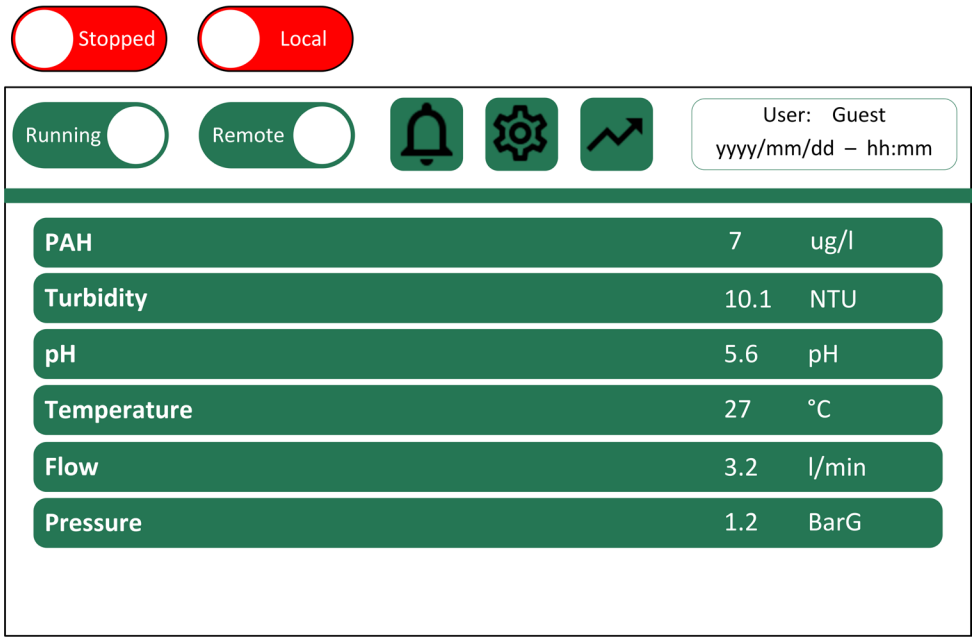


Figure 7.1: Main page

To perform a validation, press the settings button and login as a service user with level 2 access. Refer to section 4.1 or Figure 7.2 below to see how to log in as a service user.

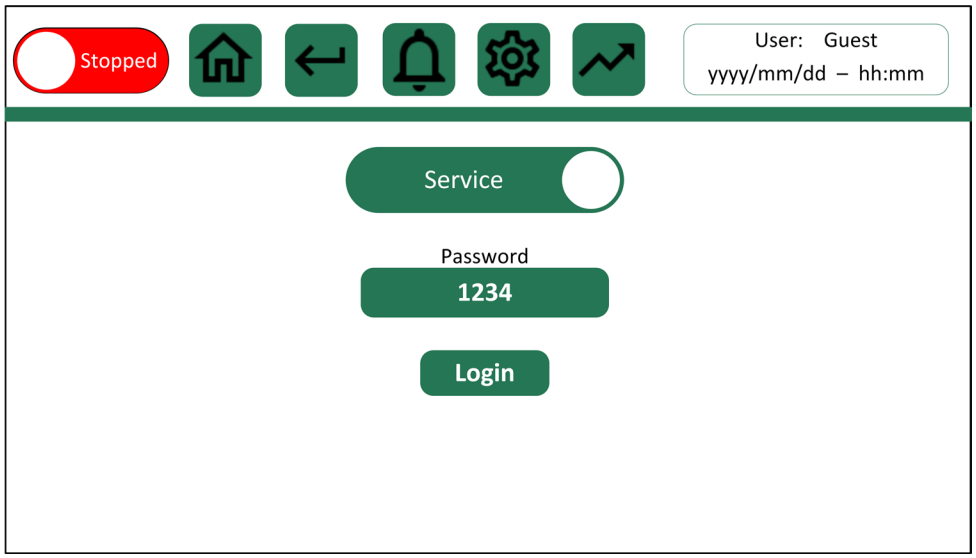


Figure 7.2: : Login screen

On logging in, the service user is shown the Settings screen. Here the user can select pH, Turbidity or PAH sensor and perform a validation, calibration, or change the moving average. The Flow, Pressure and Temperature sensors cannot be validated or calibrated but their moving average can be changed.

7.2 pH Validation & calibration

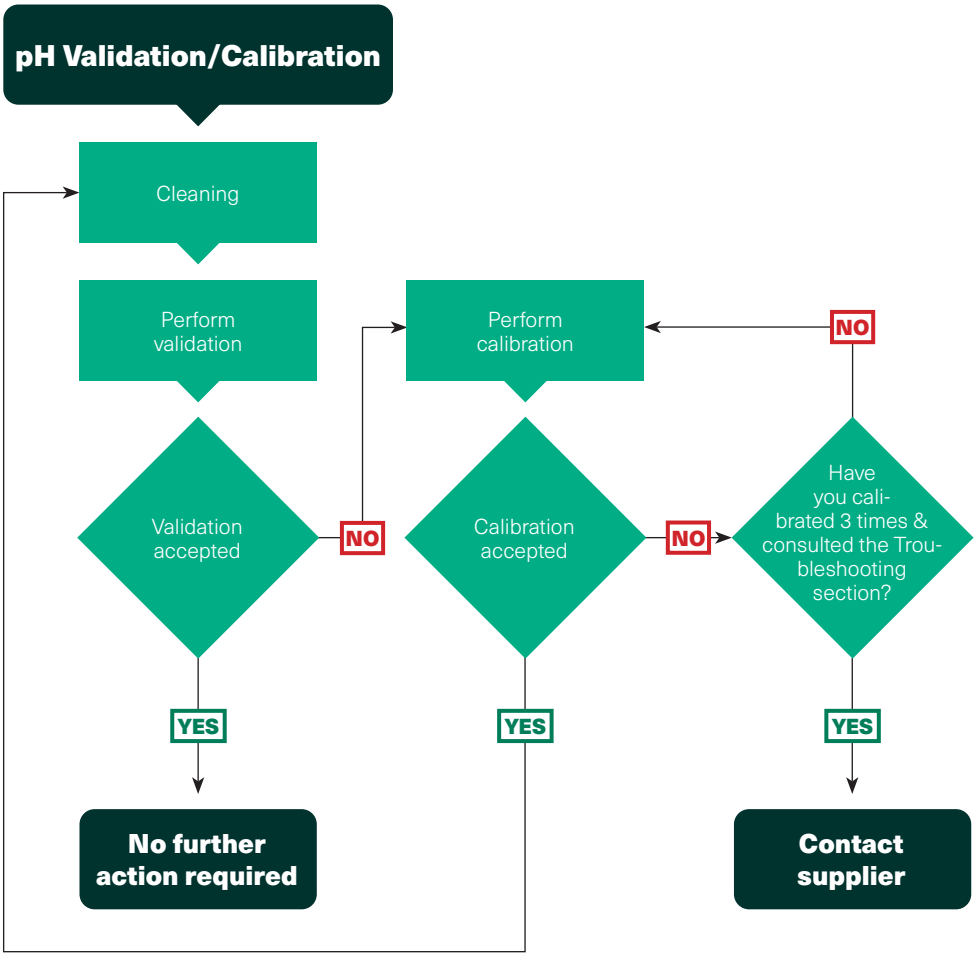


Figure 7.3: pH Validation/calibration procedure

Validations must be carried out in accordance with the planned maintenance program found in section 8 in this manual to ensure the correct performance of the pH sensor.

Calibration of the pH sensor is only required when the displayed validation value deviates more than ±0.2 pH units.

NOTICE

Validation procedure uses pH buffer 7.
Calibration procedure uses pH buffer 4, 7 & 10.

1. Select “Local” and “Stopped” on the HMI. Close the “Outlet” and “Inlet” valves. If the system is equipped with at motor valve, the valve will close when “stopped” is selected.

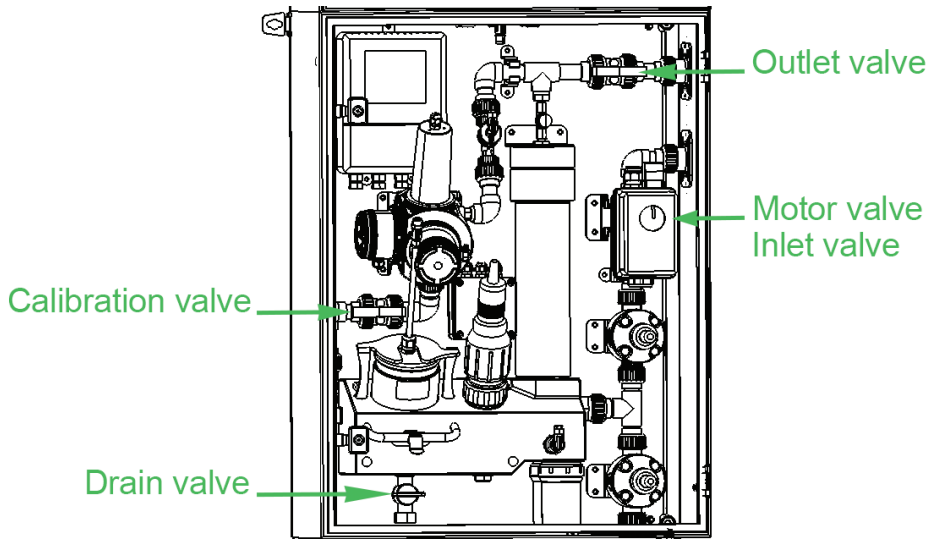


Figure 7.4: Valves

2. Open the “Drain” valve.
3. Find a clean cloth and pH buffer 7.
4. Loosen the pH sensor union nut by hand and remove the sensor from its measuring chamber.
5. **Clean** the electrode and check if the measuring chamber needs cleaning. Note that the chamber is designed to retain water to keep the tip of the electrode moist. This means there will be a small amount of water present. This is normal and the service user must remember to ensure that it is filled with water again after calibration.
6. Go to “Settings” menu. Login. Select “G6130 pH” and Select “Validation”.

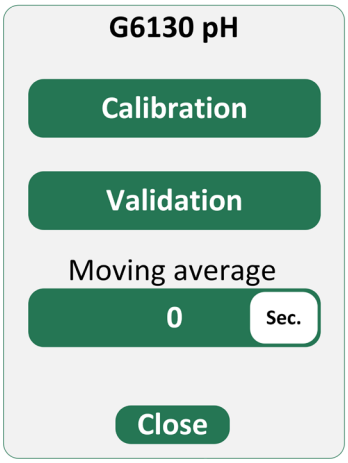


Figure 7.5: G6130 pH pop-up menu

7. Follow the instruction on screen using buffer 7 or follow steps 8-12 below.

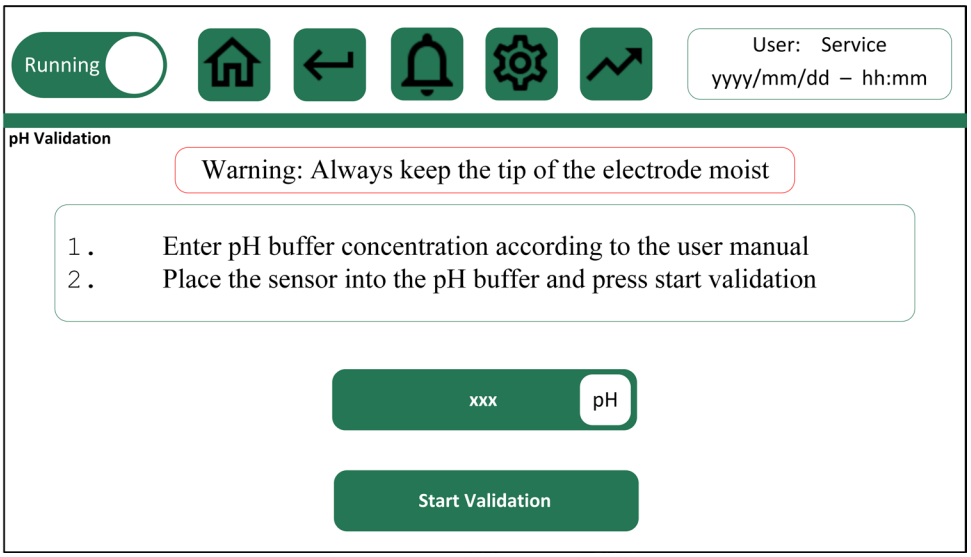


Figure 7.6: G6130 pH validation menu

8. **Validation procedure:** Make sure the rotary switch on the sensor is set to position “M” and that the pH buffer and sensor has the same temperature. Open a bag of pH buffer 7. Place the sensor into the pH buffer. Stir the sensor electrode tip around in the bag and wait a few seconds for a stable reading. Make sure there is enough pH buffer to cover the tip of the sensor electrode. Enter “7” in pH field above the “Start Validation” button, and press the “Start Validation” button.

9. Wait for the display to update the validation result. If the validation is successful, the screen will display a “Validation Passed” message and calibration will not be required. If the validation fails, the screen will display a “Validation Failed” message and calibration will be required. Refer to Figure 7.3.

10. Extract the electrode from the bag and wipe it dry with a clean cloth.

11. If the **validation** is successful, go to step 19.

12. If the **validation** fails, the sensor must be calibrated.

13. Go to “Settings” menu. Login. Select “G6130 pH”. Select “Calibration”. Follow the instruction on screen as shown in Figure 7.7, using buffer 4-7-10 or follow steps 13-21 below.

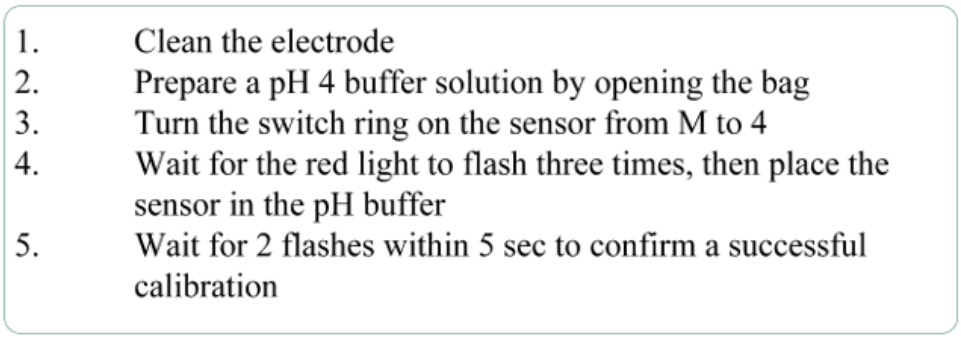


Figure 7.7: G6130 pH calibration

14. **Calibration procedure:** set the rotary switch ring from position M to the position that corresponds with the pH buffer number being used (i.e. 4, 7 or 10). Wait for the red light to flash **3 times**, then place the sensor electrode tip in the pH buffer.

15. Stir the sensor around and wait for a stable reading. Make sure there is enough pH buffer to cover the tip of the electrode.

16. The calibration may take several minutes to complete. When the calibration is successful, the red light will flash **2 times every 5 seconds**.

17. The calibration procedure is finished once calibration has been carried out for all three pH buffers.

18. Repeat the **validation procedure** (i.e. start again from step 8).

19. Ensure there is some water in the measuring chamber to keep the electrode tip moist. Top up if needed.

20. Re-insert the sensor in the measuring chamber and fasten the union.
21. Close “Drain” valve. Open “Inlet” valve and “Outlet” valve.
22. Return the system into normal operation mode: Select the slider to “Remote”.

Please refer to section 10.2 to verify that validation and calibration is valid and that the electrode does not need to be replaced.

7.3 Turbidity validation & calibration

Validation routines must follow the planned maintenance program found in section 8 in this manual to ensure the correct performance of the turbidity sensor.

Calibration of the turbidity sensor is only required when the displayed validation value deviates more than +/- 2 NTU.

Steps 1-12 and 30-32 describe the validation procedure for the turbidity module.

Steps 13-32 describe the procedure for local calibration of the Turbidity module.

1. Select “Local” and ”Stopped” on the HMI. Close “Outlet” and “Inlet” valves. Open the “Calibration” valve. See Figure 7.4.
2. Find a clean cloth, water for flushing, and turbidity standard liquids 0, 10, and 40 NTU.
3. Open the “Drain” valve.
4. Loosen the union nut on the top and remove the wiper unit.
5. Observe the fluid draining off. Flush the measuring chamber with water until it is free of all dirt and sand. Wipe the measuring chamber with the cloth.
6. Close the “Calibration” valve. Pour Standard 10.0 NTU into the chamber until the lenses are covered. DO NOT FILL COMPLETELY.
7. Refit the wiper unit loosely. Observe the displayed value on the Turbidity analyzer.
8. Go to “Settings” menu. Login. Select “G6120 Turbidity”. Select “Validation”.

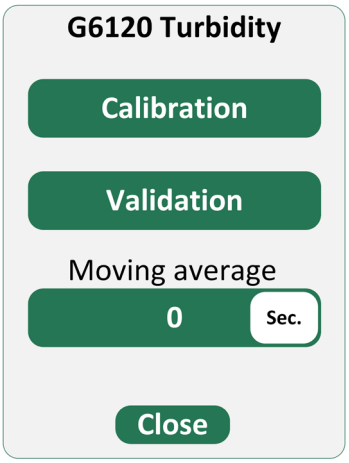


Figure 7.8: G6120 Turbidity pop-up menu

9. Follow the instruction on screen as shown in Figure 7.9 using standard 10 NTU or follow steps 10-12 below.

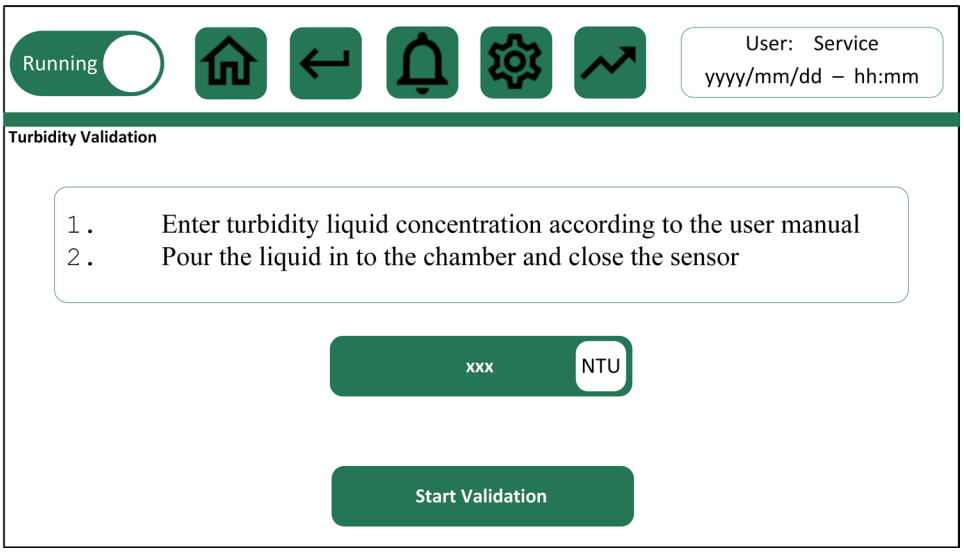


Figure 7.9: Turbidity validation

10. Enter the turbidity concentration used and press the “Start Validation” button.

11. Wait for the display to update the validation result. If the validation

is successful, a calibration is not required. When the validation is completed, go to step 30.

12. If the validation fails and the value has drifted more than +/- 2 NTU, a cleaning and/or a calibration is needed.

13. Before continuing, open the “Calibration” valve. Wait for the liquid to exit through the drain valve and then flush with clean water. Close the “Calibration” valve. Dry the measuring chamber to remove excess water.

14. **For Calibration:** Go to the “Settings” menu. Login. Select “G6120 Turbidity”. Select “Calibration”. Follow the instruction on the screen or follow steps 14-32

15. Make sure that the measuring chamber is clean. Pour standard 0.0 NTU into the chamber until the lenses are covered. Refit the wiper unit. DO NOT FILL COMPLETELY.

16. On the Turbidity Analyzer: Press ↳ and then press ↵ twice.

17. Press ↵ to select Formazine STD.

18. Press ↵ to begin Zero Calibration – observe “Calibrating Zero”.

Note: Pressing the ↵ again will skip the zero calibration.

19. After approximately 1 minute, the text “Fill Span Sol.” indicates a successful zero calibration and the system is ready for Span calibration.

20. Loosen the union nut on the top – remove the wiper.

21. Open the “Calibration” valve. Wait for the liquid to exit through the drain valve. Flush with clean water. Close the calibration valve. Dry the measuring chamber to remove any excess water

22. Pour Standard 40 NTU into the chamber until the lenses are covered. DO NOT FILL COMPLETELY.

23. Refit the wiper unit loosely.

24. Use the ↑ and ↓ buttons to adjust the value to 40 NTU. Press the ↵ to confirm.

Note: Pressing the ↵ again will skip the span calibration.

25. After approximately 1 minute, the text “CAL. Complete” indicates a successful span calibration. Press ↳ until the turbidity value is displayed.

26. Loosen the union nut on the top – remove the wiper.

27. Open the “Calibration” valve. Wait for the solution to exit through the drain valve. Flush with clean water. Close the “Calibration” valve. Dry the measuring chamber to remove any excess water.
28. Validate the sensor again. Follow HMI. Pour Standard 10 NTU into the chamber until the lenses are covered. DO NOT FILL COMPLETELY.
29. Refit the wiper unit and tighten the union nut and observe a 10 NTU value on the display.
30. If the displayed value is within +/- 2 NTU, the calibration is successful. Otherwise refer to troubleshooting.
31. Drain the sensor & tighten the union nut by hand.
32. Close “Drain” valve. Open “Calibration” “Inlet” and “Outlet” valve.
33. Return system into normal operation mode: Set the slider to “Remote”.

7.4 PAH validation/calibration

Validation is a part of the normal maintenance of the PAH module and is used to ensure the PAH module is functioning correctly. Calibration is used to correct PAH reading offsets. Figure 7.9 is a flow chart showing the procedures that must be done to ensure the PAH module is functioning correctly.

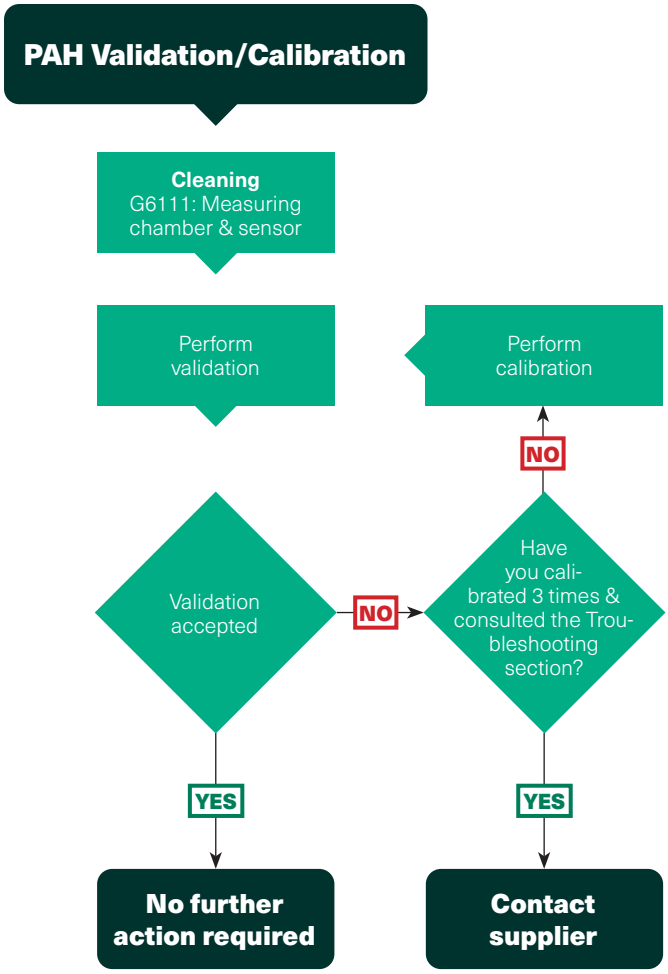


Figure 7.10: PAH Validation/calibration procedure

7.4.1 PAH validation methods

- PAH measuring chamber: Used for inline measurements
- PAH calibration chamber: Used for calibration and validation

NOTICE

The calibration kit includes a PAH calibration chamber.

Sensor performance in the measuring and calibration chamber can be double-checked by use of a test media, for example, bottled water.

Validation routines must follow the planned maintenance schedule found in section 8 in this manual to ensure the correct performance of the PAH sensor.

Calibration of the PAH sensor is only required when:

- The validation result deviates more than ±5% of the nominal standard test concentration, whose value is no less than 80% of the sensor range.

PAH validation tolerance µg/l		
Standard concentration	**Lower tolerance**	**Upper tolerance**
100	95	105
800	760	840

Table 7.1: Validation tolerance table

7.4.2 PAH sensor ranges

There are 3 different ranges available for PAH sensor:

- Low Range: 0-100 µg/l
- High Range: 0-800 µg/l
- Dual Range: 0-100/800 µg/l

NOTICE

In dual range mode, the PAH sensor will automatically choose the range required.

7.4.3 Before Validation/Calibration

PAH Sensor Check

1. Set the operation sliders to “Local” and “Stopped”. Close the “Outlet” and “Inlet” valves.
2. Open the “Drain” valve.
3. Find a clean cloth, water for flushing and calibration chamber, syringe, needle, and relevant PAH standards from the calibration kit.
4. Remove the locking plate and remove the PAH Sensor from its measuring chamber.
5. Ensure the optical windows are clean. This is vital, so please use a cloth free from oil when cleaning the optical windows.

NOTICE

It is vital to wipe the sensor dry prior to and between any validation & calibration attempt. Take care to wipe dry all crevasses and bolts while taking care not to touch and distribute the silicon grease on the O-rings.

Validation/calibration liquid selection

		Calibration liquid µg/l					Validation liquid µg/l	
		Low range calibration		High range calibration				
Module type		Low calibration	High calibration	Low calibration	Middle calibration	High calibration		
G6111	Low Range	0	100	-	-	-	100	-
G6111	High Range	-	-	0	400	800	-	800
G6111	Dual Range	0	100	-	400	800	100	800

Table 7.2: Validation/calibration liquid selection

PAH validation tolerance µg/l		
Standard concentration	**Lower tolerance**	**Upper tolerance**
100	95	105
800	760	840

Table 7.3: Validation tolerance table

NOTICE

Immerse the sensor into the calibration as quickly as possible after opening the ampoule to ensure the best performance and validity of the calibration liquid.

Do not leave the sensor in the PAH calibration liquid more than 15 seconds since UV light degrades the PAH calibration liquid. After approximately 15 seconds, the measurement value will be invalid due to the degradation of the calibration liquid.

7.4.4 PAH validation procedure

Figure 7.11: G6111 PAH sensor & PAH calibration chamber

1. Perform PAH sensor check as described in section 7.4.3
2. Go to “Settings” menu. Login. Select “G6111 PAH”. Select “Validation”

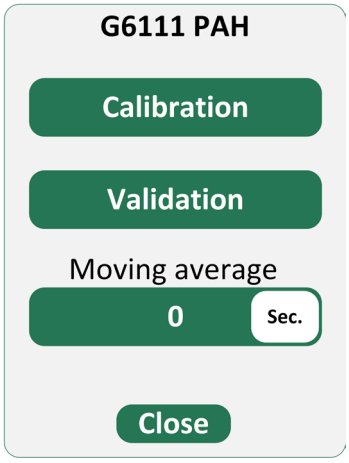


Figure 7.12: G6111 PAH pop-up menu

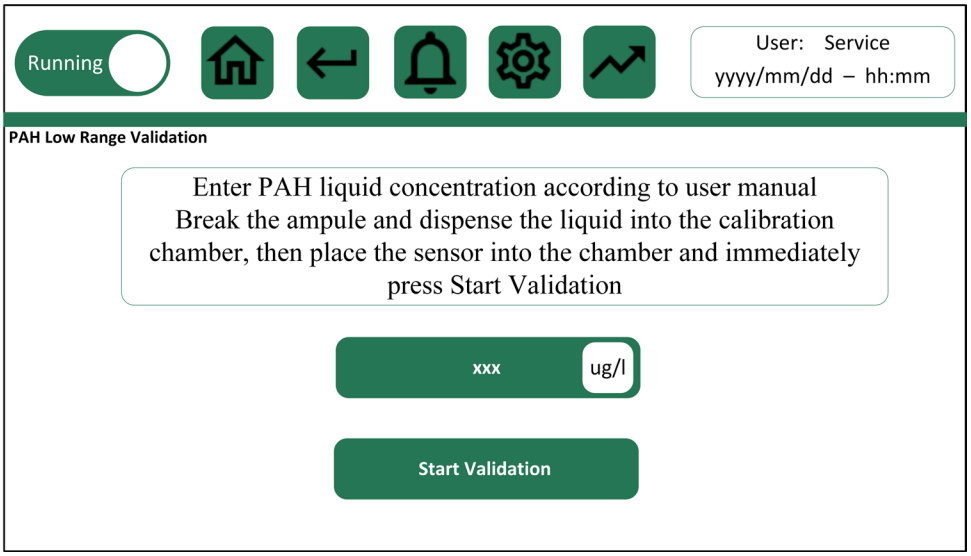


Figure 7.13: PAH validation

Enter PAH liquid concentration value based on the sensor range, please select the validation liquid in accordance with Table 7.1.

3. Take the syringe and attach the needle. Break the neck of the ampule. Fill the syringe with the entire content of the ampule. Work quickly once the ampule is opened as this will ensure the best results.

4. Inject the content of the syringe into the PAH calibration chamber. Ensure that no air is mixed with the validation liquid. Look into the chamber to check and remove any air bubbles with the tip of the syringe needle.

5. Place the cleaned PAH sensor in the calibration chamber in an upright position. Press the “Start Validation” button.

6. Wait for the display to update the validation result. If the validation is successful, a calibration is not required. If the validation fails, refer to Figure 7.9.

7. Drain the validation liquid from the calibration chamber and wipe the calibration chamber dry using a clean cloth. Clean the PAH sensor.

7.4.5 PAH calibration procedure

The Calibration is used to correct PAH reading offsets discovered after validation.

Storing a Calibration Point

Figure 7.14: G6111 PAH sensor & PAH calibration chamber

Perform PAH sensor check as described in section 7.4.3

Go to “Settings” menu. Login. Select “G6111 PAH”. Select “Calibration”. Follow the instructions on the screen or steps 1-9 below.

1. Enter the PAH liquid concentration value based on the sensor range, please select the calibration liquid in accordance with Table 7.1. Starting from the lowest concentration.

2. Take the syringe and attach the needle. Break the neck of the ampule – fill the syringe with the entire content of the ampule. Work quickly once the neck of the ampule is broken as this will ensure the best results.
3. Inject the content of the syring into the PAH calibration chamber. Ensure that no air is mixed with the calibration solution. Look into the chamber to check and remove any air bubbles using the tip of the needle.
4. Insert the cleaned PAH sensor in the calibration chamber in an upright position. Press the “Start Calibration” button.
5. Wait for the display to show “Calibration complete”.
6. Drain the Calibration liquid from the calibration chamber and wipe the calibration chamber dry with a clean cloth. Clean the PAH sensor.
7. Repeat steps 3-8 for additional calibration points in accordance with Table 7.1
8. After the PAH sensor has been successfully calibrated, perform a full validation check in accordance with section 7.4.4.
9. If the validation fails, refer to Figure 7.9.

8. Maintenance

8.1 Planned maintenance

NOTICE

The following maintenance program is for general use and must be adjusted in accordance with your specific system requirements and conditions.

The maintenance program is based on optimum conditions and compliance with the system specifications. Failure to comply with the system specifications can affect how often maintenance must be carried out on the system and its components.

Planned Maintenance Program

Description	As necessary	Weekly	Monthly	Quarterly	Every 6 months	Yearly	Every 2 years	Every 3 years	Every 4 years	Every 5 years	Maintenance Instruction Number
G6111 PAH sensor											
Visual check • PAH sensor • PAH measuring chamber		X									
Cleaning of PAH sensor and measuring chamber	X										
Validation of PAH sensor					X						
Calibration of PAH sensor	X										
PAH sensor replacement								X			
G6120 Turbidity sensor											
Validation of Turbidity sensor				X							
Calibration of Turbidity sensor	X										
Visual check • Measuring chamber		X									
Cleaning of Turbidity measuring chamber	X										

Planned Maintenance Program											
Description	As necessary	Weekly	Monthly	Quarterly	Every 6 months	Yearly	Every 2 years	Every 3 years	Every 4 years	Every 5 years	Maintenance Instruction Number
Turbidity wiper blade replacement	X										MI6200-0001
Turbidity light source replacement										X	MI6200-0002
Turbidity O-ring replacement	X										MI6200-0003
Turbidity wiper unit replacement	X										MI6200-0004
Turbidity analyser replacement	X										MI6200-0005
G6130 pH/Temp sensor											
Visual check • pH sensor • pH measuring chamber		X									
Cleaning of pH sensor & pH measuring chamber	X										
pH electrode replacement						X					MI6200-0007
pH replacement (without electrode)	X										MI6200-0013
Validation of pH sensor				X							
Calibration of pH sensor	X										
Pressure reduction valve & safety valve											
Pressure reduction valve function test					X						MI6200-0009
Replacement	X										MI6200-0008
Safety valve function test					X						MI6200-0010
Strainer											
Visual check		X									
Cleaning	X										

Figure 8.1: Planned maintenance program for the WMS

8.2 General inspection & cleaning routines

Make sure that the sensors and measuring chambers are clean. Follow the planned maintenance program.

If a sensor measurement is static or seems unrealistic, or if its response time is slow, then the sensor and measuring chamber may need to be cleaned.

Any spilled water or water that has leaked onto surfaces must be wiped up immediately. The source of the leak must be found, and the leak repaired.

Sensor readings must also be validated. Follow the planned maintenance program.

The strainers must be inspected and cleaned. We recommend that the strainers are checked every week or more frequently. Make sure to integrate the checking of strainers in the planned maintenance program that has been adapted to suit your system requirements and conditions.

8.2.1 PAH

NOTICE

Exercise caution when cleaning to avoid damaging optical windows.

The PAH sensor is generally kept clean by the flow of water in the measuring chamber. If manual cleaning is needed, use water, soap, and a clean cloth to clean both the sensor and measuring chamber.

8.2.2 Turbidity

NOTICE

Exercise caution when cleaning to avoid damaging optical windows.

The turbidity sensor is equipped with a wiper unit that removes fouling from the optical parts. The flow of water through the chamber removes most

solids and keeps them from settling. To clean the sensor manually, close the inlet and outlet valve, remove the wiper unit and clean the sensor inside using water, soap and a cloth. Flush away any deposits by opening the drain valve and pour clean water into the turbidity measuring chamber. Close drain valve again and open inlet and outlet valve.

8.2.3 pH

NOTICE

Exercise caution when cleaning to avoid damaging the glass tip of the pH electrode and to always keep it moist during cleaning.

The pH electrode is generally kept clean by the flow of water in the measuring chamber. If manual cleaning is needed, use water, soap, and a clean cloth to clean both the sensor and measuring chamber. There is a drain plug positioned in the bottom of the pH chamber and this can be used to flush out sediments.

Flush away any sediments by removing the drain plug and pouring in clean water. After flushing is completed, reinstall the drain plug securely and then pour the pH chamber half full of water prior to mounting the sensor to ensure that the tip of the electrode is kept moist.

8.3 Lifetime of components

8.3.1 PAH

The lifetime of the PAH sensor is mainly determined by the internal light source. Before each sensor leaves the factory, the remaining lifetime of the light source is determined. This is to ensure the functionality of the sensor until the next service. The sensor should be replaced every three years. Contact the manufacturer two months in advance of the 3-year replacement due date to arrange the sensor's replacement. A calibration certificate will be issued accordingly, covering the next period.

For further inquiry – please contact Green Instruments A/S.

8.3.2 Turbidity

The lifetime of the turbidity sensor is mainly determined by the light source. The light source has a lifetime of approximately 5 years.

The lifetime of the wiper blades depends on the water quality. Wiper blades must be replaced as necessary.

8.3.3 pH

The lifetime of the pH sensor is mainly determined by the lifetime of the electrode. The electrode has a shelf life of 1 year at 25 °C and has an operating lifetime of approximately 1 year at 25 °C. Storage or operation at higher temperatures or pressures will shorten the lifetime of the sensor. Pollution in the media that is being measured will also shorten the lifetime of the sensor.

9. Services

Upon request, our service engineers can perform several tasks on-board, including a full system calibration and advanced troubleshooting.

Our service engineers have in-depth system knowledge of our product and of installation and operation correction.

Contact Green Instruments service department by e-mail at

service@greeninstruments.com

9.1 Remote connectivity

Using a secure and encrypted remote link, our skilled technicians can directly access the heart of the installed system and can perform advanced diagnostics and fast troubleshooting. Contact Green Instruments for more information.

9.2 PAH services

Contact the manufacturer's spare parts department two months in advance of the PAH sensor's 3-year replacement due date to schedule its replacement.

Prior to delivery, a full calibration will be carried out by the manufacturer to comply with the requirement(s) of the regulatory agencies. A calibration certificate will be issued accordingly, covering the next period of 26,280 hours of operation (3 years of operation) or 4 years from factory calibration date whichever comes first. This is to provide customers with 1-year shelf life. An LED warning will be activated approximately 3 months in advance of the 3-year sensor replacement due date.

If the sensor's calibration date has expired the validity of the sensor will be compromised, resulting in the non-compliance of the sensor and the system will require a new sensor.

ATTENTION

Faulty sensor hazard

Failure to comply with the service due date can affect the accuracy, performance, and functionality of the sensor, resulting in failure to comply with the requirement(s) of the regulatory agencies.

9.3 Turbidity

The Turbidity Module does not require factory calibration. However, upon

request, our service engineers can perform a full calibration at our factory or on-board the vessel. A new calibration certificate will be issued.

Contact Green Instruments A/S for more information.

9.4 pH

The pH module does not require factory calibration. However, upon request, our service engineers can perform a full calibration at our factory or on-board the vessel. A new calibration certificate will be issued.

Contact Green Instruments A/S for further information.

9.5 Return of equipment

Return of equipment must be coordinated with manufacturer. You will receive a “Return form”.

Use a secure transport container that is suitable for the equipment that is being returned. All returned equipment must be free of any hazardous substances (acids, alkalis, solvents, etc.). Therefore, it is important to carefully clean the equipment prior to returning.

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

IMPORTANT: Fill out the “Return form” prior to returning the equipment. Return this form along with the equipment to be returned

10. Troubleshooting

For troubleshooting of the system, please refer to the PI diagram of each system.

Troubleshooting should always be carried out by skilled personnel.

WARNING/ATTENTION

Electrocution hazard

The water monitoring system is connected to hazardous electric voltages, which can cause personal injury or mechanical damage if not handled correctly and in accordance with normal safety regulations.

10.1 General troubleshooting

Trouble	Possible Cause	Action
Electrical		
Display is dead	Circuit breaker	Check the circuit breaker
	Power supply	Check power supply – the power supply needs to be at correct voltage
		Check the electrical wiring
Display screen shows nothing despite power supply and circuit breaker are OK	Display is defective	Replace the display
Communication error		
The system cannot find the HMI.	Faulty ethernet port	Check communication cable to HMI
	Faulty ethernet cable	Replace the HMI or PLC
pH module		

Trouble	Possible Cause	Action
Incorrect indication of pH value		Try to clean the sensor and chamber manually
		Try to validate the pH sensor
		Change the pH electrode
Turbidity module		
Incorrect indication of Turbidity value	Dirty sensor window or chamber	Try to clean the sensor optical windows and chamber manually
	Faulty wiring	Check the wiring from the Turbidity sensor to the Turbidity analyser.
	Faulty light source	Try to validate the Turbidity sensor
	Faulty wiper unit	Replace the light source: follow the maintenance instruction
		Check the wiper unit is not shorted, disconnect it from the junction box
There is no turbidity measurement on the display		Replace the Turbidity analyser or the sensor
PAH module		
Incorrect indication of PAH value	Dirty sensor window or chamber out of calibration	Check/clean the sensor and chamber thoroughly
	Calibration solution out of date	Check expiration date of PAH sensor certificate.
	Calibration solution incorrect storage temperature	Check/remove bubbles in calibration liquid
	Calibration procedure not followed correctly	Check calibration solution expiration date and temperature. Ensure these have not been too cold or hot during storage

Trouble	Possible Cause	Action
		Validate the PAH sensor – refer to section 7.4 (Figure 7.9)
Flow alarm		
Flow alarm	Blocked flow path	Clean strainer, open valves if semi-closed, check pipework is not blocked
	Check and adjust the flow regulating valve.	Check the pressure reduction valve. Clean if necessary
	Flow alarm set-point adjusted	Check the flow sensor. Clean it if necessary
		Check flow alarm set-point
	Air in system	Evacuate air by disconnecting the relevant pipework
Wrong readings		
Fluctuations of readings	Air bubbles	Check the sampling line
		Visual check that the de-bubbler is functioning. Open the needle valve more if the debubbler is not working. Check needle valve for blockage
No data log		
No data log **No historical trend curve**	Timing	Wait for the system to generate the trend curves
	Incorrectly inserted or missing SD card	Check to ensure that the SD card is inserted correctly
	Defective SD card	If yes, check the SD card's lock mode
		Replace the SD card if it is defect

10.2 PH/Temperature

Resetting Calibration Offset

The pH sensor and pH electrode must be calibrated together to ensure correct functionality. Calibration data is stored within the pH sensor while the pH electrode acts as the sensing element.

During a calibration, the calibration data within the sensor is updated/ overwritten in order to compensate for the deterioration of the pH electrode. If a defective pH electrode has been replaced by a new pH electrode, then the calibration data must be overwritten. However, the field calibration data stored in the sensor will not match the new pH electrode – resulting in the new electrode recording measurements that are offset compared to expectations.

If the offset is too large, the pH sensor will not accept the field calibration data as valid (Error code indicator: The red LED on the PH sensor will flash every second). In order to remove the calibration offset, an intermediate buffer solution must be mixed – refer to example 1 + 2 in the following tables:

Example 1: pH negative offset – reading too low

Step	Description	Buffer solution	Observed pH	Calibration data	Conclusion
Step 1	Initial test	7.0	6.5	Not accepted	Offset too large
Step 2	Reduce offset by mixing buffers	(90% buffer 7.0 + 10% buffer 10) = buffer 7.3	Before calibration: 6.8 After calibration: 7.0	Accepted. Red LED will flash 3 times	Offset reduced. Reading is 7.0 but real value should be 6.8
Step 3	Normal calibration (1 of 3)	7.0	6.7 Before calibration: 7.2 After calibration: 7.0	Accepted. Red LED will flash 3 times	Calibration success. Offset removed
Step 4	Normal calibration (2 of 3)	4.0	4.0	Accepted. Red LED will flash 3 times	Calibration success
Step 5	Normal calibration (3 of 3)	10.0	10.1	Accepted. Red LED will flash 3 times	Calibration success

Figure 10.1: pH negative offset - reading too low

Example 2: pH positive offset – reading too high

Step	Description	Buffer solution	Observed pH	Calibration data	Conclusion
Step 1	Initial test	7.0	7.5	Not accepted	Offset too large
Step 2	Reduce offset by mixing buffers	(90% buffer 7.0 + 10% buffer 4) = buffer 6.7	Before calibration: 7.2 After calibration: 7.0	Accepted. Red LED will flash 3 times	Offset reduced. Reading is 7.0 but real value should be 7.2
Step 3	Normal calibration (1 of 3)	7.0	7.3 Before calibration: 6.8 After calibration: 7.0	Accepted Red LED will flash 3 times	Calibration success Offset removed
Step 4	Normal calibration (2 of 3)	4.0	4.0	Accepted Red LED will flash 3 times	Calibration success
Step 4	Normal calibration (3 of 3)	10.0	10.0	Accepted Red LED will flash 3 times	Calibration success

Figure 10.2: pH positive offset – reading too high

Note: Use the measurement from the pH sensor when mixing the buffer solutions.

Signs of a defective electrode

The following signs indicate an electrode is reaching the end of its lifetime. The electrode must be replaced whenever one of the following signs are observed:

- The pH/Temperature sensor is difficult to calibrate. Storing a calibration point should take max. 180 seconds. The electrode must be replaced if a longer time is required.
- The pH/Temperature sensor was calibrated successfully, but the output drifts within 15 minutes after the calibration. To test drift, immerse the sensor in e.g. clean tap water – note the initial displayed pH value – leave the sensor in the water for 15 minutes - then note the displayed value after 15 minutes.

Calculate drift:
Drift = “Initial value” ÷ “15-minute value”
Max drift allowed is +/- 0.2 pH units

- The pH/Temperature sensor gives a fixed output of around pH 7.
- The pH/Temperature sensor gives no output.
- The glass tip of the electrode is damaged.
- Water has entered the electrical connection of the electrode.
- If the pH sensor flashes every second, the calibration is not accepted.

The electrode can easily be changed. To change the electrode, follow the maintenance instruction MI6100-0007.

NOTE

It is recommended that an electrode is kept in stock as a spare part.

11. System hibernation

NOTICE

It is recommended that the following spare parts are kept in stock for when the system is used again following a long period of inactivity:

- Calibration liquids
- pH electrode•
- Essential pump spare parts

If the system is inactive for at least 30 days, carry out the following procedure:

- Isolate the system by shutting off the inlet and outlet valves.
- Set power to OFF by turning the main switch on the outside of the cabinet to position “O”.
- Clean the strainers

Preparing the WMS for use again:

- Open the inlet and outlet valves.
- Set power to ON by turning the main switch on the outside of the cabinet to position “I”.

Start the WMS while observing its function and adjust the operating pressure.

12. Maintenance instructions

System type	Water monitoring system	MI6200-0001
Task:	Turbidity wiper blade replacement	
Task description:	This instruction describes how to replace it. The Wiper blade may only be replaced by a skilled technician.	

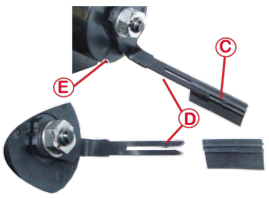
Difficulty 1-5	Overhaul interval	Estimated time consumption
	As necessary	5 min.

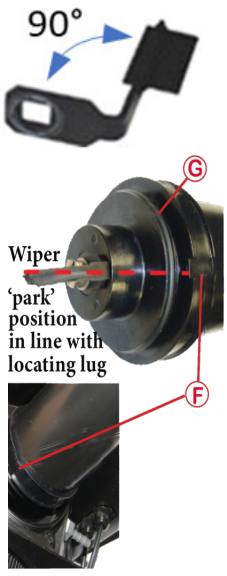
Spare Parts		Tools
Part no:	**Description:**	**Item:**
02386	Wiper blade spare part set of 4pcs	None

Procedure

1. Turn OFF WMS by switching the MAIN SWITCH on the right side of cabinet to “O” position.
2. Close the INLET VALVE and OUTLET VALVE. **Note:** In case of motor valve, turn the handle on the bottom of the motor valve to enable manual open/close the valve.
3. Open the DRAIN VALVE.
4. Loosen the wiper unit and observe the water draining out of the cabinet.
5. Pull the wiper blade (C) out of slot (D) in the wiper arm (E) and dispose of the wiper blade.
6. Ensure that the wiper arm is undamaged & at a 90^0 angle to the bottom surface of the wiper unit. Ensure that slot (D) is straight and parallel.
7. Taking care not to damage the new wiper blade, slide it into the wiper arm slot (D), ensuring the blade edge faces outwards.
8. Turn ON the WMS by switching the MAIN SWITCH to "I" position.
9. Observe the wiper arm (E) rotating and stopping at the cut-out position(F).
10. Ensure that the O-ring (G) is undamaged and positioned correctly.
11. Refit the wiper unit (B) making sure that it is orientated at the cut-out position (F) and tighten the black union (A) by hand.
12. Close the DRAIN VALVE. Open the INLET VALVE and OUTLET VALVE.

Photos:





System type	Water monitoring system	MI6200-0002
Task:	Turbidity light source replacement	
Task description:	This instruction describes how to replace it. The Turbidity sensor light source may only be replaced by a skilled technician.	

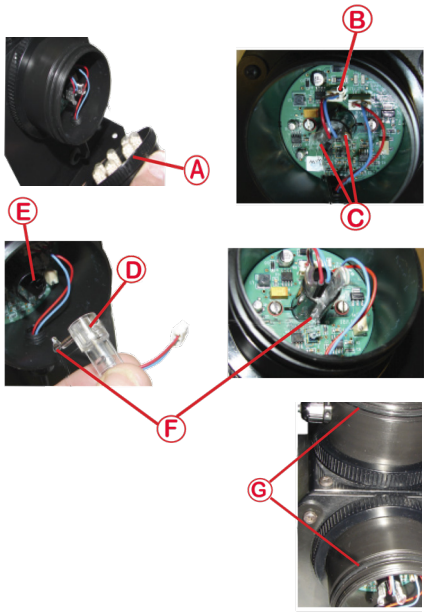
Difficulty 1-5	Overhaul interval	Estimated time consumption
🔧	Every 5 years	10 min.

Spare Parts		Tools
Part no:	**Description:**	**Item:**
02385	Light source	None

Procedure

1. Turn OFF the WMS by switching the MAIN SWITCH on the right side of cabinet to “O” position.
2. Unscrew the black end cover on the emitter (A).
3. Disconnect the emitter light source connector (B) from receptacle J2 on the print.
4. Gently squeeze the retaining tabs (C) together and pull to withdraw the light source (D) from its housing (E).
5. Carefully remove the replacement light source from its packaging – be careful not to touch the light bulb itself.
6. Insert replacement light source (D) into the housing (E). Ensure the tab on the light source (F) enters the slot in the housing. Press until the light source clicks into place.
7. Connect the light source connector (B) to receptacle J2 on the print – make sure the connector tap is orientated correctly.
8. Ensure that the end cap O-rings (G) are undamaged and in correct position.
9. Refit end caps on emitter and receiver.
10. Now a calibration procedure must be performed – please follow the calibration instructions in this user manual.

Photos:

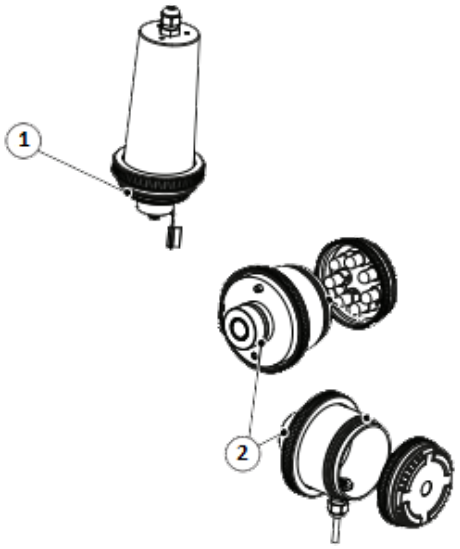


System type	Water monitoring system	MI6200-0003
Task:	Turbidity O-ring replacement	
Task description:	This instruction describes how to replace Turbidity O-rings. O-rings may only be replaced by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
🔧	As necessary	10 min.
Spare Parts	**Tools**	
Part no:	**Description:**	**Item:**
02387	Turbidity O-ring set	None

Procedure

1. Turn OFF the WMS by switching the MAIN SWITCH on the right side of cabinet to “O” position.
2. Close the INLET VALVE and OUTLET VALVE. **Note:** In case of motor valve, turn the handle on the bottom of the motor valve to enable manual open/close the valve.
3. Open the DRAIN VALVE.
4. Loosen the wiper unit and observe the water draining out of the cabinet.
5. Unscrew the Emitter and Receiver.
6. Replace the O-rings shown in the image.
7. Reassemble the Wiper unit, Emitter and Receiver.
8. Turn ON the WMS by switching the MAIN SWITCH to "I" position.
9. Close the DRAIN VALVE.
10. Open the INLET VALVE and OUTLET VALVE.

Photos



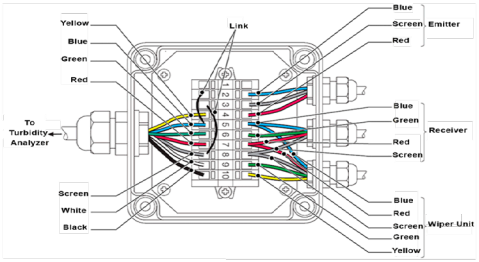
System type	Water monitoring system	MI6200-0004
Task:	Turbidity wiper unit replacement	
Task description:	This instruction describes how to replace the Turbidity wiper unit. The Turbidity wiper unit may only be replaced by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
🔧	As necessary	15 min.
Spare Parts	**Tools**	
Part no:	**Description:**	**Item:**
02805	Turbidity wiper unit	Small size flat headed screwdriver
		Medium size flat headed screwdriver
		2 x 8mm spanners

Procedure

1. Turn OFF the WMS by switching the MAIN SWITCH on the right side of cabinet to “O” position.
2. Close the INLET VALVE and OUTLET VALVE. **Note:** In case of motor valve, turn the handle on the bottom of the motor valve to enable manual open/close the valve.
3. Open the DRAIN VALVE.
4. Loosen the wiper unit and observe the water draining out of the cabinet.
5. Remove the top cover of the black junction box.
6. Disconnect the wires and take the cable out.
7. Remove the Wiper unit.
8. Install the new Wiper unit (remember to install the Wiper unit nut prior to installing the cable).
9. Ensure the wires are connected correctly and refit the top cover on the junction box.
10. Turn ON the turbidity sensor by switching the MAIN SWITCH to "I" position.
11. Close the DRAIN VALVE. Open the INLET VALVE and OUTLET VALVE.

Photos

Wiper unit electrical connections

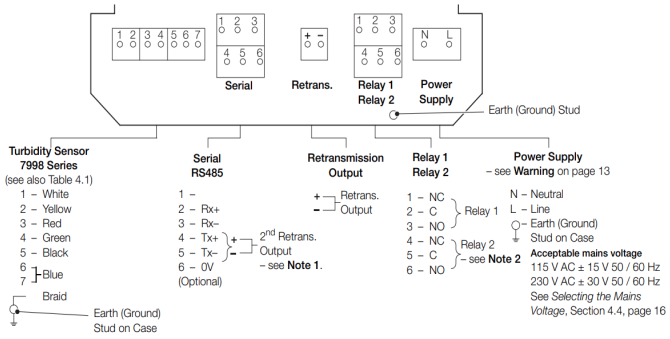


System type	Water monitoring system	MI6200-0005
Task:	Turbidity analyser replacement	
Task description:	This instruction describes how to replace the Turbidity analyser. The Turbidity analyser may only be replaced by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
🔧 🔧	As necessary	30 min.
Spare Parts	**Tools**	
Part no:	**Description:**	**Item:**
02342	Turbidity analyser	Small size flat headed screwdriver
		1 x Allen key
		2 x 19mm spanners

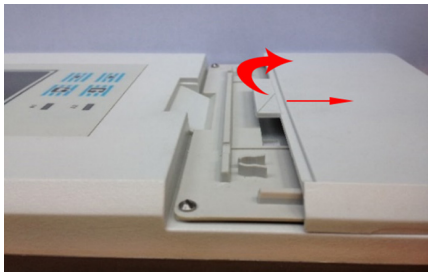
Procedure

1. Turn OFF the WMS by switching the MAIN SWITCH on the right side of cabinet to "O" position.
2. Remove front cover on Turbidity analyser.
3. Remove the plate under the front cover.
4. Disconnect all wires and take the cables out. (**Note**: Take photos or notes on exactly how the existing analyser is wired. This will make it easy to install the replacement analyser.)
5. Unmount the Turbidity analyser from the backplate.
6. Mount the new Turbidity analyser.
7. Re-insert the cables in and connect the wires in the same way configuration as before or in accordance with the wiring illustration shown below.
8. Mount the plate and front cover again.
9. Turn ON the turbidity sensor by switching the MAIN SWITCH to "I" position.

After the new Turbidity analyser has been installed, the Turbidity sensor must be calibrated. Follow the calibrations instructions in the user manual.



Photos

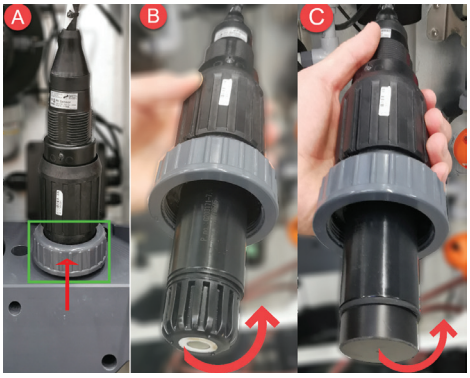


System type	Water monitoring system	MI6200-0007
Task:	pH electrode replacement	
Task description:	This instruction describes how to replace it. The pH electrode replacement may only be replaced by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
	Yearly	10 min.
Spare Parts	**Tools**	
Part no:	**Description:**	**Item:**
02389	Electrode for pH sensor	

Procedure

1. Turn OFF the WMS by switching the MAIN SWITCH on the right side of cabinet to “O” position.
2. Close the INLET VALVE and OUTLET VALVE. **Note**: In case of motor valve, turn the handle on the bottom of the motor valve to enable manual open/close the valve.
3. Open the DRAIN VALVE.
4. Loosen the pH sensor and observe the water draining out of the cabinet.
5. Fully unscrew the grey nut on the pH sensor and pull up the sensor from the measuring chamber (A).
6. **6A**. For systems in operation: Unscrew the old pH electrode by turning it counter-clockwise. (B) **6B**. For systems in commissioning: Unscrew the shipping plug by turning it counter-clockwise (C).
7. ATTENTION: The new electrode must always be kept moist. If the electrode dries out, it will not work properly (D) (E).
8. Before fitting the new pH electrode to the sensor, remove any tape or other packing material without removing the protective cap. (E) Also clean the mating surface on the pH sensor and inspect to ensure that no water has entered the electrical connection.
9. Fit the new pH electrode to the pH sensor.
10. Before reinstalling the pH sensor, ensure that the measuring chamber is half-filled with water.
11. Remove the protective cap just prior to reinstalling the pH sensor in the measuring chamber (F).
12. Turn ON the WMS by switching the MAIN SWITCH to ON.
13. The pH sensor must now be calibrated – follow the calibration instructions in the operation manual.
14. After calibration, close the DRAIN VALVE. Open the INLET VALVE and OUTLET VALVE.

Photos



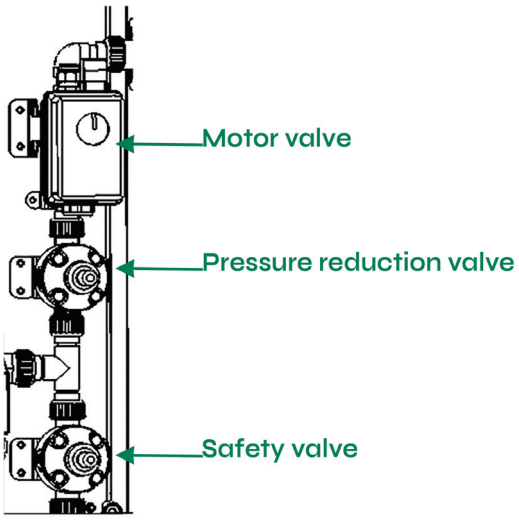
System type	Water monitoring system	MI6200-0008
Task:	Pressure reduction valve & safety valve replacement	
Task description:	This instruction identifies the location of the safety valve & the pressure reduction valve and describes how to replace them. The safety valve and pressure reduction valve may only be replaced by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
🔧	As necessary	10 min.

Spare Parts	Tools	
Part no:	**Description:**	**Item:**
02703	Pressure reduction valve	1 x 5mm Allen Key
02687	Safety valve	

Procedure

1. Turn OFF the WMS by turning the MAIN SWITCH on the right side of cabinet to "O" position.
2. Close the INLET VALVE and OUTLET VALVE. **Note**: In case of motor valve, turn the handle on the bottom of the motor valve to enable manual open/close the valve.
3. Open the DRAIN VALVE.
4. Loosen the pH sensor and observe the water draining out of the cabinet. Tighten the pH sensor after draining is complete.
5. Unscrew all the fittings connecting the valve(s) to the system (A).
6. Unscrew all the bolts holding the valve(s) in place (A).
7. Remove the old valve(s) and replace with the new valve(s) of the same type. Observe arrow indicating flow direction.
8. Reassemble in reverse order.
9. Adjust the new valve(s) to the correct pressure. See MI6200-0009 and MI6200-0010.

Photos



System type	Water monitoring system	MI6200-0009
Task:	Pressure reduction valve function test	
Task description:	This instruction describes how to test the pressure reduction valve. The test may only be carried out by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
🔧	Every 6 months	2 min.
Spare Parts	**Tools**	
Part no:	**Description:**	**Item:**
02703	Pressure reduction valve	1 x 13mm Spanner

Procedure

1. Start sampling and ensure water is running through the system.
2. Remove protective black plastic cap.
3. Unscrew locking nut.
4. ⚠ WARNING: Do not exceed the pressure rating of the system found in the system specifications section 2.2.
5. The function test is done by adjusting the system pressure up and down. Turning the adjustment screw counter-clockwise to lower the pressure and clockwise to increase the pressure.
6. When the test is done, the pressure should be adjusted so that the flow through the system is between 2 and 10 l/minute.

If the valve is not working properly, the valve must be replaced.

Photos

System type	Water monitoring system	MI6200-0010
Task:	Safety valve function test	
Task description:	This instruction describes how to test the safety valve. The safety valve may only be tested by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
🔧	Every 6 months	2 min.
Spare Parts	**Tools**	
Part no:	**Description:**	**Item:**
02687	Safety valve	1 x 13 mm spanner

Procedure

ATTENTION:

3.0 bar is the safety limit of the system!

Pressures above the safety limit could result in system damage.

1. Disconnect any connections from the outlet side on the safety valve so water coming out from the valve is visible.
2. Slowly increase the system pressure to 2.0 bar by closing the systems manual outlet valve.
   If installed, turn the adjustment screw clockwise on the pressure reduction valve.
   If adjusted correctly, the safety valve should start to open at 2.0 bar +/- 0.2 bar.
   If safety the valve does not start opening at 2.0 bar +/- 0.2 bar, re-adjust the safety valve until it opens at 2.0 bar +/- 0.2 bar.
3. Gradually increase the system pressure to 3.0 bar while observing increasing amounts of water coming out from the valve.
4. If the description in step 3 is not observed, the safety valve must be replaced.
5. Fully open the system outlet valve and if installed, adjust the pressure reduction valve so that the system flow is between 2 and 10 l/minute.

Photos

System type	Water monitoring system	MI6200-0013
Task:	pH Sensor Replacement	
Task description:	This instruction describes how to replace the pH sensor. The pH sensor may only be replaced by a skilled technician.	
Difficulty 1-5	**Overhaul interval**	**Estimated time consumption**
🔧	As necessary	5 min.

Spare Parts	Tools	
Part no:	**Description:**	**Item:**
02344	pH sensor without electrode	Small flat headed screwdriver
		17-19 mm spanner

Procedure

1. Turn OFF the WMS by turning the MAIN SWITCH on the right side of cabinet to “O” position.
2. Close the INLET VALVE and OUTLET VALVE. Note: In case of motor valve, turn the handle on the bottom of the motor valve to enable manual open/close the valve.
3. Open the DRAIN VALVE.
4. Loosen the pH sensor and observe the water draining out of the cabinet.
5. Uninstall the old pH sensor using a small flat headed screwdriver to disconnect the pH sensor wiring inside the monitoring unit. Use the 17–19 mm spanner to loosen the cable gland, then pull out the cable. (Take photos or notes of the existing pH sensor wiring. This will make it easy to install the replacement sensor.)
6. Unscrew the grey nut on the pH sensor and pull up the sensor from the measuring chamber.
7. Install the replacement pH sensor in the same way the old was installed or in accordance with the electrical drawing.
8. Check that water is inside the measuring chamber. Make sure the flat gasket is in place and tighten the grey nut.
9. Close the DRAIN VALVE. Open the INLET VALVE and OUTLET VALVE.
10. Power ON the system.

ATTENTION:

The new pH sensor requires a functioning pH electrode. A new pH electrode can be used or the existing electrode can be taken from the replaced pH sensor and used in the new pH sensor.

To replace the pH electrode, follow the instructions MI6200-0007 – pH Electrode replacement.

Photos

pH Sensor Cable Color Codes		
Serial No. < A147847	Serial No. > A147847	
Color code:	Color code:	Description:
Sheild	Sheild	PE
Black 1	Red	Power Supply 24 Vdc
Grey	White	
Black 2	Black	pH signal
Brown	Grey	Temp. signal

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