AQUIONICS
UV Delivered

PureLine M

Operation & Maintenance Manual

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1. INTRODUCTION

1.1 GENERAL

The objective of this manual is to explain clearly to users the installation and operation of the PureLine M water treatment system.
Users are advised to study this manual carefully – chapter 2 in particular is important in helping to ensure user safety.
The people that work with the systems are expected to have sufficient in-depth knowledge of the applied techniques and a thorough command of the operating instructions and to be aware of the possible dangers and risks.

1.2 SYSTEM OVERVIEW

The PureLine M water treatment system has been developed to create 'pasteurised equivalent water' to be used in the manufacture of dairy food and drink products. The system is designed to comply with the requirements of the Grade "A" Pasteurised Milk Ordinance (PMO) issued by the United States Department of Health and Human Services.
The system exposes the water to ultraviolet (UV) light which deactivates germs, viruses, bacteria, spores, fungi, algae and other micro-organisms quickly and safely. For this purpose, a number of UV lamps are placed in the liquid flow within a stainless steel reactor to deliver a known UV dose within the normal process ranges of flow rate and UV transmittance.
The system is powered and controlled via a separate control panel. The control computer within this panel continuously records the system's status and operating parameters in a secure database which is stored in the hard drive of the control computer, and backed-up regularly to a separate memory card. A separate software application (Crystal Reports v14) allows reports to be generated from the stored system data. The computer communicates using Ethernet with a touchscreen display through which the user can control and monitor the system.
The control panel also sends a signal to operate a divert valve if a PMO non-compliance occurs, to prevent untreated water from entering the process. The water is either run to drain or recirculated until the non-compliance is resolved.

1.3 DOCUMENTS

In addition to this user manual, the following documents are included:

- CE-declaration
- Certificate of quality
- Implementation card
- Product specific technical user manual, including:
    - Electrical circuit diagrams
    - Mechanical drawings
    - Drawing of the lamp configuration
    - Spare parts list

Unless stated otherwise, this user manual is valid for the systems that are indicated on the front page. Wherever system differences are relevant, this will be mentioned additionally.
The manual is based on current developments in UV technology. The supplier shall retain the right to make amendments to the documentation without being obliged to modify preceding versions.
Store this manual carefully for future use.

Attention

The pictures and drawings in this manual may deviate in detail or may be a mirror image of the actual situation.
Most photographs are taken in laboratory circumstances or on work benches.

1.4 TEXT CONVENTIONS

The following terms are used to draw additional attention to specific sections of the text:

Tip
Suggestions and advice for carrying out specific tasks more easily or practically.

Attention
This remark is placed next to the text to draw the user's attention to possible problems.

Caution
If procedures are not carried out with due care and attention, the system can be damaged.

Warning
If procedures are not carried out carefully, the user or other persons could be injured or the system could be seriously damaged.

The following symbols are used in this manual:

Summary of a number of options:

- Option 1
- Option 2
- ...

Action to be carried out:

- Step 1
- Step 2
- ...

2. SAFETY

2.1 GENERAL

The UV system is built for easy and efficient operation. Users should nevertheless take proper note of the remarks accompanying the text in this manual and act accordingly.
Persons working on or in the direct vicinity of the system must be familiar with these instructions.
In addition to the instructions in this manual, generally applicable safety rules and regulations must be observed at all times.

2.2 PICTOGRAMS AND GENERAL SAFETY INSTRUCTIONS

For using the UV system, the following pictograms and safety instructions are important:

	Wear safety glasses to prevent eye injuries from ultraviolet light. Do not look directly into a UV lamp that is switched on.
	Do not unnecessarily expose your skin to UV radiation. Wear clean gloves free of talc powder and grease when handling the lamps. If you do have to hold the lamps, do so by the connectors.
	Remember UV lamps remain hot for a considerable time after they have been turned off. Allow the lamps to cool off after use for at least 15 minutes.
	The disinfection reactor and the control unit have to be wired to an earth leakage circuit breaker with sufficient capacity. Switch the power supply off before carrying out repair work and maintenance.
	Take account of the fact that there is inadequate disinfection if the lamps are not up to temperature or if the lamps have been switched off Also: general safety symbol.
	The UV lamps contain mercury. Take defective lamps to a depot for chemical waste. See section 2.4 for details of what to do if a lamp breaks.
	Do not dispose of old lamps as unsorted municipal waste.

The following points of attention should also be taken into account:

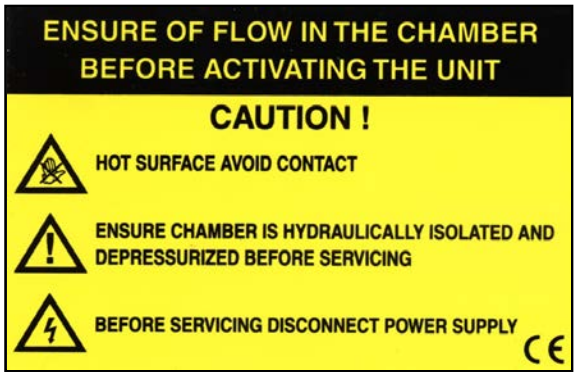
- Keep your work area clean and tidy and make sure it is properly illuminated.
- Keep control cabinets closed during normal use.
- Only use original Hanovia parts.
- Carry out proper maintenance on a regular basis. Read the maintenance instructions in chapter 6 and 7.

2.3 SYSTEM SAFETY FEATURES

The UV system is fitted with the following safety features:

- Effective protection against the UV radiation produced by the lamps.
- Safeguards to prevent the lamps and the power supply cabinet from overheating.
- Quality control of the UV lamps in order to monitor the liquid disinfection process.

The following safety stickers have been placed on the system:

	Location: ▪ End closure of the UV reactor
	Location: ▪ Outside the control cabinet(s)

Warning
Replace stickers if they are damaged or lost.

2.4 BROKEN LAMPS OR QUARTZ SLEEVES

The UV lamps contain a small amount of mercury. If a lamp breaks, the mercury has to be collected by binding it with sulphur powder. Carefully remove the mercury after collecting it.
If necessary, defective or burnt-out lamps can be sent back to the system supplier.

Warning

Avoid contact with the skin and eyes, do not breathe in any vapours and make sure there is sufficient ventilation.

Warning

Take the mercury to a depot for chemical waste in accordance with local regulations.

If one of the quartz sleeves breaks:

- Shut off the liquid supply pipes immediately and switch the system off (if this is not done automatically).
- Open the UV reactor as described in chapter 6 and 7. Remove all fragments and other lamp parts (wear suitable protective clothing and use any protective means necessary.).
- Carefully rinse the reactor with clean water and make sure that no dirt or cleansing agent residue gets into the water.
- Replace any defective components.
- Only switch on the system after the reactor has been completely filled with water again (consult the start-up procedure in section 5.6.1).

2.5 RECOMMENDED USE

- The system is designed for disinfecting UV permeable liquids such as waste water, drinking water and process water (see technical data sheet). For other applications it is advisable to contact your supplier's representative.
- There are restrictions when using liquids, which have high concentrations of dissolved minerals or salts. High concentrations of these substances can cause corrosion of metal components. Contact your supplier for further information.
- A high concentration of particulates in the medium can cause excess wear. Contact your supplier for further information.
- The system may only be used in the configuration described in this document.

2.6 NON-RECOMMENDED USE

- The system should *never*, under any circumstances whatsoever, be switched on if it is not completely built into the adjoining pipework. The UV lamps must be shielded at all times to prevent harmful UV radiation.
- Do not remove plugs or other components which allow any UV radiation to be emitted to the outside.
- Consult your supplier representative before using transparent pipework systems.
- Mechanical modifications to the system, such as drilling holes or welding on parts can damage the system.

2.7 CE-MARKING

The system complies with the EU Directive for machine safety. The respective CE declaration is supplied separately with the system. An example is shown in the appendix at the back of this manual.

3. STORAGE AND TRANSPORT

3.1 ON RECEIPT

Check the goods on receipt for signs of transport damage. Report any such cases directly to the carrier and your supplier. Take photographs of any damage and store the packaging for inspection.

3.2 STORAGE

If you do not intend to install the system immediately, it is advisable to store the components in their original packaging. Avoid jolts and excessive vibrations.
UV lamps must always be stored in the original packaging.
The storage area must meet the following requirements:

- Atmospheric humidity : 10 – 80% RH
- Temperature : 10 – 30°C

3.3 UNPACKING

Read any instructions and warning messages that may be attached to the packaging. Even though they are packed separately, please bear in mind that the lamps are fragile and should be handled with care. Keep the lamps in their individual original packaging until they are to be installed in the reactor.
Check that your delivery is complete from the packer's receipt. Report any parts that are missing directly to the carrier and your supplier.
When the system is shipped, the UV lamps are packed separately from the UV reactor. The lamps should only be fitted after the installation has been completed mechanically and electrically and connected up. The procedure for fitting the lamps is described in chapter 7.

3.4 TRANSPORT

If internal transport of the system is necessary, make sure that:

- the UV lamps have been removed and that they are stored in their original packaging;
- the system has been completely disconnected from the electricity mains;
- the system is clean and dry;
- all the components are suitably protected against external contaminants and damage.

3.5 TAKING THE SYSTEM OUT OF USE TEMPORARILY

If the system is taken out of use temporarily, it is important to flush the system with clean water so that no sand, salts or other corrosive materials remain behind in the system. Leave the system in a dry state.
Dissolved and non-dissolved particulates (such as minerals) may affect the high-grade stainless steel if the medium is stagnant.

4. GENERAL SYSTEM DESCRIPTION

4.1 SYSTEM OVERVIEW

Figure 1 illustrates the main aspects of the construction of the system. The diagram shows all possible applicable options. The actual situation can vary from the diagram depending on the application, the type of control system and the size of the reactor.

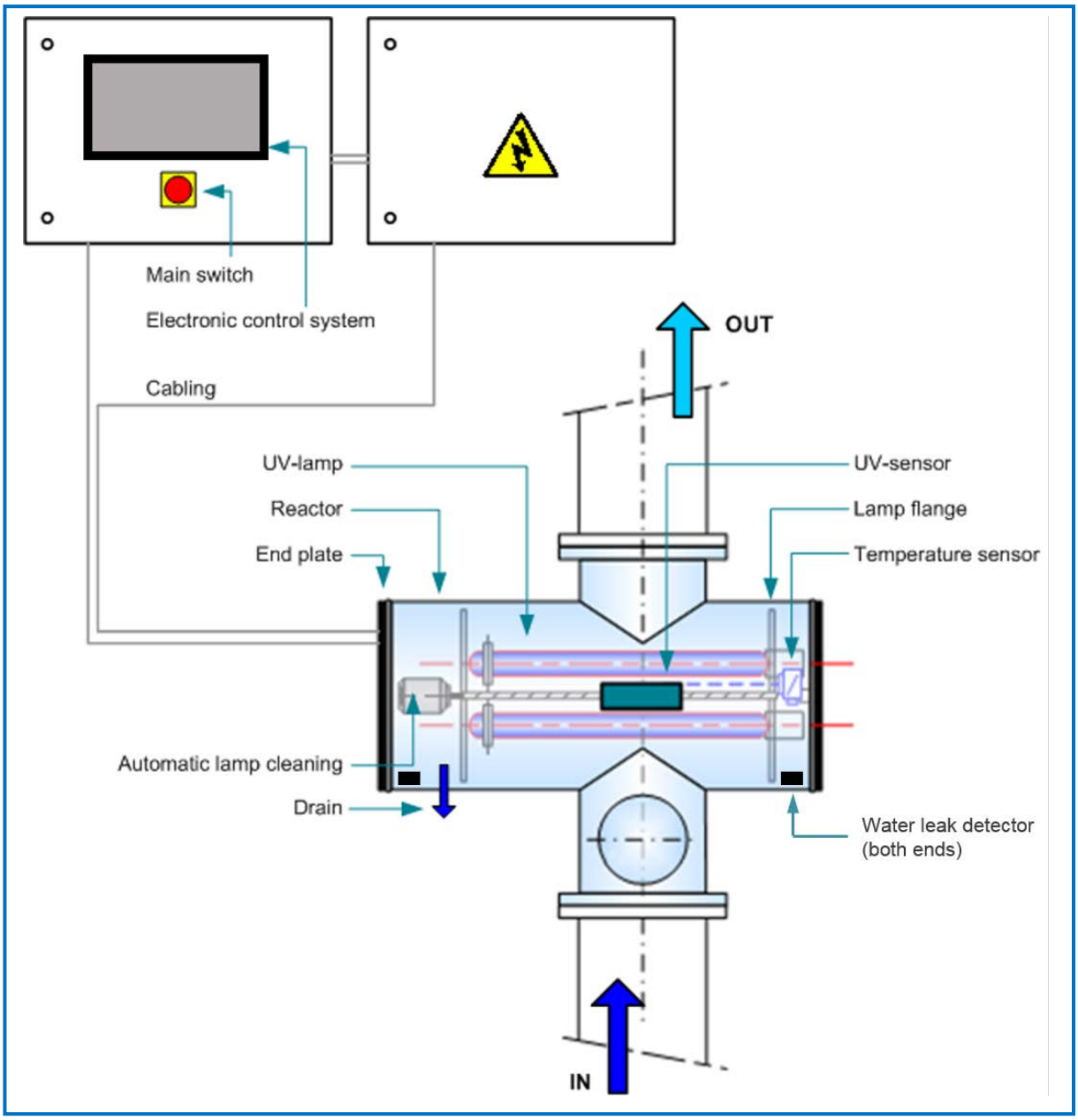


Figure 1: General system configuration

For detailed information, please see section 4.2 (Disinfection reactor) and section 4.3 (Power supply and control).
A number of tools are also available for manually testing the lamps and removing the quartz sleeves. These are described in section 4.5.
A divert valve is required to ensure compliance with the PMO. This is discussed further in section 4.4.
The control system is described in section 5.

4.2 DISINFECTION REACTOR

The disinfection reactor consists of the components that are described in the following sections.

4.2.1 UV reactor

The reactor is the main component of the UV system. On all types the liquid in and out connections are in line. The UV lamps are housed in the horizontally drawn tube segment (perpendicular to the liquid direction); the lamps are fitted between two internal flanges. An automatic wiping mechanism and the temperature sensor are also located on the inside walls. The horizontal tube segment is covered on both sides with a sealing plate.

Equipment is also present in the reactor as standard to vent and drain the system, and also for the lead through of the electrical connections.

The size and the design of the reactor depend on the required disinfection capacity and the nature of the liquid.

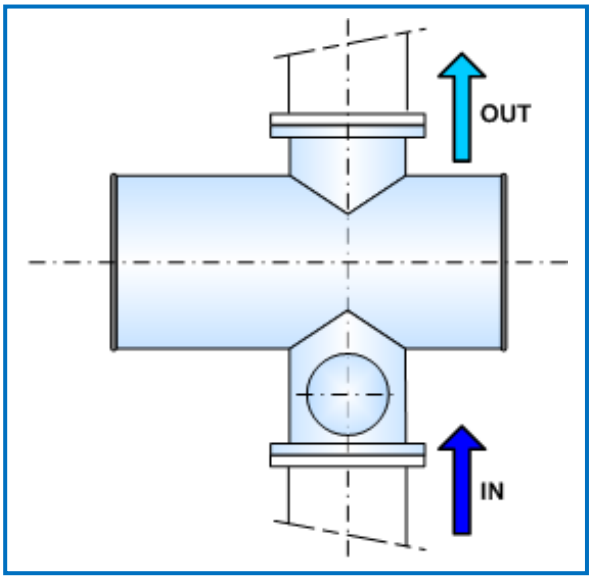


Figure 2: UV reactor

4.2.2 UV lamps

The number and type of UV lamps built into the system depend on the system size and the nature of the liquid that has to be disinfected.
The lamps are placed in quartz sleeves (see Figure 3) and therefore do not come into direct contact with the liquid. They can be fitted from either flange. This has to be done according to a strict procedure. See chapter 7 for further instructions.
After switching the lamps on, it can take 1 to 5 minutes before the full UV intensity is reached.

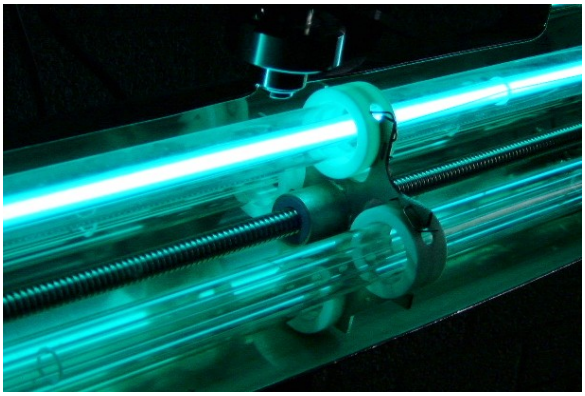


Figure 3: UV lamps

The life span of the lamps will be drastically reduced if they are repeatedly switched on and off. This results in decreasing UV intensity. Any contaminants on the quartz sleeves also lead to reduced UV output.

Caution

To avoid damaging the UV lamps, never touch them with your bare hands.

Warning

Remember that a lamp that has just been switched off will be extremely hot.

Warning

The UV lamps contain a small amount of mercury. See section 2.4 for what to do with broken lamps.

4.2.3 UV sensor

A UV sensor (see Figure 4) is fitted as standard on the steel reactor and this measures the UV intensity of the UV lamps at a fixed point. This sensor sends information to the control system so that the lamp power level can be adjusted as soon as the lamp intensity decreases, the quartz sleeve becomes dirty or the quality of the liquid changes.
The UV sensor works within a measuring range of 240 – 300 nm.
All UV systems have been rated (sized) for a specific end of lamp life UV output in combination with a defined fouling of the quartz tubes. This UV intensity reading is defined as 100% (at maximum power).

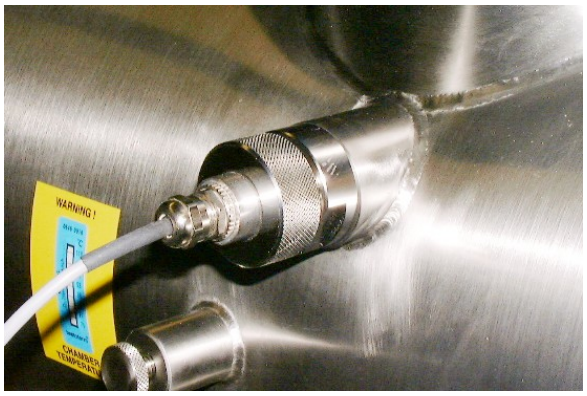


Figure 4: UV sensor

The UV sensor is factory-calibrated and does not need to be recalibrated when lamps are replaced. However, periodic cleaning is required (see section 6.2). In addition, a periodic (yearly) reference check is necessary. In case of deviation, the sensor must be replaced.

4.2.4 Temperature sensor

The UV lamps produce a considerable amount of heat that is removed if the flow rate of the liquid passing through the system is sufficiently high. In order to monitor the temperature of the liquid, a temperature detector (type PT-100) is fitted in the system so that unsafe situations can be prevented (see Figure 5).
As soon as the liquid temperature exceeds the pre-set value (default value: 113°F), an alarm is given and the system shuts down.

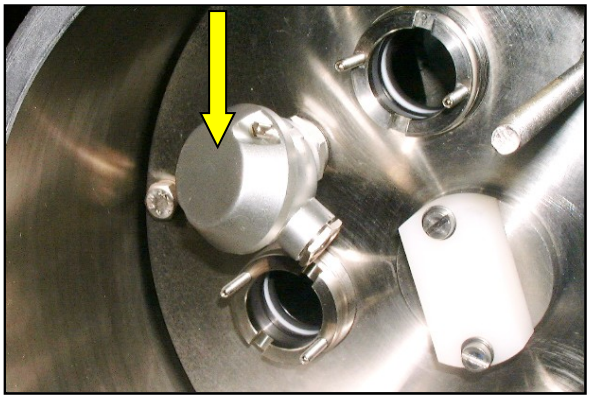


Figure 5: Temperature sensor

The system has the following hardware features included.

4.2.5 Automatic wiping

An automatic cleaning system is used to keep the quartz sleeve clean by wiping the surface with a rubber ring.
A threaded spindle and an electric motor operate the wiper plate with the wiper rings. Two sensors located on the outside of the reactor signal the end position of the wiper plate.
The electric motor is mounted on the flange in the reactor by means of a number of wire ends (Figure 6) and is protected by a sealing plate.

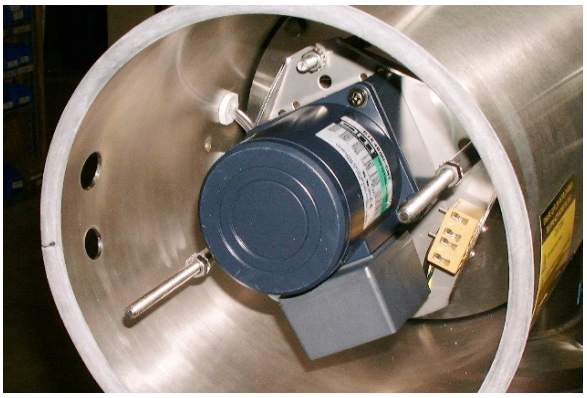


Figure 6: Motor of the automatic cleaning mechanism

4.2.6 Water leak detector

A water leak detector is fitted at each end of the UV chamber, near the drain outlet (Figure 7). Water that bridges the elements of the detector will generate an alarm (section 5.9.1).

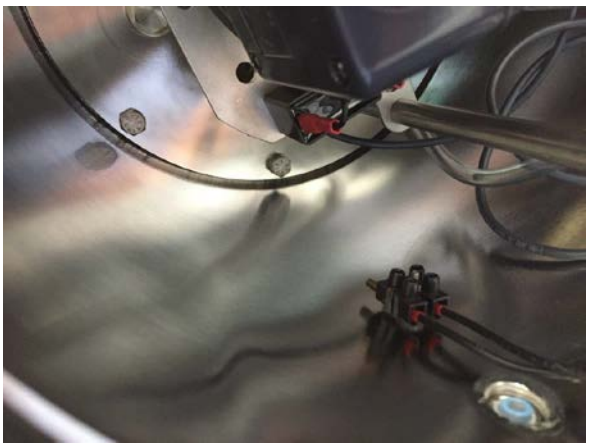


Figure 7: Water leak detector

4.2.7 Relay for solenoid valve

A solenoid valve can be placed in the drain plug connector to enable the liquid in the reactor to be drained by entering an electrical command signal.

4.3 CONTROL CABINETS

4.3.1 Main configuration and display

The UV disinfection system is connected to a power supply cabinet and a control unit. Depending on the size of the system and specific customer requirements, a combined cabinet can be supplied.
The cabinets are fitted with the following components:

The main switch:
This switch, fitted to the door of the cabinet, switches the whole system on and off.

Cabinet ventilators:
These remove the heat produced by the lamp power supplies.

Control panel:
Operation of the system and control of the disinfecting process can be achieved by the use of a touch screen control panel. The panel is fitted on the front of the control cabinet. The system can also be controlled remotely via a SCADA system. Refer to chapter 5 for more information.

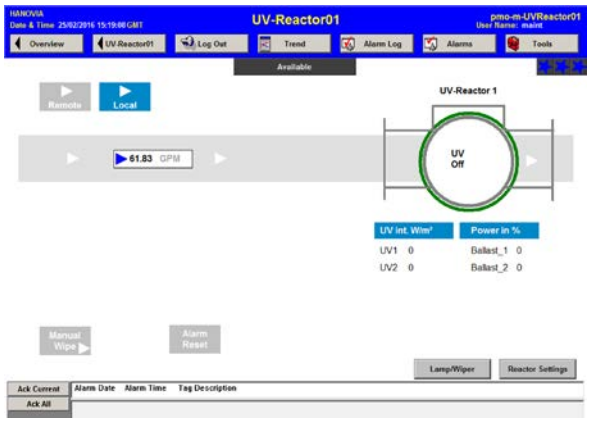


Figure 8: Touch screen control panel display

4.4 DIVERT VALVES

4.4.1 Single valve mode

To ensure compliance with the requirements of the PMO, a divert valve must be installed downstream from the UV reactor and be controlled by the plant's control system. This valve is used to prevent water from entering the process if one of the following events occurs:

- Lamp fault
- UV/flow/transmittance sensor input fault
- Low UV dose
- UV transmittance below a minimum level
- Flow rate outside set limits
- Any trip

If one of these events occurs, the UV system will send a signal to the plant's control system to operate the divert valve. The UV system then waits a specified time period (selected by the user), and then checks that the valve has operated correctly. The UV system will then be switched off if it has not already tripped.
Refer to section 5.6.3 for further information.

4.4.2 Multi-valve mode

In addition to signalling for a single divert valve to prevent the water running to process, the PureLine M system can automatically control three additional valves in a water recirculation system. These valves have the following functions:

- Sending water to drain.
- Recirculating water back through the UV chamber via a heat exchanger.
- Switching on the cold water system to the heat exchanger for cooling the recirculated water.

The recirculating pump for the cold water system is also controlled by the software.
The recirculation system can be used to prepare disinfected water before it is needed by operating the UV system with the divert valve closed. A signal from the plant's control system causes the clean water to be sent to process by opening the divert valve.
If a non-compliance occurs, then the system switches back to recirculation mode and switches off the UV system if it has not already tripped.
Refer to section 5.6.4 for further information.

4.4.3 Divert valve location

The divert valve must be supplied by the customer and should be installed at a point downstream that gives sufficient time for the valve to operate before any water that was in the reactor when the fault occurred passes into process.
The distance required between the divert valve and the reactor, D, can be calculated using the following equation (refer to Figure 9):

$$D = \left(\frac{F}{A}\right) \times (t_s + t_v)$$

where
F = water flow rate in m^3/s (divide the value in m^3/h by 3600)
A = cross-sectional area of pipe in m^2
t_s = time for software to send signal to valve (≈1 second)
t_v = time required for valve to close in seconds

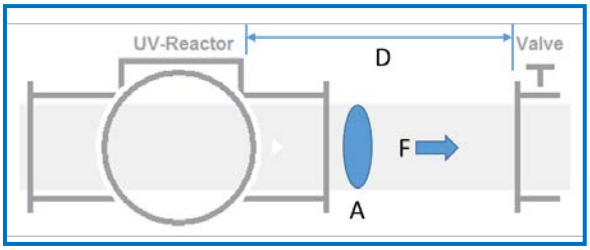


Figure 9: Location of divert valve

Attention

The PMO requires that the divert valve is fail-safe, that is, it will close in the event of a power failure to stop water passing untreated through the UV reactor and into process.

4.5 ACCESSORIES

The following additional accessories are available:

Lamp tester:
The lamp tester gives a high-voltage pulse that can be used to test the working of the lamps. The tester works with a 9 V-battery and generates a safe pulse of 3.000 V / 1 µA / 160 KHz.

Figure 10: Lamp tester

Jupito:
The Jupito is a mechanical aid for easily removing the quartz sleeves that reduces the risk of damage. The device can be extremely useful especially when the sleeves are stuck because of dirt and contaminants.
The use of the Jupito is described in section 7.3.

Figure 11: Jupito

5. CONTROL SYSTEM DESCRIPTION AND OPERATION

5.1 FUNCTIONS OF THE CONTROL SYSTEM

The UV system control system enables the process to be monitored and controlled either remotely via a SCADA connection or locally using a touchscreen display on the control panel. The system also controls the operation of a divert valve to prevent any water that has not been treated properly from entering the process. Finally, a database stores the essential operating data at 5-second intervals, and a separate application allows reports on system performance to be generated as required.

In the event of a power failure, an integrated battery will power the control system for at least 20 minutes to allow the control panel to operate and data logging to continue (the UV reactor will not operate).

The control software features a number of screens for configuring system settings, and two control screens from which to monitor and control the process, **Overview** and **UV Reactor**. These various screens are described in the following sections.

5.1.1 Access to the control software

There are four levels of access to the software, under the following user names: **Guest**, **Operator**, **Secure** and **Maintenance**.

- Guest: the software defaults to this user level after 15 minutes of inactivity. The Guest user only permits screens to be viewed; no control functions are available.
- Operator: this user level allows the lamps to be switched on and off, alarms to be acknowledged and wipe cycles to be performed.
- Secure: this user level allows alarms to be reset, usage data to be cleared, and a limited range of settings to be configured.
- Maintenance: this user level permits access to all system settings and features (not for customer use).

The stars under the toolbar indicate which user level is currently logged in to the system (Operator = 1, Secure = 2, Maintenance = 3).

To log in to the system:

➢ Press the **Log In** button.

➢ Enter the required user name and password and press **OK**:

- Guest: no password
- Oper (Operator): 1
- Secure: 2
- Maint (Maintenance): manufacturer use only

Touch the user name or password text box to display the on-screen keyboard.

Warning

Changing certain system parameters can lead to insufficient disinfection levels or malfunctioning of the entire system, and may prevent the minimum PMO performance requirements being met.

The configuration of the system should only be changed by personnel who are fully aware of the implications of the changes.

5.2 OVERVIEW SCREEN

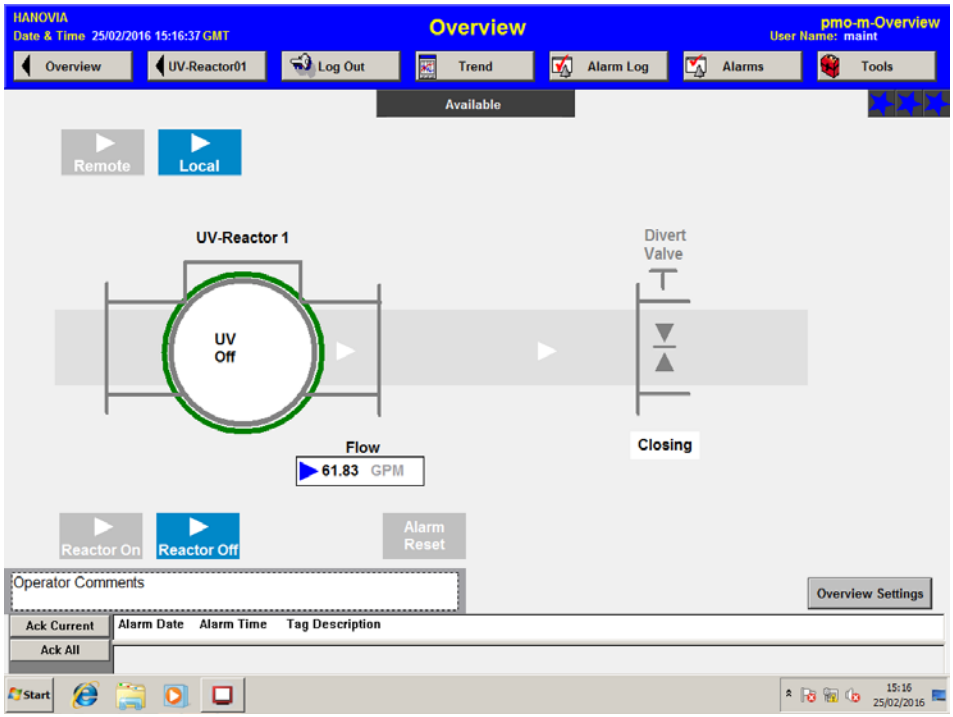


Figure 12: Overview screen (single valve mode)

The Overview screen displays the status of the water treatment process stream, comprising the UV reactor and the divert valve. The functions of the Overview screen features and buttons are:

Element	Description
UV REACTOR	The picture of the reactor on the screen is coloured depending on whether the system is operating normally (green), has a non-critical warning (amber) or has tripped (flashing red).
FLOW	The value from the flow sensor (if fitted) is displayed.
DIVERT VALVE	The divert valve is shown as in Figure 12 if it is **open**, when the system is operating as required and the treated water is directed to process. If the valve is shown crossed out, the operation is non-compliant with the PMO requirements and the valve has **closed** to prevent the water going to process.
LOG IN/OUT	Press this button to either log in as one of the standard users, or log out to the Guest user. See section 5.1.1 for further details.
TREND	Displays a graph of the essential system parameters logged in the database plotted against time and date. Use the buttons to move around the graph and change the scale.
ALARM LOG	Displays a log of the alarms recorded in the system database (section 5.7.3).
ALARMS	Displays a list of active alarms which flash while they are active, and remain on the screen until they are resolved (section 5.7.1). The most recent of these alarms can also be seen at the bottom of the main screen, where they can be acknowledged.
TOOLS	Allows the software application to be shut down (Maintenance user only).
REMOTE / LOCAL	Remote mode enables fully automatic control of the system via SCADA. Local mode allows the system to be controlled from the touchscreen (depending on the user's access level).
REACTOR ON / OFF	Switches the lamps on and off. Only available in Local mode.

Element	Description
ALARM RESET	Resets the system from a trip after the cause has been resolved. Only Secure and Maintenance users can operate this button.
OPERATOR COMMENTS	Used to record any comments required. These are saved in the system database and will appear as a sub-report in the footer of the main report. Touch the text box to display the on-screen keyboard.
OVERVIEW SETTINGS	Allows a range of system settings to be configured (section 5.8).

If the system is in multi-valve mode, then the Overview screen displays the additional components that are controlled by the software, as shown in Figure 13.

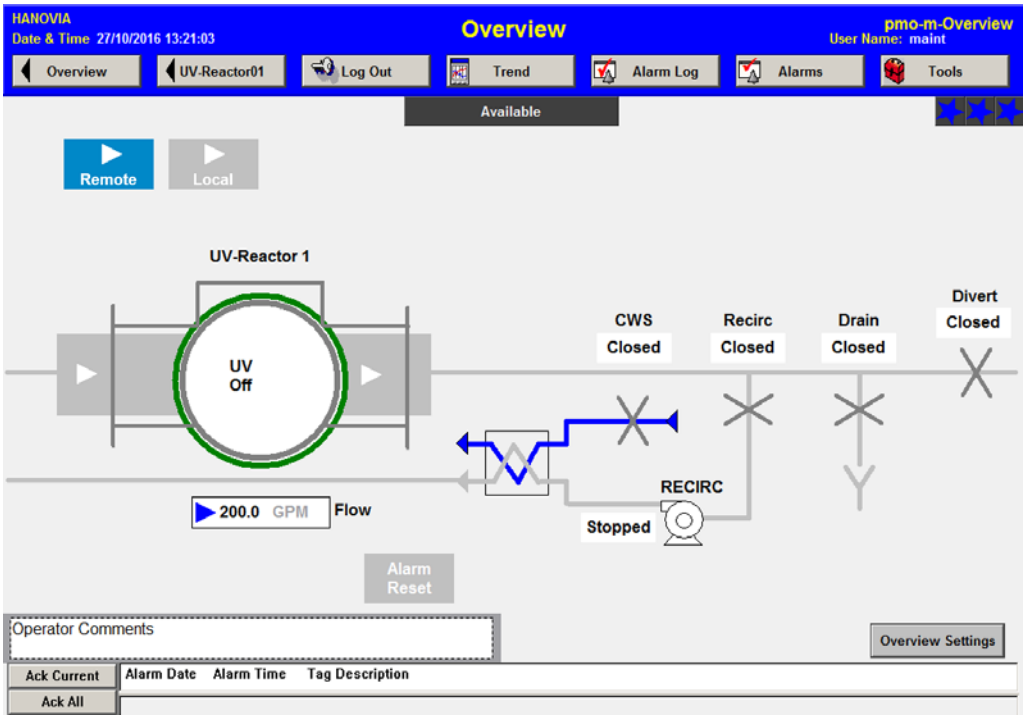


Figure 13: Overview screen (multi-valve mode)

Element	Description
DIVERT VALVE	The main divert valve to prevent the treated water running to process. If the valve is shown crossed out, the operation is non-compliant with the PMO requirements and the valve has **closed** to prevent the water going to process.
DRAIN VALVE	A valve to send the treated water to drain.
RECIRC VALVE	A valve to recirculate water through the UV chamber after cooling with a heat exchanger.
CWS VALVE	A valve to switch on the cooling water to the heat exchanger.
RECIRC PUMP	A pump to recirculate water through the UV chamber.

5.3 REACTOR SCREEN

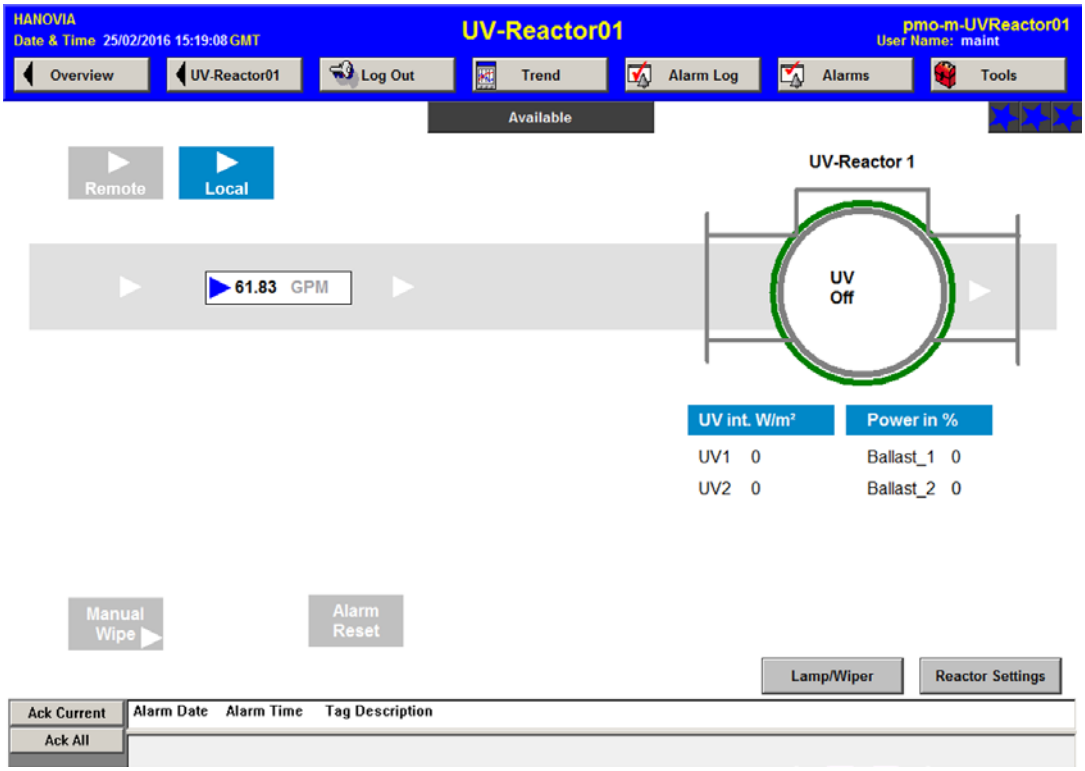


Figure 14: Reactor screen

The Reactor screen gives more information about the UV system and allows the lamps and wiper to be controlled (if the software is operating under the Secure or Maintenance user). The functions of the screen features and buttons (ignoring those which are also shown on the Overview screen) are:

Element	Description
UV REACTOR	The table beneath the reactor displays the measured UV intensity and the power output from each ballast (expressed as a percentage of the maximum power).
MANUAL WIPE	Only available in Local mode. Performs an immediate wiping operation (this does not affect the automatic wiper interval).
LAMP / WIPER	Allows control of the wiper and individual lamps and reports their usage data (section 5.6.1).
REACTOR SETTINGS	Allows system settings to be configured (section 5.8).

5.4 CONTROL CABINET CONNECTIONS

The tables below describe all the inputs and outputs that are available to the user. Refer to the drawings provided with your system for further details.

Digital Inputs

All digital inputs are 0–24 V dc signals.

Signal	Description
REMOTE START/STOP	A High signal switches the lamps on, a Low signal switches them off.
REMOTE CLEAR MESSAGE	A High signal pulse (minimum 3 seconds) clears any resolved alarm messages.
REMOTE WIPER	A High signal pulse (minimum 3 seconds) initiates a wipe cycle.
REMOTE SET POWER HIGH	A High signal switches the system from low to high power, with the lamp operated at 100% of their output.
DIVERT VALVE TO PROCESS	A High signal confirms that the divert valve has been opened to direct the treated water to process.
DIVERT VALVE TO RECIRCULATION	A High signal confirms that the divert valve has been closed to stop the treated water passing to process.
PROCESS WATER	A High signal directs the UV system to stop recirculating water and prepare to send treated water to process (multi-valve mode only; refer to section 5.6.4).

Digital Outputs

All digital outputs are volt-free contacts.

Signal	Description
SYSTEM IN REMOTE MODE	A High signal indicates that the system is operating in Remote mode.
SYSTEM STANDBY	A High signal indicates the system is in standby mode (power is on but lamps are not running).
SYSTEM COOLING DOWN	A High signal indicates that the system is in the cooling stage, and the lamps cannot be switched on.
ANY TRIP	A Low signal indicates that one or more trips are active.
ANY WARNING	A Low signal indicates that one or more warnings are active.
UV DOSE/ INTENSITY FAILURE	A Low signal indicates that the UV dose or intensity has failed (the value has remained below the minimum level for longer than the delay time).
SYSTEM READY	A High signal indicates that the UV lamps are warmed up and the UV dose is above the set-point.
WIPER FAILURE	A Low signal indicates a wiper failure.
WATER LEAKAGE ALARM (OPTION)	A Low signal indicates that a water leak has been detected.

Signal	Description
WATER TEMP WARNING	A High signal indicates that the water temperature has exceeded the warning level. This output can also be used to operate the bleed valve on the reactor if one is installed.
WATER/ CABINET TEMP ALARM	A Low signal indicates that either the water or cabinet temperature has exceeded the trip level.
LAMP FAILURE	A Low signal indicates that one or more lamps have failed.
DIVERT VALVE TO PROCESS	A High signal indicates that the divert valve is open and treated water is being directed to process.
DRAIN VALVE	A High signal opens the drain valve in the recirculation system (multi-valve mode only).
BLEED VALVE	A High signal opens the cold water supply (CWS) valve to cool down the recirculated water via a heat exchanger (multi-valve mode only).
RECIRCULATION VALVE	A High signal opens the recirculation valve (multi-valve mode only).
RECIRCULATION PUMP	A High signal starts the recirculation pump (multi-valve mode only).
UV COMPLIANT	A High signal indicates that the treated water is in compliance with the PMO and can be used in process.

Analog Inputs

Signal	Description
FLOW SENSOR	4–20 mA input signal from flow sensor.
TRANSMITTANCE SENSOR	4–20 mA input signal from transmittance sensor.

Analog Outputs

Signal	Description
UV INTENSITY OUT	4–20 mA output signal of measured UV intensity.
UV DOSE OUT	4–20 mA output signal of calculated UV dose.
LAMP DRIVER POWER OUTPUT	0–20 mA output signal of power from lamp driver (ballast).

5.5 INSTALLATION AND PREPARING FOR OPERATION

5.5.1 General

When installing the system, the following guidelines must be adhered to:

- The surroundings must be free of corrosive vapours, steam, excessive condensation, dripping liquids, explosive mixtures and gasses, salt air and large amounts of dust.
- Do not expose the cabinets to the outside air (when cabinets are rated IP ≤ 54).
- The relative humidity must be lower than 95%.
- The ambient temperature must be between 5 and 40°C; the average temperature over a 24-hour period may not exceed 35°C.
- The system must not be subjected to heavy jolts or vibrations.
- Do not expose the system to magnetic or radioactive radiation.

5.5.2 Mechanical installation

When installing the reactor, the following points must be adhered to:

- Ensure a correct flow direction.
- Make sure that the piping system can be deaerated if necessary.
- The UV lamps must always be placed horizontally.
- For service work, a free space must be left as indicated in the supplied drawings.
- Make sure that the drain plug, the hatch, the vent tap (if this is present), the earth connection and the UV sensor are easily accessible.
- Make sure that the installation in which the system will be integrated is resistant to UV radiation – this also applies specifically to gaskets, valves and vents.
- Make sure that UV radiation can never escape into the outside air, to prevent eye injury.
- Valves for taking samples must be placed approximately 1 meter before or respectively 0.5 meters behind the system.
- Clean the external pipework and the UV system thoroughly before assembly.
- If applicable: make sure that after cleaning the drinking water cannot be polluted.
- Position the UV system with the help of the end flanges and appropriate installation in the pipe system. Make sure there is no mechanical stress.
- Check all connections to make sure they do not leak.
- Clean the whole system again after assembly.
- Install the lamps according to the instructions in section 7.

5.5.3 Electrical installation

Attention

Installation work may only be carried out by qualified personnel.

Connect the power supply and control cabinet according to the supplied electro technical diagrams and local regulations. The following points must also be taken into account:

- Place the cabinets at a maximum distance of 15 meters from the reactor. Note:
  - For B410 and B810 lamps: max 7 meters.
  - For greater distances: contact your supplier.
- If the power supply and control cabinets are not integrated, the distance between the two may be no greater than 5 meters.
- Position the cabinets so that the ventilators can take in and blow out air freely (they should not extract hot air from surrounding equipment.).
- Use cables with the following minimum specifications:
  - UV lamps: as delivered;
  - UV Sensor: 2 x 0.25 mm^2, shielded;
  - PT-100 (temp. sensor): 2 x 0.50 mm^2, shielded.
- The cables of the UV sensor and PT-100 must be earthed directly after the control cabinet entry point using the respective connection points.
- Make sure the connection between the disinfection reactor and the power supply cabinet is earthed properly (and the connection between the cabinets, if they are separate).
- Connect any external systems to the potential-free contacts of the control unit. See the supplied circuit diagrams for further details.

5.5.4 Preparing for operation

After the mechanical and electrical installation work has been completed, the following precautionary measures should be taken before operating the system:

- The pipework system with the UV system must be completely filled with liquid and de-aerated.
- The flow-rate of the liquid medium must be sufficiently high to cool the system. A flow of at least 2 m^3/hour per kW of lamp power is a typical value.
- Check whether the circuit breakers in the control cabinet are in the correct position.
- Check whether the correct supply voltage is present on the connection contacts in the control cabinet.
- Turn on the main switch.
- If a flow meter is not available, enter a fixed value for the flow rate to be used in dose calculations in the Overview settings screen (section 5.8).
- Repeat the previous step for the UV transmittance value if a transmittance meter is not available.

Warning

Only switch the unit on if the end plates are fitted or wear safety glasses. If the end plates are not present, a small amount of UV light can always escape along the lamp holders and this can damage your eyes.
Never look directly into a UV lamp that has been switched on.

5.6 OPERATION

5.6.1 Switching on and off

1. Make sure that the pipework system is completely filled with liquid and that the flow rate is at normal operating levels to ensure cooling of the reactor.
2. Switch on the cabinet power switch.
3. Log in to the software (section 5.1.1).
4. Select **Remote** or **Local** mode (section 5.8).
5. If using Remote mode, send a start signal from your SCADA system to the Remote Start/Stop input.
   OR
   If using Local mode, press **Reactor On**.
6. Allow the lamps to warm up for 5 minutes.
7. Check the Reactor screen to make sure all the lamps have been switched on.

When operating normally, the Overview screen will resemble Figure 15.

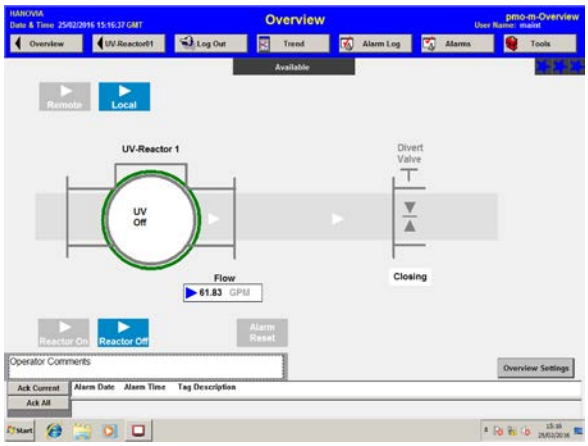


Figure 15: Overview screen after start-up

> **Warning**
>
> If the lamps are not fully heated up, there is no guarantee of an adequate UV dose. The flow of liquid is required for cooling the lamps.

To switch off the system:

- If using Remote mode, send a stop signal from your SCADA system to the Remote Start/Stop input.
  OR
- If using Local mode, press **Reactor Off**.

The lamps can be switched off individually using the Lamp/Wiper screen, shown in Figure 16 (accessible from the Reactor screen). This screen also shows the number of times the lamps have been switched on and the number of hours for which they have been running.

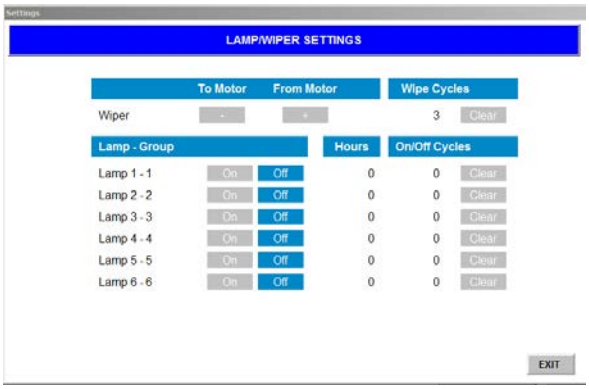


Figure 16: Lamp/wiper settings screen

> **Attention**
>
> When the lamps have been switched off, it takes 10 minutes before the control system can switch them on again.
> Repeatedly switching the lamps on and off considerably shortens their life span.

5.6.2 Automatic cleaning system

The automatic wiper will clean the quartz sleeve at set intervals or if the measured UV intensity falls below a limiting value.
The '+' and '-' buttons on the Lamp/Wiper Settings screen (accessible from the Reactor screen and shown in Figure 16) allows the wiper to be moved manually either forwards (**From motor**) or backwards (**To motor**).

5.7 REMOTE CONTROL EVENT SEQUENCES

5.7.1 Single valve mode

Event sequence for switching on the system:
1. Plant control system sends signal to **Remote Start/Stop** input on UV system.
2. UV lamps switched on and allowed to warm up.
3. If system has no non-compliant conditions (section 4.4.1), then **UV Compliant** signal sent to plant control system.
4. Divert valve is opened by plant control system. Valve sends **Divert Valve to Process** signal to UV system.

Event sequence if UV system becomes non-compliant (section 4.4.1):
1. **UV Compliant** signal to plant control system switched off.
2. Exception data logging starts (section 5.10.4).
3. Plant control system closes divert valve, switches off **Divert Valve to Process** signal, and stops flow through UV chamber.
4. If warning condition exists in UV system, lamps switched off.

After rectifying the problem, allow the lamps to cool down and reset the system before restarting.

Event sequence for switching off the system:
1. Plant control system switches off **Remote Start/Stop** signal to UV system.
2. Plant control system switches off flow through UV chamber, closes divert valve, and switches off **Divert Valve to Process** signal to UV system.
3. UV system switches lamps off and switches off **UV Compliant** signal to plant control system.

5.7.2 Multi-valve mode

Event sequence for starting water treatment in recirculation mode (to provide immediate process water when required):
1. Plant control system sends signal to **Remote Start/Stop** input.
2. UV system switches on lamps and opens recirculation valve.
3. UV system switches on recirculation pump.
4. When lamps warmed up, and if system has no non-compliant conditions (section 4.4.1), then **UV Compliant** signal sent to plant control system.

Event sequence for sending recirculating water to process:
1. Plant control system sends signal to **Process Water** input on UV system.
2. UV system switches off recirculation pump.
3. UV system opens drain valve (to purge untreated water).
4. When recirculation pump has stopped, recirculation valve closed.
5. Plant control system switches on flow through UV chamber.
6. When drain valve delay has elapsed, plant control system opens divert valve.
7. Valve sends **Divert Valve to Process** signal to UV system.
8. UV system closes drain valve.

Event sequence for re-establishing recirculation mode:
1. Plant control system switches off signal to **Process Water** input on UV system.
2. Plant control system switches off flow through UV chamber and closes divert valve.
3. UV system opens recirculation valve.
4. UV system switches on recirculation pump.
5. System recirculates water until plant control system either switches on **Process Water** input or switches off **Remote Start/Stop** signal (see below).

Event sequence for switching off the system:
1. Plant control system switches off both **Process Water** and **Remote Start/Stop** signals to UV system.
2. Plant control system switches off flow through UV chamber and closes divert valve.
3. UV system opens recirculation valve.
4. When valve open, UV system switches on recirculation pump.
5. UV system switches off lamps.
6. Water recirculates until cooling down time has elapsed.
7. UV system switches off recirculation pump.

Event sequence if UV system becomes non-compliant during recirculation:
1. UV system switches off **UV Compliant** signal to plant control system.
2. Exception data logging starts (section 5.10.4).
3. If warning condition exists in UV system, lamps switched off.
4. Water recirculates until cooling down time has elapsed.
5. UV system switches off recirculation pump.

After rectifying the problem, allow the lamps to cool down and reset the system before restarting.

Event sequence if UV system becomes non-compliant while water going to process:
1. UV system switches off **UV Compliant** signal to plant control system.

2. Exception data logging starts (section 5.10.4).
3. Plant control system switches off flow through UV chamber, switches off **Process Water** signal to UV system, and closes divert valve.
4. UV system opens recirculation valve.
5. When valve open, UV system switches on recirculation pump.
6. Once divert valve closed, UV system switches off lamps if warning condition exists.
7. Water recirculates until cooling down time has elapsed.
8. UV system switches off recirculation pump.

After rectifying the problem, allow the lamps to cool down and reset the system before restarting.

5.8 WARNINGS AND TRIPS

Malfunctions result in **WARNING** or **TRIP** alarms. Events can be defined as trips (T) or warnings (W) in the Settings screens (see section 5.8). Trip alarms automatically shut down the UV system.

Attention

The trip and warning settings do not affect the behavior of the divert valves, which will operate whenever the conditions in section 4.4.1 occur.

5.8.1 Alarms screen

The Alarms screen (Figure 17) lists the current alarms as they occur, in chronological order. The alarms are colour-coded as either amber (warnings) or red (trips). The messages flash until they are acknowledged using the **Ack Current**, **Ack Page** or **Ack All** buttons. Each entry remain in the list as long as the cause of the alarm is present, at which time they are removed from the Alarms screen. Refer to section 5.9.1 for information on how to resolve alarms.
If there are many active alarms, you can scroll through the respective messages using the **[⬇]** and **[⬆]** arrows.

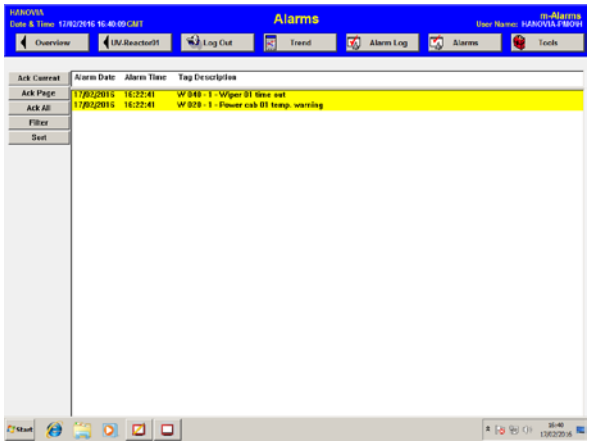


Figure 17: Alarms screen

5.8.2 Resetting the system

After a trip has occurred, perform the following actions to restart the system:

1. Acknowledge the event (section 5.7.1).
2. Correct the cause of the trip.
3. Log in as a Secure user (section 5.1.1).
4. Press the **Reset** button on the Alarms screen.
5. Restart the system (section 5.6.1).

5.8.3 Alarm log

The alarm log (Figure 18) provides a record of all alarms that are stored in the system database.

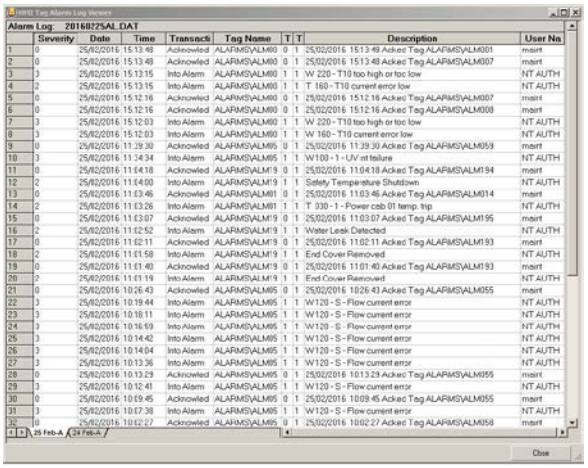


Figure 18: Alarm log

5.9 SETTINGS

There are two Settings screens in the software, accessible through the Overview and Reactor screens. The Overview Settings screen allows the most critical settings to be configured, with the remainder being available on the Reactor Settings screen. The settings that can be configured are shown in the tables below; those that are not required for the PureLine M system are grayed.

Overview Settings

Setting	Description
MODEL NUMBER	The model number of the system. **Not to be changed by users.**
MINIMUM DOSE SET POINT	Select the minimum UV dose that must be delivered by the system.
TEMPERATURE UNITS	Select from degrees Celsius or Fahrenheit.
FLOW UNITS	Select from m^3/hr, GPM (gallons per minute) or MGD (million gallons per day).
FLOW 20 MA REFERENCE SET POINT	Enter the maximum flow measurable by the sensor.
IF NO FLOW MEASURED	Enter a fixed value for the water flow rate that the system uses to calculate the UV dose when the flow rate is not measured directly. Set to 0 to enable the 4–20 mA analogue input.
IF NO T10 MEASURED	Enter a fixed value for the UV transmittance of the water that the system uses to calculate the UV dose when the transmittance is not measured directly. Set to 0 to enable the 4–20 mA analogue input.
VALVE DELAY	Select the time delay that the system allows for the valves to close in seconds. Set to 999 if the valves are not controlled by the system.
DRAIN VALVE DELAY	Select the time delay to allow untreated water to be purged from the recirculation system before sending water to process.
FLOW SENSOR INPUT FAILURE	Select whether this alarm (generated when the sensor input current is below 3.6 mA) is classed as a warning (W) or a trip (T).
FLOW RANGE FAILURE	Select whether this alarm (generated when the flow is outside the specified range) is classed as a warning (W) or a trip (T).
T10 SENSOR INPUT FAILURE	Select whether this alarm (generated when the sensor input current is below 3.6 mA) is classed as a warning (W) or a trip (T).
T10 RANGE FAILURE	Select whether this alarm (generated when the transmittance is outside the specified range) is classed as a warning (W) or a trip (T).
LAMP DRIVER	Electronic ballasts only. Select the driver model (Nedap/ETA+).
VALIDATION FACTOR (VF)	This factor is used in the calculation of the UV dose. **Not to be changed by users.**
UV SENSITIVITY (DL)	This is used in other system applications and is not relevant to the PureLine M operation.
SINGLE OR MULTI VALVE SYSTEM	Select whether the system is required to control single or multiple control valves in the event of non-compliance with the PMO (section 4.4).
UV CONTROL METHOD	Select the model that calculates the UV dose: DVGW, ABS, USEPA-MP, USEPA-MP (T1), USEPA-MP (DL), NWRI-2003, NWRI-2012, NWRI-CFD. **Not to be changed by users.**

Setting	Description
PMO APPLICATION	This should be set to **Yes** permanently, as it controls the signal to operate the flow valve(s) (section 4.4).
PMO REPORTS	Select the format of reports to be generated by the system. **Standard** reports display all events, **Exception** reports only display events when the system is non-compliant with the PMO. Reports can display data collected every 5 seconds, 1 minute or 1 hour.

Reactor Settings

Setting	Description
POWER CONTROL	Auto – lamp power is controlled on the basis of the UV dose. Manual – lamp power is set at a fixed value (the Manual Power Level).
MANUAL POWER LEVEL	Select the power level for manual control: Conventional ballasts – select from Minimum / Medium / Maximum (approximately 60 / 80 / 100%). Electronic ballasts – must be within the minimum and maximum power levels (see below).
WIPE IN STANDBY	Select whether or not the wiper mechanism continues to operate when the system is in standby (that is, when the power supply is switched on but the lamps are not running).
WIPE CYCLE INTERVAL	Select the time interval for performing cleaning cycles in minutes. (Set to 0 to disable the automatic wiper.)
UV FAIL LEVEL HIGH	Select the upper warning level for the UV dose as a percentage of the minimum dose set point.
UV FAIL DELAY HIGH	Select the time in seconds that the system will wait after the UV signal goes above the high UV fail level before triggering a high UV alarm.
UV FAIL LEVEL LOW	Select the lower warning level for the UV dose as a percentage of the minimum dose set point.
UV FAIL DELAY LOW	Select the time in seconds that the system will wait after the UV signal goes below the low UV fail level before triggering a low UV alarm. This should be a shorter time period than the UV Fail Delay High.
WATER TRIP TEMPERATURE	Select the water temperature at which the system will trip.
WATER WARNING TEMPERATURE	Select the water temperature at which a warning is triggered.
UV SENSOR INPUT FAILURE	Select whether this alarm is classed as a warning (W) or a trip (T).
UV INTENSITY LOW	Select whether this alarm is classed as a warning (W) or a trip (T).
UV INTENSITY FAILURE	Select whether this alarm is classed as a warning (W) or a trip (T).
WIPER FAILURE	Select whether this alarm, caused by a motor trip or failure to complete a wipe cycle, is classed as a warning (W) or a trip (T).
LAMP FAULT	Select whether this alarm is classed as a warning (W) or a trip (T).
NUMBER OF UV LAMPS PER GROUP	Set the number of lamps running on a single ballast. **Not to be changed by users.**

Setting	Description
NUMBER OF ANALOG OUTPUTS	Set the number of analogue outputs to be used for electronic ballasts. **Not to be changed by users.**
BALLAST TYPE	Choose between Electronic (EL) or Conventional (Conv.). **Not to be changed by users.**
MINIMUM POWER LEVEL	Set the minimum power setting for electronic ballasts (0–50%). **Not to be changed by users.**
MAXIMUM POWER LEVEL	Set the maximum power setting for electronic ballasts (0–100%). **Not to be changed by users.**
NUMBER RESTARTS	Set the number of attempts to start the lamp that are permitted before the system issues a lamp fault alarm. **Not to be changed by users.**
TI TIME	Set the integral time factor for the UV dose control with electronic ballasts. **Not to be changed by users.**
PB FACTOR	Set the proportional factor for the UV dose control with electronic ballasts. **Not to be changed by users.**
UP RANGE (CB)	Conventional ballasts only. Select the tolerance (%) on the upper intensity limit that must be exceeded before the lamp power is reduced.
UV INTENSITY CAL 20 MA	Enter the maximum UV intensity measurable by the sensor.
STARTING UP TIME	Set the time period permitted for the lamps to start before the system issues a lamp fault alarm.
WARMING UP TIME	Set the time period permitted for the lamps to reach full power. No low UV alarms will be triggered during this time period.
COOLING DOWN TIME	Set the time period for which the lamps must cool down before being restarted.
FLOW STABILIZATION TIME	Set the time period for the system operation to stabilise before the UV dose is measured.
ENERGY CONTROL DELAY	Set the time period for which the UV output is monitored before any change in the power output is applied.
WIPER TIME OUT	Select the time limit for each wiper cycle after which the system will generate a wiper fault alarm.
PRE-GLOWING TIME (EL)	Set the time period for which lamps are held at high voltage before being started (electronic ballasts only).
LAMP DELAY	Set the time period that the system allows for a lamp to be activated before a lamp fault alarm is issued (conventional ballasts only).
LAMP RESTART DELAY	Set the time period that must pass before a lamp can be restarted.

Figure 19 shows how the system generates alarms in response to a reduction in the measured UV dose. The ballast is automatically adjusted to compensate for the reduction, which may correct the dose before the delay time has passed and an alarm is generated.

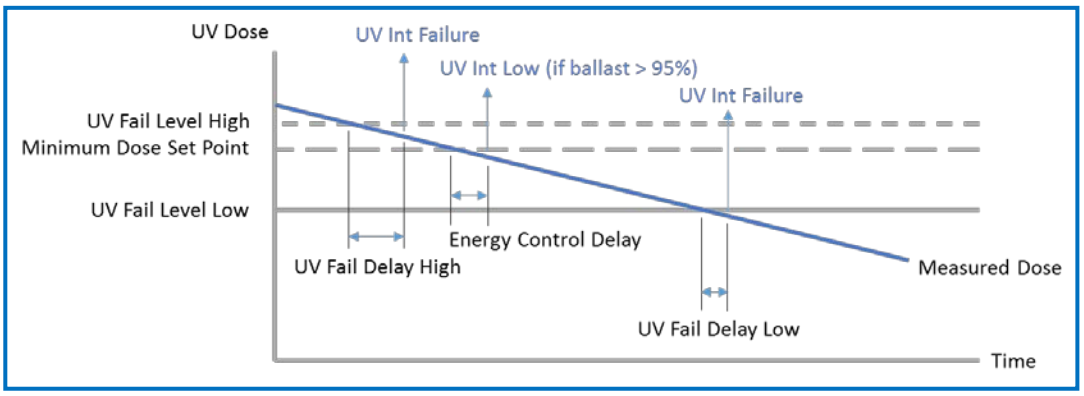


Figure 19: UV dose control

5.10 TROUBLESHOOTING

5.10.1 Alarms

The table below describes appropriate actions to be taken if a particular system alarm occurs.

Alarm	Description and Action
EARTH LEAKAGE	Check quartz sleeves and UV lamps for excessive moisture. Check wiring and load.
POWER CAB TEMP WARNING	Cabinet temperature has exceeded 50ºC. Check the cabinet ventilation.
POWER CAB TEMP TRIP	Cabinet temperature has exceeded 60ºC. Check the cabinet ventilation.
WIPER TIME OUT	Maximum wipe cycle time has been exceeded. Check the wiper operation and detector switches.
WIPER CURRENT	Current protection for the wiper motor has been activated. Check the wiper limit switches and that the wiper is running freely.
WATER TEMP HIGH PRE-WARNING	Water temperature has exceeded the warning level. Check the flow rate.
WATER TEMP TRIP ALARM	Water temperature has exceeded the alarm level and the system has tripped. Check the flow rate.
TEMP SENSOR CURRENT ERROR	Temperature sensor current is below 3 mA. Check the wiring to the sensor.
VSA TEMP HIGH ERROR	Electronic ballast deactivated due to overheating. Check the cabinet ventilation and the dust filter on the ballast.
FLOW CURRENT ERROR	Flow sensor current is below 3 mA. Check the wiring to the sensor.
UV CURRENT ERROR	UV sensor current is below 3 mA. Check the wiring to the sensor.
T10 CURRENT ERROR	Transmittance sensor current is below 3 mA. Check the wiring to the sensor.
UV LAMP GROUP FAULT	A UV lamp or lamp group has failed. Replace the lamp.
UV INT LOW	UV dose has been below the minimum set point with the ballast operating at 95% for longer than the energy control delay time. Perform a wipe cycle. Remove and clean or replace the quartz sleeve. Check the transmittance value of the water.
UV INT FAILURE	UV dose has been below the Fail Delay High or Low level for longer than the corresponding delay time. Perform a wipe cycle. Remove and clean or replace the quartz sleeve. Check the transmittance value of the water.
FLOW TOO HIGH/LOW	Flow rate is outside the specified range. Check the process conditions.
T10 TOO HIGH/LOW	Transmittance value is outside the specified range. Check the process conditions.
END COVER REMOVED	Check end cover is properly fitted and connects with detector switches.
WATER LEAK DETECTED	Check that securing bolts are tightened on lamp flanges.

Alarm	Description and Action
VALVE ERROR	The divert valve has not moved into the correct position.
VALVE TIMEOUT	A control valve has not responded within the required time period (10 seconds by default).

5.10.2 Malfunctions of the temperature sensor

As long as the lamps are switched on, the operating system shall continuously monitor the temperature of the liquid in order to prevent overheating of the UV lamps.
If you suspect that the temperature detector (PT100) is defective, you can check this by measuring a current value to the control point.
Measure the liquid temperature using an external thermometer. Connect an ammeter in accordance with Figure 20 and check whether the measured current agrees with the value in the table. The value may deviate by a maximum of 0.15 mA.

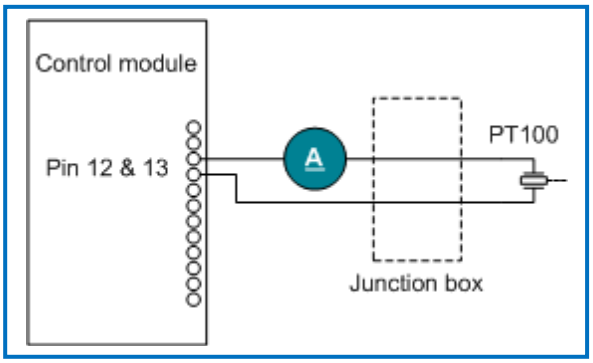


Figure 20: Measuring the PT100 current

Temp [°C]	Current [mA]
0	4.00
5	4.76
10	5.53
15	6.30
20	7.07
25	7.84
30	8.61
35	9.38
40	10.15
45	10.92
50	11.69
55	12.46
60	13.23
65	14.00
70	14.76
75	15.53
80	16.30
85	17.07
90	17.84
100	20.00

5.10.3 Other troubleshooting

- The UV Alarm is active, but the lamps and quartz sleeves are working properly:
  - Check the liquid.
- The UV lamps do not switch on:
  - Check whether the lamps are not cooling down.
  - Check whether the earth leakage or the circuit breakers have dropped out.
  - If the system is set to **Remote** control, check whether the external signal is active. See the system circuit diagrams for further details.

Attention
If there are any other problems with your system, contact the technical support department using the details on the inside of the front cover.

5.11 REPORTING DATA

The operating data of the system is stored in a secure SQL database which cannot be accessed by users. However, reports containing selected data can be prepared using an associated software application, SAP Crystal Reports.

5.11.1 Database records

The secure database for the system's operating data is capable of storing data taken at 5-second intervals for up to 2 years of continuous operation. The following parameters and events are recorded:

- Flow rate
- UVT (transmittance)
- UV dose
- PMO Compliance (0 = non-compliant, 1 = compliant)
- Divert valve position (0 = closed, 1 = opened, 2 = closing, 3 = opening)
- Status:
    - 1 = lamp fault
    - 2 = UV sensor input fault
    - 3 = Flow sensor input fault
    - 4 = UVT sensor input fault
    - 5 = UV dose low
    - 6 = UV transmittance range fault
    - 7 = Flow rate range fault
    - 8 = Any trips
- Operator comments
- Loss of data
- Date and time

Once the database is full, the system begins overwriting the oldest data with the new entries.

5.11.2 Backing-up data

The database is stored on a solid-state hard drive within the system control cabinet. A complete copy of this database is automatically saved to a memory card at midnight after each occasion that the software is restarted. Additionally, every 24 hours, the most recent data added to the database is automatically saved to the memory card.

Tip
Replace the memory card every 12–24 months with an empty card (see section 5.10.3).

5.11.3 Replacing the memory card

1. Insert the new memory card into your desktop PC or laptop.
2. Create a folder on the new memory card called **SQLBackup**.
   Note: This exact name must be used.
3. Press the **Tools** button, and then press the **Shutdown** button to close the software.
4. Switch off the cabinet power switch (Figure 1).
5. Open the cabinet door and locate the memory card on the underside of the controller (on the back of the door).
   You need a screwdriver to remove the cover over the card.
6. Push the black button to the left of the memory card upwards to release the card (Figure 21).

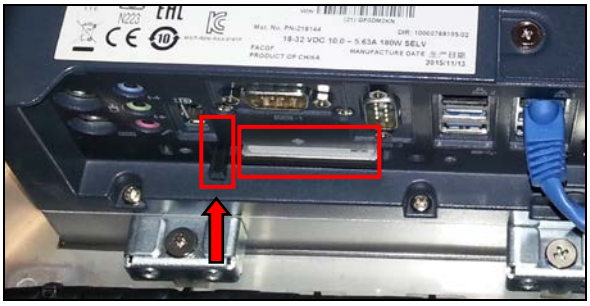


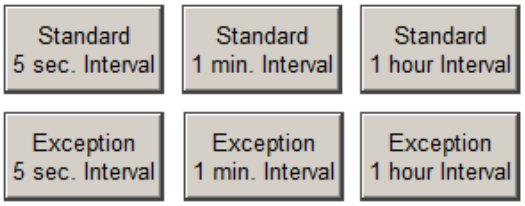
Figure 21: Removing the memory card

7. Insert the new card and push upwards until it clicks into place. Replace the cover.
8. Close the cabinet and switch on the cabinet power switch.

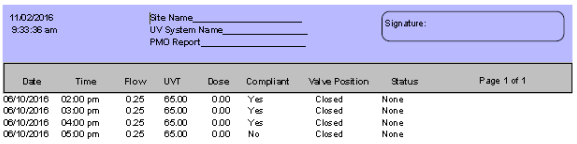
The software will restart and create a full copy of the database on the new card.

5.11.4 Generating reports

1. On the Overview screen, press **Overview Settings**.
2. Press **Page Down** to view the PMO Reports setting.



3. Select the required report option.
   Standard reports contain all data within a selected time period. **Exception** reports only contain data when the system was non-compliant with the PMO. Once the selection is made, the last report generated is displayed.
4. Press the Refresh icon on the toolbar near the top of the screen.
   The Refresh Report Data dialog is displayed.
5. To refresh the report for the date and time range selected previously, select **Use current parameter values** and then press **OK**.
   The updated report is displayed (Figure 22).
   OR
   To select a new reporting period, select **Prompt for new parameter values** and then press **OK**.
6. Select a new date and time range using the Enter Values dialog. Click the Calendar icon to quickly select a date. Choose to include the selected dates by selecting **Include this value**. Select **No lower value** to report all previous data and select **No upper value** to report data up to the moment that the report is created. Press **OK**.
   The updated report is displayed (Figure 22).


11/02/2016
9:33:36 am
Site Name_____
UV System Name_____
PMO Report_____
Signature:
Page 1 of 1

Date	Time	Flow	UVT	Dose	Compliant	Valve Position	Status
06/10/2016	02:00 pm	0.25	65.00	0.00	Yes	Closed	None
06/10/2016	03:00 pm	0.25	65.00	0.00	Yes	Closed	None
06/10/2016	04:00 pm	0.25	65.00	0.00	Yes	Closed	None
06/10/2016	05:00 pm	0.25	65.00	0.00	No	Closed	None

Figure 22: Report example

Standard reports contain columns for the Date, Time, Flow, UVT (transmittance), UV Dose, Compliant, Valve Position and Status. In addition, any operator comments or loss of data from the selected reporting period are presented as a sub-report in the footer of the main report.
Exception reports are similar except that there is no Compliant column (all the data in these reports refers to periods when the system was non-compliant).
Note: Non-compliance events are recorded as they occur, regardless of the time interval selected for the report.

5.11.5 Exporting reports

1. Press the Export icon on the main toolbar in the Report screen.
   The Export dialog is displayed.
2. Select the **PDF** format option.
3. Select the destination option.
   Reports can be saved either to the control computer hard drive or to an external disk connected through the USB port on the control panel.
4. Press **OK**.
   The Export Options dialog is displayed.
5. Select whether to print the entire report or select a page range, and press **OK**.
   The Choose Export File dialog is displayed.
6. Browse to the file location and select a file name, and press **Save**.
   The report is saved to the chosen location.

6. MAINTENANCE OF THE REACTOR AND THE CONTROL CABINETS

6.1 CLEANING THE QUARTZ SLEEVES

6.1.1 General

The quartz sleeves have to be cleaned on a regular basis. The optimum frequency for doing this depends on the liquid and has to be established on the basis of on-hand experience working with the system.
If the optional cleaning mechanism is used, cleaning can take place while the system is operating.
If there is no cleaning mechanism fitted, then one of the following methods must be used:

- Chemical cleaning (see section 6.1.2).
- Disassembling and manual cleaning of the quartz tubes (see section 7).

6.1.2 Chemical cleaning method

If the quartz sleeves become very dirty, chemicals may be added to the medium to dissolve the deposit.

- Turn off the liquid flow and the main switch of the UV system.
- Place appropriate chemicals (for example, 5% phosphoric acid) in the disinfection reactor via an external connection.
- Drain the liquid off via the drain plug or the (optional) solenoid valve after the time the chemicals need to work has elapsed. Remember to remove the ventilation plug before draining.
- Rinse the disinfection reactor with water, and drain once again via the drain hole.
- Make sure that no dirt or cleansing agent can get into the drinking water when resuming usage.
- Replace the drain and ventilation plugs.

6.2 CLEANING THE UV SENSOR AND QUARTZ WINDOW

The UV sensor measures the efficiency of the UV lamps in combination with the level of contamination of the water. A quartz window on the inside of the UV reactor covers the measuring surface of the sensor. Contamination may occur on this window and has a negative effect on the UV measurement.
When the system is serviced, the quartz window should be cleaned chemically as described in section 6.1.2.

6.2.1 Cleaning procedure

Warning

- Turn off the main switch and the circuit breakers in the power supply cabinet.
- Turn off the flow and drain the liquid in the disinfection reactor.

Step	Instruction	
1.	➢ Loosen the sensor swivel nut.	
2.	➢ Take the sensor out of the reactor carefully and clean the quartz window with a soft cloth and a small amount of alcohol.	
3.	➢ Loosen the quartz holder with a hand tool (32 mm).	

Step	Instruction	
4.	➢ Clean the quartz holder with a soft cloth and a small amount of alcohol.	
5.	➢ Fit all parts in reverse order. ➢ Switch the system on again.	

6.3 MAINTENANCE OF THE AUTOMATIC CLEANING MECHANISM

6.3.1 Introduction and safety aspects

Several parts have to be replaced after approximately 7,000 wiper movements or at least once per year.

Warning

- Turn off the main switch and the circuit breakers in the power supply cabinet.
- Turn off the flow and drain the liquid in the disinfection reactor.

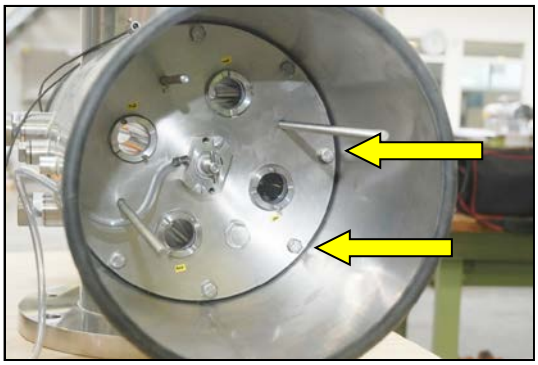
Warning

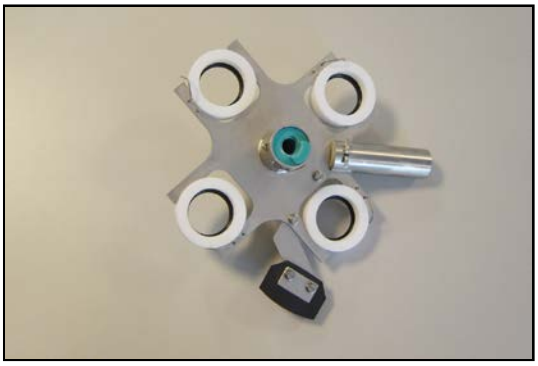
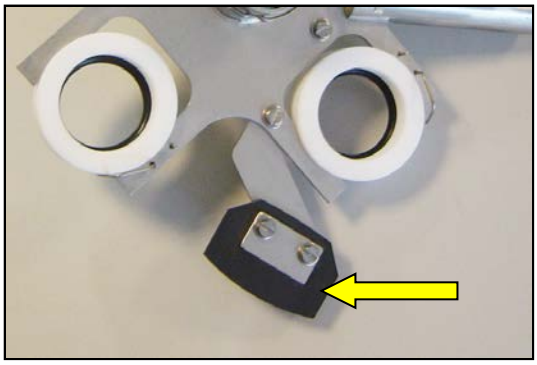
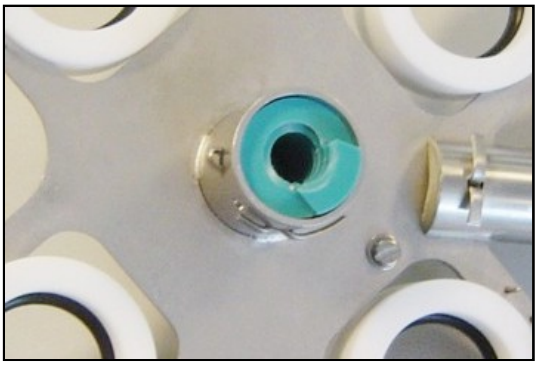
- Remember that the lamps can be hot.

Caution

- Wear clean gloves free of talc powder and grease to avoid damaging the lamps.

6.3.2 Wiper replacement procedure

Step	Instruction	
1.	➢ Remove the lamps and the quartz sleeves, as described in section 7.1 and 7.2.	
2.	On the side of the motor of the cleaning mechanism: ➢ Remove the lamp flange of the disinfection reactor, together with the threaded spindle and the wiping blade.	

Step	Instruction	
3.	➢ Unscrew the wiping blade of the spindle. ➢ Replace the wiper rings.	
4.	➢ If necessary, replace the wiper flap for the sensor window. See item 4 in Figure 23.	
5.	➢ Replace the seal of the threaded spindle (item 1 in Figure 23) and the plastic threaded nut (item 2) as necessary but at least once a year. ➢ Disassemble the bearing casing (item 3), and remove the bearing and replace the seal. ➢ Reassemble the parts. ➢ Replace the lamps and quartz sleeves according to the instructions in section 7.2.	

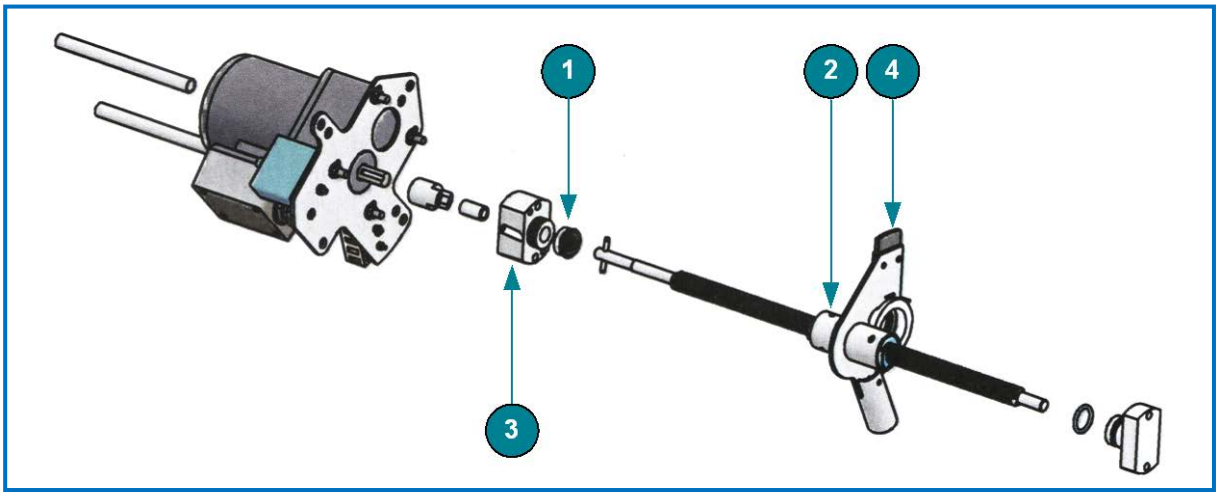


Figure 23: Exploded view of automatic cleaning mechanism

6.4 VENTILATION OF THE CONTROL CABINET

- Regularly check and, if necessary, replace the dust filters in the cabinet ventilators.

6.5 EARTH LEAKAGE CIRCUIT BREAKER CHECK

- Every month, check the earth leakage circuit breaker to make sure it is working properly by pressing the test button. The system should shut down immediately.

6.6 CLEAN-IN-PLACE

If high temperature or chemical cleaning is to be performed on the process equipment, the UV system must be switched off completely:

1. Turn off the UV lamps using the **Reactor OFF** button if in Local mode, or a SCADA command if in Remote mode.
2. Switch off the system at the main switch.

Once the cleaning process is completed, allow the chamber temperature to return to normal levels before switching the system on (section 5.6.1).

7. REPLACING LAMPS AND QUARTZ SLEEVES

This procedure describes the actions needed to initially fit or replace UV lamps and to clean or replace quartz sleeves.

7.1 SAFETY PRECAUTIONS

Warning

- Turn off the main switch and the circuit breakers in the power supply cabinet.
- Turn off the flow and drain the liquid in the disinfection reactor..

Warning

- Remember that the lamps can be hot.

Caution

- Wear clean gloves free of talc powder and grease to avoid damaging the lamps.

Attention

Outworn lamps and lamp groups must be replaced as soon as their UV intensity (after cleaning) is 5% or less above the minimum value.

Attention

See the ‘Detail Lamp Configurations’ diagram for the position of the lamps in the disinfection reactor. This is important in obtaining an optimum distribution of the UV illumination in the liquid flow.

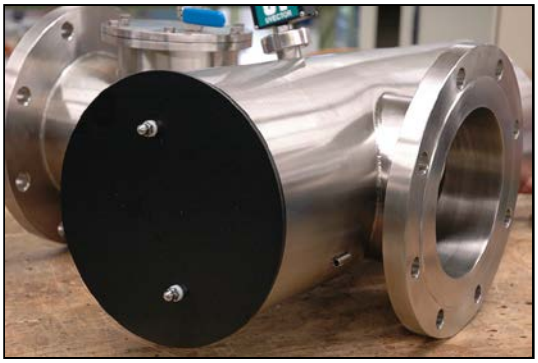
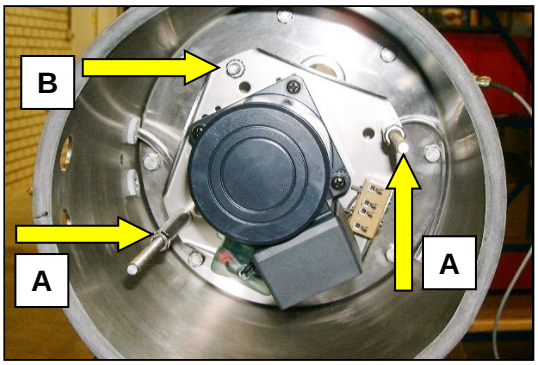
Attention

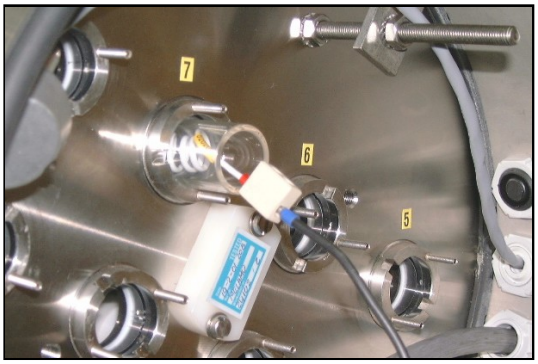
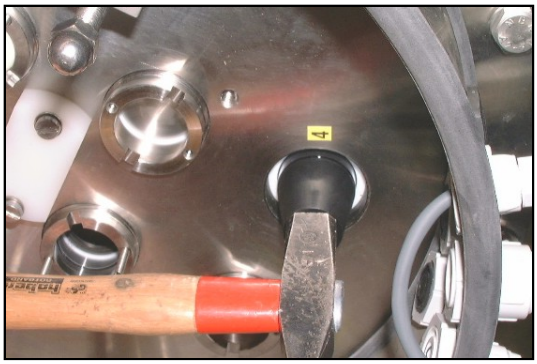
If the lamp located nearest the UV sensor has to be replaced because of a defect, it must be replaced with a lamp that is already being used in the system. In this way, lamps with differing outputs will least affect the UV measurement.

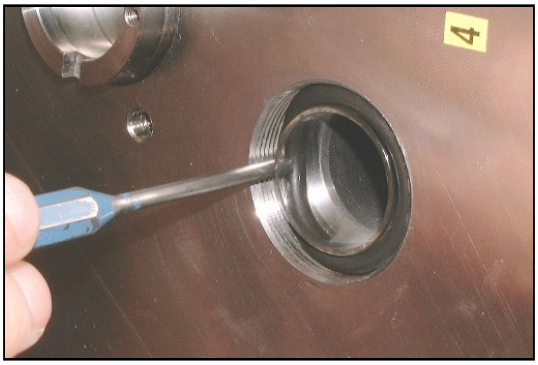
7.2 MAIN REPLACEMENT PROCEDURE

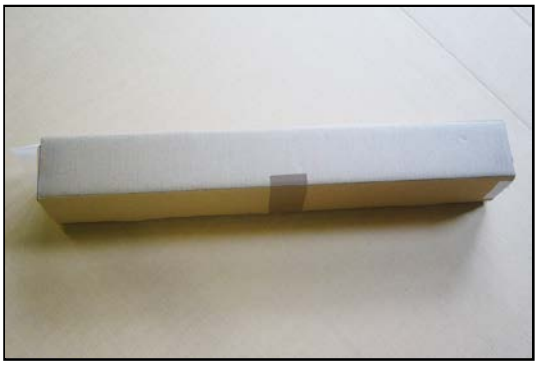
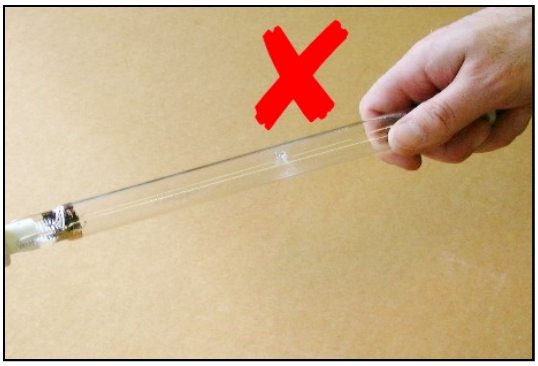
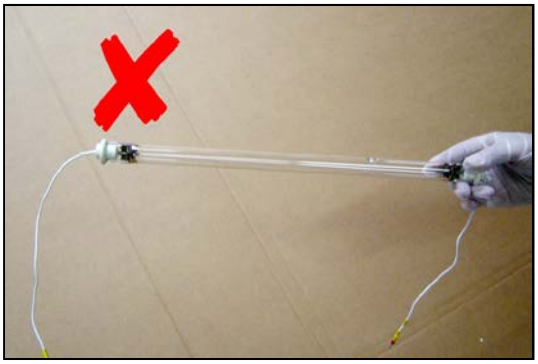
Tip

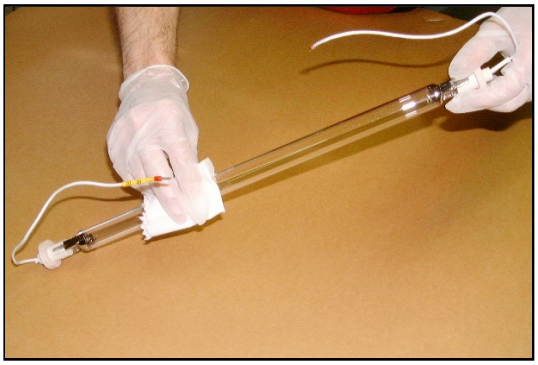
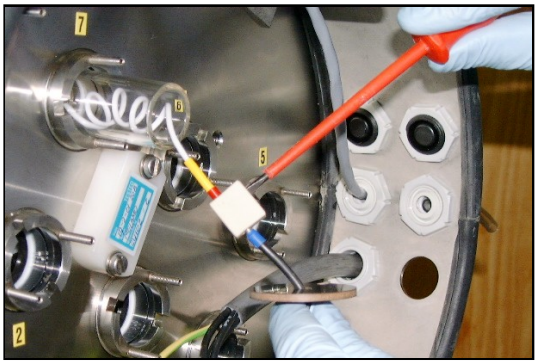
- Steps 1 to 3 and 12 to 21 are sufficient when fitting the lamps for putting into use the first time.
- Steps 1 to 5 and 12 to 21 are sufficient for the replacement of a worn or defective lamp (without cleaning the quartz sleeve).

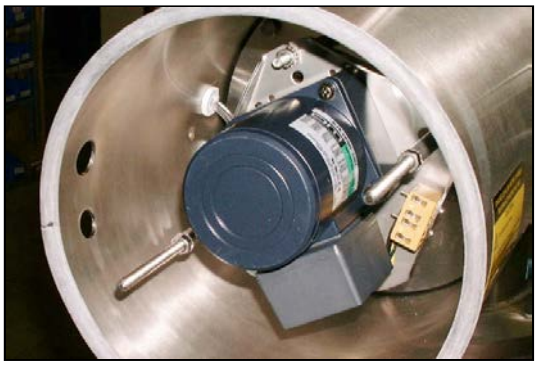
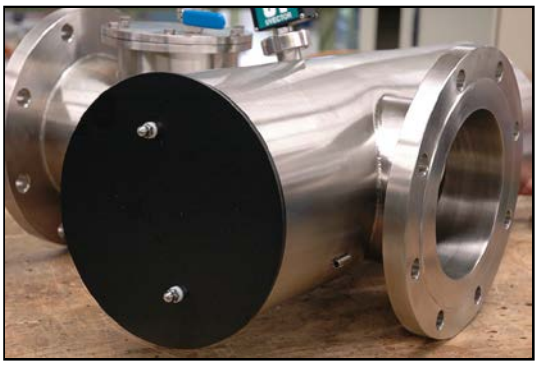
Step	Instruction	
1.	➢ Remove the black cover plate on both sides.	
2.	With systems with automatic cleaning mechanism, if necessary: ➢ Remove the nuts (A) and the extension pipes on the side of the wipe motor. ➢ Remove the nuts (B) of the motor plate. ➢ Take out the motor with motor plate.	
3.	➢ Remove the lamp holder plate (2 M4 nuts) on both sides of the reactor.	

Step	Instruction	
4.	➢ Loosen the lamp wire on the connector block (both sides).	
5.	➢ Take the old lamp out of the quartz sleeve, together with the two glass tubes (make sure that the two glass tubes do not get mixed up as there may be a difference in length).	
6.	➢ On both sides use the flat spanner to unscrew the M44 nut from the tube.	
7.	➢ Place the black mandrel into the end of the quartz tube. ➢ Carefully tap the tube out of the sealing rings using a hammer. ➢ Or: use the Jupito (see section 7.3).	

Step	Instruction	
8.	➢ Clean the tube using alcohol. Never touch the tube with bare hands. ➢ If necessary: replace the wipe-rings (see section 6.3.2). ➢ Refit the quartz tube in the UV body.	
9.	➢ Moisten the black O-rings using clean water and slide these over the quartz tube on both sides. ➢ Push the O-rings into place using an appropriate tool. ➢ Keep the tube symmetrical between both ends.	
10.	➢ Place both white backing rings over both ends of the quartz sleeve.	
11.	➢ Using the special spanner, screw the M44 nuts back into the body on both sides.	

Step	Instruction	
12.	➢ New UV lamps are supplied in cardboard packaging, including instructions.	
13.	➢ Never touch the glass of the lamp with bare hands.	
14.	➢ Do not hold the lamp by one end.	
15.	➢ Wear clean gloves and only hold the lamp by the ends.	

Step	Instruction	
16.	➢ If necessary clean the lamp with a cotton cloth and a little alcohol, but never touch it with bare hands.	
17.	➢ Slide the lamp carefully into the quartz sleeve. Keep the lamp horizontal. ➢ Make sure that the two glass tubes are not mixed up as there may be a difference in length.	
18.	➢ First connect the lamp wire on the non-service side, so that the wiring connector is easily accessible. ➢ Then connect the lamp wire on the service side (see photograph).	
19.	➢ To keep the lamp in position the lamp holder plate must be slid over the wire ends and secured with the M4 nuts. ➢ Do not use any tools for this.	

Step	Instruction	
20.	➢ If necessary: fit the wipe motor.	
21.	➢ Fit the black cover plate on both sides.	

7.2.1 Resetting the service history

After replacing the lamp and servicing the wiper mechanism, the service history of the components must be reset in the software.

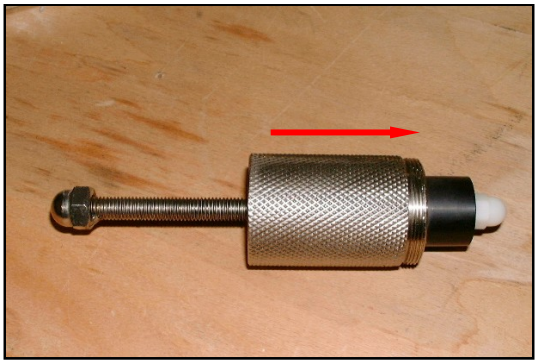
1. Log in as either the Secure or Maintenance user.
2. Press the **UV Reactor** button on the top toolbar to display the Reactor screen.
3. Press the **Lamp/Wiper** button to display the Lamp/Wiper screen.
4. Press the **Clear** button for the wiper and for each lamp that has been replaced, as appropriate.

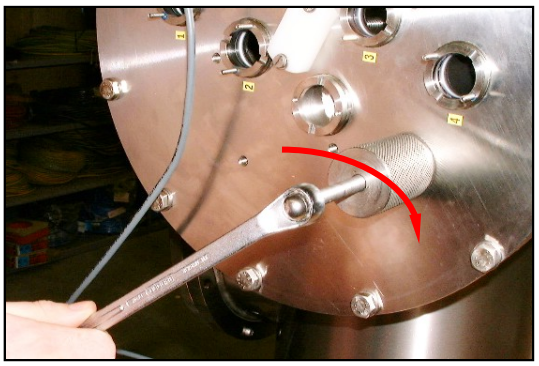
7.3 REMOVING QUARTZ SLEEVES WITH THE JUPITO

Quartz sleeves that have become stuck due to water pollution may be removed easily using the Jupito. The use of a hammer is not necessary.

Caution
If a quartz sleeve is really stuck, there is always the risk that it will break.

Use the Jupito as follows:

Step	Instruction	
1.	➢ Remove the UV lamp and the two M-44 nuts that lock the quartz sleeve (see section 7.2).	
2.	➢ Screw the holder of the Jupito fully in the direction of the white plastic cap.	
3.	➢ Therefore not like this.	

Step	Instruction	
4.	➢ Screw the holder into the lamp flange of the UV reactor. ➢ Do not tighten the holder so that the O rings of the quartz sleeves are not clamped extra tight.	
5.	➢ Using a ring spanner turn the spindle *carefully* several turns to the right.	
6.	➢ The quartz sleeve is now pressed out of the UV reactor on the other side.	

8. DISPOSAL

8.1 GENERAL

If the UV system is no longer used and has to be disassembled, the following steps should be carried out (these points only apply to official supplier parts as described in this manual):

- Ensure that the liquid flow has been shut down and that the entire pipework system is empty.
- Ensure that the control cabinet and operating console have been disconnected.
- Remove the electricity mains connections (plugs) and remove the plugs from the cables.
- Disassemble the disinfection reactor, remove the UV lamps carefully according to the instructions of chapter 7.
- Dispose of the lamps according to local regulations or send them back to the system supplier.
- Disassemble the system further working from top to bottom. Use appropriate tools for this and observe safety procedures.

Attention

All parts must be disposed of in accordance with local regulations; preferably by sending them to a company that can recycle the materials.

Attention

Do not dispose of the equipment as unsorted municipal waste.

8.2 RETURNING OLD LAMPS

Used lamps can be returned to the system supplier. To do this, ask for the required “RMA number” beforehand.

Attention

Do not dispose of old lamps as unsorted municipal waste.

APPENDIX A CE DECLARATION (EXAMPLE)

EC Declaration of conformity

In accordance with Machine guideline 2006/42/EG – Appendix II.1.A

Declares that the product

Product : UV system
Type :
Serial number :

is in conformity with the European directives:

- Machine Directive 2006/42/EC (with amendments)
- EMC Directive 2004/108/EC (with amendments)

On behalf of the manufacturer the technical documentation may be set up by the signatory of this declaration.

The UV system is in conformity with the following harmonised standards:

- EN 349:1994 +A1:2008 : Safety of machinery -- Minimum gaps to avoid crushing of parts of the human body
- EN-ISO 12100:2010 : Safety of machinery -- General principles for design -- Risk assessment and risk reduction
- EN-ISO 13850:2006 : Safety of machinery -- Emergency stop -- Principles for design
- EN-ISO 13857:2008 : Safety of machinery -- Safety distances to prevent hazard zones being reached by upper and lower limbs
- EN-IEC 60204-1:2006 : Safety of machinery -- Electrical equipment of machines -- Part 1: General requirements
- EN-IEC 61000-6-2:2005 : Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards -- Immunity for industrial environments
- EN-IEC 61000-6-3:2007 : Electromagnetic compatibility (EMC) -- Part 6-3: Generic standards -- Emission standard for residential, commercial and light-industrial environments

Signature

Date:

Name :

APPENDIX B QUALITY CERTIFICATE (EXAMPLE)

Quality certificate

Warranty certificate

Product : UV system
Type :
Serial number :
Hanovia order no.:

Hanovia hereby certifies that this Ultraviolet System was designed, manufactured and tested according to applicable Hanovia procedures. These procedures are ISO 9001 and ISO 14001 controlled, and are designed to assure that the installation meets the agreed specifications and that environmental guidelines are maintained.

The Test Results have been found to comply with the above-mentioned specification.

Hanovia warrants its installations for a period of 1 year from delivery, according to the “General Terms & Conditions, Orgalime”, and the “Hanovia Standard Terms & Conditions” that are available on request.

Test Engineer
Signature:

Name :
Date :

Quality Control
Signature:

Name :
Date :

In case of any inconvenience or if you have recommendations for improvement please contact our **Customer Service Department**: