xylem
Let's Solve Water

Installation, Operation, and Maintenance Manual

90029701_2.0

Duron 6

PLC UV System, One Channel

xylem
Let's Solve Water

Table of Contents

1 Introduction and Safety....5
1.1 Introduction....5
1.2 Safety terminology and symbols....5
1.3 User safety....7
1.4 Special hazards....7
1.4.1 UV exposure....7
1.4.2 Mercury in UV lamps....8
1.4.3 Di(2–ethylhexyl)phthalate (DEHP) and cadmium (Cd) in cables....8
1.4.4 For USA only: Labels for FIFRA and California Proposition 65....8
1.4.5 Interference emission....9
1.5 Protecting the environment....9
1.6 End-of-life product disposal....9
1.7 Spare parts....10
1.8 Warranty....10

2 Transportation and Storage....11
2.1 Precautions....11
2.2 Examine the delivery....11
2.2.1 Examine the package....11
2.2.2 Examine the unit....12
2.3 Lifting guidelines....12
2.3.1 Lifting....12
2.4 Storage guidelines....12
2.4.1 Long-term storage....13

3 System Description....15
3.1 System overview....15
3.2 UV bank....16
3.3 Automatic wiping system....18
3.4 Level control....19
3.4.1 Low-level probe....20
3.4.2 Ultrasonic level sensor....20
3.4.3 Downward opening penstock....21
3.4.4 Finger weir....21
3.4.5 Fixed pipe weir....22
3.5 UV transmittance monitor....22
3.6 Channel cover....23
3.7 Cabinets....23
3.7.1 Control 48 PLC cabinet....24
3.7.2 ICA cabinet....24
3.7.3 Electronic ballast cabinet....25
3.7.4 Lift control cabinet....25
3.7.5 Wiper control cabinet....25
3.7.6 Optional cabinets....26

4 Mechanical Installation....28
4.1 Precautions....28
4.2 Necessary tools and equipment....29
4.3 Requirements....29
4.4 Drill size and depth....30
4.4.1 Install the anchor bolt....31

4.5 Drilling: mounting plates and mixing rods....32
4.5.1 Attach the drilling template....33
4.5.2 Drill the holes for the mounting plate and the mixing rod....34
4.5.3 Remove the drilling template....35
4.6 Drilling: ultrasonic level sensor and low-level probe....35
4.7 Install the mounting plate....35
4.8 Install the mixing rod....37
4.9 Install the module guide rack....38
4.10 UV module installation....39
4.10.1 Prepare the UV module....39
4.10.2 Install the UV module....40
4.10.3 Adjust the sealing plate on the UV module....41
4.11 Install the centering angle bracket....42
4.12 Adjust the electric lift box....43
4.13 Install the UV light shield....45
4.13.1 Adjust the UV light shield at the UV module....46
4.14 Install the ultrasonic level sensor....47
4.14.1 Adjust the ultrasonic level sensor....47
4.15 Install the low-level probe....49
4.15.1 Adjust the low-level probe....50
4.16 Installation of optional equipment....50
4.16.1 Fixed weir....50
4.16.2 Downward opening penstock....50
4.16.3 Air compressor....50
4.16.4 UV transmittance monitor....50

5 Electrical Installation....51
5.1 Precautions....51
5.2 Necessary tools and equipment....52
5.3 Cabinet installation....52
5.3.1 Requirements....52
5.3.2 Install the cabinet....52
5.3.3 Install the additional cabinets....53
5.3.4 Install the wiper control cabinet or the lift control cabinet....55
5.4 Cable installation....55
5.4.1 Requirements....55
5.4.2 Install the cables....56

6 Maintenance....58
6.1 Precautions....58
6.2 Inspection....60
6.3 Clean the transparent surfaces....62
6.4 Isolate the UV system....62
6.5 Operation of the UV module lift....63
6.5.1 Electric lift operation....63
6.5.2 Manual lift operation....65
6.6 UV module removal....67
6.6.1 Remove the UV module: Electric lift....67
6.6.2 Remove the UV module: Manual lift....68
6.7 UV module installation....69
6.7.1 Install the UV module: Electric lift....69
6.7.2 Install the UV module: Manual lift....70
6.8 Clean the UV module manually....70
6.9 Replace the UV lamps....71
6.9.1 Remove the UV lamp....71
6.9.2 Install the UV lamp....72
6.10 Replace the wiper rings....73

6.10.1 Remove the wiper rings....73
6.10.2 Install the wiper rings....74
6.11 Replace the spindle nut....75
6.11.1 Remove the spindle nut....75
6.11.2 Install the spindle nut....78
6.12 Replace the UV sensor....79
6.12.1 Remove the UV sensor....79
6.12.2 Install the UV sensor....81
6.13 Clean the filter mat....82

7 Water Sampling....83
7.1 Precautions....83
7.2 Standard....83
7.3 Examples of equipment....83
7.4 Sampling plan....84
7.5 Prepare the UV system....85
7.6 Sample collection....86
7.6.1 Collect the sample: Manually....86
7.6.2 Collect the sample: Depth sampler....86

8 Troubleshooting....87
8.1 Precautions....87
8.2 Warning....88
8.2.1 AIR CONDITIONER FAILURE, CHANNEL 'x' BANK 'y'....88
8.2.2 AIR COMPRESSOR OVERLOAD....89
8.2.3 AIR PRESSURE LOW....89
8.2.4 LAMP FAILURE, CHANNEL 'x' BANK 'y'....89
8.2.5 LAMP HOUR GUARANTEE EXCEEDED, CHANNEL 'x' BANK 'y'....90
8.2.6 LAMP HOUR GUARANTEE EXCEEDED, CHANNEL 'x' BANK 'y' ROW 1....90
8.2.7 LAMP HOUR GUARANTEE EXCEEDED, CHANNEL 'x' BANK 'y' ROW 2....91
8.2.8 MODULE LIFT FAILURE, CHANNEL 'x' BANK 'y'....91
8.2.9 SIGNAL FAILURE: INLET PENSTOCK POSITION, CHANNEL 'x'....91
8.2.10 SURGE SUPPRESSOR FAILURE, CHANNEL 'x' BANK 'y'....92
8.2.11 UPS NOT OK....92
8.2.12 UV DOSE LOW WARNING, CHANNEL 'x'....92
8.2.13 UV INTENSITY LOW WARNING, CHANNEL 'x' BANK 'y'....93
8.2.14 UV TRANSMITTANCE BELOW MINIMUM DESIGN UVT....94
8.2.15 UV TRANSMITTANCE MANUAL OVERRIDE IS ENABLED....95
8.2.16 WIPE COUNT EXCEEDS WARRANTY, CHANNEL 'x' BANK 'y'....95
8.2.17 WIPE COUNT EXCEEDS WARRANTY, CHANNEL 'x' BANK 'y' MODULE 1....95
8.2.18 WIPER FAILURE, CHANNEL 'x' BANK 'y' MODULE 1....95
8.2.19 WIPER NOT AT END, CHANNEL 'x' BANK 'y'....96
8.2.20 WIPER NOT AT REST, CHANNEL 'x' BANK 'y'....96
8.3 Alarm....97
8.3.1 24V PSU #1 FAILURE, CHANNEL 'x' BANK 'y'....97
8.3.2 BALLAST INTERMEDIATE VOLTAGE FAILURE, CHANNEL 'x' BANK 'y'....98
8.3.3 BALLAST TEMPERATURE HIGH, CHANNEL 'x' BANK 'y'....98
8.3.4 ECOTOUCH COMMUNICATION FAILURE, CHANNEL 'x' BANK 'y'....98
8.3.5 ENCLOSURE OVERLOAD BREAKER, CHANNEL 'x' BANK 'y'....99
8.3.6 ENCLOSURE TEMPERATURE HIGH, CHANNEL 'x' BANK 'y'....99
8.3.7 FLOW PER LAMP EXCEEDS MAXIMUM VALIDATED LIMIT. RED IS EXTRAPOLATED, CHANNEL 'x'....99
8.3.8 ICA 24V PSU #1 FAILURE....100
8.3.9 ICA 24V PSU #1 OVERLOAD....100
8.3.10 ICA ENCLOSURE 24V PSU FAILURE....101
8.3.11 ICA ENCLOSURE OVERLOAD....101
8.3.12 ICA IS ON UPS POWER....101

8.3.13 ICA MAINS FAILURE..... 102
8.3.14 INLET PENSTOCK FAILURE, CHANNEL 'x'..... 102
8.3.15 INLET PENSTOCK FAILED TO CLOSE, CHANNEL 'x'..... 103
8.3.16 INLET PENSTOCK FAILED TO OPEN, CHANNEL 'x'..... 103
8.3.17 INLET PENSTOCK NOT IN REMOTE, CHANNEL 'x'..... 103
8.3.18 INLET PENSTOCK OVERLOAD FAILURE, CHANNEL 'x'..... 104
8.3.19 INLET PENSTOCK TORQUE CLOSE, CHANNEL 'x'..... 104
8.3.20 INLET PENSTOCK TORQUE OPEN, CHANNEL 'x'..... 104
8.3.21 I/O BOARD FAILURE, CHANNEL 'x' BANK 'y'..... 105
8.3.22 LAMP FAILURE, Channel 'x' Bank 'y' ROW 1..... 105
8.3.23 MULTIPLE LAMP FAILURE, CHANNEL 'x' BANK 'y'..... 105
8.3.24 OUTLET PENSTOCK FAILURE, CHANNEL 'x'..... 106
8.3.25 OUTLET PENSTOCK FAILED TO CLOSE, CHANNEL 'x'..... 106
8.3.26 OUTLET PENSTOCK FAILED TO OPEN, CHANNEL 'x'..... 107
8.3.27 OUTLET PENSTOCK NOT IN REMOTE, CHANNEL 'x'..... 107
8.3.28 OUTLET PENSTOCK OVERLOAD FAILURE, CHANNEL 'x'..... 108
8.3.29 OUTLET PENSTOCK POSITION FAILURE, CHANNEL 'x'..... 108
8.3.30 OUTLET PENSTOCK TORQUE CLOSE, CHANNEL 'x'..... 109
8.3.31 OUTLET PENSTOCK TORQUE OPEN, CHANNEL 'x'..... 109
8.3.32 RACK 1 BALLAST OVERLOAD, CHANNEL 'x' BANK 'y'..... 110
8.3.33 REMOTE IO COMMUNICATIONS FAILURE, CHANNEL 'x'..... 110
8.3.34 SAFETY RELAY FAILURE, CHANNEL 'x' BANK 'y'..... 111
8.3.35 SCADA COMMUNICATIONS FAILURE..... 111
8.3.36 SIGNAL FAILURE: FLOW RATE, CHANNEL 'x'..... 112
8.3.37 SIGNAL FAILURE: OUTLET PENSTOCK POSITION, CHANNEL 'x'..... 112
8.3.38 SIGNAL FAILURE: ULTRASONIC LEVEL SENSOR 1, CHANNEL 'x'..... 112
8.3.39 SIGNAL FAILURE:ULTRASONIC LEVEL SENSOR 2, CHANNEL 'x'..... 113
8.3.40 SIGNAL FAILURE: UV INTENSITY, CHANNEL 'x' BANK 'y'..... 113
8.3.41 SIGNAL FAILURE: UV SYSTEM FLOW RATE..... 114
8.3.42 SIGNAL FAILURE: UV TRANSMITTANCE MONITOR..... 114
8.3.43 UV DOSE BELOW MINIMUM DESIGN DOSE, CHANNEL 'x'..... 115
8.3.44 UV INTENSITY LOW ALARM, CHANNEL 'x' BANK 'y'..... 116
8.3.45 UV SYSTEM FLOW BELOW MINIMUM DESIGN FLOW..... 117
8.3.46 UV SYSTEM FLOW EXCEEDS MAXIMUM DESIGN FLOW 117
8.3.47 UV TRANSMITTANCE BELOW MINIMUM VALIDATED LIMIT. RED IS EXTRAPOLATED..... 118
8.3.48 UV TRANSMITTANCE MONITOR NOT OK..... 118
8.3.49 WATER LEVEL HIGH, CHANNEL 'x'..... 118
8.3.50 WATER LEVEL LOW, CHANNEL 'x'..... 119
8.3.51 WATER LEVEL LOW VIA ULTRASONIC SENSOR, CHANNEL 'x'..... 119

9 Other Relevant Documentation or Manuals..... 120
9.1 Reference documents..... 120

10 Glossary..... 121
10.1 Terms..... 121

1 Introduction and Safety

1.1 Introduction

Purpose of the manual

The purpose of this manual is to provide the necessary information for working with the unit. Read this manual carefully before starting work.

Read and keep the manual

Save this manual for future reference, and keep it readily available at the location of the unit.

Other manuals

See also the safety requirements and information in the original manufacturer's manuals for any other equipment furnished separately for use in this system.

Intended use

WARNING:

Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment and the surroundings. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.

Basis of the manual

This manual is based on the requirements of the relevant EU directives, the relevant standards and on the results of the risk assessment for the types of unit and their application.

1.2 Safety terminology and symbols

About safety messages

Before handling the product, it is important to read, understand, and follow the safety messages and regulations carefully. They are published to prevent these hazards:

- Personal accidents and health problems
- Damage to the product and its surroundings
- Product malfunction

Hazard levels

Hazard level		Indication
	DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
	WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
	CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury

Hazard level	Indication
NOTICE:	Notices are used when there is a risk of equipment damage or decreased performance, but not personal injury.

Special symbols

Some hazard categories have specific symbols, which are shown in the following table.

Electrical hazard	Ultraviolet radiation	Electromagnetic field

Hot surface	Mercury

The following table shows symbols for personal protective equipment.

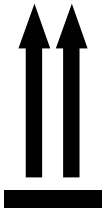
Safety goggles	Face shield

Protective gloves	Safety footwear	Safety helmet

The symbols in the following table show specific precautions.

Do not touch the electrical parts	No unauthorized persons	Disconnect the power supply

Transport and storage symbols

This way up	Keep dry	Fragile, handle with care
The arrows show the upright position.	The crates shall be transported and stored in a dry environment.	These are fragile components. Handle them with special care.
		

1.3 User safety

All regulations, codes, and health and safety directives must be followed.

The site

- The lockout and tagout procedures must be followed before any work is started on the product, such as transport, installation, maintenance, or service.
- The surroundings of the equipment must always be noted. Hazards from the operating site or the surrounding equipment must be taken into attention.

Qualified personnel

Only personnel that are qualified for the UV system are allowed to install, operate, and maintain the UV system.

Repairs

Only authorized Xylem personnel are allowed to repair the UV system.

Personal protective equipment and safety devices

- Suitable and approved personal protective equipment must always be used as required.
- All safety devices must be functional and in use always during operation of the UV system.

1.4 Special hazards

1.4.1 UV exposure

Normal operation

The UV light is shielded when the channel covers are closed. There is no risk of UV exposure for the site operator during normal operation and maintenance.

CAUTION: Ultraviolet (UV) Light Hazard

UV light can burn eyes and skin. Never operate the UV lamps outside of the UV system.

Unshielded operation

In certain situations of maintenance UV light may be emitted from openings.

UV light causes strong sunburn to the skin, and irritates the eyes, leading to conjunctivitis.

Personal protective equipment

Always use applicable personal protective equipment to protect the skin and eyes.

- Use safety goggles or a face shield which are approved for UV light.
- Use clothes which cover your skin completely.

1.4.2 Mercury in UV lamps

The UV lamps contain small amounts of mercury. Depending upon the exposure, mercury is known to be toxic.

WARNING: Chemical Hazard

This product can expose you to Mercury. Mercury is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to: *www.P65Warnings.ca.gov*.

Safe disposal

End-of-life products that contain mercury must be managed correctly to protect the public health and the environment.

NOTICE:

The UV lamps contain mercury. They must be disposed of in accordance with the disposal laws.

For more information, see *https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_de* and *www.lamprecycle.org*
1-866-457-6697

1.4.3 Di(2–ethylhexyl)phthalate (DEHP) and cadmium (Cd) in cables

The cables contain small amounts of DEHP and cadmium.

WARNING: Chemical Hazard

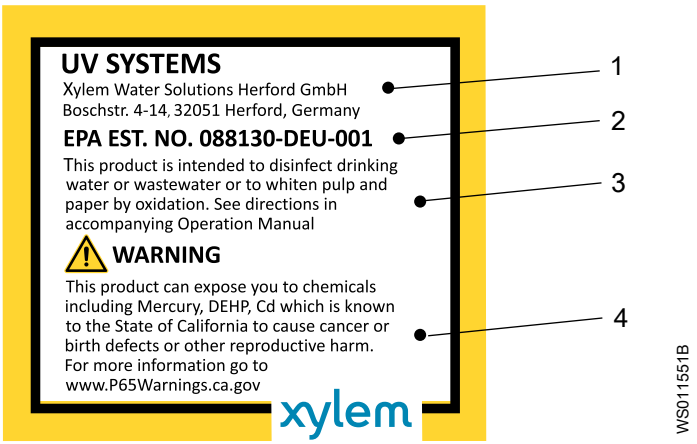
This product can expose you to Di(2-ethylhexyl)phthalate (DEHP). DEHP is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to: *www.P65Warnings.ca.gov*.

WARNING: Chemical Hazard

This product can expose you to Cadmium. Cadmium is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to: *www.P65Warnings.ca.gov*.

1.4.4 For USA only: Labels for FIFRA and California Proposition 65

This product is regulated in the United States of America by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). In compliance with FIFRA requirements, certain components of this product have the following label.



Item	Description
1	Company name and address
2	Establishment number from Environmental Protection Agency (EPA), USA
3	Intended use of the product and reference to the directions to be followed
4	List of chemicals that this product can expose which are known to the State of California to cause cancer or birth defects or other reproductive harm. For more information, go to *www.P65Warnings.ca.gov*.

1.4.5 Interference emission

NOTICE:

This equipment is not intended for use in residential environments. It might not provide adequate protection to radio reception in residential environments.

1.5 Protecting the environment

Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities
- Sorting, recycling and disposal of solid or liquid waste
- Clean-up of spills

Exceptional sites

CAUTION: Radiation Hazard

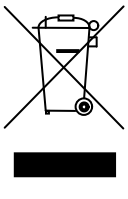
Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

1.6 End-of-life product disposal

Handle and dispose of all waste in compliance with local laws and regulations.

EU and UK only: Correct disposal of this product — waste electrical and electronic equipment

- EU: Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)
- UK: SI 2013 No. 3113



This marking on the product, accessories or literature indicates that the product should not be disposed of with other waste at the end of its working life.

1.7 Spare parts

CAUTION:

Only use the manufacturer's original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the warranty.

1.8 Warranty

Warranties are regulated by the sales agreement between the parties.

2 Transportation and Storage

2.1 Precautions

CAUTION:

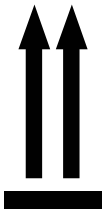
The operator must be aware of safety precautions to prevent physical injury.

CAUTION: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

Transport and storage symbols

NOTICE:

This way up	Keep dry	Handle the sensor with care.
The arrows show the upright position.	The crates shall be transported and stored in a dry environment.	These are fragile components. Handle them with special care.
		

Personal protective equipment

NOTICE:

The following personal protective equipment is needed:

- Safety gloves
- Safety footwear
- Safety helmet

2.2 Examine the delivery

2.2.1 Examine the package

1. Open the box.
2. Examine the package for damaged or missing items upon delivery.
   All the parts or assemblies that are shipped individually are listed on the packing list.
   The electronic ballasts are shipped in separate transport boxes.
3. Record any damaged or missing items:
   a) Contact the local sales and service representative to file a claim.
   b) If anything is broken or defective, then file a claim with the shipping company.

If the product is picked up at a distributor, make a claim directly to the distributor.

2.2.2 Examine the unit

1. Remove packing materials from the product.
   Dispose of all packing materials in accordance with local regulations.
2. To determine whether any parts have been damaged or are missing, examine the product.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
   Use care around nails and straps.
4. If there is any issue, then contact a sales representative.

2.3 Lifting guidelines

2.3.1 Lifting

Always inspect the lifting equipment and tackle before starting any work.

WARNING: Crush Hazard

Always lift the unit by its designated lifting points.
Use suitable lifting equipment and ensure that the product is properly harnessed.
Wear personal protective equipment.
Stay clear of cables and suspended loads.

NOTICE:

Never lift the unit by its cables or hose.

Lifting equipment

Lifting equipment is always required to handle the unit. The lifting equipment must fulfill the following requirements:

- The minimum height between the lifting hook and the floor must be sufficient to lift the unit. For more information, see Overview Drawing in the binder.
- The lifting equipment must be able to hoist the unit straight up and down, preferably without the need for resetting the lifting hook.
- The lifting equipment must be correctly anchored and in good condition.
- The lifting equipment must support the weight of the entire assembly. For more information, see the packing list.
- Only authorized personnel may use the lifting equipment.

2.4 Storage guidelines

Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

NOTICE:

Protect the product against humidity, heat sources, and mechanical damage.

NOTICE:

Do not place heavy weights on the packed product.

Stacking limit

The stacking limit of the packaging material is printed on the packaging material and given on the packing list. For more information, see Storage and Handling Guideline, STDS-003 in the binder.

Ambient condition

NOTICE:

Protect the unit from freezing temperature.

Temperature	5°C (41°F) – 40°C (104°F)
Humidity	Less than 75% without condensation

2.4.1 Long-term storage

Prepare the UV system

If the UV system is stored for the winter, this procedure must be followed.

1. Lift each UV module.

Lift type	Action
Electric	For information see, *Lift the UV module* on page 63.
Manual	For information see, *Lift the UV module* on page 65.

2. Clean the UV modules.

   For more information, see step *3* on page 70.
3. Disconnect the following items:
   - UV module connector
   - UV lamp connectors
   - Ground cable
4. If the UV lamp modules must be stored indoors, do the following steps:
   a) Use the quick connector to release each UV lamp module from the UV modules.
   b) Carefully slide each UV lamp module from the UV modules.
   c) Identify the positions of each UV lamp module correctly.

      Position markings must not be made on the quartz sleeves.
5. If the UV modules must be stored indoors, remove the UV modules.

   For more information, see *UV module removal* on page 67.
6. Turn off the main isolators of the following items:
   - Lift control cabinet
   - Wiper control cabinet
7. Turn off and lock out the main isolator of the control cabinet.

- Drain the water from the UV channels.
- If the control cabinet is not in a climate-controlled location, turn on the external power to the control cabinet. The external power is used to operate the heaters that prevent condensation.

Restore the UV system

Before the UV system is restored after the winter, the following conditions must be checked:

- There must not be any unwanted deposits on the UV system.
- There must be effluent in the UV channels.

1. Clean each UV module.

   For more information, see step *3* on page 70.
2. If the UV lamp modules were removed, do the following steps:
   a) Identify the correct position of each UV lamp module.
   b) Carefully slide the UV lamp modules into the UV modules.

      The position labels on the UV lamp modules must be removed.
   c) Use the quick connector to connect each UV lamp module to the UV modules.

3. If the UV modules were removed, install the UV modules.
   For more information, see *UV module installation* on page 69.
4. Turn on the main isolators of the following items:
   - Lift control cabinet
   - Wiper control cabinet
5. After 30 minutes, turn on the main isolator of the control cabinet.
   The UV lamps turn on immediately and attain full power after 10 minutes.

3 System Description

3.1 System overview

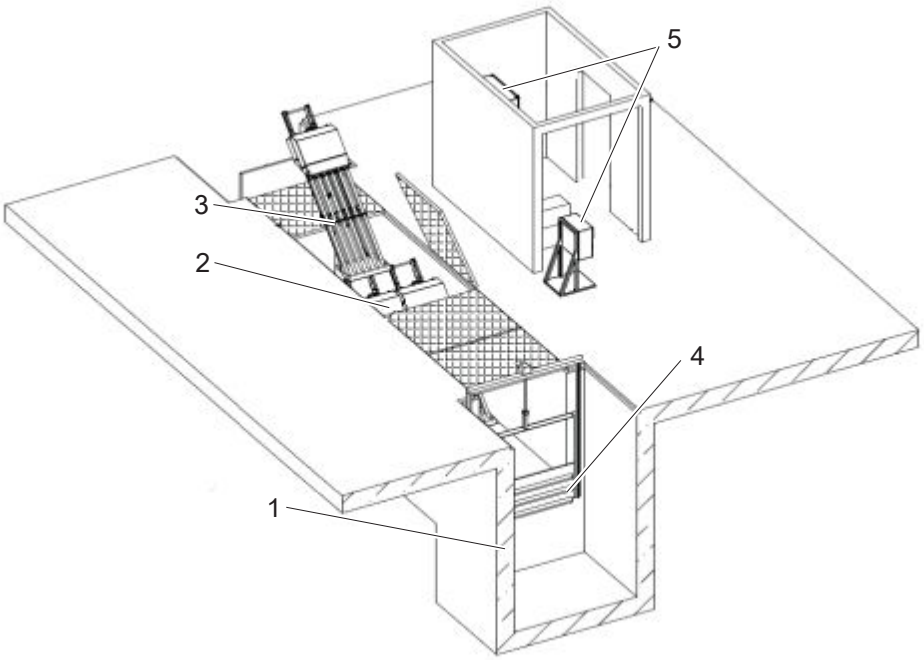
Intended use

The system is installed in a concrete channel.

Application

- Municipal wastewater disinfection for effluents that are treated in these stages:
  - Primary
  - Secondary
  - Tertiary
- Aquaculture
- Stormwater overflow
- Water reuse

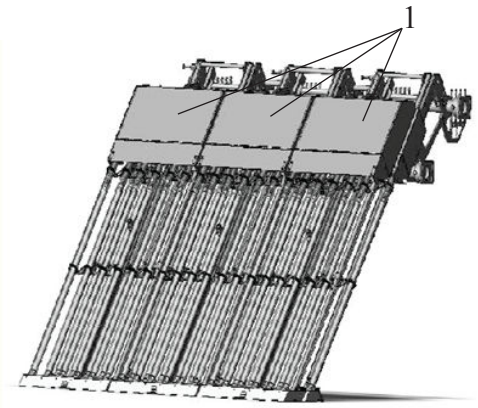
System design



Position	Item	Description
1	UV channel	Controls the effluent water For more information, see *UV channel* on page 30.
2	UV bank	Consists of one or more UV modules
3	Automatic wiping system	Consists of the following options: • Pneumatic, includes an air compressor • Electric One option is available according to the type of drive.

Position	Item	Description
4	Level control	Consists of the following items: • Low-level probe • Ultrasonic level sensor • Weir of one of the following types: – Downward opening penstock (DOP) – Finger weir – Fixed pipe weir
-	UV transmittance (UVT) monitor	Measures the UV transmittance of the water
5	Cabinets	Consists of the following cabinets: • Control 48 PLC or a combination of cabinets For more information, see *Cabinets* on page 23. • Lift control This cabinet is available when the module guide rack has an electric lift. • Wiper control
-	Customer-supplied parts	Consists of the following parts: • Flowmeter • UV channel cover • Isolation gates for the UV channel inlet

3.2 UV bank



1. UV modules

The UV bank is a modular system that consists of one or more UV modules.

UV module

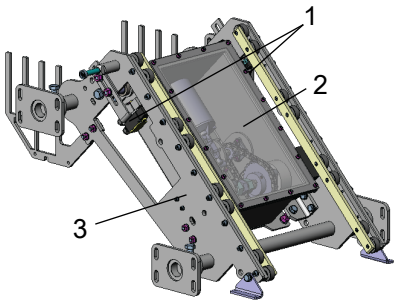
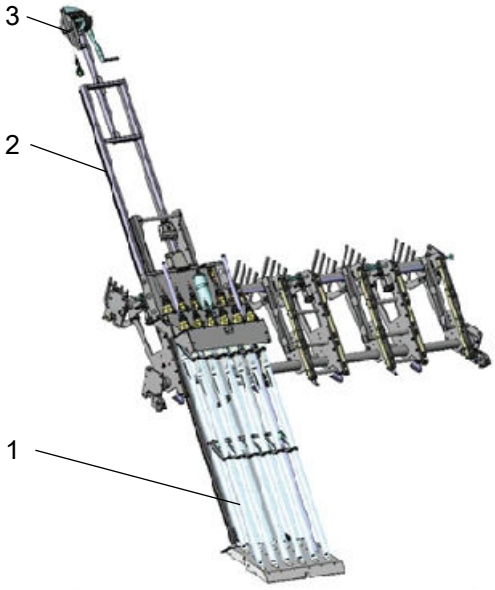
- The UV module consists of UV lamp modules that are arranged in two rows.
- The number of UV lamp modules in the UV module changes according to the configuration of the UV system.

Quantity of UV lamps in the UV module	Weight of the UV module
12	150 kg (331 lbs)
16	185 kg (408 lbs)
20	220 kg (485 lbs)

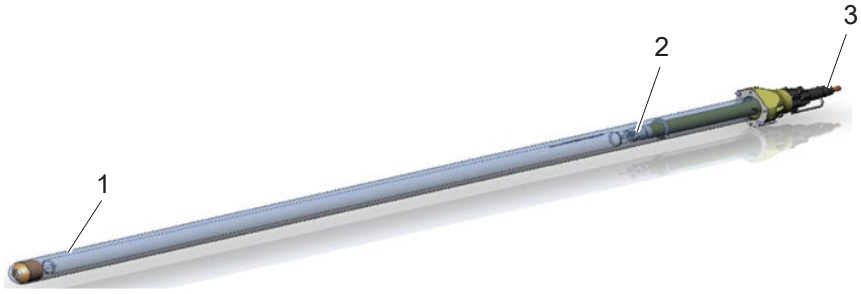
Module guide rack

- The module guide rack is a stainless steel structure that supports the UV modules in the UV channel.
- The rack has a lifting system so that the operator can lift an individual UV module.

The following options are available:

Lifting system	Description
Electric	The electric lift consists of the following items: – A box that contains an electric motor and a gear system – Ground fault circuit interrupters  1. Ground fault circuit interrupters 2. Electric lift 3. Module guide rack
Manual	A mobile lifting structure is attached to the module guide rack. The mobile lifting structure consists of the following items: – Frame – Manual winch  1. UV module 2. Mobile lifting structure 3. Manual winch

UV lamp module

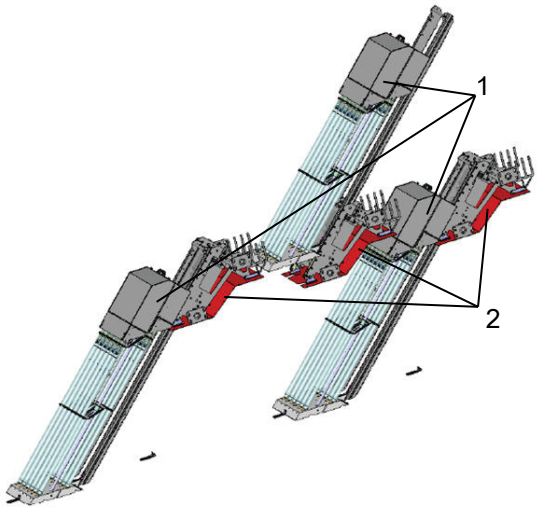


1. Quartz sleeve
2. UV lamp
3. Electrical connector

The UV lamp module gives UV light that disinfects the water.

Part	Description
Quartz sleeve	Protects the UV lamp
Electrical connector	Makes the electrical connection to the UV lamp

UV light shield



1. UV banks
2. UV light shields

UV light shields are installed between the UV banks. These UV light shields block the UV light when the UV channel covers are removed.

Interlock switch

Each UV module has an interlock switch which is a safety device.

When one of the following conditions occurs, the interlock switch automatically disconnects the power supply to the entire UV bank:

- The UV module cover is removed.
- The UV module is lifted.

UV sensor

1. UV sensor
2. UV lamp module

There is one UV sensor in one UV bank. The UV sensor measures the UV intensity of the UV lamps in the UV bank.

3.3 Automatic wiping system

The automatic wiping system automatically cleans the quartz sleeves of the UV modules.

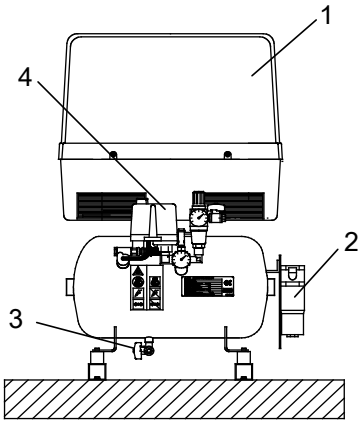
1. Wiper rings, quartz sleeves
2. Wiper blade
3. UV sensor

Part	Description
Wiper rings	The wiper rings move along the length of the quartz sleeves. There are two sets of wiper rings for one UV module.
Wiper blade	The wiper blade on the wiper cleans the UV sensor.

The following options are available:

Drive	Description
Pneumatic	A pneumatic actuator operates the wiper. An air compressor supplies compressed air to the pneumatic actuator. For more information, see *Air compressor* on page 19.
Electric	An electric motor operates the wiper.

Air compressor



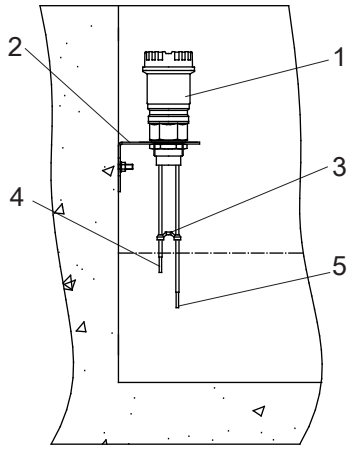
1. Motor
2. Pressure reducer with filter and automatic drain valve, 4 bar (58 psi)
3. Air receiver with manual drain valve, maximum 10 bar (145 psi)
4. Mains disconnector

The air compressor supplies compressed and filtered air to the pneumatic actuator of the automatic wiping system.

3.4 Level control

The level control system maintains and controls the water level in the UV channel.

3.4.1 Low-level probe

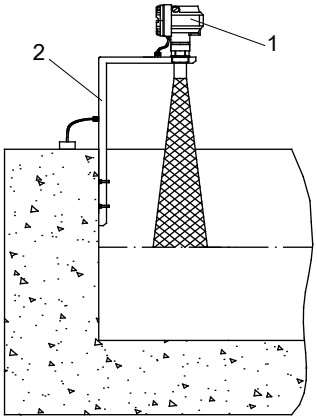


1. Probe housing
2. Bracket
3. Spacer
4. Probe rod, minimum level
5. Probe rod, ground level

The low-level probe is installed after the last UV bank of the UV channel. This low-level probe protects the UV lamps so that they do not overheat and turns off the UV system automatically under one of the following conditions:

- The water level is low in the UV channel.
- There is no water in the UV channel.

3.4.2 Ultrasonic level sensor



1. Ultrasonic level sensor
2. Bracket, stainless steel

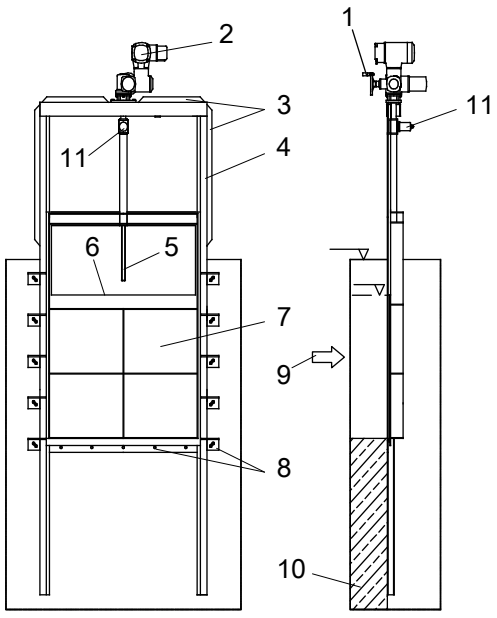
The ultrasonic level sensor is located before the first UV bank in the UV channel.

This ultrasonic level sensor sends a 4–20 mA feedback signal to operate the downward opening penstock (DOP) automatically.

Condition	DOP action
Water level > Target water level	Opens
Water level < Target water level	Closes

An extra ultrasonic level sensor measures the flow rate in each UV channel. The measured flow rate is used in the UV dose calculation.

3.4.3 Downward opening penstock

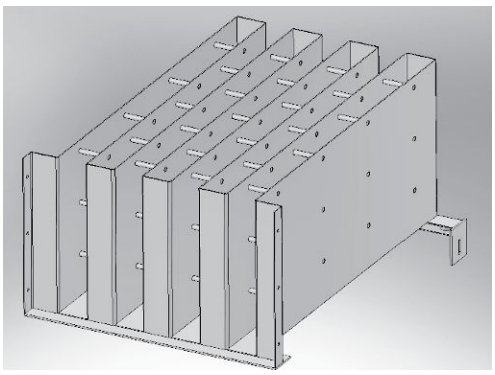


1. Handwheel
2. Electric actuator
3. Conduit
4. Fixed frame with gasket
5. Spindle
6. Overflow edge
7. Weir plate
8. Bracket
9. Concrete structure
10. Lubrication point
11. Spindle nut

The downward opening penstock (DOP) controls the water level in the UV channel. An electric actuator operates this DOP.

This DOP maintains a targeted effluent level of the water in the UV channel that is independent of the flow rate.

3.4.4 Finger weir

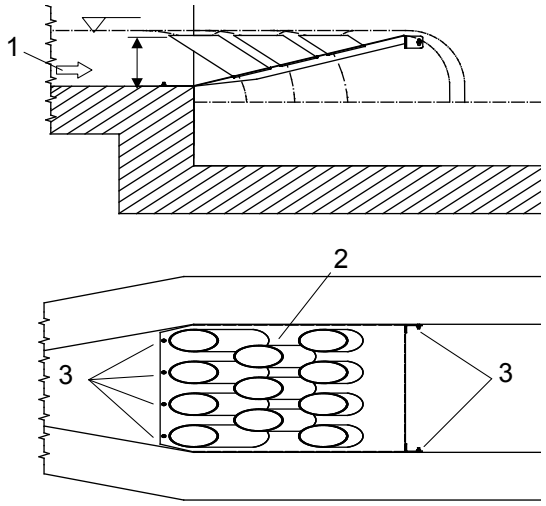


The finger weir consists of stainless steel plates. These plates force the water level in the UV channel to move up and flow over the edge of the weir.

The finger weir maintains the water level in the UV channel under the following conditions:

Condition	Water level
No water flow	Minimum
Water disinfection at peak flow rate	Maximum

3.4.5 Fixed pipe weir



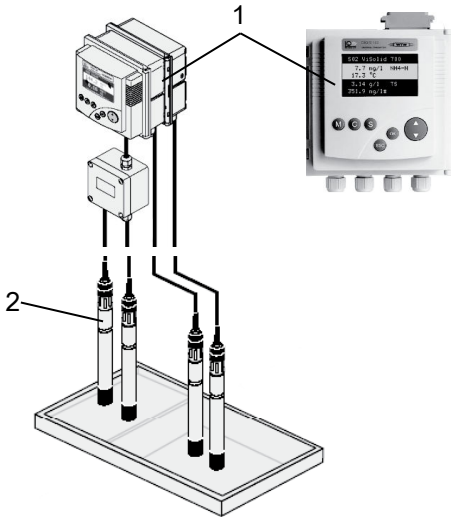
1. Water flow
2. Pipes, stainless steel
3. Anchor bolts, stainless steel

The fixed pipe weir consists of pipes. The orientation of the pipes forces the water level in the UV channel to move up and flow down through the pipes.

The finger weir maintains the water level in the UV channel under the following conditions:

Condition	Water level
No water flow	Minimum
Water disinfection at peak flow rate	Maximum

3.5 UV transmittance monitor



1. Controller, UV transmittance
2. Sensor, UV transmittance

The UV transmittance (UVT) monitor is installed at the inlet of the UV channel. This UVT monitor has the following purposes:

- Measures the UV transmittance of the water in the UV channel
- Sends a 4–20 mA signal that is relative to UVT

  PLC displays the UVT as 0% to 100%. The measured value is used to calculate the following parameters:

Disinfection method	Parameters
PSS	The average UV intensity in the UV channel
NWRI and UVDGM	The relative UV lamp output (**S/So**) and **RED** in the UV channel

3.6 Channel cover

The channel covers are customer-supplied parts.

Requirements

- The material must be UV resistant.
- The channel cover must guarantee that no UV light can exit.
- The channel cover must be available to walk on.
- The channel cover must be protected against unauthorized opening.

  The customer can install safety switches in the UV channel.

  These safety switches can be connected to the terminals safety switch channel cover to include them into the control of the UV system. For more information see the Wiring Diagram in the binder.

For more information, see the Duron Guideline Channel Cover.

3.7 Cabinets

The cabinets are configured according to the following requirements:

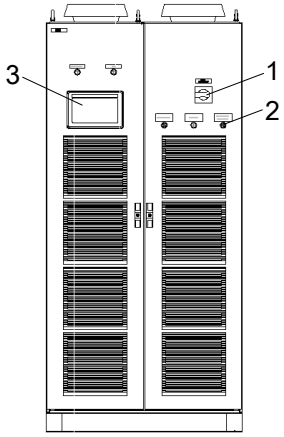
- Quantity of UV lamps
- Site conditions
- Customer specifications

  For more information, see the order confirmation, General Arrangement drawing, and External Cabinet layout drawing in the binder.

Quantity		Cabinet configurations								Remarks
		Quantity of primary cabinets			Quantity of optional cabinets					
UV banks	UV lamps	Control 48 PLC	ICA	Electronic ballast[1]	Incomer distribution	Incomer distribution control	Incomer	Distribution[1]	Transformer[2]	
≤ 4	≤ 48	1	-	-	-	-	-	-	1	Preferred configuration
> 4	> 48	-	1	≥1	-	-	-	-	1	
		-	1	≥1	1	-	-	-	1	-
		-	-	≥1	-	1	-	-	1	
		-	1	≥1	-	-	1	≥1	1	

1 . The quantity of this cabinet changes according to the quantity of UV lamps.
2 . The transformer cabinet is used when a transformer is necessary.

3.7.1 Control 48 PLC cabinet

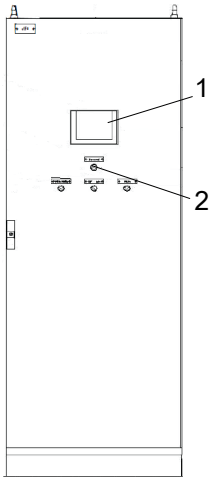


1. Main isolator
2. Alarm reset button
3. HMI

This cabinet consists of the following items:

- UV system controller
- Control switches and instruments
- Electronic ballasts
- Power control for the electronic ballasts
- Wiper control
- Electrical terminals
- Monitoring and safety devices
- Air conditioner, optional

3.7.2 ICA cabinet

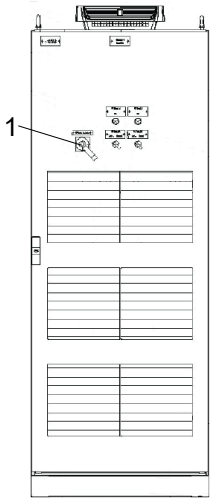


1. HMI
2. Alarm reset button

This cabinet consists of the following items:

- UV system controller
- Control and instrument mechanisms
- Wiper control
- Monitoring and safety mechanisms

3.7.3 Electronic ballast cabinet

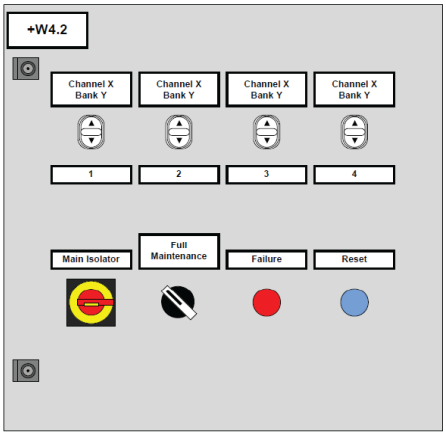


1. UV bank isolator

This cabinet includes the following items:

- Electronic ballasts
- Power control for the electronic ballasts by EcoTouch controller
- Air conditioner, optional

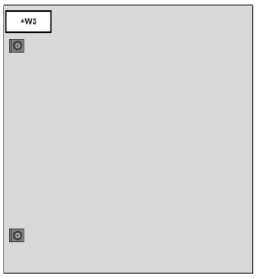
3.7.4 Lift control cabinet

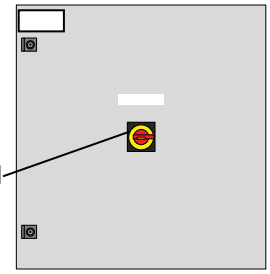


This cabinet is located near each UV channel and includes electrical controls that operate the electric lift of the module guide rack.

3.7.5 Wiper control cabinet

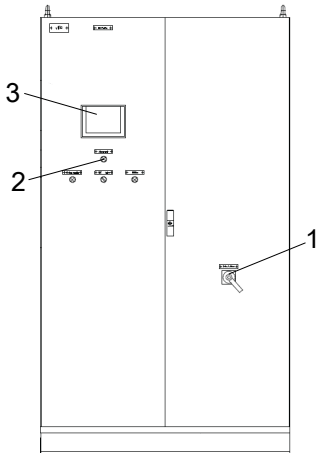
This cabinet controls the automatic wiping system and has the following options:

Option	Description
Pneumatic	Contains the valves that distribute pressurized air to the pneumatic wipers 

Option	Description
Electric	Contains the controls that operate the electric wipers  1. Main isolator

3.7.6 Optional cabinets

Cabinet for incomer distribution control

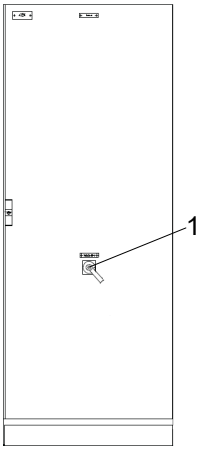


1. Main isolator
2. Alarm reset button
3. HMI

This cabinet consists of the following items:

- UV system controller
- Controller for the automatic wiping system
- Electrical terminals
- Monitoring and safety devices
- Power control and distribution components for the electronic ballast cabinets

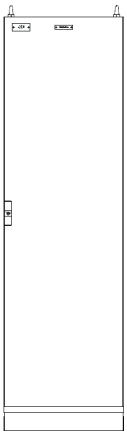
Incomer cabinet



1. Main isolator

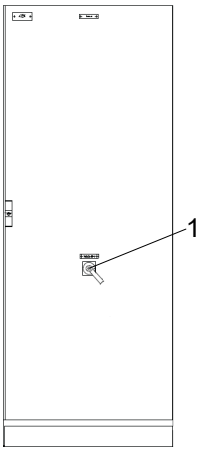
This cabinet consists of all the components that are necessary for the input power supply.

Distribution cabinet



This cabinet consists of all the components that are necessary for the power distribution to the electronic ballast cabinet and ICA cabinet.

Incomer distribution cabinet

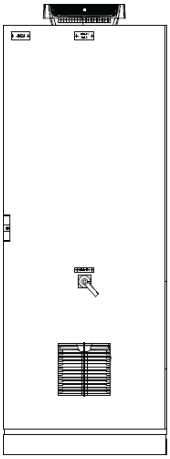


1. Main isolator

This cabinet consists of all the components that are necessary for the following items:

- Input power supply
- Power distribution for the electronic ballast cabinets

Transformer cabinet



This cabinet contains the transformer.

4 Mechanical Installation

4.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 5 have been read and understood.

WARNING: Fall Hazard

Falls into the UV channel can cause serious injuries. Always keep the channel covers closed.

WARNING: Crush Hazard

The UV module can fall down or swing uncontrollably, and injure people or damage property. Never use a crane to lift the UV modules during strong winds.

WARNING: Crush Hazard

If the UV module is not attached safely, it can fall down. Set the safety lock pins in the locked position before the maintenance of the UV module starts. Install the safety block before the maintenance below the UV module starts. Do not remove the safety lock pins and safety block during maintenance.

WARNING: Crush Hazard

Always lift the unit by its designated lifting points.

Use suitable lifting equipment and ensure that the product is properly harnessed.

Wear personal protective equipment.

Stay clear of cables and suspended loads.

CAUTION: Cut Hazard

Steel sheets can have sharp edges. Wear protective gloves.

CAUTION: Entanglement Hazard

Loose clothing can entangle in the shaft that rotates. Do not wear loose clothing.

NOTICE:

Contamination by mild steel can cause dust and discolor the surface of stainless steel. This contamination can destroy the protective oxide layer and create pitting.

- Work that created particles of mild steel must be done away from surfaces that are made of stainless steel.
- The stainless steel parts must be covered correctly.

NOTICE:

The operator must not climb on the UV module or put anything on it.

NOTICE:

The operator must not climb on the UV channel cover or put anything on it.

NOTICE:

The operator must make sure that the cables are not damaged.

NOTICE:

UV lamps and quartz sleeves are fragile. These parts must be handled carefully.

NOTICE:

The UV system shall not be turned ON/OFF more than four times on an average 24 operating hour period.

Personal protective equipment

NOTICE:

The following personal protective equipment is needed:

- Protective gloves
- Safety footwear
- Safety helmet
- Safety goggles or face shield for UV protection

4.2 Necessary tools and equipment

- Service tools
- Drill bits:
  - 6 mm (0.23 in)
  - 8 mm (0.31 in)
  - 12 mm (0.47 in)
- Drilling template
- Measuring tape
- Spirit level
- Crane
- Lifting device
- Ladder

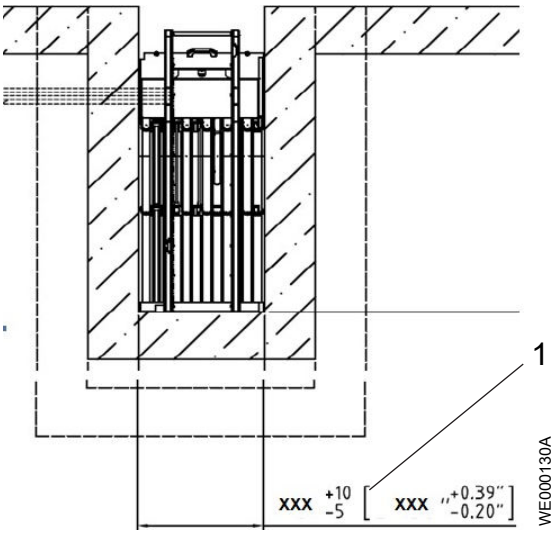
4.3 Requirements

- The site layout must be correct and all dimensions must be as specified in the drawings.

  For more information, see the General Arrangement Drawing, the Mounting Instruction UV Module, and the installation drawing in the binder.
- The site must be installed with the following customer-supplied components:
  - Flowmeter, optional

    In case the second ultrasonic level sensor for flow calculation is not included in the scope of supply.
  - Channel cover
  - Isolation gates for the UV channel inlet
- The UV channel dimensions must follow the local codes and regulations. For more information, see *UV channel* on page 30.

UV channel



1. Tolerance: +10 mm (0.39 in) to –5 mm (0.20 in)

- The UV channel design must follow these local codes and regulations:
  - DIN 1045

    The concrete quality must follow the C30/37 given in DIN 1045.
  - DIN 18202

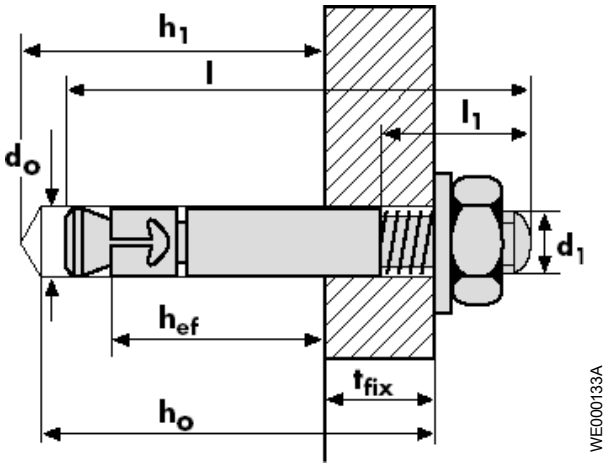
    The surface flatness must follow DIN 18202, table 3, line 7.
  - ACI 318
  - ENV 206
  - GBJ 10–89
- The face sides of the UV channel must follow these designs:
  - The deviation from vertical and surface finish must not be more than ± 5 mm (0.19 in).
  - There is no chamfer at the penstock or fixed weirs side.
- The UV channel width at the bottom must be smooth for the installation of the UV module.

For more information about the dimensions, see the project-specific drawings in the binder.

UV channel width, mm (inch)	UV channel depth, mm (inch)		Number of UV lamps for each UV bank	UV module for each UV bank
	Electrical wiper	Pneumatic wiper		
750 (29.53)	1900 (74.80)	2000 (78.74)	12	1 (12)
990 (38.98)			16	1 (16)
1230 (48.43)			20	1 (20)
1465 (57.68)			24	2 (12, 12)
1709 (67.28)			28	2 (12, 16)
1949 (76.73)			32	2 (16, 16)
2185 (86.02)			36	2 (16, 20)
2429 (95.63)			40	2 (20, 20)
2668 (105.04)			44	3 (12, 16, 16)
2905 (114.37)			48	3 (12, 16, 20)

4.4 Drill size and depth

The anchor bolts are supplied with the UV system. If the anchor bolts are not supplied, see the manufacturer instructions in the binder.



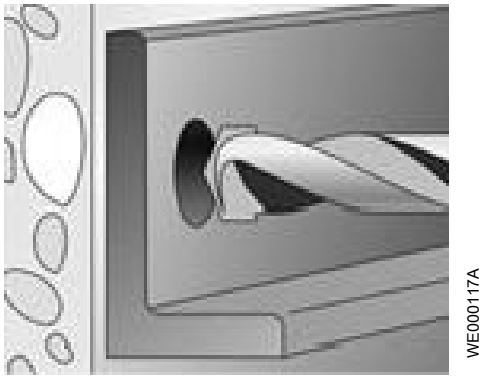
Drill diameter, do	Minimum drill depth, h1	Approximate length, l	Width across flats	Maximum torque	Thread, d1
mm (inch)				Nm (lbf·ft)	-
6 (0.23)	75 (2.95)	70 (2.75)	10 (0.39)	7.5 (5.53)	M6
8 (0.31)	80 (3.14)	75 (2.95)	13 (0.51)	20 (14.75)	M8
12 (0.47)	100 (3.93)	110 (4.33)	19 (0.74)	60 (44.25)	M12

4.4.1 Install the anchor bolt

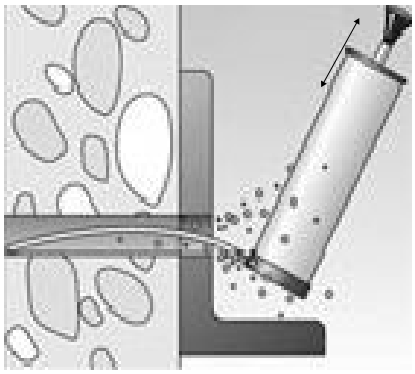
For more information, see the following documents in the binder:

- Installation instructions
- General Arrangement Drawing

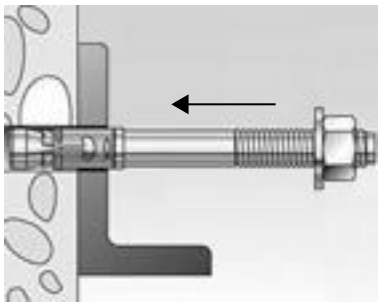
1. Drill a hole in the parts.
   For more information, see *Drill size and depth* on page 30.



2. Use compressed air to clean the hole.



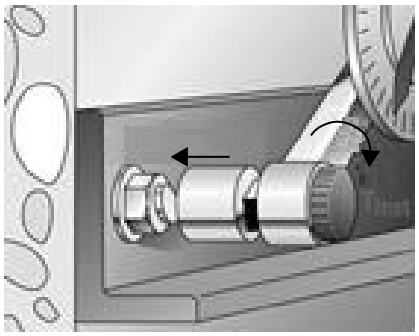
3. Insert the anchor bolt in the hole of the parts.



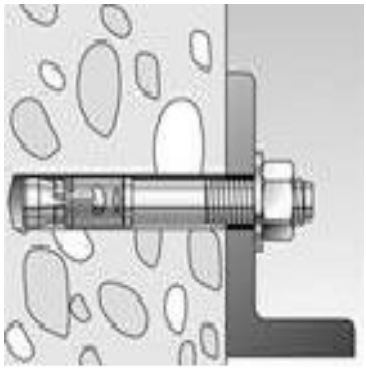
4. Attach the hexagon nut on the anchor bolt.

   The extension of the anchor bolt from the hexagon nut must be from 2 mm (0.078 in) to 3 mm (0.11 in).

5. Turn the anchor bolt in the hole.

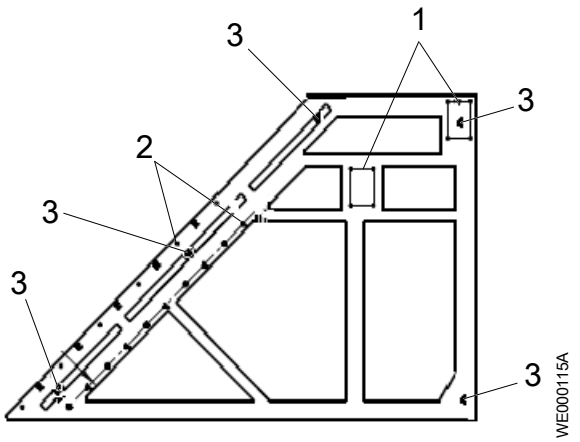


6. Use a wrench to tighten the hexagon nut.



4.5 Drilling: mounting plates and mixing rods

A drilling template is used to drill the holes in the UV channel at the identified position.

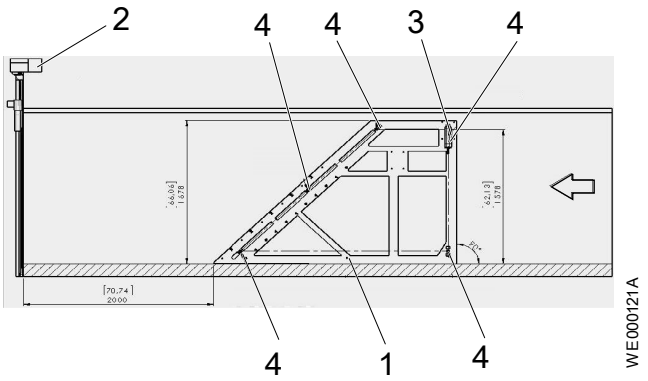


Hole position	Item	Number of holes
1	Mounting plates	8
2	Mixing rod for the UV channel walls, left and right	6
3	Drilling template	5

4.5.1 Attach the drilling template

Necessary items:

Item	Quantity
Drilling template	1
Anchor bolt, 6 mm (0.24 in)	5
Hexagon nut	5



1. Drilling template
2. Downward opening penstock
3. Drill
4. Holes for the drilling template

1. Locate the position of the last UV bank in the UV channel.

   For more information, see the General Arrangement Drawing in the binder.
2. Attach the drilling template flat against the UV channel wall.

   The drilling template must be aligned with the UV channel floor. For more information, see the UV channel tolerances in the binder.
3. Drill the holes on the UV channel wall.

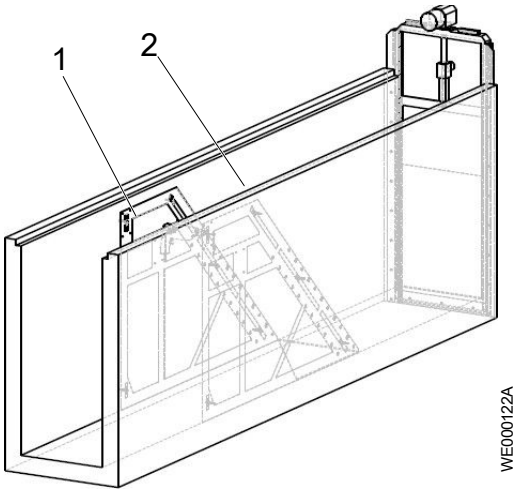
   The drill must be aligned at angle of 90° to the wall.

Hole dimension	Hole size, mm (inch)
Diameter	6 mm (0.23 in)

Hole dimension	Hole size, mm (inch)
Depth	65 mm (2.55 in)

4. Attach the anchor bolt and hexagon nut.

   For more information, see *Install the anchor bolt* on page 31.

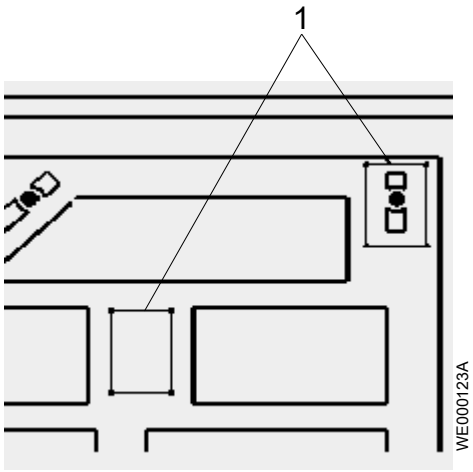


1. Drilling template
2. UV channel wall

4.5.2 Drill the holes for the mounting plate and the mixing rod

1. Attach the drilling template on one side of the UV channel.
2. Drill the holes for the mounting plate.

   There are total 16 drill holes are required in one UV bank.

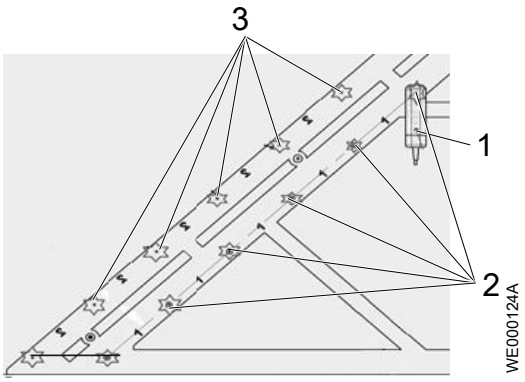


1. Mounting plate positions

3. Drill the holes for the mixing rod.

   There are total six drill holes are required on each side of the mixing rod.

   Do not drill both sets on the same side of the UV channel. For more information, see the installation drawing package in the binder.

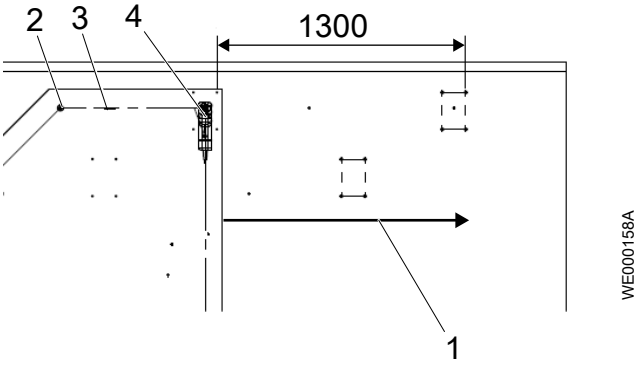


1. Drill
2. Hole position in flow direction, right side of the UV channel
3. Hole position in flow direction, left side of the UV channel

4. Remove the drilling template.

   For more information, see *Remove the drilling template* on page 35.

If there is more than one UV bank in a UV channel, then attach the drilling template at a distance of 1300 mm (51.18 in) in the opposite flow direction.



1. Opposite flow direction
2. Drill hole
3. Drilling template
4. Drill

Repeat this procedure for the other side of the UV channel, and for more than one UV channel in the UV system.

4.5.3 Remove the drilling template

1. Remove the hexagon nut from the anchor bolt.
2. Remove the drilling template from the UV channel wall.
3. Trim and smoothen the extra length of the anchor bolt.

4.6 Drilling: ultrasonic level sensor and low-level probe

Before the module guide rack is installed, all the holes for the low-level probe and ultrasonic level sensor must be drilled.

For more information, see the project-specific drawings in the binder:

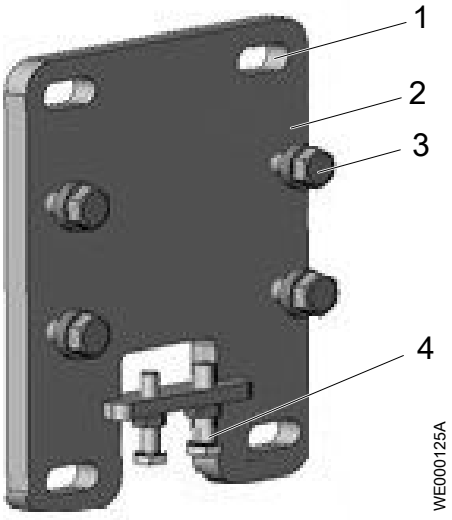
- General Arrangement Drawing
- Installation Ultrasonic Sensor
- Installation Low Level Probe

4.7 Install the mounting plate

Necessary items:

Item	Quantity
Mounting plate	4
Anchor bolts, 12 mm (0.47 in)	16
Hexagon nut	16

The holes positions on the UV bank must be correct. For more information, see the drawing U-85629 in the binder.

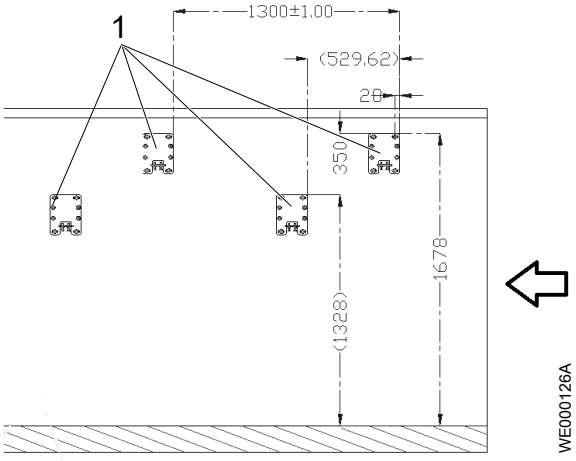


1. Hole for the anchor plate
2. Mounting plate
3. Screw
4. Adjusting screw

1. Enlarge the holes on the mounting plates.

   The size of the holes must be 12 mm (0.47 in).
2. Hold the mounting plate against the UV channel wall.

   The position and the orientation of the mounting plate must be correct. For more information, see the Mounting Instruction UV Module drawing in the binder.
3. Align the holes on the mounting plate with the holes on the UV channel wall.



1. Mounting plates

4. Attach the anchor bolts and hexagon nuts to the mounting plate.

   For more information, see *Install the anchor bolt* on page 31.

Repeat this procedure for the other mounting plates.

4.8 Install the mixing rod

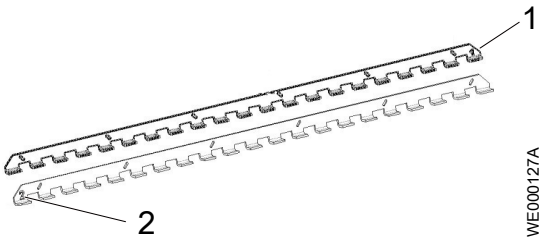
Necessary items:

Item	Quantity
Mixing rod	2
Anchor bolts, 6 mm (0.23 in)	12
Hexagon nut	12

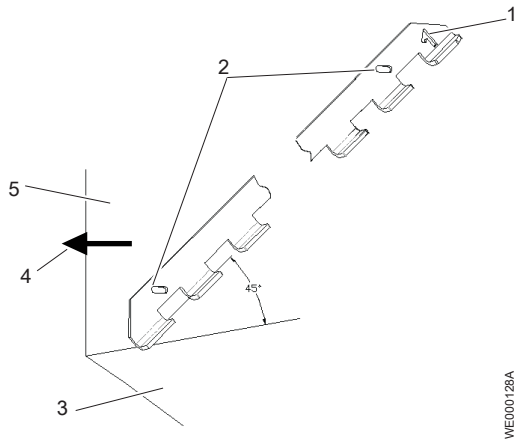
The holes position on the UV bank must be correct. For more information, see the drawing U-85629 in the binder.

This table shows the identification of the mixing rod:

Identification	Mixing rod position
1	Flow direction, right side
2	Flow direction, left side



1. Put the mixing rod against the UV channel wall.
2. Align the holes on the mixing rod with the holes on the UV channel wall.
   For more information, see the installation drawing in the binder.



1. Mixing rod, right side
2. Holes for the anchor bolts
3. UV channel floor
4. Flow direction
5. Flat side towards UV channel wall

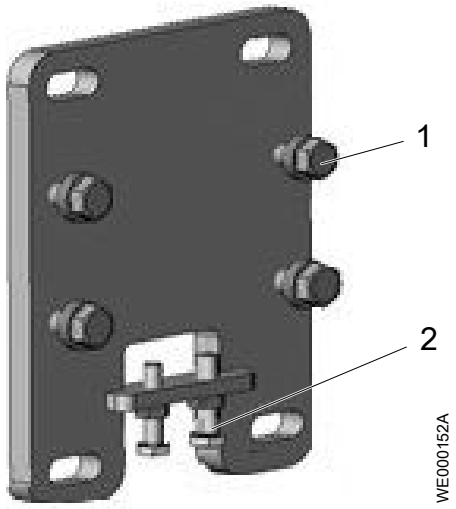
3. Attach the anchor bolts and the hexagon nuts on the mixing rod.
   For more information, see *Install the anchor bolt* on page 31.
   – Trim the extra threads of the anchor bolts.
     The threads of the anchor bolts must not extend beyond two to three threads.
4. Check the position of the left mixing rod.
5. If necessary, align the UV module and the components on the mixing rod.

4.9 Install the module guide rack

NOTICE:

The operator must make sure that the cables are not damaged during installation or maintenance.

1. The mounting bolts and washers must be removed from the mounting plates.



a. Bolts and washers
b. Adjusting screws

2. The adjusting screws of all the mounting plates must be on the same level.

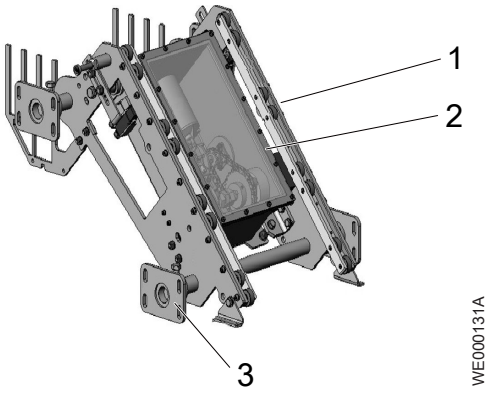


Figure 1: Electric lift assembly

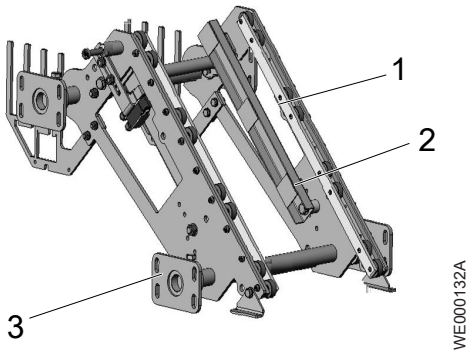
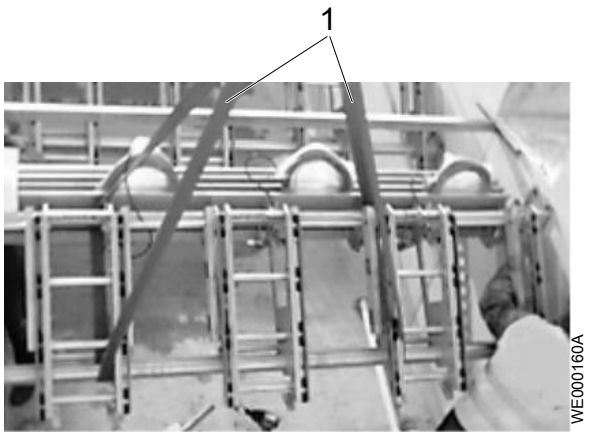


Figure 2: Manual lift assembly

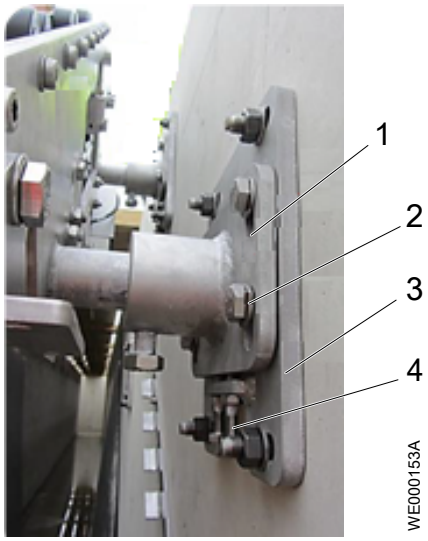
1. Module guide rail
2. Electric lift assembly or manual lift assembly
3. Fixing plate

1. Use the correct lifting equipment and slings to lower the module guide rack into the UV channel.



1. Slings

2. Align all the fixing plates on the module guide rack with the mounting plates on the UV channel wall.



1. Fixing plate
2. Bolt and washer
3. Mounting plate
4. Adjusting screw

3. Use a spirit level to check the level of the module guide rack.
4. If necessary, use adjusting screws to correct the level.
5. Align the position of the module guide rack from the center of the UV channel.

   If there is space between the mounting flange and the mounting plate, see the drawing of the operating tolerances of the UV channel.

   a) If necessary, add stainless steel shims to decrease the space.
   b) Use screws to tighten the fixing plate to the module guide rack.
6. Attach the bolts and the washers on the mounting plates.
7. Apply thread-locking fluid to the mounting plates.

Repeat this procedure for the other UV banks.

4.10 UV module installation

4.10.1 Prepare the UV module

The position of the UV module in the module guide rack is numbered. For more information, see the General Arrangement Drawing in the binder.

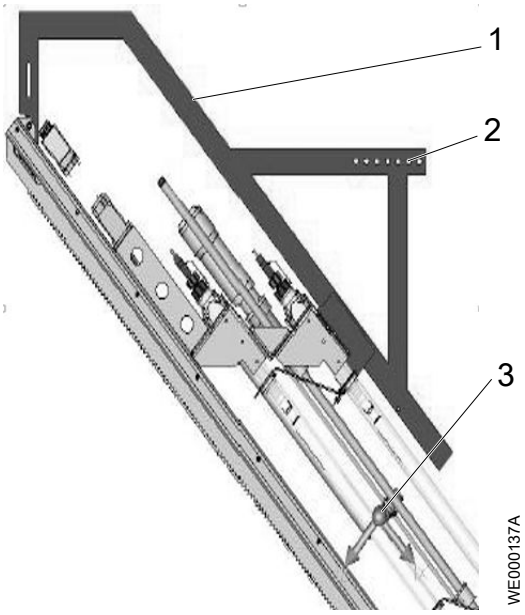
1. Remove the locking devices and packing material.
2. Locate UV module 1 and the position of UV module 1 on the module guide rack.
3. Remove the screws and the cover plate of the UV module.

4.10.2 Install the UV module

NOTICE:

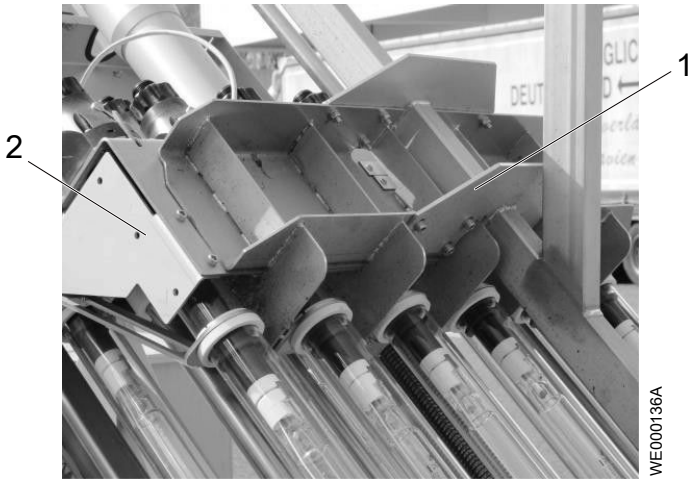
UV lamps and quartz sleeves are fragile. These parts must be handled carefully.

1. Attach a lifting device to the UV module.



1. Lifting device
2. Crane attachment point
3. Center of mass

a) Insert the lifting device on the quartz sleeve holder.



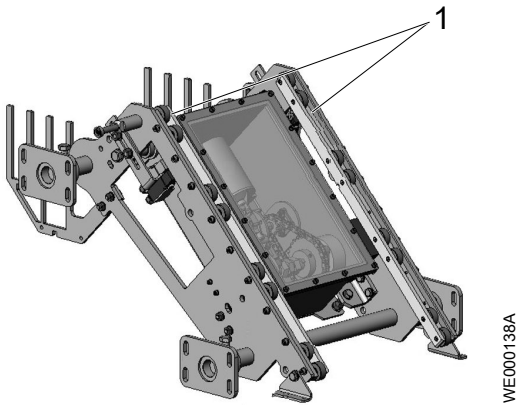
1. Lifting device
2. Quartz sleeve holder

b) Insert the hook of the lifting device to the other side of the circular bar.

1. Circular bar
2. Hook

c) Attach the crane hook at the crane attachment point.

2. Use the lifting device to lift the UV module at an angle of 45°.
3. Shift the UV module so that it is above the module guide rack.
4. Lower the UV module into the module guide rails of the module guide rack.



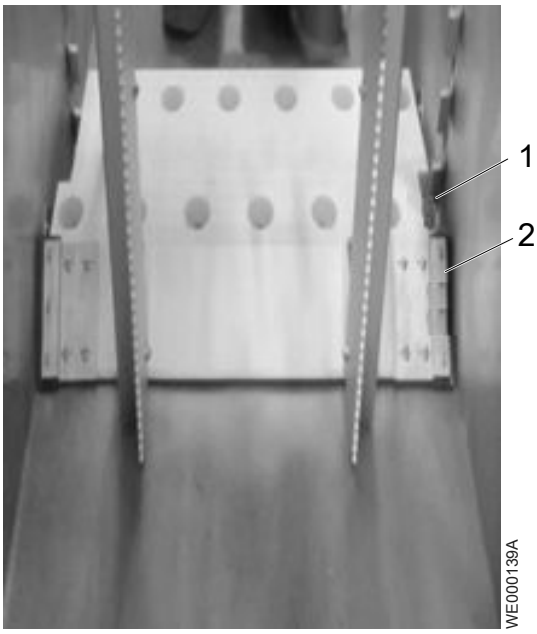
1. Module guide rails

5. Slowly lower the UV module into the UV channel.
6. Check the UV module position when the UV module is at the bottom of the UV channel.
7. Align the UV module with the module guide rack in the UV channel.
8. Install the centering angle bracket.
   For more information, see *Install the centering angle bracket* on page 42.
9. Adjust the sealing plate of the UV module.
   For more information, see *Adjust the sealing plate on the UV module* on page 41.
10. If the UV system has an electric lift box, then adjust the electric lift box.
    For more information, see *Adjust the electric lift box* on page 43.
11. Remove the following items from the UV module:
    1. Crane hook
    2. Lifting device

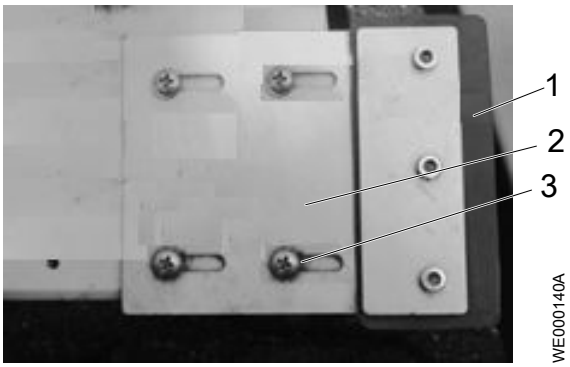
Repeat this procedure for all the UV modules.

4.10.3 Adjust the sealing plate on the UV module

Each UV module contains sealing plates that seal the adjacent UV module. After the UV module is put in the UV channel, the sealing plates must be adjusted.



1. Base plate of the UV module
2. Sealing plate



1. Rubber seal
2. Sealing plate
3. Cross screw

1. Loosen the cross screws.

   The cross screws must not be removed.
2. Move the position of the sealing plate so that it is nearer to the UV channel wall.
3. Check that there is no gap between the following items:
   - The rubber seal and the UV channel side wall
   - The rubber seal and the adjacent UV module, when the UV bank contains more than one UV module

   There must not be any force between the rubber seal and the UV channel wall or the adjacent UV module.
4. If necessary, enlarge the holes of the cross screws to remove the pressure on the sealing plate.
5. Tighten the cross screws.
6. Check that the sealing plate does not break when the UV module moves up and down.

Repeat this procedure for all the UV modules.

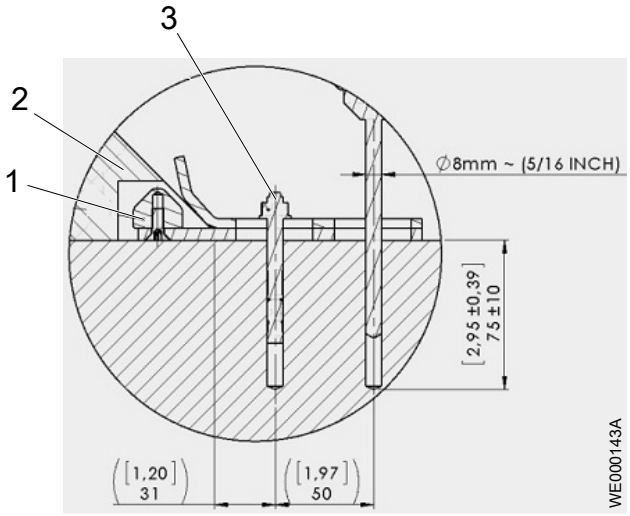
4.11 Install the centering angle bracket

Necessary item:

Item	Quantity
Angle bracket	One for each UV module

The UV module must be lowered completely into the UV channel.

The centering angle bracket stops the UV module at the bottom of the UV channel.



1. Guide pin
2. UV module
3. Anchor bolt

1. Locate the guide pin of each UV module.
2. Drill two holes on the UV channel floor.

Hole dimension	Hole size, mm (inch)
Diameter	8 (0.31)
Depth	75 (2.95)

1. Angle bracket

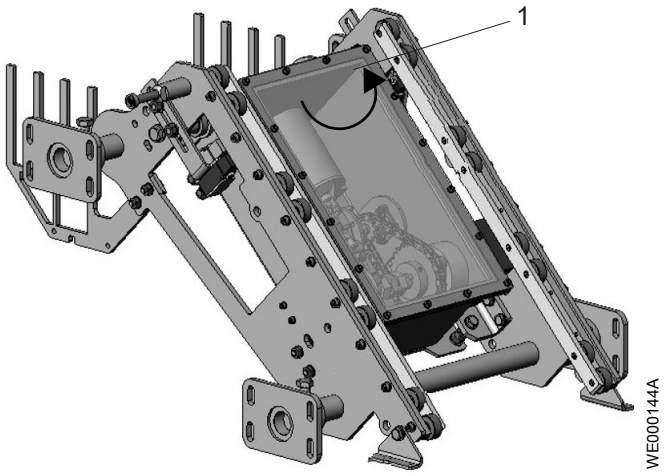
3. Use the anchor bolts to attach the angle bracket to the UV channel floor.

   The first anchor bolts must be put approximately 31 mm (1.22 in) from the UV module edge on the UV channel floor.

4.12 Adjust the electric lift box

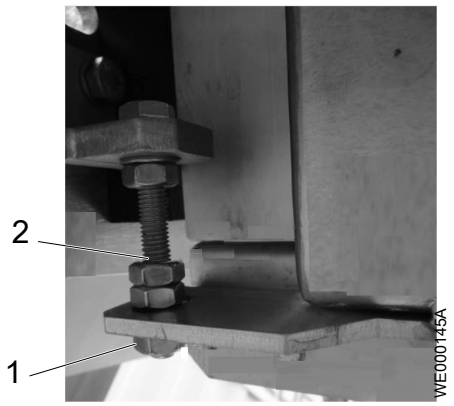
Before the electric lift box is adjusted, the UV module must be lowered into the UV channel.

The drive mechanism box for the electric lift is located inside the UV module. The electric lift box is pivot-mounted at the top of the UV module.



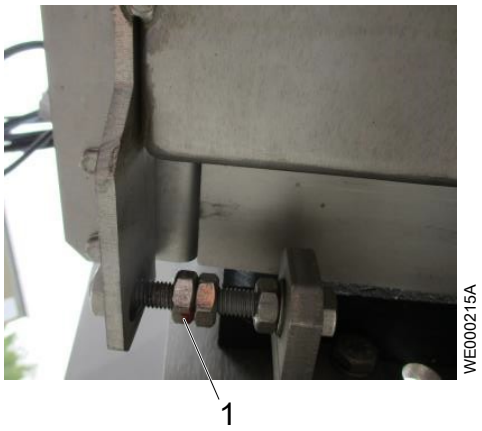
1. Electric lift box

1. Check the nut when the electric lift box is at the lower setting of the adjusting screw.



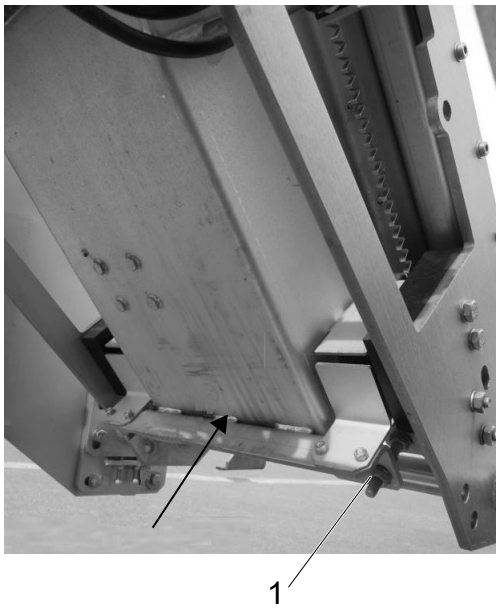
1. Nut
2. Adjusting screw

2. If the nuts are loosened, then move them to the upper position.



1. Nut

3. Manually lift the electric lift box from the bottom.



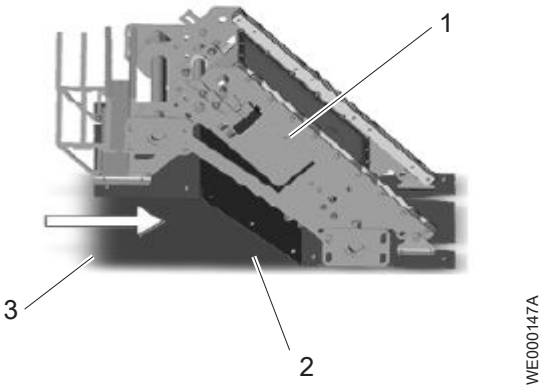
1. Nut

4. Lock the electric lift box at each side with the nuts.
5. Use the nuts to tighten the adjusting screws.

4.13 Install the UV light shield

Necessary items:

Item	Quantity for each UV module
UV light shield	1
Movable plate	6
Screws	8



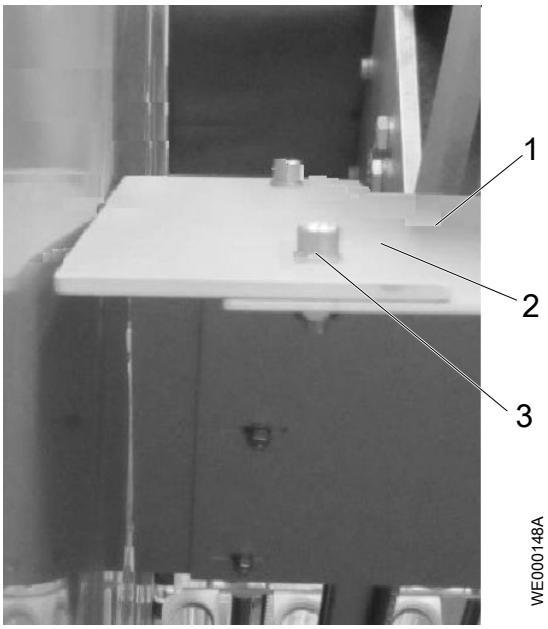
1. Module guide rack
2. UV light shield
3. Flow direction

1. Attach the UV light shield under the UV module.

   The movable plates must be installed upside.
2. Align the UV light shield with the brackets of the UV light shield at the UV module.
3. Use screws to fix the UV light shield on the brackets.
4. Slide the movable plate back and forth until there is no gap between the UV light shield and the UV channel wall.

4.13.1 Adjust the UV light shield at the UV module

After adjustment of the electric box, the UV light shield must be adjusted.



1. UV light shield
2. Movable plate
3. Screw

1. Loosen the screws.
2. Slide the movable plate back and forth until there is no gap between the UV light shield and the UV channel wall.
3. Tighten the screws.

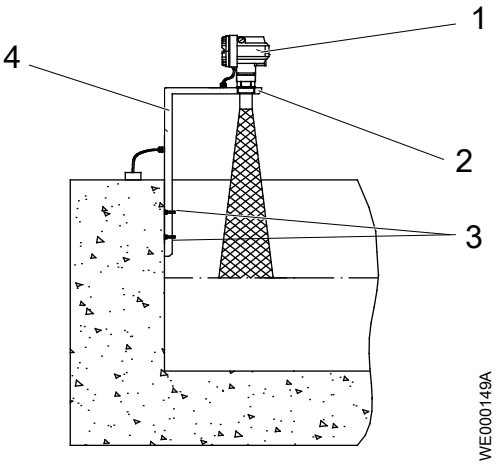
4.14 Install the ultrasonic level sensor

Before the UV module is lowered into the UV channel, the ultrasonic level sensor must be installed.

For more information about the number and position of the ultrasonic level sensor, see these documents in the binder:

- General Arrangement Drawing
- Order Specification
- Endress+ Hauser for Prosonic FMU 40

The ultrasonic level sensors are not needed on the UV systems with fixed weirs.



1. Ultrasonic level sensor
2. Nut
3. Anchor bolts
4. Angle bracket

1. Put the angle bracket against the UV channel wall.

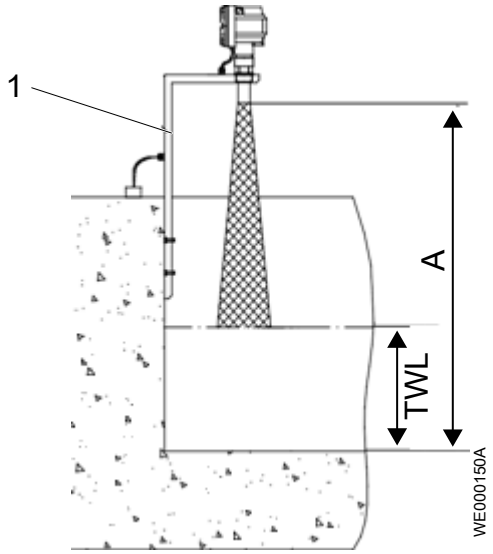
   For more information, see the installation drawing in the binder.
2. Identify the location of the drill holes.
3. Drill the holes for the anchor bolts.
4. Use anchor bolts to attach the angle bracket.

   For more information, see the installation drawing and *Install the anchor bolt* on page 31.
5. Install the ultrasonic level sensor through the hole in the angle bracket.
6. Tighten the nut.
7. Connect the electrical cables.
8. Check that the electrical isolation between the control signals and the power supply is correct.
9. Carefully clean the surface of the ultrasonic level sensor.

4.14.1 Adjust the ultrasonic level sensor

For more information, see the following documents in the binder:

- Vendor manual, Endress + Hauser ultrasonic level measurement FMU40
- General Arrangement Drawing
- Installation drawing, U-88216



1. Angle bracket

1. Turn on the HMI of the ultrasonic level sensor.

   For more information see the Vendor manual, Endress + Hauser in the binder.
2. Select these parameters on the HMI of the ultrasonic level sensor:
   a) Language
   b) Measurement in **mm** or **inch**
   c) **Basic setup** > **tank shape** > **no ceiling**
3. Measure A.

   A= Distance between the UV sensor head and the bottom of the UV channel
4. Calculate B.

   B = TWL + blocking distance

   For more information, see the General Arrangement Drawing in the binder.
5. Change the following parameters:
   – The **full calibration** according to B
   – **No. of decimals** to **no decimals** on the function screen
6. Fill the UV channel with water.

   The water level can be simulated. The distance value between the UV sensor and bottom of the UV channel must be recorded.
   a) Use the measuring tape to measure the water level.
   b) Compare this level with the water level that the HMI shows.
   c) Repeat *step 1* to *step 2* with minimum two different levels.
7. If the water level measurement differs between the HMI and measuring tape, then repeat *step 1* to *step 6*.
8. In **Safety settings** on HMI of the ultrasonic level sensor, change the following sensor parameters:

Output on alarm	**User-specific**
	2.40 mA
Output on echo loss	**Alarm**
Delay time	5 s

Dimension	**Measurement**
UV sensor head to channel bottom	4 mA

Dimension	Measurement
UV channel bottom and TWL + 100 mm (3.93 inch)	20 mA

9. Check that the water level values are the same on these user interfaces:
   – HMI of the ultrasonic level sensor
   – HMI of the Duron system

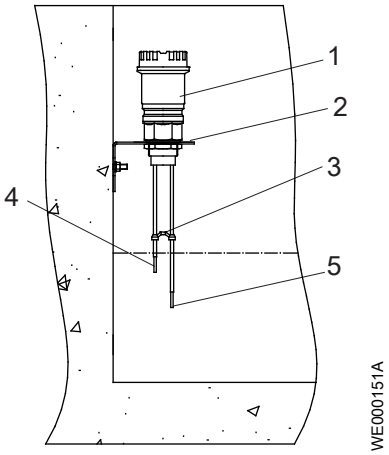
4.15 Install the low-level probe

Before the UV module is lowered into the UV channel, the low-level probe must be installed.

For more information, see the following documents in the binder:

- Vendor manual, Endress + Hauser for Liquipoint FTW32
- General Arrangement Drawing

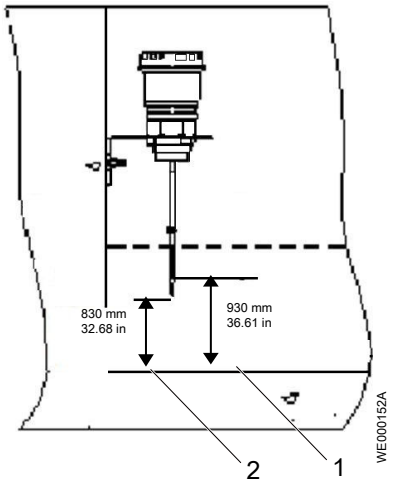
1. Put the angle bracket against the UV channel wall.
   For more information, see the installation drawing in the binder.
2. Identify the location of the drill holes.
   a) Drill the holes for the anchor bolts.
   b) Use anchor bolts to attach the angle bracket.
   For more information, see the installation drawing and *Install the anchor bolt* on page 31.
3. Assemble the sensor housing.



1. Sensor housing
2. Bracket
3. Spacer
4. Sensor rod, minimum level
5. Sensor rod, ground level

   a) Attach the sensor assembly through the large hole in the bracket.
   b) Attach the lock nut.
   c) Cut the probe rods to the correct lengths.

Probe rod	Length
Ground level	830 mm (32.08 in)
Minimum level	930 mm (36.61 in)



1. 930 mm (36.61 in)
2. 830 mm (32.08 in)

4. Connect the electrical cables.

   For more information, see the single line and electrical diagrams in the binder.

Repeat this procedure for all the UV channels in the UV system.

4.15.1 Adjust the low-level probe

After the electrical cables are connected, the low-level probe must be adjusted.

1. Check the function of the low-level probe by using a water container.
2. Measure the distance from the end of the probe rod to the bottom of the UV channel.

   For more information, see the installation drawing in the binder.
3. If small adjustment is necessary, loosen the bracket nuts.

   The nuts must not be removed.
4. Slide the bracket and probe assembly up or down until the distance is correct.

   The bracket must be in the horizontal position.
5. Tighten the bracket nuts.

4.16 Installation of optional equipment

4.16.1 Fixed weir

Necessary items:

- Fixed weir assembly
- Silicone gel

For more information, see the General Arrangement Drawing and installation drawing of the fixed weir in the binder.

4.16.2 Downward opening penstock

For more information, see the General Arrangement Drawing and vendor installation documentation in the binder.

4.16.3 Air compressor

The air compressor is used for the pneumatic wiper only. For more information, see the General Arrangement Drawing and the compressor instructions in the binder.

4.16.4 UV transmittance monitor

For more information, see the manufacturer instructions in the operation and maintenance manual in the binder.

5 Electrical Installation

5.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 5 have been read and understood.

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.

WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must perform all electrical work. Comply with all local codes and regulations.

WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

WARNING: Crush Hazard

Always lift the unit by its designated lifting points.

Use suitable lifting equipment and ensure that the product is properly harnessed.

Wear personal protective equipment.

Stay clear of cables and suspended loads.

CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

NOTICE:

The operator must make sure that the power supply for the UV system follows the specifications in the technical data.

NOTICE:

The operator must make sure that the cables are not damaged.

Personal protective equipment

NOTICE:

The following personal protective equipment is needed:

- Protective gloves
- Safety footwear
- Safety helmet
- Safety goggles or face shield for UV protection

5.2 Necessary tools and equipment

- Electrical tools
- Drill bits
- Spirit level
- Measuring tape
- Crane

  For more information about the load requirements of cabinets, see the packing list in the binder.

5.3 Cabinet installation

5.3.1 Requirements

Location

- All cabinets must follow the local codes and regulations.
- The electrical conduit and cable routing must follow the project-specific drawing in the binder.

Cabinets

- The cabinets must be protected from direct sunlight.
- The ambient temperature must follow the design specifications that are on the data plate.
- The mains supply must follow the requirements of the UV system. For more information, see the data plate or the Wiring Diagram in the binder.
- Fuses must be installed in the power supply of the cabinet on site.
- All the fuses, circuit breakers, and ground fault circuit interrupters must have the correct ratings, and follow the local regulations.
- The electrical load resistance for all the analog input and output signals of 4-20 mA must be below 500 ohms.
- The cabinets must have the following clearance. For more information, see the project-specific drawing in the binder.

Description	Clearance, cm (inch)
Airflow around ventilation areas	≥ 30 (11.8)
Rear side of the cabinets	100 (39.37), recommended

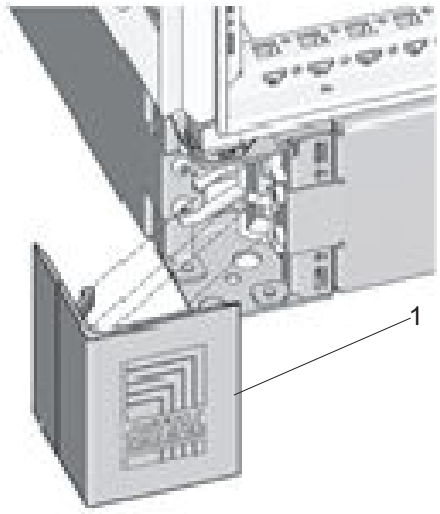
5.3.2 Install the cabinet

This procedure is applicable for the following cabinets:

- Ballast
- Control 48 PLC

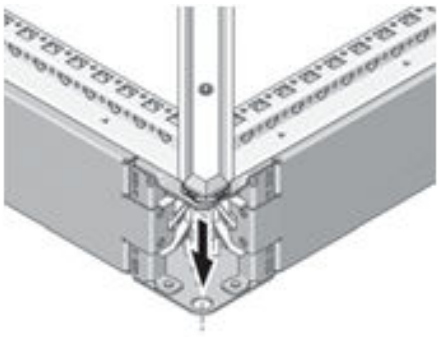
- Distribution
- ICA
- Incomer
- Incomer distribution
- Incomer distribution control

1. Put the cabinet on the floor.
   For more information, see the General Arrangement Drawing in the binder.
2. Remove the cover plates from the corners of the cabinet base.



1. Cover plate

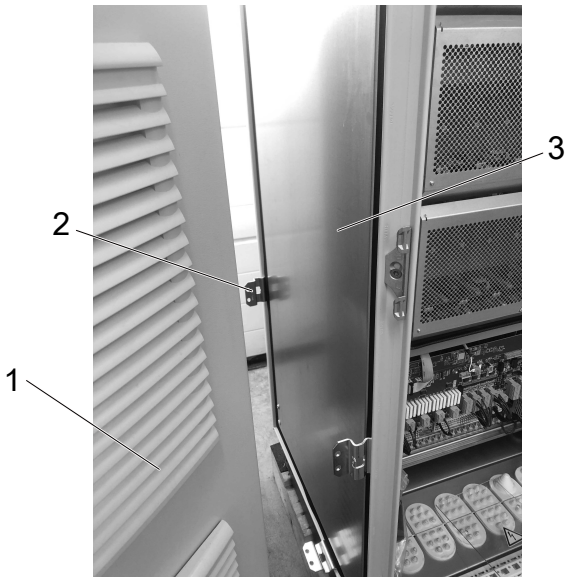
3. Put mark on the floor to identify the hole positions.



4. Remove the cabinet.
5. Drill holes on the identified positions.
   The holes must be cleaned.
6. Insert anchor bolts.
7. Put back the cabinet in the correct position.
8. Tighten nuts and washers on the anchor bolts.
9. Attach the cover plates.

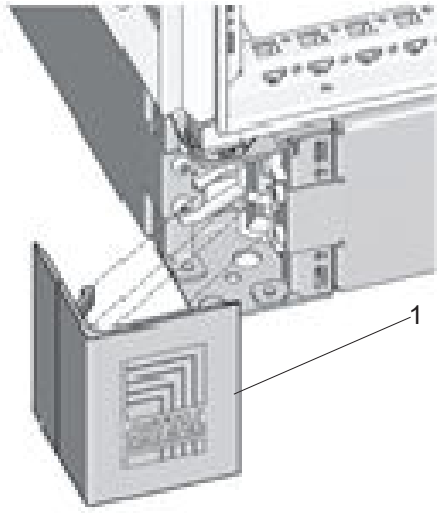
5.3.3 Install the additional cabinets

If there is more than one cabinet, the order of cabinets must be identified. For more information, see the External Cabinet layout drawing in the binder.



1. First cabinet
2. Brackets
3. Second cabinet

1. Identify the first cabinet on the floor.
2. From the second cabinet, remove the cover plates from the corners of the cabinet base.



1. Cover plate

3. Move the second cabinet to the correct side of the first cabinet.
   a) Check the position of the baying brackets.

      The second cabinet must be put in an upright position and without any gaps between the first cabinet.
4. Put mark on the floor to identify the hole positions.
5. Remove the second cabinet.
6. Drill holes on the identified positions.

   The holes must be cleaned.
7. Insert anchor bolts.
8. Put back the second cabinet in the correct position.
   a) Check the position of the baying brackets

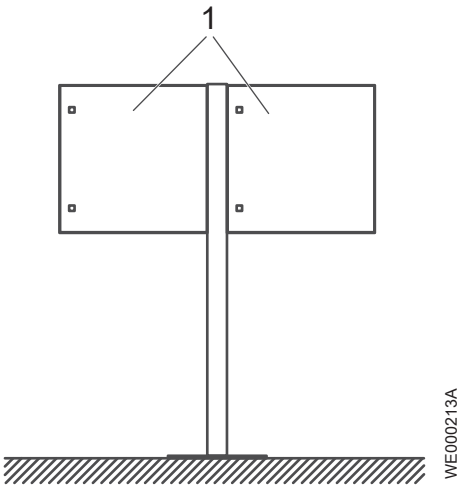
      The second cabinet must be put in an upright position and without any gaps between the first cabinet.

9. Tighten the nuts and washers on the anchor bolts of the second cabinet.
10. Attach the first cabinet with the brackets of the second cabinet by using screws.

If applicable, repeat this procedure for the additional cabinets.

5.3.4 Install the wiper control cabinet or the lift control cabinet

1. Put the stand and the control cabinets on the floor.
   For more information, see the General Arrangement Drawing in the binder.



1. Control cabinet

2. Identify the hole positions on the floor.
   For more information, see the Installation Wiper Control Cabinet drawing or Installation Lift Control Cabinet drawing in the binder.
3. Remove the stand and the control cabinets.
4. Drill the holes on the identified positions.
   The holes must be cleaned.
5. Insert anchor bolts.
6. Put back the stand and control cabinets on the floor.
7. Tighten the nuts and washers on the anchor bolts.

5.4 Cable installation

5.4.1 Requirements

The following documentations must be available:

- General Arrangement Drawing
- External Cabinet Layout
- Wiring Diagram
- Cable List Overview

Cables

- The cable specifications and installation of potential equalization must follow the local rules and regulations.
- All cables, except main power supply cables, must be screened.
  The screens must be connected to the screen clamps to make sure electrical continuity.
- The cables must be in good condition, not have any sharp bends, and not be pinched.
- The cables must not be rolled into coils but it is possible to arrange the cables in large S-shaped loops.
- The minimum bend radius of a cable must be ten times more than the cable diameter.
- The cable ends must have end sleeves.

Power cables

- If the power cable is pulled loose, then the ground (earth) conductor must be the last conductor to come loose from its terminal.
- The ground (earth) conductor must be longer than the phase conductors.
- The cable diameter of the power cables and all related wires must follow the Wiring Diagram.

UV lamp cables

- The UV lamp cables must be of a minimum length. For more information, see *Install the cables* on page 56.
- The UV lamp cables that connect to the control cabinet must be shortened at the ends.

Signal cables

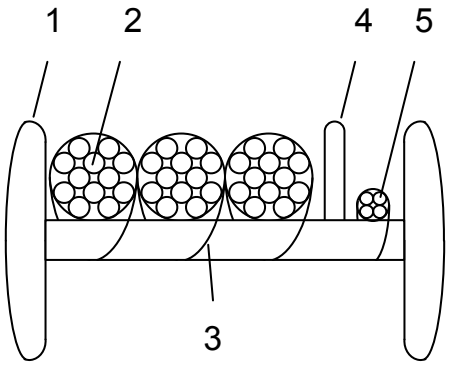
The signal cables must be installed separately from these cables:

- Power cables
- UV lamp cables

Cable duct and conduit

System	Maximum number of UV lamp cables	Diameter, mm (inch)
ELR60, 600 W	9	75 (3)
	18	100 (4)

Cable tray



1. Cable tray
2. UV lamp cables
3. Cable tie
4. Separation plate
5. Sensor cables

For more information, see the project-specific Wiring Diagram and Cable List Overview in the binder.

5.4.2 Install the cables

Before the cables are installed, the electrical category documents in the binder must be read and understood.

- The ground wire must be as short as possible.
- The UV lamp cables must be installed separately from the other cables and must have the following minimum length:

UV lamps	Minimum cable length
ELR60	8 m (26.25 ft)

If power generators are used for the main power supply, the operator must contact the manufacturer for approval.

1. Install the following items between the cabinets and the UV bank:
   – Ground wire
   – UV lamp cables

     For more information, see the installation sheets that are located inside the electronic ballast cabinet and control cabinet.
   – UV sensor cables
2. If applicable, install the cables that connect the control cabinets to the following cabinets:
   – Electronic ballast cabinet
   – Incomer cabinet
   – Distribution cabinet
   – Incomer distribution cabinet
   – Transformer cabinet

   For more information, see the Wiring Diagram and the Cable List Overview in the binder.
3. If applicable, install the cables that connect the following cabinets to the control cabinet and the UV bank:
   – Wiper control cabinet
   – Lift control cabinet
4. If applicable, connect all the external cables to the customer terminals.

   For more information, see the Wiring Diagram in the binder.
5. Connect the related cables to the following items:
   – Low-level sensor
   – Ultrasonic level sensor, optional
   – Downward opening penstock (DOP), optional
   – Flowmeter and signal cables, optional
   – UV transmittance (UVT) monitor, optional
6. Check that all the terminals and connections are connected correctly.
7. Connect the power supply cable.

Before the UV system is turned on for the first time, record the results of the following values:

- Insulation measurements
- Loop resistances
- Incoming voltages

6 Maintenance

6.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 5 have been read and understood.

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.

WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

WARNING: Crush Hazard

The UV module can fall down or swing uncontrollably, and injure people or damage property. Never use a crane to lift the UV modules during strong winds.

WARNING: Crush Hazard

Always lift the unit by its designated lifting points.

Use suitable lifting equipment and ensure that the product is properly harnessed.

Wear personal protective equipment.

Stay clear of cables and suspended loads.

WARNING: Crush Hazard

If the UV module is not attached safely, it can fall down. Set the safety lock pins in the locked position before the maintenance of the UV module starts. Install the safety block before the maintenance below the UV module starts. Do not remove the safety lock pins and safety block during maintenance.

WARNING: Fall Hazard

Falls into the UV channel can cause serious injuries. Always keep the channel covers closed.

CAUTION: Entanglement Hazard

Loose clothing can entangle in the shaft that rotates. Do not wear loose clothing.

CAUTION: Sewage Hazard

Risk of infection during maintenance of theUV channel components. Follow all the regulations, codes, and health and safety directives.

CAUTION: Ultraviolet (UV) Light Hazard

UV light can burn the eyes and the skin. Never operate the UV lamps while UV module is lifted for service.

CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

CAUTION: Ultraviolet (UV) Light Hazard

UV light can burn the eyes and the skin. Never operate the UV lamps outside the UV system. Use personal protective equipment.

CAUTION: Thermal Hazard

The surfaces or parts of the unit may become hot during operation. Allow surfaces to cool before starting work, or wear heat-protective clothing.

NOTICE:

UV lamps and quartz sleeves are fragile. These parts must be handled carefully.

NOTICE:

The operator must not climb on the UV module or put anything on it.

NOTICE:

The operator must not climb on the UV channel cover or put anything on it.

NOTICE:

The operator must make sure that the cables are not damaged.

Personal protective equipment

NOTICE:

The following personal protective equipment is needed:

- Protective gloves
- Safety footwear
- Safety helmet
- Safety goggles or face shield for UV protection

6.2 Inspection

UV channel

Part	Action	Interval
UV channel	Clean the UV channel.	Depends on the operational condition
Weir	1. Check the weir for blockage. 2. If necessary, clear the blockage.	Daily
	1. Check for leakage around the sealed joints. 2. If necessary, repair the sealed joints. For more information, contact the local sales and service representative.	
Downward opening penstock (DOP)	1. Check the gate movement and the DOP for blockage. 2. If necessary, clear the blockage.	Daily
	Do the maintenance checks. For more information, see to the operation manual of the DOP.	Depends on the operational condition
Ultrasonic level sensor	1. Check for that there are no unwanted materials in the effluent water. 2. If necessary, remove the unwanted materials.	Daily
	Do the maintenance checks. For more information, see the operation manual of the ultrasonic level sensor.	Depends on the operational condition
Low-level probe	1. Check the probe rods of the low-level probe for blockage or algal bloom. 2. If necessary, clear the blockage or the algal bloom.	Daily
UV transmittance (UVT) monitor	Do the maintenance checks. For more information, see the operation manual of the UVT monitor.	Depends on the operational condition

UV lamp modules

Part	Action	Interval
Wiper	1. Check the cleaning function of the wiper rings. 2. If necessary, replace the wiper rings. For more information, see *Replace the wiper rings* on page 73.	Weekly
	Replace the wiper rings. For more information, see *Replace the wiper rings* on page 73.	30 000 cycles
Wiper blade	1. Check the cleaning function of the wiper blade. 2. If necessary, replace the wiper blade. For more information, see *Replace the wiper rings* on page 73.	Weekly
	Replace the wiper blade. For more information, see *Replace the wiper rings* on page 73.	15 000 cycles
Spindle nut	Replace the spindle nut of the electric wiper. For more information, see *Replace the spindle nut* on page 75.	30 000 cycles

Part	Action	Interval
Quartz sleeves	1. Check the quartz sleeves for contamination. 2. If necessary, clean the quartz sleeves. For more information, see *Clean the transparent surfaces* on page 62.	Monthly
UV lamps	Replace the UV lamps. For more information, see *Replace the UV lamps* on page 71.	14 000 hours

Module guide rack

Part	Action	Interval
Electric lift, optional	1. Check the operation of the electric lift. For more information, see *Electric lift operation* on page 63. 2. If necessary, repair the electric lift. For more information, contact the local sales and service representative.	Depends on the operational condition

Air compressor

Part	Action	Interval
Air receiver	Drain the moisture from the manual drain valve.	Weekly
Cylinder	1. Check for air leaks. 2. If necessary, repair the leaks. For more information, contact the local sales and service reprenstative.	Weekly
	1. Check the operation of the cylinder. 2. If necessary, replace the cylinder. For more information, contact the local sales and service reprenstative.	
Filter	1. Check the operation of the automatic drain valve. 2. If necessary, replace the automatic drain valve. For more information, see the air compressor manual.	Weekly

Cabinets

Part	Action	Interval
HMI • Control 48 PLC cabinet • ICA cabinet • IDC cabinet	1. a. Check the status of the alarms in the HMI. b. If necessary, check the related system. c. Reset the alarm. For more information, see *Troubleshooting* on page 87.	Daily
	1. Check the operation hours and the operation cycles of the UV lamps. 2. If necessary, replace the UV lamps. For more information, see *Replace the UV lamps* on page 71.	Monthly

Part	Action	Interval
Fans • Control 48 PLC cabinet • Electronic ballast cabinets	1. Check the operation of the fans. 2. If necessary, replace the fans. For more information, contact the local sales and service representative.	Daily
	Replace the fans. For more information, contact the local sales and service representative.	30 000 hours
Filter mats • Control 48 PLC cabinet • Electronic ballast cabinets	Clean the filter mats. For more information, see *Clean the filter mat* on page 82.	Monthly
Air conditioner filters, optional	Clean the filter mats of the air conditioner.	Monthly
Fans of the electronic ballasts • Ballast racks in the electronic ballast cabinets	Replace the fans. For more information, contact the local sales and service representative.	40 000 hours

UV system

Part	Action	Interval
All parts	1. Check the UV system for damage and corrosion. 2. If necessary, repair the damaged parts. 3. If necessary, remove the corrosion. For more information, contact the local sales and service representative.	Monthly

6.3 Clean the transparent surfaces

The following parts have transparent surfaces:

- Quartz sleeve
- UV sensor window

Clean, cut-resistant gloves must be used to handle these parts.

Dirt or fingerprints on the transparent surfaces decrease the UV transmittance and the efficiency of the UV system.

Dirt and fingerprints that are not removed can burn into the glass during operation.

Use the following items to clean dirt and fingerprints from the transparent surfaces:

– Clean and soft cloth
– Pure alcohol

Record the task in the operation logbook.

6.4 Isolate the UV system

1. Close and lock out the inlet and the outlet isolation valves.
2. Turn off the UV system.
   The UV lamps turn off after sometime.
   For more information, see the control philosophy manual in the binder.
3. Turn off and lock out the main isolator of the UV system.
4. Isolate and lock out the main power supply.
5. Drain the water from the UV channels.

Record the task in the operation logbook.

6.5 Operation of the UV module lift

NOTICE:

The operator must make sure that the flow is less than 108 m³/h for each UV lamp.

Only one UV module is lifted or lowered at a time.

6.5.1 Electric lift operation

It is not possible to lift the UV module under the following conditions:

- The UV module wiper is in operation.
- The UV bank is turned on.
- The electric lift drive has failed.

Lift the UV module

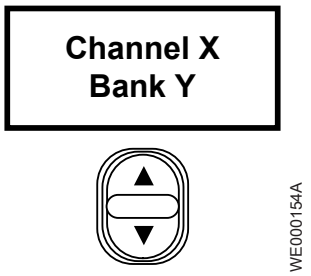
1. Remove the following items:
   1. Floor covers of the UV bank
   2. UV module covers
2. Disconnect the following items:
   - UV module connector
   - UV lamp connectors
   - Ground cable
3. On the HMI, go to the **Module Lift** screen.
4. Select the UV bank that must be lifted.

   The push button of the lift control cabinet of the selected UV bank lights up under the following conditions:

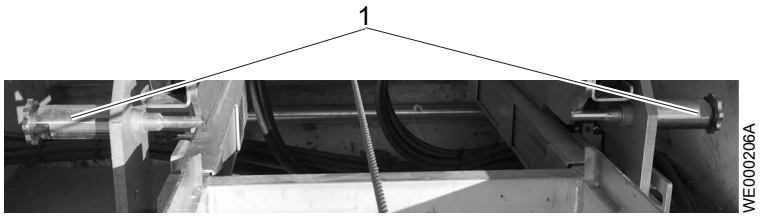
Conditions	Result
– The UV system is in the automatic mode. – The UV channel is not in the maintenance mode.	1. If a standby UV bank is available, the standby UV bank turns on. 2. After sometime, the selected UV bank turns off. 3. The push-button lights up.
– The UV system is in one of the following modes: – Off – Manual – Automatic – The UV channel is in the maintenance mode.	1. The selected UV bank is turned off. 2. The push-button lights up.

5. Push down the up arrow of the push button until the UV module lifts completely.

   The electric lift stops automatically when the UV module is at the highest position.



6. Set the safety lock pins to the locked position.



1. Safety lock pins

7. If maintenance is necessary below the UV module, install the safety block on each UV module.
   a) Insert the safety block into the guide rail of the UV module.
      The safety block must be pushed down to the end position.

1. Safety block
2. Safety lock pin
3. Guide rail

   b) Use a wrench to tighten the bolts of the safety block.
      The bolts must be tightened fully.

After maintenance, the UV module must be lowered.

Lower the UV module

1. If installed, remove the safety block from each UV module.
2. Remove the safety lock pins from the locked position.
3. Push down the down arrow of the push-button of the applicable UV bank until the UV module lowers completely.
   The electric lift stops automatically when the UV module is at the lowest position.
4. Connect the following items:
   - UV module connector
   - UV lamp connectors
   - Ground cable
5. Reset the safety relay alarm of the UV bank.
   For more information, see *SAFETY RELAY FAILURE, CHANNEL 'x' BANK 'y'* on page 111.
6. Install the following items:
   1. UV module covers
   2. Floor covers of the UV bank
7. On the HMI, go to the **Module Lift** screen.
8. Cancel the applicable UV bank.
   The push-button light of the lift control cabinet goes off.
   The selected UV bank turns on or turns off under the following conditions:

Conditions	Result
– The UV system is in the automatic mode. – The UV channel is not in the maintenance mode.	The UV bank turns on or turns off according to the dose-pacing algorithm.
– The UV system is in the automatic mode. – The UV channel is in the maintenance mode.	The selected UV bank stays turned off.
– The UV system is in the manual mode. – The UV bank switch is in the **Manual** position.	The selected UV bank turns on.

6.5.2 Manual lift operation

The UV module must not be lifted under the following conditions:

- The UV module wiper is in operation.
- The UV bank is turned on.

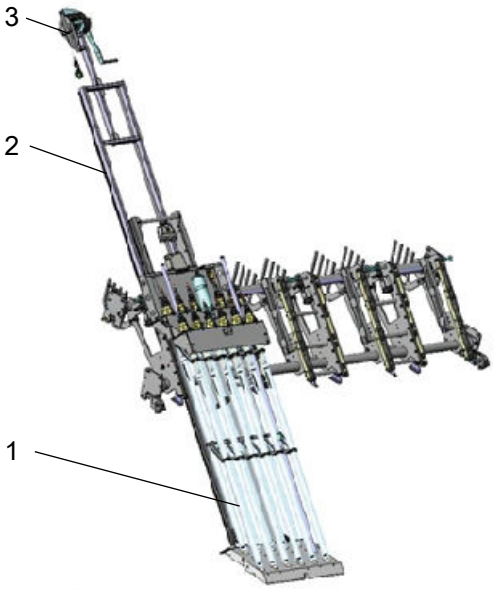
Lift the UV module

1. Remove the following items:
   1. Floor covers of the UV bank
   2. UV module covers
2. Disconnect the following items:
   – UV module connector
   – UV lamp connectors
   – Ground cable
3. On the HMI, go to the **Module Lift** screen.
4. Select the UV bank that must be lifted.

   The selected UV bank turns off under the following conditions:

Conditions	Result
– The UV system is in the automatic mode. – The UV channel is not in the maintenance mode.	1. If a standby UV bank is available, the standby UV bank turns on. 2. The selected UV bank turns off after 10 minutes.
– The UV system is in one of the following modes: – Off – Manual – Automatic – The UV channel is in the maintenance mode.	The selected UV bank is turned off.

5. Attach the mobile lifting structure to the UV module.

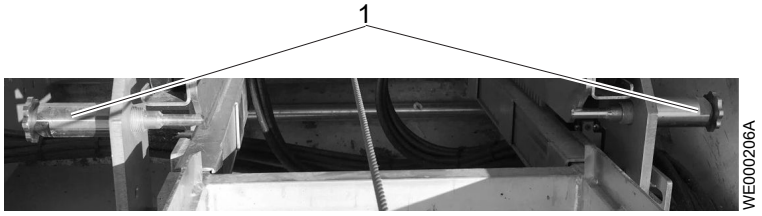


1. UV module
2. Mobile lifting structure
3. Manual winch

6. Use the manual winch to lift the UV module.

   The UV module must be lifted to the highest position.

7. Set the safety lock pins to the locked position.



1. Safety lock pins

8. If maintenance is necessary below the UV module, install the safety block on each UV module.

   a) Insert the safety block into the guide rail of the UV module.

      The safety block must be pushed down to the end position.

1. Safety block
2. Safety lock pin
3. Guide rail

   b) Use a wrench to tighten the bolts of the safety block.

      The bolts must be tightened fully.

After maintenance, the UV module must be lowered.

Lower the UV module

1. If installed, remove the safety block from each UV module.
2. Remove the safety lock pins from the locked position.
3. Use the manual winch to lower the UV module.

   The UV module must be lowered to the lowest position.
4. Remove the mobile lifting structure.
5. Connect the following items:
   - UV module connector
   - UV lamp connectors
   - Ground cable
6. Reset the safety relay alarm of the UV bank.

   For more information, see *SAFETY RELAY FAILURE, CHANNEL 'x' BANK 'y'* on page 111.
7. Install the following items:
   1. UV module covers
   2. Floor covers of the UV bank
8. On the HMI, go to the **Module Lift** screen.
9. Cancel the applicable UV bank.

   The selected UV bank turns on or turns off according to the following conditions:

Conditions	Result
– The UV system is in the automatic mode. – The UV channel is not in the maintenance mode.	1. The UV bank turns on or turns off according to the dose-pacing algorithm.
– The UV system is in the automatic mode. – The UV channel is in the maintenance mode.	The selected UV bank stays off.
– The UV system is in the manual mode. – The UV bank switch is in the **Manual** position.	The selected UV bank turns on.

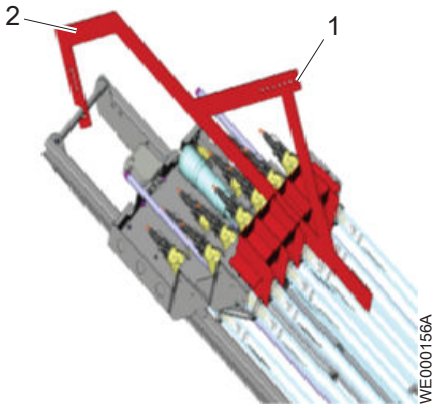
6.6 UV module removal

The crane that is used to lift the UV module must support the weight of the UV module. For more information, see *UV module* on page 16.

6.6.1 Remove the UV module: Electric lift

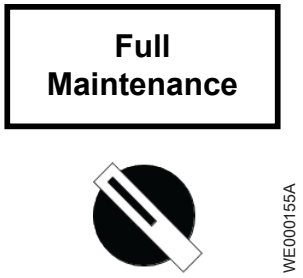
1. Lift the UV module.

   For more information, see *Lift the UV module* on page 63.
2. Attach the following items:
   1. Module lift device to the UV module
   2. Crane hook to the hook attachment point of the module lift device

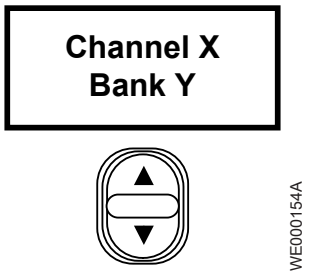


a. Hook attachment point
b. Module lift device

3. Use the crane hoist to support the UV module.
4. Remove the safety lock pins from the locked position.
5. Set the **Full Maintenance** switch of the lift control cabinet to the on position.



6. Push down the up arrow button of the lift control cabinet.



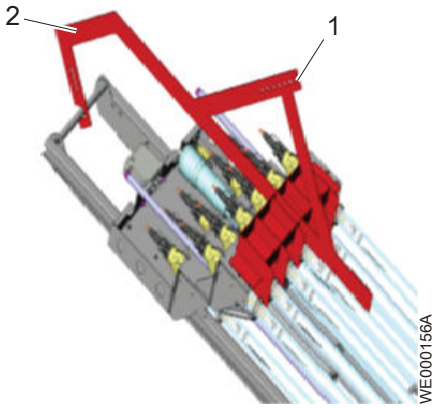
The gear racks of the UV module must detach from the pinions of the module guide rack.

7. Carefully transport the UV module to the designated area.
8. Set the **Full Maintenance** switch to the off position.
9. Remove the following items:
   1. Crane hook from the Module lift device
   2. Module lift device

Record the task in the operation logbook.

6.6.2 Remove the UV module: Manual lift

1. Lift the UV module.
   For more information, see *Lift the UV module* on page 65.
2. Attach the following items:
   1. Module lift device to the UV module
   2. Crane hook to the hook attachment point of the module lift device



a. Hook attachment point
b. Module lift device

3. Use the crane hoist to support the UV module.
4. Remove the safety lock pins from the locked position.
5. Use the manual winch to detach the UV module from the pinions of the module guide rack.
6. Remove the mobile lifting structure.
7. Carefully transport the UV module to the designated area.
8. Remove the following items:
   1. Crane hook from the Module lift device
   2. Module lift device

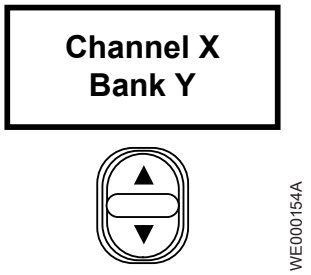
Record the task in the operation logbook.

6.7 UV module installation

The crane that is used to lift the UV module must support the weight of the UV module. For more information, see *UV module* on page 16.

6.7.1 Install the UV module: Electric lift

1. Attach the following items:
   1. Module lift device to the UV module
   2. Crane hook to the hook attachment point of the module lift device
2. Carefully transport the UV module to the UV channel.
3. Align the gear racks of the UV module on the pinions of the module guide rack.
4. Push down the down arrow button of the lift control cabinet.
   The UV module must be lowered to a depth of 20 cm (7.9 in) approximately.



5. Remove the following items:
   1. Crane hook from the module lift device
   2. Module lift device
6. Lower the UV module
   For more information, see *Lower the UV module* on page 64.

Record the task in the operation logbook.

6.7.2 Install the UV module: Manual lift

1. Attach the following items:
   1. Module lift device to the UV module
   2. Crane hook to the hook attachment point of the module lift device
2. Carefully transport the UV module to the UV channel.
3. Align the gear racks of the UV module on the pinions of the module guide rack.
4. Attach the mobile lifting structure to the UV module.
5. Use the manual winch to attach the UV module to the pinions of the module guide rack.
6. Remove the following items:
   1. Crane hook from the module lift device
   2. Module lift device
7. Lower the UV module

   For more information, see *Lower the UV module* on page 67.

Record the task in the operation logbook.

6.8 Clean the UV module manually

Necessary items:

- Non-metallic brush
- Clean-soft cloth
- Steam cleaner or clean water supply from an external hose to remove biofouling
- Commercial acid cleaner to remove scale formation

This procedure is applicable when the automatic wiping operation does not remove the fouling on the quartz sleeves completely.

1. Turn off the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn off the UV bank.

   The UV lamps must be allowed to cool down for 10 minutes.

   For more information, see the control philosophy manual in the binder.
2. Lift the UV module.

Lift type	Action
Electric	For more information, see *Lift the UV module* on page 63.
Manual	For more information, see *Lift the UV module* on page 65.

3. Clean the following locations of the UV module:

Location	Cleaning items
Surface of the UV module	– Non-metallic brush – Steam cleaner, clean water, or commercial acid cleaner The dirt must not be washed into the UV channel.
UV sensor window	– Clean-soft cloth – Steam cleaner, clean water, or commercial acid cleaner
Quartz sleeves	

   The cables and connectors of the UV module must be dried.
4. Lower the UV module.

Lift type	Action
Electric	For more information, see *Lower the UV module* on page 64.

Lift type	Action
Manual	For more information, see *Lower the UV module* on page 67.

5. Turn on the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn on the UV bank.
   For more information, see the control philosophy manual in the binder.
6. Push the alarm reset button to clear the alarms.
   The UV system must operate correctly.

Record the task in the operation logbook.

6.9 Replace the UV lamps

Before a defective UV lamp is replaced, check the following conditions:

Condition	Action
The UV intensity is low.	1. If the quartz sleeves are dirty, clean the quartz sleeves. For more information, see *Clean the UV module manually* on page 70. 2. If the UV intensity is low after the quartz sleeves are cleaned, replace the defective UV lamps with spare UV lamps.
All the UV lamps must be replaced according to the maintenance interval.	Replace all the UV lamps with new UV lamps. The replaced UV lamps that have remaining lamp hours can be used as spare UV lamps.
The defective UV lamp is near the UV sensor.	Replace the defective UV lamp with a UV lamp from the same UV bank that has average lamp life. For more information, see the BANK OVERVIEW screen on the HMI in the control philosophy in the binder. A new UV lamp must not be used because a new UV lamp generates higher UV intensity. A spare UV lamp must then be installed at the position from where the UV with an average lamp life is removed.
The UV system uses row control.	Replace the UV lamps in first row of the UV module with spare UV lamps that have longer lamp hours. If spare UV lamps are not available, new UV lamps must be used.

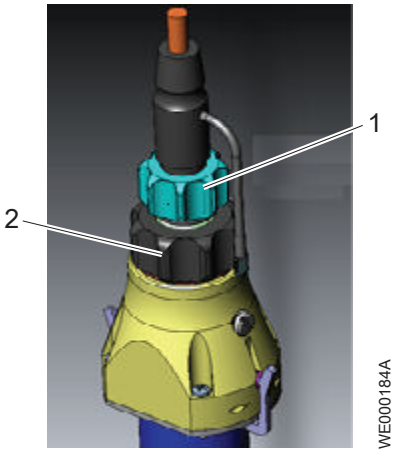
6.9.1 Remove the UV lamp

NOTICE:

Protective gloves must be used to handle the UV lamp and the UV lamp module.

The UV lamp module must be held by the ceramic end pieces.

1. Turn off the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn off the UV bank.
   The UV lamps must be allowed to cool down for 10 minutes.
   For more information, see the control philosophy manual in the binder.
2. Remove the following items:
   1. Floor covers of the UV bank
   2. UV module covers
3. Disconnect the UV lamp connector.
4. Manually loosen the UV lamp holder.



1. UV lamp connector
2. UV lamp holder

5. Carefully remove the UV lamp from the quartz sleeve.
6. If all the UV lamps of the UV bank must be removed, repeat step *3* on page 71 through step *5* on page 72 for each UV lamp.

Record the task in the operation logbook.

6.9.2 Install the UV lamp

NOTICE:

Protective gloves must be used to handle the UV lamp and the UV lamp module.

The UV lamp module must be held by the ceramic end pieces.

1. Check the condition of the quartz sleeve of the UV lamp that is removed.

Condition	Action
Fouling	Clean the quartz sleeve. For more information, see *Clean the transparent surfaces* on page 62.
Cracks	Replace the quartz sleeve.

2. Carefully insert the UV lamp into the quartz sleeve.
3. Manually tighten the UV lamp holder.
4. Connect the UV lamp connector.
5. If all the UV lamps of the UV bank must be replaced, repeat step *1* on page 72 through step *4* on page 72 for each UV lamp.
6. Update the UV lamp parameters.

Condition	Action
All the UV lamps of the UV bank are replaced.	1. On the HMI, go to the **Bank Lamp Status** screen. 2. Reset the UV lamp hours.
One UV lamp is replaced.	1. On the HMI, go to the **Lamp Hour** screen. 2. Enter the new UV lamp hours.

For more information, see the control philosophy manual in the binder.

7. Install the following items:
   1. UV module covers
   2. Floor covers of the UV bank
8. Turn on the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn on the UV bank.

For more information, see the control philosophy manual in the binder.

9. Reset the safety relay alarm of the UV bank.

   For more information, see *SAFETY RELAY FAILURE, CHANNEL 'x' BANK 'y'* on page 111.

Record the task in the operation logbook.

6.10 Replace the wiper rings

6.10.1 Remove the wiper rings

NOTICE:

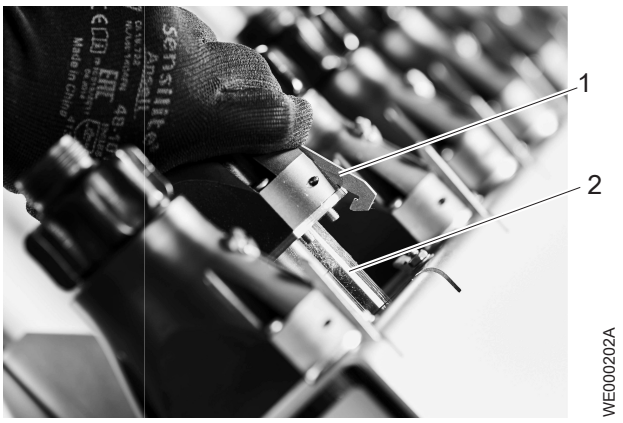
Protective gloves must be used to handle the UV lamp and the UV lamp module.

The UV lamp module must be held by the ceramic end pieces.

1. Turn off the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn off the UV bank.

   The UV lamps must be allowed to cool down for 10 minutes.

   For more information, see the control philosophy manual in the binder.
2. Remove the following items:
   1. Floor covers of the UV bank
   2. UV module covers
3. Remove the UV lamp modules.
   a) Disconnect the UV lamp connectors.
   b) Use the quick connector to release each UV lamp module from the UV module.



1. Quick connector
2. UV lamp module

   c) Carefully slide each UV lamp module from the UV module.
4. Lift the UV module.

Lift type	Action
Electric	Do steps *3* on page 63 through *6* on page 63.
Manual	Do steps *3* on page 65 through *7* on page 66.

5. Remove the wiper rings and the wiper blade from the wiper arm.

   There is one wiper blade in each UV bank.

1. Wiper rings
2. Wiper blade
3. UV sensor

Record the task in the operation logbook.

6.10.2 Install the wiper rings

NOTICE:

Protective gloves must be used to handle the UV lamp and the UV lamp module.

The UV lamp module must be held by the ceramic end pieces.

1. Clean the quartz sleeves.

   For more information, see *Clean the transparent surfaces* on page 62.
2. Install the new wiper rings and the wiper blade on the wiper arm.
3. Lower the UV module.

Lift type	Action
Electric	Do steps *2* on page 64 through *3* on page 64.
Manual	Do steps *2* on page 67 through *4* on page 67.

4. Install the UV lamp modules.
   a) Carefully slide each UV lamp module into the UV module.
   b) Use the quick connector to connect each UV lamp module to the UV module.
5. Connect the following items:
   – UV module connector
   – UV lamp connectors
   – Ground cable
6. Reset the safety relay alarm of the UV bank.

   For more information, see *SAFETY RELAY FAILURE, CHANNEL 'x' BANK 'y'* on page 111.
7. Install the following items:
   1. UV module covers
   2. Floor covers of the UV bank
8. Reset the wiping cycles counter.
   a) On the HMI, go to **Pneumatic wiping system** or **Electric wiping system** screen.
   b) Reset the **Wipe count** parameter of the UV bank.

      For more information, see the control philosophy manual in the binder.
9. Turn on the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn on the UV bank.

   For more information, see the control philosophy manual in the binder.

Record the task in the operation logbook.

6.11 Replace the spindle nut

6.11.1 Remove the spindle nut

NOTICE:

Protective gloves must be used to handle the UV lamp and the UV lamp module.

The UV lamp module must be held by the ceramic end pieces.

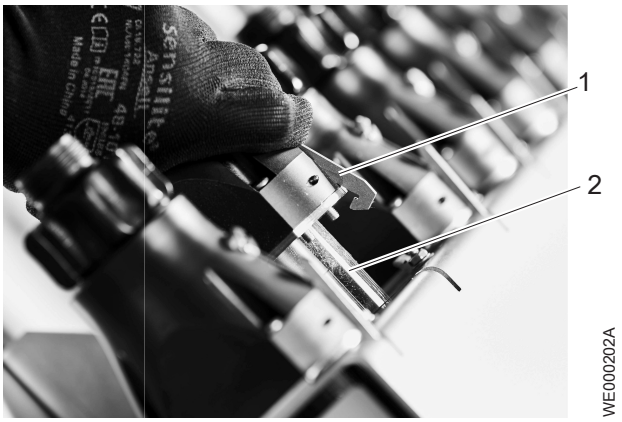
1. Turn off the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn off the UV bank.

   The UV lamps must be allowed to cool down for 10 minutes.

   For more information, see the control philosophy manual in the binder.
2. Remove the UV module.

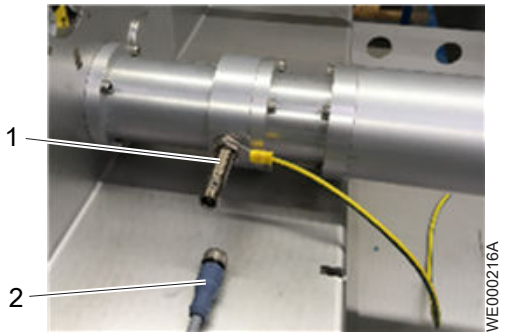
   For more information. see *Remove the UV module: Electric lift* on page 67.
3. Carefully transport the UV module to the designated area.
4. Remove the UV lamp modules.

   All the UV lamp modules that are around the wiper motor must be removed.
   a) Use the quick connector to release each UV lamp module from the UV module.



1. Quick connector
2. UV lamp module

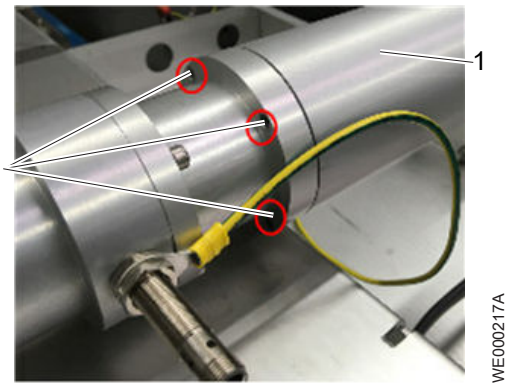
   b) Carefully slide each UV lamp module out of the UV module.
5. Disconnect the proximity sensor connector of the wiper motor.



1. Proximity sensor
2. Connector

6. Remove the wiper motor housing.
   a) Remove the screws of the wiper motor housing.

      A hexagon wrench must be used to loosen the screws.

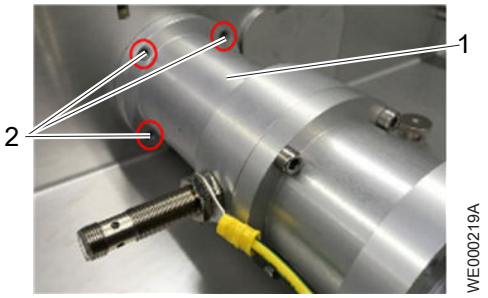


1. Wiper motor housing
2. Screws

b) Remove the wiper motor housing.

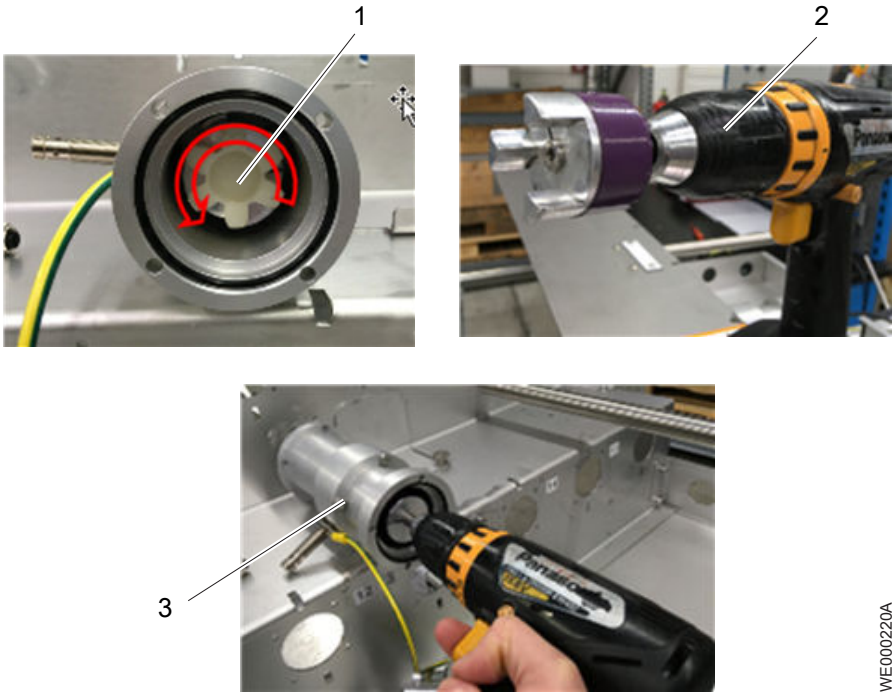
7. Remove the screws of the coupler.

   A hexagon wrench must be used to loosen the screws.



1. Coupler
2. Screws

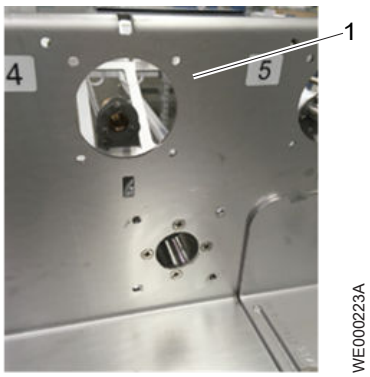
8. Remove the spindle nut.
   a) Use one of the following methods to rotate the spindle in the counterclockwise direction:
      – Manually
      – Cordless screwdriver with an adapter



1. Spindle
2. Cordless screwdriver with an adapter
3. Coupler

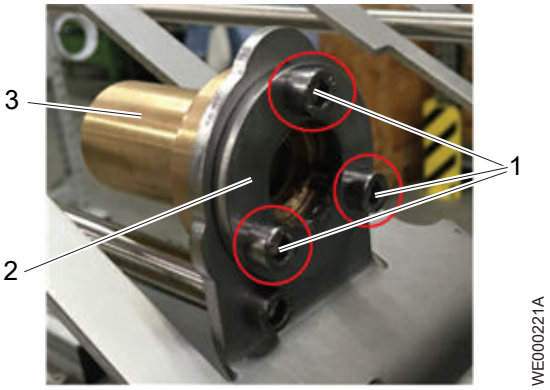
b) Rotate the spindle until the spindle detaches from the spindle nut.

c) Remove the spindle from the UV module.



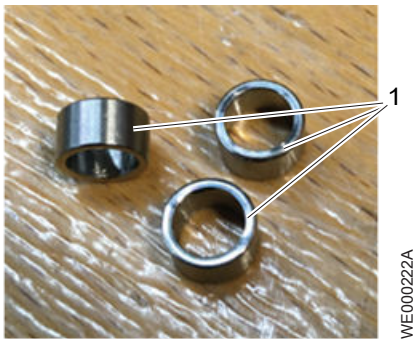
1. UV module

d) Remove the screws that hold the spindle nut.



1. Screws
2. Flange
3. Spindle nut

e) Carefully remove the spacers that are between the screws and the flange.



1. Spacers

f) Remove the spindle nut.

Record the task in the operation logbook.

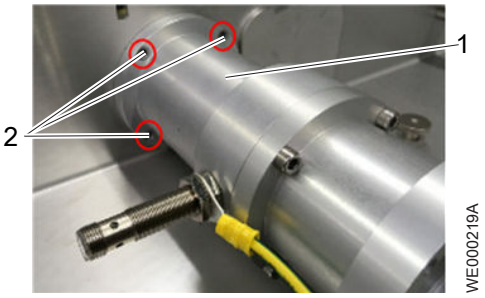
6.11.2 Install the spindle nut

NOTICE:

Protective gloves must be used to handle the UV lamp and the UV lamp module.

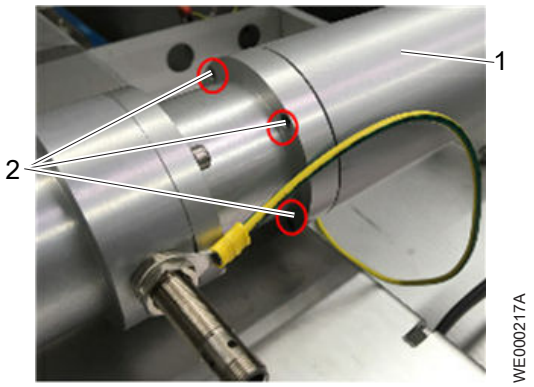
The UV lamp module must be held by the ceramic end pieces.

1. Install the spindle nut.
   a) Carefully install the spacers between the screws and the flange.
   b) Install the screws that hold the spindle nut.
2. Install the spindle.
   a) Put back the spindle.
   b) Use one of the following methods to rotate the spindle in the clockwise direction:
      – Manually
      – Cordless screwdriver with an adapter
   c) Rotate the spindle.
      The threads of the spindle must connect to the spindle nut.
3. Install the coupler.
   a) Put back the coupler.
   b) Install the screws.
      A hexagon wrench must be used to tighten the screws.



1. Coupler
2. Screws

4. Install the wiper motor housing.
   a) Put back the wiper motor housing.
   b) Install the screws.
      A hexagon wrench must be used to tighten the screws.



1. Wiper motor housing
2. Screws

5. Connect the proximity sensor connector.
6. Install the UV lamp modules.
   a) Carefully slide each UV lamp module into the UV module.
   b) Use the quick connector to connect each UV lamp module to the UV module.
7. Restore the UV module.
   For more information. see *Install the UV module: Electric lift* on page 69.
8. Turn on the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn on the UV bank.
   For more information, see the control philosophy manual in the binder.

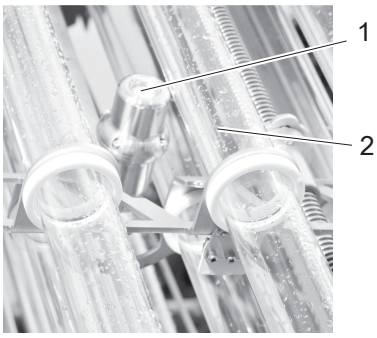
Record the task in the operation logbook.

6.12 Replace the UV sensor

6.12.1 Remove the UV sensor

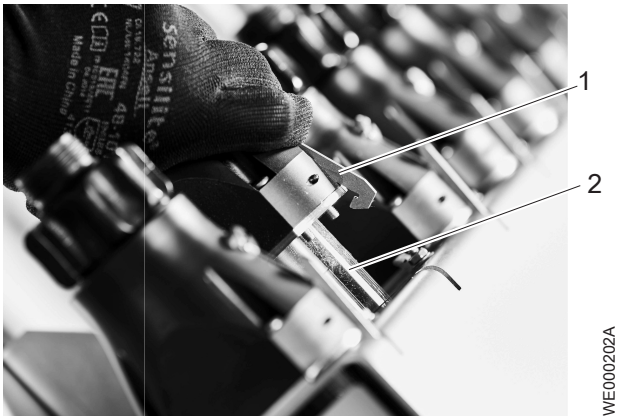
NOTICE:
Protective gloves must be used to handle the UV lamp and the UV lamp module.
The UV lamp module must be held by the ceramic end pieces.

1. Turn off the applicable UV bank.
   a) On the HMI, go to the **Maintenance Mode** screen.
   b) Turn off the UV bank.
   The UV lamps must be allowed to cool down for 10 minutes.
   For more information, see the control philosophy manual in the binder.
2. Remove the following items:
   1. Floor covers of the UV bank
   2. UV module covers
3. Remove the UV lamp module.
   a) Disconnect the connector of the UV lamp module that is opposite to the UV sensor.



1. UV lamp module
2. UV sensor

b) Use the quick connector to release the UV lamp module from the UV module.



1. Quick connector
2. UV lamp module

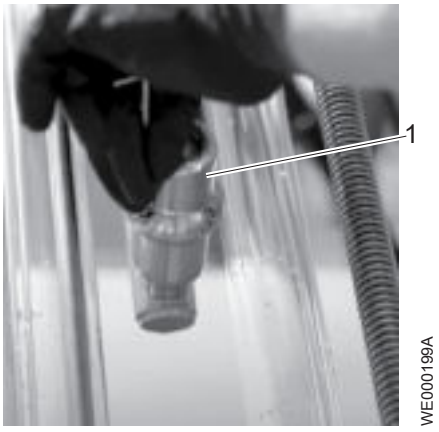
c) Carefully slide the UV lamp module from the UV module.

4. Lift the UV module.

Lift type	Action
Electric	Do steps *3* on page 63 through *6* on page 63.
Manual	Do steps *3* on page 65 through *7* on page 66.

5. Remove the UV sensor.
   a) Remove the UV sensor cover.

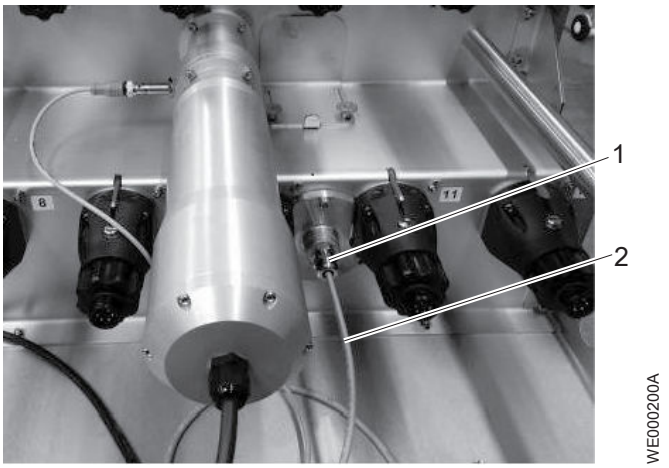
      A hexagon wrench must be used to remove the screws of the UV sensor cover.



1. UV sensor cover

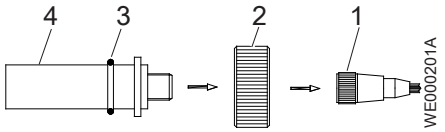
   b) Loosen the nut of the UV sensor cable that is at the top of the UV module.

      A wrench must be used to loosen the nut.



1. Nut
2. UV sensor cable

c) Release the tension of the UV sensor cable.
d) Disconnect the connector from the UV sensor.
e) Loosen the knurled nut by using hand.
f) Remove the UV sensor.



1. Connector
2. Knurled nut
3. O-ring
4. UV sensor

Record the task in the operation logbook.

6.12.2 Install the UV sensor

NOTICE:

Protective gloves must be used to handle the UV lamp and the UV lamp module.

The UV lamp module must be held by the ceramic end pieces.

1. Install the UV sensor.
   a) If the O-ring is damaged, replace the O-ring.
   b) Connect the UV sensor connector.
   c) Manually tighten the knurled nut.
   d) Use a wrench to tighten the nut of the UV sensor cable.
   e) Install the UV sensor cover.

      A hexagon wrench must be used to tighten the screws of the UV sensor cover.
2. Lower the UV module.

Lift type	Action
Electric	Do steps *2* on page 64 through *8* on page 64.
Manual	Do steps *2* on page 67 through *9* on page 67.

3. Install the UV lamp module.
   a) Carefully slide the UV lamp module into the UV module.
   b) Use the quick connector to connect the UV lamp module to the UV module.
   c) Connect the UV lamp connector.
4. Turn on the applicable UV bank.

a) On the HMI, go to the **Maintenance Mode** screen.
b) Turn on the UV bank.

For more information, see the control philosophy manual in the binder.

Record the task in the operation logbook.

6.13 Clean the filter mat

Turn off the applicable cabinet.

Cabinets	Conditions	Action
Control 48 PLC	-	1. Set the **Auto-Off** switch to **Off**. 2. Turn off the main isolator.
Electronic ballast	The electronic ballast cabinet is in **Standby** or **Assist** mode.	Turn off the UV bank isolator.
	The electronic ballast cabinet is in **Duty** mode.	1. Set the UV bank in **Standby** mode. 2. Turn off the UV bank isolator.

For more information, see the control philosophy manual in the binder.

The filter mat must be clean so that the airflow increases and the internal temperature of the control cabinet decreases.

1. Remove the fan guard from the air inlet.
2. Remove the filter mat from the air inlet.
3. Use one of the following items to clean the filter mat:
   - Blower
   - Laundry detergent at 60°C (140°F)

   The filter mat must be dried.
4. Put the filter mat on the air inlet.
5. Install the fan guard on the air inlet.

Turn on the applicable cabinet.

Cabinets	Action
Control 48 PLC	1. Turn on the main isolator. 2. Set the **Auto-Off** switch to **Auto**.
Electronic ballast	Turn on the UV bank isolator.

For more information, see the control philosophy manual in the binder.

Record the task in the operation logbook.

7 Water Sampling

7.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 5 have been read and understood.

WARNING: Fall Hazard

Falls into the UV channel can cause serious injuries. Always keep the channel covers closed.

CAUTION: Sewage Hazard

Risk of infection during maintenance of theUV channel components. Follow all the regulations, codes, and health and safety directives.

CAUTION: Cut Hazard

Steel sheets can have sharp edges. Wear protective gloves.

CAUTION: Entanglement Hazard

Loose clothing can entangle in the shaft that rotates. Do not wear loose clothing.

NOTICE:

The operator must not climb on the UV module or put anything on it.

Personal protective equipment

NOTICE:

The following personal protective equipment is needed:

- Protective gloves
- Safety footwear
- Safety goggles or face shield for UV protection

7.2 Standard

The sampling must be done according to ISO 19458:2006, Part 1: Guidance on the design of sampling programs and sampling techniques, or the equivalent.

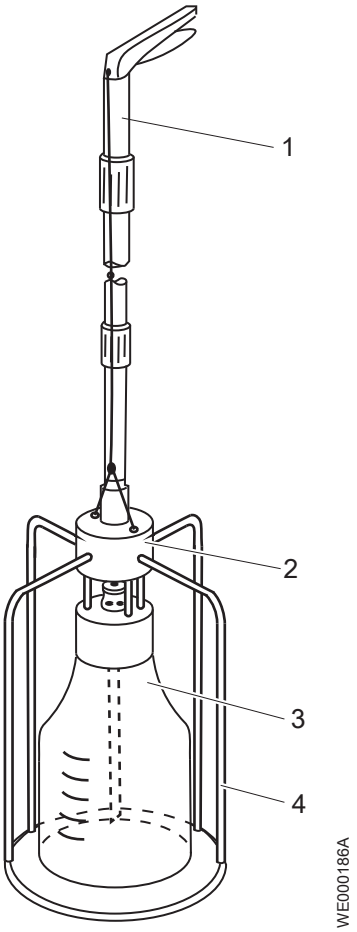
7.3 Examples of equipment

Sterile bottle

A sterile bottle is used to collect samples manually from small UV channels. The volume of the bottle must meet the requirements of the laboratory.

Depth sampler

A depth sampler is used to collect samples from large UV channels.



Position	Part	Description
1	Telescopic rod	The rod must be minimum 1 m (3.3 ft).
2	Valve	The valve has a wire that is connected to the handle of the telescopic rod.
3	Bottle	A sterile bottle must be used. The volume of the bottle must meet the requirements of the laboratory.
4	Cage	The cage protects the bottle.

7.4 Sampling plan

Requirements

- The total number of sampling bottles must be prepared according to the number of samples that are necessary.
- The sampling plan must be changed according to the number of parameters that are recorded. During sampling, the following parameters must be recorded for each sample:
  - Transmittance
  - UV dose
  - Flow rate
  - Suspended solids
  - Temperature
  - Values from the sensors
  - Power

Example

Bottle number			1	2	3
Date		DD-MM-YYYY	19.06.2005		
Time		hh:mm	08:00		
Flow rate		m^3/h	1000		
UV transmission, T1 cm		%	67		
UV dose		J/m^2	450		
Suspended solids		mg/L	5		
Total coliforms	Before the UV treatment	1/100 ml	80 000		
	After the UV treatment	1/100 ml	47		
Fecal coliforms	Before the UV treatment	1/100 ml	20,000		
	After the UV treatment	1/100 ml	7		
Enterococci	Before the UV treatment	1/100 ml	1 000		
	After the UV treatment	1/100 ml	4		
Running hours	Bank A	h	10		
	Bank B	h	8		
On and off cycles	Bank A		256		
	Bank B		275		
Remarks			• Rainy • Lamp failure • UV lamp • Number 15		

7.5 Prepare the UV system

- The UV lamps and the UV channels must be clean.
- The flow rate must be correct. For more information, see *Adjust the flowmeter*.
- The effluent in the UV channel must be disinfected for a specified time. For more information, contact the local sales and service representative.

1. Start the UV disinfection.

   For more information, see *Commissioning, Startup, Operation, and Shutdown*.

   After the UV system starts, the following conditions must be checked:

   – All the UV lamps must turn on.

     If necessary, the defective lamps must be replaced. For more information, see *Replace the UV lamps* on page 71.

   – There are no warnings of low UV intensity. For more information, see *Troubleshooting* on page 87.

2. Stop the UV disinfection.

   For more information, see *Commissioning, Startup, Operation, and Shutdown*.

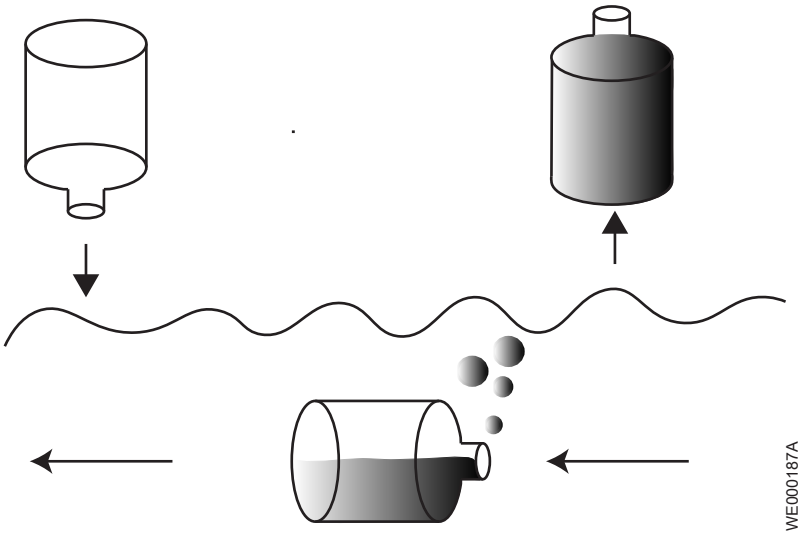
7.6 Sample collection

Requirements

- The samples must be collected from the UV channel before and after UV treatment.
- During the sample collection, the bottle must not touch the parts of the UV system in the UV channel.

7.6.1 Collect the sample: Manually

1. Remove the bottle cap.
   The inner surface or the neck of the bottle must not be touched.
2. Lower the bottle into the UV channel.
   The bottle must be lowered to a minimum depth of 30 cm (11.8 in).
3. Hold the bottle in the opposite direction of the water flow.
   The bottle must stay submerged until the bottle is filled completely.



4. Quickly close the bottle.
5. Remove the bottle from the UV channel.
   After the water sample is collected, the bottle must not be refilled.

The bottle must be kept in a cooler and sent immediately to the laboratory.

7.6.2 Collect the sample: Depth sampler

1. Use the handle to lower the depth sampler into the UV channel.
   The depth sampler must be lowered to a minimum depth of 30 cm (11.8 in).
2. Open the valve of the bottle.
   The bottle must stay submerged until the bottle is filled completely.
3. Close the valve of the bottle.
4. Remove the following items:
   1. The depth sampler from the water
   2. The bottle from the cage
5. Quickly use a cap to close the bottle.

The bottle must be kept in a cooler and sent immediately to the laboratory.

8 Troubleshooting

8.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 5 have been read and understood.

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.

WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

WARNING: Crush Hazard

The automatic wiper or the penstock can operate automatically. Stay clear of the automatic wiper or the penstock when the UV system is in operation.

WARNING: Crush Hazard

If the UV module is not attached safely, it can fall down. Set the safety lock pins in the locked position before the maintenance of the UV module starts. Install the safety block before the maintenance below the UV module starts. Do not remove the safety lock pins and safety block during maintenance.

WARNING: Fall Hazard

Falls into the UV channel can cause serious injuries. Always keep the channel covers closed.

CAUTION: Ultraviolet (UV) Light Hazard

UV light can burn the eyes and the skin. Never operate the UV lamps outside the UV system. Use personal protective equipment.

CAUTION: Thermal Hazard

The surfaces or parts of the unit may become hot during operation. Allow surfaces to cool before starting work, or wear heat-protective clothing.

CAUTION: Entanglement Hazard

Loose clothing can entangle in the shaft that rotates. Do not wear loose clothing.

NOTICE:

UV lamps and quartz sleeves are fragile. These parts must be handled carefully.

NOTICE:

The operator must make sure that the water level in the UV channel stays constant. The UV module must not be submerged.

NOTICE:

The operator must not climb on the UV channel cover or put anything on it.

NOTICE:

The UV system must not be turned on and off more than four times in a 24-hour operating period.

Personal protective equipment

NOTICE:

- Safety gloves
- Safety footwear
- UV protective safety goggles or UV protective face shield

8.2 Warning

During the UV disinfection process, the UV system generates warnings for issues that have minor effects on the UV disinfection process. The operator must acknowledge these warnings.

The project-specific warnings and alarms may differ from those listed here. For more information, see the control philosophy in the binder.

Channel x Bank y

x represents the UV channel number such as Channel 1, Channel 2, and Channel 3.

y represents the Bank letter such as Bank A, Bank B, and Bank C.

8.2.1 AIR CONDITIONER FAILURE, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The air conditioner of the related electronic ballast cabinet fails.	The PLC resets automatically after the air conditioner failure is resolved.	• Check the air conditioner. – If necessary, the air conditioner must be repaired.

8.2.2 AIR COMPRESSOR OVERLOAD

This warning is applicable to the pneumatic wiper.

Symptom and cause	UV system action	Remedy
The air compressor is overloaded. Causes: • The circuit breaker for the air compressor has tripped. • The air compressor fuses are blown.	-	Check these items of the air compressor: • Circuit breaker – If the circuit breaker has tripped, reset it. • Fuses – If the fuses are blown, replace them. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.3 AIR PRESSURE LOW

This warning is applicable to the pneumatic wiper.

The time delay for this warning is set on the user interface. For more information, see the Control Philosophy in the binder.

Symptom and cause	UV system action	Remedy
The pressure switch trips when the air pressure is low. Causes: • There is a leak in the air line. • An isolation valve in the air line is closed. • The power supply of the air compressor has tripped or turned off. • The air compressor is defective.	The warning resets automatically after the normal air pressure is restored.	Check these items: • Air line – If there are leaks, repair them. – If there is blockage, remove it. • Isolation valves – If the isolation valves are closed, open them. • Air compressor – If the power supply to the air compressor is turned off, turn on the power supply. – If the air compressor is defective, repair or replace it. For more information, contact the local sales and service representative.

8.2.4 LAMP FAILURE, CHANNEL 'x' BANK 'y'

The time delay for this warning ranges from 0 to 30 minutes and it is set on the user interface. For more information, see the Control Philosophy in the binder.

Symptom and cause	UV system action	Remedy
At least one UV lamp in the UV bank is defective. Causes: • The UV lamp has failed. • The electronic ballast has failed.	-	• If the following electrical connections are incorrect, connect them correctly: – The UV lamp cables to the electronic ballast – The UV ballast to the flexible circuit board • Check the **Bank Operating Hours**: – If the UV lamp hours are more than the maximum operation hours, replace the UV lamps. For more information, see *Replace the UV lamps* on page 71. • If the UV lamps are defective, replace them. For more information, see *Replace the UV lamps* on page 71. • If the electronic ballast is defective, replace it. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.5 LAMP HOUR GUARANTEE EXCEEDED, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The UV lamps are used for more than the specified hours in the Xylem warranty.	-	Check the UV lamp parameters: • **Bank Operating Hours** – If the UV lamp hours are more than the maximum operation hours, replace the UV lamps. For more information, see *Replace the UV lamps* on page 71. – Reset the lamp hours to zero. For more information, see the **BANK OVERVIEW** screen in the control philosophy in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.6 LAMP HOUR GUARANTEE EXCEEDED, CHANNEL 'x' BANK 'y' ROW 1

Symptom and cause	UV system action	Remedy
The UV lamps in the row are used for more than the specified hours in the Xylem warranty.	-	• Check the UV lamp hours. For more information, see the relevant **LAMP HOUR** screen. • Replace the UV lamps of row 1 with UV lamps from row 2. • Set the UV lamp hours by using the values from row 2. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.7 LAMP HOUR GUARANTEE EXCEEDED, CHANNEL 'x' BANK 'y' ROW 2

Symptom and cause	UV system action	Remedy
The UV lamps in the row are used for more than the specified hours in the warranty.	-	• Check the UV lamp hours. For more information, see the relevant **LAMP HOUR** screen. • Replace the UV lamps of row 2 with new UV lamps. • Reset the UV lamp hours. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.8 MODULE LIFT FAILURE, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The electric lift of the UV module failed. Causes: • The lift motor, drive, or gear has failed. • The power supply to the lift control cabinet has failed.	The lifting for the bank is disabled.	Check these items: • Lift motor, drive, and gear – If the lift motor, drive, or gears are defective, repair or replace it. • Power supply to the lift control cabinet – If there is no power supply, connect the power supply. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.9 SIGNAL FAILURE: INLET PENSTOCK POSITION, CHANNEL 'x'

This warning is applicable to the inlet penstock.

The time delay for this warning is set on the user interface. For more information, see the Control Philosophy in the binder.

Symptom and cause	UV system action	Remedy
The 4–20mA signal to the PLC is missing. Causes: • The analog signal wire is disconnected. • The analog input module is defective or damaged. • The power supply to the inlet penstock has failed. • The inlet penstock actuator is defective.	-	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. For more information, contact the local sales and service representative. • Inlet penstock actuator – If there is no power supply to the inlet penstock actuator, connect the power supply. – If the inlet penstock actuator is defective, repair or replace it. For more information, see the inlet penstock manual in the binder.

8.2.10 SURGE SUPPRESSOR FAILURE, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
A power spike or power surge occurred.	The warning resets automatically after the power surge suppressor is replaced.	• Check these items: – Power supply – Components of the internal power distribution – Fuses – UV bank components • If necessary, replace the following items: – Fuses – Surge suppressor – Damaged components because of the power surge

8.2.11 UPS NOT OK

Symptom and cause	UV system action	Remedy
The UPS is not operational.	The PLC resets automatically after the cause of the failure is resolved.	• Check the UPS battery. – If the UPS battery is not charged, charge it. – If the UPS battery is not operational, replace it. For more information, see the UPS vendor manual in the binder.

8.2.12 UV DOSE LOW WARNING, CHANNEL 'x'

There is no warning when the UV channel is in maintenance mode.

The time delay for this warning is set on the user interface. For more information, see the Control Philosophy in the binder.

Symptom and cause	UV system action	Remedy
The received UV dose is less than the **UV DOSE LOW WARNING SETPOINT**.	The warning automatically resets when the UV dose is more than the **UV DOSE LOW WARNING SETPOINT**.	Check these items: • UV modules – If the UV lamps are defective, replace them. For more information, see *Replace the UV lamps* on page 71. – If the UV sensor and the quartz sleeves are dirty, clean them. For more information, see *Clean the transparent surfaces* on page 62 and *Clean the UV module manually* on page 70. • UV lamp parameters – **Bank Operating Hours** If the UV lamp hours are more than the maximum operation hours, replace the UV lamps. – **Bank ON/OFF Cycles** If the operation cycles of the UV lamp are more than the maximum operation cycles, replace the UV lamps. For more information, see the **BANK OVERVIEW** screen in the binder and *Replace the UV lamps* on page 71. • Automatic-wiping system – If the automatic-wiping does not clean the quartz sleeves correctly, do these steps: – Decrease the wiping interval. – Increase the number of wipes in a wiping cycle. – If the wiper rings are worn out, replace them. For more information, see *Replace the wiper rings* on page 73.

8.2.13 UV INTENSITY LOW WARNING, CHANNEL 'x' BANK 'y'

There is no warning when the UV system is in maintenance mode.

The time delay for this warning is set on the user interface. For more information, see the Control Philosophy in the binder.

Symptom and cause	UV system action	Remedy
The UV intensity is less than the warning setpoint. Causes: • The UV lamps are near the end-of-lamp life. • The UV lamps near the UV sensor have failed. • The wiper rings are worn out. • The UV sensor and the quartz sleeves are dirty.	The warning automatically resets when the UV intensity is more than the warning setpoint.	Check these items: • Water quality – If the water is turbid, do the necessary steps to improve the water quality. • UV modules – If the UV lamps are defective, replace them. For more information, see *Replace the UV lamps* on page 71. – If the UV sensor and the quartz sleeves are dirty, clean them. For more information, see *Clean the transparent surfaces* on page 62 and *Clean the UV module manually* on page 70. • UV lamp parameters – **Bank Operating Hours** If the UV lamp hours are more than the maximum operation hours, replace the UV lamps. – **Bank ON/OFF Cycles** If the operation cycles of the UV lamp are more than the maximum operation cycles, replace the UV lamps. For more information, see the **BANK OVERVIEW** screen in the control philosophy in the binder and *Replace the UV lamps* on page 71. • Automatic-wiping system – If the automatic wiping does not clean the quartz sleeves correctly, do these steps: – Decrease the wiping interval. – Increase the number of wipes in a wiping cycle. – If the wiper rings are worn out, replace them. For more information, see *Replace the wiper rings* on page 73.

8.2.14 UV TRANSMITTANCE BELOW MINIMUM DESIGN UVT

The time delay for this warning is set on the user interface. For more information, see the Control Philosophy in the binder.

Symptom and cause	UV system action	Remedy
The UV transmittance is less than the **Minimum design UV transmittance** setting.	The warning resets automatically when the UV transmittance is more than the **Minimum design UV transmittance** setting.	Check these items: • Water quality – If the water is turbid, do the necessary steps to improve the water quality. • UVT monitor – If the UVT monitor calibration is incorrect, calibrate it correctly. For more information, see the UVT manual in the binder.

8.2.15 UV TRANSMITTANCE MANUAL OVERRIDE IS ENABLED

This warning is applicable when there is an online UVT monitor. The UVT is used for dose calculations.

When the override function is enabled, then the operator has to confirm sufficient disinfection.

Symptom and cause	UV system action	Remedy
There is a problem with the UVT monitor.	The UVT value that is entered in the HMI is used to calculate UV dose or **RED**.	• To operate the UV system, by using a fixed UVT value: – Use a manual UVT measuring device to find the UVT value. – Press **ENABLE UV TRANSMITTANCE SIGNAL OVERRIDE** push button on the **CHANNEL OVERVIEW** screen to enable manual override feature. – Enter **UVT**. • After the problem with the UVT monitor is resolved, press **DISABLE UV TRANSMITTANCE SIGNAL OVERRIDE** push button to disable manual override features. The UV dose or **RED** equation uses actual UVT for UV dose or **RED** calculations. After all the remedies are completed, then the low-priority alarm is cleared.

8.2.16 WIPE COUNT EXCEEDS WARRANTY, CHANNEL 'x' BANK 'y'

This warning is applicable for the electric wiper.

Symptom and cause	UV system action	Remedy
The number of wipes for the wiper rings has reached the specified maximum limit in the warranty.	The warning resets automatically after the wipe count is reset.	• Replace the wiper rings. For more information, see *Replace the wiper rings* on page 73.

8.2.17 WIPE COUNT EXCEEDS WARRANTY, CHANNEL 'x' BANK 'y' MODULE 1

This warning is applicable to the electric wiper.

This warning is similar for UV module 2 and 3.

Symptom and cause	UV system action	Remedy
The number of wipes for the wiper rings has reached the specified maximum limit in the warranty.	The warning resets automatically after the wipe count is reset.	• Replace the wiper rings. For more information, see *Replace the wiper rings* on page 73.

8.2.18 WIPER FAILURE, CHANNEL 'x' BANK 'y' MODULE 1

This warning is applicable for the electric wiper.

Symptom and cause	UV system action	Remedy
The wiper controller of the UV module does not report the **Wipe In Progress** signal in 30 seconds. Causes: • The wiper of the UV module has failed. • The **Wipe In Progress** signal is active for more than 10 minutes. Causes: The wiper control cabinet has failed.	The PLC skips the wiping cycle for the UV module that has wiper failure.	Check these items: • Wiper – If the wiper mechanism is blocked, remove the blockage. – If the wiper of the UV module is defective, repair or replace them. • Wiper controller – If the power supply is disconnected, connect it. • wiper control cabinet – If the wiper control cabinet has failed, repair or replace them. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.19 WIPER NOT AT END, CHANNEL 'x' BANK 'y'

This warning is applicable for the pneumatic wiper.

Symptom and cause	UV system action	Remedy
The wiper of the UV bank does not reach the end position during the operation. Causes: • The wipers are blocked. • The reed switch at the end position of the wiper is defective. • There is a leak in the air line. • The air compressor is defective.	The wiper is disabled for the UV bank that has wiper failure.	Check these items: • Wiper – If the wiper mechanism is blocked, remove the blockage. • Quartz sleeves – If the quartz sleeves are dirty, clean them. For more information, see *Clean the transparent surfaces* on page 62. • Reed switch – If the reed switch is defective, replace it. • Air compressor – If there are leaks, repair them. – If the air compressor is defective, repair or replace it. For more information, see the air compressor manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.2.20 WIPER NOT AT REST, CHANNEL 'x' BANK 'y'

This warning is applicable for the pneumatic wiper.

Symptom and cause	UV system action	Remedy
The wiper of the UV bank does not reach the rest position during the operation. Causes: • The wipers are blocked. • The reed switch at the rest position of the wiper is defective. • There is a leak in the air line. • The air compressor is defective.	The wiper is disabled for the UV bank that has wiper failure.	Check these items: • Wiper – If the wiper mechanism is blocked, remove the blockage. • Quartz sleeves – If the quartz sleeves are dirty, clean them. For more information, see .*Clean the transparent surfaces* on page 62 • Reed switch – If the reed switch is defective, replace it. • Air compressor – If there are leaks, repair them. – If the air compressor is defective, repair or replace it. For more information, see the air compressor manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the warning.

8.3 Alarm

During the UV disinfection process, the UV system generates alarms that have major effects on the UV disinfection process. The operator must acknowledge these alarms immediately.

The project-specific warnings and alarms may differ from those listed here. For more information, see the control philosophy in the binder.

Channel x Bank y

x represents the UV channel number such as Channel 1, Channel 2, and Channel 3.

y represents the Bank letter such as Bank A, Bank B, and Bank C.

8.3.1 24V PSU #1 FAILURE, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
• The power supply unit of the 24 VDC shows an error. • The power supply unit of the 24 VDC cannot energize the contactors and other 24 V devices in the cabinet. Causes: • The circuit breaker or fuse has tripped or is turned off. • There is a short circuit in the 24 VDC power supply. • The power supply unit of the 24 VDC is defective.	• All the affected lamps of this bank turn off. If necessary and available, standby rows lamps turns on. • Lamp power set to 100% • If necessary and available, the standby UV bank turns on automatically. • After the alarm is cleared, the UV lamps turn on. • The alarm resets automatically after the 24 V power is restored.	Check these items: • 24 V circuit – If there is a short circuit, repair the electrical wiring. For more information, contact the local sales and service representative. • Power supply unit, 24 VDC – If there is no power supply of the 24 VDC, connect it. – If the circuit breaker has tripped, reset it. – If the fuses are blown, replace them.

8.3.2 BALLAST INTERMEDIATE VOLTAGE FAILURE, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The electronic ballasts have an abnormal voltage condition.	• If a standby bank is available: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The failed UV bank turns off after standby UV bank turns on and contributes for dose calculation. • If a standby bank is not available: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The failed UV bank stays on.	• If one or more than one electronic ballast is defective, replace it. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.3 BALLAST TEMPERATURE HIGH, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The electronic ballasts have a high temperature condition.	• If a standby bank is available: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The failed UV bank turns off after standby UV bank turns on and contributes for dose calculation. • If a standby bank is not available: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The failed UV bank stays on.	• If one or more than one electronic ballast is defective, replace it. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.4 ECOTOUCH COMMUNICATION FAILURE, CHANNEL 'x' BANK 'y'

The time delay of this alarm is 30 seconds.

Symptom and cause	UV system action	Remedy
The UV PLC is not able to monitor or control the UV bank. Causes: • The communications between the UV PLC and the EcoTouch for the UV bank have failed. • The cable between the UV PLC and EcoTouch is disconnected. • The power supply to the EcoTouch has failed.	• If the UV lamps in the UV bank are not turned on, the EcoTouch turns on the UV lamps in the UV bank. • The power of all the UV lamps is set to 100%. • If necessary and available, the standby UV bank turns on automatically. • The alarm resets automatically after the EcoTouch communication is resolved.	Check these items: • Communication cable between UV PLC and EcoTouch – If the communication cable is disconnected, connect the communication cable. • Power supply to the EcoTouch – If the power supply is defective or damaged, repair or replace the power supply.

8.3.5 ENCLOSURE OVERLOAD BREAKER, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The circuit breaker of the cabinet is overloaded.	• All the UV lamps that are related to the cabinet turn off. • The UV PLC detects that the UV bank is not available. • The power of the UV lamps for other UV banks is set to 100%. • If necessary and available, the standby UV bank turns on automatically.	Check these items: • Circuit breaker – If the circuit breaker has tripped, reset it. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.6 ENCLOSURE TEMPERATURE HIGH, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The ambient temperature in the cabinet is more than 50ºC (131ºF). Causes: • There is a problem with the cabinet fans. • The fans of the electronic ballasts do not operate. • The filter mats of the cabinet are dirty or blocked. • The settings of the air conditioner are incorrect. • The air conditioner is defective.	• All UV lamps that are related to the cabinet turn off. • The UV PLC detects that the UV bank is not available. • The power of the UV lamps for other UV banks is set to 100%. • If necessary and available, the standby UV bank turns on automatically.	Check these items: • Fans of the cabinet and the electronic ballasts – If the fans are not operational, repair or replace the fans. For more information, contact the local sales and service representative. • Filter mats of the cabinet – If the filter mats are dirty or blocked, clean them. For more information, see *Clean the filter mat* on page 82. • Fuses – If fuses of the air conditioner are defective, replace the fuses. • Air conditioner – If the settings of the air conditioner unit are incorrect, then correct the settings to 38°C (100.4°F). For more information, see the air conditioner manual in the binder. – If the air conditioner is defective, repair or replace the air conditioner. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.7 FLOW PER LAMP EXCEEDS MAXIMUM VALIDATED LIMIT. RED IS EXTRAPOLATED, CHANNEL 'x'

This alarm is applicable when the disinfection method is NWRI or UVDGM.

There is no alarm when the UV system is in maintenance mode.

Symptom and cause	UV system action	Remedy
The water flow rate for each UV lamp is more than the maximum validated flow per lamp limit. The RED is extrapolated.	• The power of all the UV lamps is set to 100%. All UV banks in the channel turn on. • The measured water flow rate for each UV lamp is used in the RED equation. • The screen for the UV channel, RED, changes to red color to show that RED is extrapolated. • The UV channel is considered fail. – If there are no standby UV channels available, then the failed UV channel continues to operate. – If a standby UV channel is available, then the failed UV channel continues to operate until the standby UV channel is in operation. • The alarm resets automatically when the water flow is less than the maximum validated flow per lamp limit.	Check these items: • Water flow rate – If the water flow rate is more than the maximum design flow setpoint, decrease the water flow rate. • Flowmeter – If the flowmeter reading or signal calibration is incorrect, calibrate it correctly. For more information, see *Adjust the flowmeter*.

8.3.8 ICA 24V PSU #1 FAILURE

This alarm is similar for the power supply unit-2.

Symptom and cause	UV system action	Remedy
Without UPS: • The power supply unit of 24 VDC that is installed in the ICA cabinets shows an error. • The power supply unit of 24 V cannot energize the main PLC, HMI, and other 24 V devices that are related to the cabinet. With UPS: • The power supply unit of 24 VDC that is installed in the ICA cabinets shows an error. • The UPS supplies limited power to the main PLC, HMI, and other 24 V devices. Causes: • The circuit breaker or fuse has tripped or is turned off. • There is a short circuit in the 24 VDC power supply. • The 24 VDC power supply is defective.	Without UPS: • The UV PLC, HMI, and other 24 V devices that are connected with the cabinet are turned off. • The UV PLC has no control over the UV system. • The outlet penstock does not maintain the water level setpoint. • The alarm resets automatically after the 24 V power is restored. With UPS: • The UV PLC, HMI, and other 24 V devices that connect to the ICA cabinet receive limited power. • The UV PLC has control over the UV system.	Check these items: • Circuit breaker – If the circuit breaker has tripped, reset it. • Fuses – If the fuses are blown, replace them. • 24 V circuit If there is a short circuit, repair the electrical wiring. For more information, contact the local sales and service representative. • 24 VDC power supply unit – If there is no power supply, repair or replace them.

8.3.9 ICA 24V PSU #1 OVERLOAD

This alarm is similar for the power supply unit (PSU)-2.

Symptom and cause	UV system action	Remedy
Causes: • There is no power supply. • The circuit breaker of the 24 V PSU-1 in the ICA cabinet has tripped.	The alarm resets automatically when the 24 VDC power of the ICA is restored.	Check these items: • The power supply unit of 24 V – If there is no power supply, repair or replace them. • Circuit breaker – If the circuit breaker has tripped, reset it. • Fuses – If the fuses are blown, replace them.

8.3.10 ICA ENCLOSURE 24V PSU FAILURE

Symptom and cause	UV system action	Remedy
Without UPS: • The power supply unit of 24 VDC that is installed in the ICA cabinets shows an error. • The power supply unit of 24 V cannot energize the main PLC, HMI, and other 24 V devices that are related to the cabinet. With UPS: • The power supply unit of 24 VDC that is installed in the ICA cabinets shows an error. • The UPS supplies limited power to the main PLC, HMI, and other 24 V devices. Causes: • The circuit breaker or fuse has tripped or is turned off. • There is a short circuit in the 24 VDC power supply. • The 24 VDC power supply is defective.	Without UPS: • The UV PLC, HMI, and other 24 V devices that are connected with the cabinet are turned off. • The UV PLC has no control over the UV system. • The outlet penstock does not maintain the water level setpoint. • The alarm resets automatically after the 24 V power is restored. With UPS: • The UV PLC, HMI, and other 24 V devices that connect to the ICA cabinet receive limited power. • The UV PLC has control over the UV system.	Check these items: • Circuit breaker – If the circuit breaker has tripped, reset it. • Fuses – If the fuses are blown, replace them. • 24 V circuit – If there is a short circuit, repair the electrical wiring. For more information, contact the local sales and service representative. • 24 VDC power supply unit – If there is no power supply, repair or replace them.

8.3.11 ICA ENCLOSURE OVERLOAD

Symptom and cause	UV system action	Remedy
There is no power supply to the ICA cabinet. Causes: • The circuit breaker of the ICA cabinet has tripped.	The alarm resets automatically after the 24 VDC power of the ICA is restored.	Check these items: • Power supply to the ICA – If the power supply is disconnected, connect it. • Circuit breaker – If the circuit breaker has tripped, reset it.

8.3.12 ICA IS ON UPS POWER

The UPS energizes the UV PLC and HMI.

Symptom and cause	UV system action	Remedy
Causes: • The power supply to the ICA is lost. • The circuit breaker of the ICA has tripped or is turned off. • The fuses of the ICA are blown.	• The alarm resets automatically after the 24 VDC power supply of the ICA is restored. • If cabinets have three-phase power, then the UV banks stay on.	Check these items: • Power supply to the ICA – If the power supply to the ICA is disconnected, connect it. For more information, contact the local sales and service representative. • Circuit breaker – If the circuit breaker has tripped, reset it. • Fuses – If the fuses are blown, replace them.

8.3.13 ICA MAINS FAILURE

Symptom and cause	UV system action	Remedy
Without UPS: • The phase monitor in the ICA cabinets shows an error. • There is no power supply to the PLC, HMI, and other 24 V devices that are connected to the cabinets. With UPS: • The phase monitor in the ICA cabinet shows an error. • The UPS supplies limited power to the main PLC, HMI, and other 24 V devices related with the cabinet.	Without UPS: • The UV PLC, HMI, and other 24 V devices that are connected with the cabinet are turned off. • The UV PLC has no control over the UV system. • The outlet penstock does not maintain the water level setpoint. • The alarm resets automatically after the 24 V power is restored. With UPS: • The UV PLC, HMI, and other 24 V devices that connect to the ICA cabinet receive limited power. • The UV PLC has control over the UV system.	Check these items: • Power supply to the ICA – If there is no power supply, repair or replace it.

8.3.14 INLET PENSTOCK FAILURE, CHANNEL 'x'

This alarm is applicable to the inlet penstock.

Symptom and cause	UV system action	Remedy
Causes: • The inlet penstock actuator has failed. • The inlet penstock is stuck. • The power supply to the actuator is turned off or has tripped. • The phase sequence is incorrect. • The torque limit has more than its limit.	• The UV PLC detects that the UV channel is not in operation. • If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing.	Check the inlet penstock for local alarms. • If the power supply to the inlet penstock is disconnected, connect the power supply. • If the phase sequence of the inlet penstock actuator is incorrect, correct the phase sequence. • If the inlet penstock mechanism is blocked, close the inlet penstock locally. • If the inlet penstock actuator is defective, repair or replace it. For more information, see the inlet penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.15 INLET PENSTOCK FAILED TO CLOSE, CHANNEL 'x'

This alarm is applicable to the inlet penstock.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
Causes: • The inlet penstock actuator has failed to open. • The power supply to the inlet penstock actuator is turned off or has tripped. • The phase sequence is incorrect. • The torque limit is more than its limits.	• The UV PLC detects that the UV channel has failed and the inlet penstock does not close. • The UV channel continues to operate even when the UV dosing is not necessary.	Check the inlet penstock for local alarms. • If the power supply to the inlet penstock is disconnected, connect the power supply. • If the phase sequence of the inlet penstock actuator is incorrect, correct the phase sequence. • If the inlet penstock actuator is defective, repair or replace it. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.16 INLET PENSTOCK FAILED TO OPEN, CHANNEL 'x'

This alarm is applicable to the inlet penstock.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
Causes: • The inlet penstock actuator has failed to open. • The power supply to the inlet penstock actuator is turned off or has tripped. • The phase sequence is incorrect. • The torque limit is more than its limits.	• The UV PLC detects that the UV channel is not available. • If a standby bank is available, it turns on.	Check the inlet penstock for local alarms. • If the power supply to the inlet penstock is disconnected, connect the power supply. • If the phase sequence of the inlet penstock actuator is incorrect, correct the phase sequence. • If the inlet penstock actuator is defective, repair or replace it. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.17 INLET PENSTOCK NOT IN REMOTE, CHANNEL 'x'

This alarm is applicable to the inlet penstock.

Symptom and cause	UV system action	Remedy
The UV PLC cannot control the inlet penstock. Causes: • The selector switch at the inlet penstock is in the **Local** position. • The power supply to the inlet penstock actuator is disconnected.	• If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing. • The alarm resets automatically after the selector switch is turned to the **Remote** position.	Check these items: • Selector switch at the inlet penstock actuator – If the position is at **Local**, change the position to **Remote**. • Power supply to the inlet penstock actuator – If the power supply to the inlet penstock is disconnected, connect the power supply. For more information, see the penstock manual in the binder.

8.3.18 INLET PENSTOCK OVERLOAD FAILURE, CHANNEL 'x'

This alarm is applicable to the inlet penstock.

Symptom and cause	UV system action	Remedy
The UV PLC is not able to control the inlet penstock. Cause: • The circuit breaker of the inlet penstock has tripped.	• The UV PLC detects that the UV channel is not in operation. • If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing. • The alarm resets automatically after the cause of failure is resolved.	Check the circuit breaker of the inlet penstock. • If the circuit breaker has tripped, reset it. For more information, see the penstock manual in the binder.

8.3.19 INLET PENSTOCK TORQUE CLOSE, CHANNEL 'x'

This alarm is applicable to the inlet penstock.

Symptom and cause	UV system action	Remedy
The inlet penstock does not close. Causes: • The actuator is stuck. • The torque limit of the actuator is more than the closed torque limit.	• The UV PLC detects that the UV channel has failed and the inlet penstock does not close. • The UV channel continues to operate even when the UV dosing is not necessary.	Check the actuator of the inlet penstock for local alarms. • If the inlet penstock mechanism is blocked, remove the blockage. • Close the inlet penstock locally to reset the torque alarm. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.20 INLET PENSTOCK TORQUE OPEN, CHANNEL 'x'

This alarm is applicable to the inlet penstock.

Symptom and cause	UV system action	Remedy
The inlet penstock does not open. Causes: • The actuator is stuck. • The torque limit of the actuator is more than the open torque limit.	• The UV PLC detects that the UV channel is not available. • If a standby channel is available, it turns on	Check the inlet penstock for local alarms. • If the outlet penstock mechanism is blocked, remove the blockage. • Close the inlet penstock locally to reset the torque alarm. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.21 I/O BOARD FAILURE, CHANNEL 'x' BANK 'y'

The time delay of this alarm is 10 seconds.

Symptom and cause	UV system action	Remedy
The terd I/O board has failed. Causes: • The power supply to the I/O board has failed. • The I/O board has a problem with communication.	• The UV PLC detects that the UV bank is not available. • The power of the UV lamps for other UV banks is set to 100%. • If necessary and available, the standby UV bank turns on automatically. • The alarm resets automatically, after the failure is resolved.	Check these items: • The communication cable between EcoTouch and I/O board – If the communication cable is damaged or disconnected, repair or connect the communication cable. • Power supply to the I/O board – If the power supply is failed, repair or replace the power supply.

8.3.22 LAMP FAILURE, Channel 'x' Bank 'y' ROW 1

This warning is similar for Row 2.

Symptom and cause	UV system action	Remedy
At least one UV lamp in the row is defective. Causes: • The UV lamp in the row has failed. • The electronic ballast has failed. • The UV lamps have failed.	• With standby bank: – The row is considered fail and does not contribute to dose calculation. – The power of the UV lamps is set to 100%. – The standby UV bank turns on. – The failed UV bank turns off after standby UV bank turns on and contributes for dose calculation. • Without standby bank: – Rows are considered fail and do not contribute to dose calculation. – The power of the UV lamps is set to 100%. – The failed row stays on.	Check these items: • UV lamp – If the UV lamps are defective, replace them. For more information, see *Replace the UV lamps* on page 71. • Electronic ballast – If the electronic ballast is defective, replace it. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.23 MULTIPLE LAMP FAILURE, CHANNEL 'x' BANK 'y'

The time delay of this alarm is 5 minutes. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The number of UV lamps that failed in the bank are more than the **Maximum Number of Lamps Allowed to Fail** parameter. Causes: • The UV lamps have failed. • The electronic ballast has failed. • The power supply to the UV lamp has failed.	• The lamp failure alarm for the respective UV bank is reset. • With standby bank: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The standby UV bank turns on. – The failed UV bank turns off after standby UV bank turns on and contributes for dose calculation. • Without standby bank: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The failed UV bank stays on.	Check these items: • UV lamp – If the UV lamps are defective, replace them. For more information, see *Replace the UV lamps* on page 71. • Electronic ballast – If the electronic ballast is defective, replace it. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.24 OUTLET PENSTOCK FAILURE, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

Symptom and cause	UV system action	Remedy
Causes: • The outlet penstock actuator has failed. • The outlet penstock is not able to move. • The power supply to the actuator is turned off or has tripped. • The phase sequence is incorrect.	• The UV PLC detects that the UV channel is not in operation. • If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing. • The UV channel continues to operate until a standby channel turns on under the following conditions: – The UV PLC can control the inlet penstocks and can isolate the UV channel. – A standby UV channel is available.	Check the outlet penstock for local alarms. • If the power supply to the outlet penstock is disconnected, connect the power supply. • If the phase sequence of the outlet penstock actuator is incorrect, correct the phase sequence. • If the outlet penstock actuator is defective, repair or replace it. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.25 OUTLET PENSTOCK FAILED TO CLOSE, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
Causes: • The outlet penstock actuator has failed to close. • The power supply to the outlet penstock actuator is turned off or has tripped. • The phase sequence is incorrect. • The torque limit has more than its limit.	• The UV PLC detects that the outlet penstock has failed and the penstock does not close. • The UV channel continues to operate even when UV dosing is not necessary.	Check the outlet penstock for local alarms. • If the power supply to the outlet penstock actuator is disconnected, connect the power supply. • If the phase sequence of the outlet penstock actuator is incorrect, correct the phase sequence. • If the outlet penstock actuator is defective, repair or replace it. For more information, see the outlet penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.26 OUTLET PENSTOCK FAILED TO OPEN, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
Causes: • The outlet penstock actuator has failed to open. • The power supply to the outlet penstock actuator is turned off or has tripped. • The phase sequence is incorrect. • The torque limit is more than its limits.	• The UV PLC detects that the UV channel is not available. • If applicable, a standby UV channel turns on.	Check the outlet penstock for local alarms. • If the power supply to the outlet penstock is disconnected, connect the power supply. • If the phase sequence of the outlet penstock actuator is incorrect, correct the phase sequence. • If the outlet penstock actuator is defective, repair or replace it. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.27 OUTLET PENSTOCK NOT IN REMOTE, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

Symptom and cause	UV system action	Remedy
The UV PLC is not able to control the outlet penstock. Causes: • The selector switch at the outlet penstock is in the **Local** position. • The power supply to the outlet penstock actuator is disconnected.	• The UV PLC detects that the UV channel is not in operation. • If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing. • The UV channel continues to operate until a standby channel turns on under the following conditions: – The UV PLC has control of the inlet penstocks and is able to isolate the UV channel. – A standby UV channel is available.	Check these items: • Selector switch at the outlet penstock actuator – If the position is at **Local**, change the position to **Remote**. • Power supply to the outlet penstock actuator – If the power supply is disconnected, connect it. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.28 OUTLET PENSTOCK OVERLOAD FAILURE, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

Symptom and cause	UV system action	Remedy
The UV PLC cannot control the outlet penstock. Cause: • The circuit breaker of the outlet penstock has tripped.	• The UV PLC detects that the UV channel is not in operation. • If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing. • The UV channel continues to operate until a standby channel turns on under the following conditions: – The UV PLC has control of the inlet penstocks and is able to isolate the UV channel. – A standby UV channel is available.	Check the circuit breaker of the outlet penstock. • If the circuit breaker has tripped, reset it. For more information, see the penstock manual in the binder.

8.3.29 OUTLET PENSTOCK POSITION FAILURE, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The UV PLC does not receive a 4–20 mA signal on the outlet penstock position. Causes: • The analog signal wiring is disconnected. • The analog input module is defective or damaged. • The outlet penstock actuator is defective. • The power supply to the actuator has failed.	• If the flow rate is calculated from the outlet penstock position, the UV PLC uses the maximum flow rate for the dose equation. • The UV channel is detected as inactive for the multiple UV channel systems. A standby UV channel turns on and the failed UV channel turns off. • The alarm resets automatically after the 4–20 mA signal is restored.	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. • Outlet penstock actuator – If the outlet penstock actuator is defective, replace it. – If there is no power supply to the outlet penstock actuator, connect the power supply. For more information, see the penstock manual in the binder.

8.3.30 OUTLET PENSTOCK TORQUE CLOSE, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

Symptom and cause	UV system action	Remedy
The outlet penstock does not close. Cause: • The actuator is stuck. The torque limit of the actuator is more than the close torque limit.	• The UV PLC detects that the UV channel is not in operation. • If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing. • The UV channel continues to operate until a standby channel turns on under the following conditions: – The UV PLC has control of the inlet penstocks and is able to isolate the UV channel. – A standby UV channel is available.	Check the outlet penstock for local alarms. • If the outlet penstock mechanism is blocked, remove the blockage. • Open the outlet penstock locally to reset the torque alarm. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.31 OUTLET PENSTOCK TORQUE OPEN, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

Symptom and cause	UV system action	Remedy
The outlet penstock does not open. Cause: • The actuator is stuck. The torque limit of the actuator is more than the open torque limit.	• The UV PLC detects that the UV channel is not in operation. • If the UV channel is on standby, then this UV channel is detected as not operative. • If the UV channel is in operation, the following actions occur: – The UV channel is detected as failed. – The UV channel continues to operate even it is not needed for the UV dosing. • The UV channel continues to operate until a standby channel turns on under the following conditions: – The UV PLC has control of the inlet penstocks and is able to isolate the UV channel. – A standby UV channel is available.	Check the outlet penstock for local alarms. • If the outlet penstock mechanism is blocked, remove the blockage. • Close the outlet penstock locally to reset the torque alarm. For more information, see the penstock manual in the binder. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.32 RACK 1 BALLAST OVERLOAD, CHANNEL 'x' BANK 'y'

This warning is similar for Rack 2, Rack 3, Rack 4, Rack 5, and Rack 6.

Symptom and cause	UV system action	Remedy
• The rack is overloaded. • The UV lamps of the respective rack have turned off. Causes: • The circuit breaker of the rack has tripped.	• With standby bank: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The standby UV bank turns on. – The failed UV bank turns off after standby UV bank turns on and contributes for dose calculation. • Without standby bank: – UV bank is considered fail and does not contribute to dose calculation. – The power of all the UV lamps is set to 100%. – The failed UV bank stays on.	• If the circuit breaker has tripped, reset it. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.33 REMOTE IO COMMUNICATIONS FAILURE, CHANNEL 'x'

The time delay of this alarm is 30 seconds.

Symptom and cause	UV system action	Remedy
The UV PLC does not receive the information from Remote. Causes: • The power supply to remote I/O station has failed. • The communications cable is damaged. • The remote I/O modules have failed.	• The alarm resets automatically, after communications are restored for 30 seconds.	Check these items: • Power supply for I/O station – If there is no power supply, repair or replace it. • Communication cable – If the communication cable is damaged, repair or replace it. • Remote I/O modules – If the modules are damaged, repair or replace them. If the UV channel is in operation: • Monitor the water level locally. • Control the outlet penstock through local mode at the actuator. For more information, contact the local sales and service representative.

8.3.34 SAFETY RELAY FAILURE, CHANNEL 'x' BANK 'y'

Symptom and cause	UV system action	Remedy
The safety relay has tripped. Causes: • A UV module is lifted. • A UV module cover is open.	• The UV PLC detects that the UV bank is not available. • The lifted UV bank turns off. • The power of all the UV lamps is set to 100%. • If a standby bank is available, it turns on.	Check the UV module. • If the UV module is lowered partially, lower it completely. • If the UV module connectors are not connected, connect them. Check the module cover. • If the module covers are not in position, correct the assembly. After all the causes are resolved, the push button must be pressed to clear the alarm and reset the safety relay.

8.3.35 SCADA COMMUNICATIONS FAILURE

This alarm is applicable when the water flow source is **SCADA**.

The time delay of this alarm is 60 seconds.

Symptom and cause	UV system action	Remedy
The UV PLC does not receive the information from SCADA system. Thus the UV PLC does not receive the water flow rate. Causes: • The communications cable is damaged. • The **SCADA** PLC has failed. • The communications module for the UV PLC or **SCADA** PLC has failed.	• The UV PLC uses the **MAXIMUM DESIGN FLOW** parameter for the UV dose equation and that is shown on the HMI. • The alarm resets automatically, after SCADA communications are restored.	Check these items: • Communication cable – If the communication cable is damaged, repair or replace it. • **SCADA** PLC – If the **SCADA** PLC has failed, repair or replace them. • Communications module between the UV PLC and **SCADA** PLC – Repair the communications module between the UV PLC and **SCADA** PLC. For more information, contact the local sales and service representative.

8.3.36 SIGNAL FAILURE: FLOW RATE, CHANNEL 'x'

This alarm is applicable when the flow source is from the 4–20 mA signal.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The water flow rate from the **4-20 mA** signal to the PLC is missing. Causes: • The analog signal wiring is disconnected. • The analog input module is defective or damaged. • The power supply to the flowmeter has failed.	The PLC uses the maximum design flow rate for the dose equation and that is shown on the PLC.	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. • Flowmeter – If there is no power supply to the flowmeter, connect the power supply. – If the flowmeter is defective, replace it. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.37 SIGNAL FAILURE: OUTLET PENSTOCK POSITION, CHANNEL 'x'

This alarm is applicable to the outlet penstock.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The penstock position from the **4-20 mA** signal to the PLC is missing. Causes: • The analog signal wiring is disconnected. • The analog input module is defective or damaged. • The outlet penstock actuator is defective. • The power supply to the outlet penstock actuator has failed.	• The maximum flow for each UV channel is used for the UV dose equation and is shown on the HMI. • The alarm resets automatically after the **4–20 mA** signal is restored.	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. • Outlet penstock actuator – If the outlet penstock actuator is defective, replace it. – If there is no power supply to the outlet penstock actuator, connect the power supply. For more information, see the outlet penstock manual in the binder.

8.3.38 SIGNAL FAILURE: ULTRASONIC LEVEL SENSOR 1, CHANNEL 'x'

This alarm is applicable when the flow source is from the 4–20 mA signal.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The water level from the **4-20 mA** signal to the PLC is missing. Causes: • The analog signal wiring is disconnected. • The analog input module is defective or damaged. • The ultrasonic level sensor is defective. • The power supply to the ultrasonic level sensor has failed.	• The UV PLC stops the control over the outlet penstock and the outlet penstock is stuck in the last position. – If the UV channel is on standby, then the UV channel is considered not operative. – The UV channel is in operation until a standby UV channel turns on and the alarm condition is cleared. • The alarm resets automatically after the **4–20 mA** signal is restored.	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. For more information, contact the local sales and service representative. • Ultrasonic level sensor – If there is no power supply to the ultrasonic level sensor, connect the power supply. – If the ultrasonic level sensor is defective, replace it. For more information, see the ultrasonic sensor manual in the binder.

8.3.39 SIGNAL FAILURE:ULTRASONIC LEVEL SENSOR 2, CHANNEL 'x'

This alarm is applicable when the flow source is from the 4–20 mA signal.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The water level from the **4-20 mA** signal to the PLC is missing. Causes: • The analog signal wiring is disconnected. • The analog input module is defective or damaged. • The ultrasonic level sensor is defective. • The power supply to the ultrasonic level sensor has failed.	• The UV PLC uses maximum design flow rate for the dose equation and that is shown on the HMI. – If the UV channel is on standby, then the UV channel is considered not operative. – The UV channel is in operation until a standby UV channel turns on and the alarm condition is cleared. • The alarm resets automatically after the **4–20 mA** signal is restored.	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. • Ultrasonic level sensor – If there is no power supply to the ultrasonic level sensor, connect the power supply. – If the ultrasonic level sensor is defective, replace it. For more information, see the ultrasonic sensor manual in the binder.

8.3.40 SIGNAL FAILURE: UV INTENSITY, CHANNEL 'x' BANK 'y'

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The UV sensor for the respective UV bank has failed. Causes: • The analog signal wire is disconnected from the I/O board. • The UV sensor is defective.	• The power of all the UV lamps is set to 100%. • All the UV banks in the channel turn on. • If a standby UV bank is available: – The standby bank turns on. – The failed UV bank turns off. • If a standby UV bank is not available: – The failed bank stays on. • The alarm resets automatically after the UV sensor signal is restored. .	Check these items: • Signal wire – If the signal wire between the UV sensor and the I/O board is disconnected, connect the signal wire. • UV sensor – If the UV sensor is defective, replace it.

8.3.41 SIGNAL FAILURE: UV SYSTEM FLOW RATE

This alarm is applicable when the flow source is from the 4–20 mA signal.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the folder.

Symptom and cause	UV system action	Remedy
The water flow rate from the **4-20 mA** signal to the PLC is missing. Causes: • The analog signal wiring is disconnected. • The analog input module is defective or damaged. • The power supply to the flowmeter has failed.	The UV PLC uses **maximum design flow rate** for the dose equation that is shown on the HMI.	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. • Flowmeter – If there is no power supply to the flowmeter, connect the power supply. – If the flowmeter is defective, replace it. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.42 SIGNAL FAILURE: UV TRANSMITTANCE MONITOR

This alarm is applicable to the UV transmittance monitor.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The **4-20 mA** signal from the UV transmittance monitor to the UV PLC is missing. Causes: • The analog signal wiring is disconnected. • The analog input module is defective or damaged. • The UVT monitor has failed. • The power supply to the UVT monitor has failed.	The UV PLC uses the **minimum design UVT** value for the RED equation or the average intensity equation (PSS).	Check these items: • Analog signal wiring – If the wires are disconnected, connect them. • Analog input module – If the analog input module is defective or damaged, repair or replace it. • UVT monitor – If the UVT monitor is defective, replace it. – If there is no power supply to UVT monitor, connect the power supply. For more information, see the control philosophy in the binder. For more information, contact the local sales and service representative. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.43 UV DOSE BELOW MINIMUM DESIGN DOSE, CHANNEL 'x'

There is no alarm when the UV system is in maintenance mode.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The UV dose is less than the minimum design dose or the UV disinfection is less than the disinfection target. Causes: • The UV lamps are near the end-of-lamp life. • The UV lamps near the UV sensor have failed. • The UV sensors and quartz sleeves are dirty. • The wiper rings are worn out. • The UV transmittance is too low.	• The power of all the UV lamps is set to 100%. • The UV channel is considered fail. – If there are no standby UV channels available, then the failed UV channel continues to operate. – If a standby UV channel is available, then the failed UV channel continues to operate until the standby UV channel is in operation.	Check these items: • UV modules – If the UV lamps are defective, replace them. For more information, see *Replace the UV lamps* on page 71. – If the UV sensor and the quartz sleeves are dirty, clean them. For more information, see *Clean the transparent surfaces* on page 62 and *Clean the UV module manually* on page 70. • UV lamp parameters – **Bank Operating Hours** If the lamps hours are more than 14 000 hours, replace the UV lamps. – **Bank ON/OFF Cycles** If the UV lamp operating cycles are more than the maximum operation cycles, replace the UV lamps. For more information, see *The Bank A status screen* and *Replace the UV lamps* on page 71. • Automatic-wiping system – If the automatic wiping does not clean the quartz sleeves correctly, do these steps: – Decrease the wiping interval. – Increase the number of wipes in a wiping cycle. – If the wiper rings are worn out, replace them. For more information, see *Replace the wiper rings* on page 73. After all the causes are resolved, the alarm reset push button must be pressed to clear the alarm.

8.3.44 UV INTENSITY LOW ALARM, CHANNEL 'x' BANK 'y'

There is no alarm when the UV system is in maintenance mode.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The UV intensity is less than the alarm setpoint. Causes: • The UV lamps are near the end-of-lamp life. • The UV lamps near the UV sensor have failed. • The wiper rings are worn out. • The UV sensors and quartz sleeves are dirty.	The alarm resets automatically when the UV intensity is more than the alarm setpoint.	Check these items: • Water quality – If the water is turbid, do the necessary steps to improve the water quality. • Automatic-wiping system – If the automatic wiping does not clean the quartz sleeves correctly, do these steps: – Decrease the wiping interval. – Increase the number of wipes in a wiping cycle. – If the wiper rings are worn out, replace them. For more information, see *Replace the wiper rings* on page 73. • UV modules – If the UV lamps are defective, replace them. For more information, see *Replace the UV lamps* on page 71. – If the UV sensor and the quartz sleeves are dirty, clean them. For more information, see *Clean the transparent surfaces* on page 62 and *Clean the UV module manually* on page 70. • UV lamp parameters – **Bank Operating Hours** If the UV lamp hours are more than the maximum operation hours, replace the UV lamps. – **Bank ON/OFF Cycles** If the operation cycles of the UV lamp are more than the maximum operation cycles, replace the UV lamps. For more information, see *The Bank A status screen* and *Replace the UV lamps* on page 71.

8.3.45 UV SYSTEM FLOW BELOW MINIMUM DESIGN FLOW

The time delay of this alarm is 60 seconds.

Symptom and cause	UV system action	Remedy
The water flow rate is less than the low alarm limit for more than 60 minutes.	The alarm resets automatically when the flow rate for each UV lamp is more than the minimum design flow setpoint.	If the water flow rate is less than the minimum design flow setpoint, increase the water flow rate.

8.3.46 UV SYSTEM FLOW EXCEEDS MAXIMUM DESIGN FLOW

The time delay of this alarm is 60 seconds.

Symptom and cause	UV system action	Remedy
The water flow rate for the UV system is more than the maximum design flow limit for more than one minute.	• The power of all the UV lamps is set to 100%. • The alarm resets automatically when the water flow is less than the maximum design flow limit.	Check these items: • Water flow rate – If the water flow rate is more than the maximum design flow setpoint, decrease the water flow rate. • Flowmeter – If the flowmeter reading or signal calibration is incorrect, calibrate it correctly. For more information, see *Adjust the flowmeter*.

8.3.47 UV TRANSMITTANCE BELOW MINIMUM VALIDATED LIMIT. RED IS EXTRAPOLATED

This alarm is applicable when the disinfection method is NWRI or UVDGM.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The UV transmittance is less than the minimum UV transmittance limit.	• The power of all the UV lamps is set to 100%. • All the UV banks in the channel turn on. • The measured UVT is used in the RED equation. • The screen for the UV channel, RED, changes to red color to show that RED is extrapolated. • The alarm automatically resets when the UVT limit is more than the minimum UVT limit.	• Check the water quality. – If the water is turbid, do the necessary steps to improve the water quality. • Clean the UV sensor window. • Calibrate the UVT monitor. For more information, see the UVT manual in the binder.

8.3.48 UV TRANSMITTANCE MONITOR NOT OK

Symptom and cause	UV system action	Remedy
The UV monitor shows a failure.	• The UV PLC uses the minimum design UVT value for the RED or PSS equation. • The alarm resets automatically when the failure of the UVT monitor is resolved.	Check these items: • UVT monitor – If there is no power supply to the UVT monitor, connect the power supply. – If the UVT monitor is defective, replace it. For more information, see the UVT monitor manual in the binder. • Analog input module – If the analog input module is defective or damaged, repair or replace them. For more information, contact the local sales and service representative.

8.3.49 WATER LEVEL HIGH, CHANNEL 'x'

This alarm is applicable to the high-level probe.

The time delay for this alarm is set on the HMI. For more information, see the control philosophy in the binder.

Symptom and cause	UV system action	Remedy
The water level in the UV channel is more than the high alarm limit. Causes: • The water flow rate is too high. • The high-level probe is defective, clogged, or damaged.	The alarm resets automatically after the water level is restored.	Check these items: • Water flow rate – If the water flow rate is more than the maximum design flow setpoint, decrease the water flow rate. • High-level probe – If the high-level probe is defective, replace or repair it. • Outlet penstock, if applicable – If the outlet penstock does not work correctly, repair it. For more information, see the outlet penstock manual in the binder.

8.3.50 WATER LEVEL LOW, CHANNEL 'x'

This alarm is applicable when the water flow source is from SCADA.

Symptom and cause	UV system action	Remedy
The water level in the UV channel is less than the low alarm limit. Causes: • The water flow rate is too low. • The low-level probe is defective or damaged.	• The UV lamps in the UV channel turn off for safety. • If the UV channel has an outlet penstock, the following actions occur: – The outlet penstock closes automatically. – The UV PLC detects that the UV channel has failed. – The standby UV channel starts to operate. • The alarm resets automatically after the water level is restored. • After the alarm is cleared, the UV lamps turns on.	Check these items: • Water flow rate – If the water flow rate is low, increase the water flow rate. • Low-level probe – If the low-level probe is defective, replace it. • Outlet penstock, if applicable – If the outlet penstock does not work correctly, repair it. For more information, see the outlet penstock manual in the binder.

8.3.51 WATER LEVEL LOW VIA ULTRASONIC SENSOR, CHANNEL 'x'

The time delay of this alarm is 40 seconds.

Symptom and cause	UV system action	Remedy
The water level in the UV channel is less than the low alarm limit that is set in the parameters of ultrasonic level sensor. Causes: • The water flow rate is too low. • The ultrasonic sensor is defective or damaged.	• The UV lamps in the UV channel turn off for safety. • The UV PLC turns off the electronic ballast contactors. • If the UV channel has an outlet penstock, the following actions occur: – The outlet penstock closes automatically. – The UV PLC detects that the UV channel has failed. – The standby UV channel starts to operate. • The alarm resets automatically after the water level is restored. • After the alarm is cleared, the UV lamps turns on.	Check these items: • Water flow rate – If the water flow rate is low, increase the water flow rate. • Ultrasonic sensor – If the ultrasonic sensor is defective, replace and repair it. • Outlet penstock, if applicable – If the outlet penstock does not work correctly, repair it. For more information, see the outlet penstock manual in the binder.

9 Other Relevant Documentation or Manuals

9.1 Reference documents

The following documents are included in the binder:

Category	Name
PLC	• Control Philosophy • PLC Signal List
Storage guidelines	UV System - Storage and Handling Guidelines STDS-003
Drawings	• General Arrangement Drawing • Mounting Instruction UV Module • Installation Low-Level Probe • Installation Ultrasonic Sensor • Installation Lift Control Cabinet, optional • Installation Wiper Control Cabinet, optional • Installation Pipe Weir, optional • Installation Compressor, optional • Pneumatic Diagram, optional
Electrical	• Wiring Diagram • Cable List Overview • External Cabinet Layout • Internal Cabinet Layout • Electrical Part List • SOP lamp Cable Wiring Procedure
Certificates	• UV Sensor Certificate • Declaration of Conformity • Certificates Management System
Production	• Packing List • Test Report
Spare parts	Spare parts list_Duron

The project-specific vendor documents are included in the binder as a CD-ROM or a USB drive.

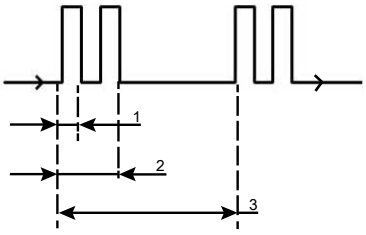
10 Glossary

10.1 Terms

Term	Description
absorbance	The measurement of UV light amount which is absorbed by water, microbial DNA, bulb envelope, and quartz sleeve at a specific wavelength This measurement explains absorption and dispersion in the medium. Typical units: m^{-1}, cm^{-1}
BOL	Beginning of life
cabinet for incomer distribution control	A cabinet that controls the input power supply to the UV system, distributes the power supply to the electronic ballast cabinets, and controls the UV system.
downward opening penstock (DOP)	It is also known as downward opening weir gate. DOP is used for water level control in the UV channel.
dose response	The level of inactivation of a microorganism because of the UV dose Inactivation = $\log_{10}(N_0/N)$ N_0 = the number of microorganisms present before UV light exposure N = the number of microorganisms present after UV light exposure
disinfection	The process that stops or inactivates harmful microorganisms
distribution cabinet	A cabinet that distributes the power supply to the electronic ballast cabinets.
electronic ballast cabinet	A cabinet that contains the electronic ballasts
electronic ballast	A device that is installed in the control cabinet and controls the UV lamps
EOL	End-of-life
EcoTouch	A Wedeco proprietary equipment In standard systems, the EcoTouch display is used as a UV controller and an HMI. In customized systems with a PLC, the EcoTouch display is used as a gateway controller between the PLC and the electronic ballast interface. The EcoTouch is installed on the door of the control cabinet, or inside the electronic ballast cabinet, depending on the configuration of the UV system.
flow rate	The volume of water that passes through the UV channel and comes into contact with UV light for a time period The volume is fixed and the flow rate changes. The flow rate must not be more than the design flow rate. Flow rate = volume per residence time
Flex board	This is a flexible circuit board that distributes the three-phase voltage, neutral, and also the digital bus to six TDS ballasts. The board monitors the operational status of the electronic ballasts for each rack and communicates with EcoTouch.
fouling	The buildup of dissolved materials on the surface of the quartz sleeves and the UV sensor. This buildup decreases the effectiveness of the UV disinfection.

Term	Description
HMI	Human-machine interface A screen that shows information and allows the site operator to interact with the UV system In standard systems, the EcoTouch display is used as a UV controller and an HMI. In customized systems with a PLC, any screen that is connected to the PLC is used as an HMI.
incomer cabinet	A cabinet that controls the input power supply to the UV system.
incomer distribution cabinet	A cabinet that controls the input power supply to the UV system and distributes the power supply to the electronic ballast cabinets.
irradiated volume	The volume of UV banks in which water is exposed to UV light.
J/m²	Joule per square meter
L/O/R	Local-Off-Remote
low-level probe	A low-level probe that protects the UV lamps from overheating when the water level is insufficient The low-level probe is installed downstream in the last UV bank in the UV channel.
lamp aging	A decrease in the UV intensity of the UV lamps depends on the operating hours, and the operational conditions.
lamp power	The electric power consumption of a UV lamp
mA	Milliampere
main isolator	A disconnector from the mains to isolate from the power supply
minimum UV dose	The minimum UV dose that is necessary to maintain the necessary disinfection
mW/cm²	Milliwatt per square centimeter
normal operation	Independent and automatic operation
nm	Nanometer
online UVT monitor	The monitoring instrument in the UV channel which measures the real-time values of UV transmission in the water for UV light
OOS	Out of service
outlet penstock	A weir gate that is installed in the outlet of the UV channel, see downward opening penstock (DOP)
PSU	Power supply unit
PSS	Point source summation Computer-aided modeling that calculates the performance of the UV system
quartz sleeve	A quartz tube that surrounds and protects the UV lamps The quartz sleeves have direct contact with water.
residence time	The amount of time that the microorganisms are in contact with UV light. Residence time of each bank = Irradiated UV bank volume ÷ water flow rate in the UV channel
RED	Reduction Equivalent Dose The calculated dose at a specific operational condition that is based on biodosimetry
running hours	The operating hours of the UV lamps
SCS	Supervisory control system
SCADA	Supervisory control and data acquisition A plant-wide control system which interacts with the UV system
target dose	The adjustable setpoint of the UV controller which is compared to the calculated UV dose Target dose = Minimum UV dose + Safety margin

Term	Description
target intensity	The adjustable setpoint of the UV controller which is compared to the actual UV intensity Target intensity = Minimum UV intensity + Safety margin
TERD board	This board is a Wedeco specific I/O module that distributes the following inputs and outputs to the EcoTouch: • Discrete inputs • Discrete outputs • Analog inputs • Analog outputs
UPS	Uninterruptible power supply Ensuring the supply of electrical loads in the event of faults
UV	Ultraviolet
UV controller	A microprocessor-controlled computer that automates the electro-mechanical processes The computer continuously monitors the state of the input and output devices to make decisions based on a program logic. The standard systems use EcoTouch and the customized systems use a PLC.
UV dose	The amount of UV light that is used to get the required disinfection 1 J/m² = 0.1 mJ/cm² = 0.1 mW-s/cm²
UV intensity	The power for each surface unit The magnitude of UV light in the UV bank is 1 W/m² = 0.1 mW/cm².
UV lamp	A lamp that emits UV light in the UVC range
UV light	The electromagnetic radiation that has a wavelength between 200 nm and 400 nm In this manual, UV light refers to light that has a wavelength of 254 nm.
UV sensor	A photodetector that measures the UV intensity at a single point in the UV bank
UV system	Equipment that uses UV light to disinfect water
UV transmittance	The ratio of UV light that enters the water compared to the UV light that leaves the water The lower the UV transmittance, the more UV intensity is required for the same UV dose with the same flow. %UVT = 100 x 10^{-A}, where A = Absorbance
UVDGM	Ultraviolet Disinfection Guidance Manual
UV channel	A channel that exposes water to UV light The UV channel has the following main components: • UV banks which include the UV modules • Low-level probe • Outlet weir for level control
UV bank	Each UV bank consists of one or more UV modules. Several UV banks installed serially in one UV channel. The UV banks in the UV channel are identified alphabetically A, B, C, D from the UV channel inlet.
UV module	A UV module holds the UV lamps in the UV channel. The UV module has the following main components: • UV lamp modules • Wiping system • UV sensor • Safety switch The UV modules in the UV bank are identified numerically as 1–4.

Term	Description
UV lamp module	UV lamp module consists of the following components: • Quartz sleeves • UV lamp • Electrical connector The UV lamp module gives UV light that disinfects the water. For more information, see *UV lamp module* on page 17
wiper control cabinet	A wiper control cabinet contains the controls of the automatic wiping system The wiper control cabinet is installed next to the UV channel, close to the corresponding UV bank.
W/m²	Watt per square meter
wiping cycle	One cycle = Two strokes of the wiper between the following positions: • Start position to the end position • End position to the start position  1. Wiping 2. Wiping cycle 3. Wiping interval
wiping interval	The time between two wiping cycles
wiper arm	The mechanical assembly of the UV module which moves the wiper rings over the quartz sleeves
wiper blade	The wiper blade on the wiper cleans the UV sensor.

Xylem |’zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We’re a global team unified in a common purpose: creating advanced technology solutions to the world’s water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

xylem
Let’s Solve Water

Xylem Water Solutions Herford GmbH
Boschstrasse 4–14
32051 Herford
Germany
Tel: +49 5221 930 0
Fax: +49 5221 930 222
wedeco.de@xylem.com
www.xylem.com/wedeco

Visit our Web site for the latest version of this document and more information

The original instruction is in English. All non-English instructions are translations of the original instruction.

© 2022 Xylem Inc