Request for Proposals (RFP)
RFP # VSW-KTB-2019-20
(Re-Advertising)

Addendum One

Department of Environmental Conservation
Village Safe Water Program

City of Thorne Bay, Alaska
General Contractor Services for Construction of Water Plant and Wastewater Plant Improvements

Date of Issue: February 25, 2019

The RFP Package is hereby clarified or changed as follows:

1. Submittal deadline is not changed
2. Questions and Answers
3. Attachments

The questions and answers and attachments begin on page 2. This Addendum is hereby made part of the RFP and is a total of 6 pages (not including attachments).

All other terms and conditions for this RFP remain unchanged.

Issued by: Fred Parrish
Procurement Officer
(907) 269-7674

2. Questions and Answers

Question 1: With Federal funds included in the project – are there special procurement rules like AIS or Buy American or America? (Impacts price and schedule)

Answer 1: No, AIS and Buy American or America are not applicable for this RFP.

Question 2: Do you have the dates for delivery to site for the Owner-supplied equipment? (Would like for scheduling)

Answer 2: There are three Owner-supplied equipment.

1. The Water Treatment Plant Control Panel, WTCP, is due to be delivered by April 15, 2019.

2. The UV Disinfection Unit for the wastewater disinfection scope of work has been delivered.

3. The Nanofiltration equipment for the water plan is expected to arrive in Thorne Bay around April 15, 2019 as well.

Question 3: Bid schedule of values – there are several items that have no unit or quantity listed, such as A3.7 or A4.12, and so on …

a. Some note "by others" or "Training by others"
b. Some do not note – they are blank, see A7.1

- Do we insert any pricing for these items? Or do we insert zero?
- Will there be allowance amounts to insert?
- Not clear what we do with those bid items.

Answer 3: The following listed SOV line items are to be completed by engineer or others. The general contractor should have respective tradesman on site so that engineer may communicate work observations and findings:

A3.7, A4.2, A5.6, A6.12, A7.4, A7.6, A8.6, A8.7, and A9.3.

And for the WWP UV Disinfection SOV:

B2.11, and B3.6 (if the additive option is exercised).

Question 4: WWTP spec 400505 section 2.1.A references an Exposed Piping Schedule which is missing from this spec. Please provide this schedule.

Answer 4: All exposed process piping is Schedule 80 PVC, Reference Attachment A, Table 400505-A.

Question 5: WWTP spec 400531 section 2.2.C.3 indicates the use of minimum 1/8" thick backup flanges of 304SS. This is not an industry standard for PVC flanges. It is assumed this is referring to the industry standard use of nut and bolt washers under the bolt head or nut on the PVC flange. Please clarify this spec. If the above observation is clarified to specify bolt or nut washers instead of a backup flange, then it should be noted that industry standard 304SS bolt or nut washers are not a minimum 1/8" thick.

Answer 5: Revise 400531 Section 2.2.C.3 to read:

"2.2.C.3 Flanged: Provide Type 304 stainless still flange bolt, nut, and flat washers hardware on all flange connections."

Question 6: WWTP drawing M03, Eqpt & Fitting Schedule ID 3, Qty 4, 6" Push-On Flange (Sch 80). Please clarify this description of a "push-on" flange. Industry standard nomenclature for a "push-on" flange would describe a gasketed joint. It is assumed that the description should describe a solvent weld joint using the nomenclature "socket" or "spigot" or both as the need requires.

Answer 6: Remove and replace item 3 in the equipment and fitting schedule, Sheet M03, to read: "6-inch Diameter Solvent Weld Socket Flange."

Question 7: WWTP drawing M03, Eqpt & Fitting Schedule ID 2, Qty 2, 6" Butterfly Valve Fl x Fl. Please clarify this item. The drawing and other ID descriptions indicate that the "bypass valve" should be 8", not 6". Further, this "bypass valve" cannot be installed with the stem vertically because the actuator operating nut will not orient to a vertical position. Please redraw this valve with the stem in a horizontal position, preferably on the same side as the "UV" valve stem.

Answer 7: Correct, the bypass is an 8-inch butter fly valve (1) and the valve labeled as ID #2 is a 6-inch butterfly valve (1). On sheet M02/M03, remove and replace the orientation of the 8-inch diameter bypass butterfly with the operating nut in the horizontal position.

Question 8: WWTP drawing S02, at the field located bar grate openings for the two valves in item 4 above, are these openings required to be banded and re-galvanized as described in spec section 055300? Can they be shop installed?

Answer 8: If the opening is made in the field, re-banding will not be required and cut edges and surfaces can be repaired with molten zinc or spray-cold galvanizing paint. DEC anticipates the openings will be small. Shop installation would be ideal if through close coordination and detailing, the result is the locations are correct. The Engineer takes no exception to Contractor endeavoring to accomplish the latter.

Question 9: WTP drawing A04 indicates 1 hr walls for the generator and chemical rooms but the details for this construction are ½" AC plywood over 2x studs. Please clarify or provide the UL listed design that provides a 1 hr rating using plywood on wood studs.

Answer 9: Sheet A04:
At locations on sheet A04 that indicate 1 hour walls but have the wall type W1 call out, remove this call out and provide wall tag W2.

Remove note 'Above existing wall' and replace with 'Verify that existing wall is UL U379 construction and continues to structure above'

Sheet A08:

Add partition type W2 to A08 and detail to be UL U379 with the following construction:

-5/8" Moisture and mold resistant, type x gypsum wall board

-2x6 Framing @ 16" o.c.

-5/8" Moisture and mold resistant, type x gypsum wall board

Add note to sheet A08 that reads, 'top and bottom wall condition and all wall penetrations to have fire rated seals to maintain continuous one-hour wall rating'.

Question 10: At detail 11 of sheet A09, the rigid insulation and galvanized flashing at mandoors will be exposed to foot traffic and possible damage. Should this detail look more like detail 10 (at overhead doors)?

Answer 10: Detail 11/A09:
Revise detail to show 2" rigid insulation terminating at concrete slab. Expansion joint and concrete slab to be next to concrete foundation as shown in detail 10/A09.

Question 11: Sheet G03 at or near the raw water pump has a wye strainer colored in red before F-100 (drawn as a basket strainer). Please clarify. Is this the work more fully described on sheet D03 which contains a new strainer SC-100?

Answer 11: Reference sheet D17 for detailed description of the work.

Question 12: The UV Equipment Package states that it is provided by the Owner. Is the UV Davit Crane Owner or Contractor furnished?

Answer 12: The davit crane is to be furnished and installed by the Contractor. Sheet M03 note 1 states "CONTRACTOR TO PROVIDE AND INSTALL EQUIPMENT HOIST, CAPTAIN SERIES 571 OR APPROVED EQUAL, SEE PROJECT SPECIFICATIONS".

For clarification, there is a call-out on the sheet M02 isometric view that should state "Furnish and Install Specified Hoist", instead of "Furnished and install". The UV supplier bid is appended, including the scope of supply on pages 13 and 14.

Question 13: The UV portion states the contractor must locate a bypass while the project is underway, is this the Contractor or DEC's responsibility?

Answer 13: An 8" bypass line runs directly from the clarifier to the final effluent piping to the bay. The bypass line is shown on sheet C01 and may be used during construction.

A normally open isolation valve exists between the aeration basin and existing contact basin, which is not shown on C01.

Closing the normally open valve and opening the bypass will route effluent directly to the bay, allowing construction as required on the contact basin.

Question 14: Is there a schedule or allotted days and time for this project?

Answer 14: As part of the "Work Plan and Approach" section of the proposal, offerors are to include details on their proposed schedule. Project expectations include:

i. Mobilization within 4-6 weeks of Contract Notice to Proceed
ii. Majority of construction in summer 2019
iii. Final completion by end of calendar year 2019

Offerors will be evaluated on their work plan; not just on timeliness, but on overall value to the City of Thorne Bay.

Question 15: Is the proposal due date still March 7, 2019?

Answer 15: Yes, the proposal due date is March 7, 2019 at 3:00 p.m. (AKST).

Question 16: What is the last day for question submittal?

Answer 16: Questions shall be submitted and acknowledged by DEC prior to the submittal deadline.

Question 17: Frequency of on-site quality control inspections? Is this owner provided or contractor provided?

Answer 17: VSW as an agent for the City will be working with DOWL, the Engineer, to review submittals, and provide occasional on-site construction inspection. A resident project inspector will not be present full-time. It is the responsibility of the General Contractor to prepare a quality control plan in accordance with the 014500 section and the quality assurance section of each specification. The quality control plan shall be subject to review and approval by VSW and DOWL. In accordance with section 014500 the General Contractor is responsible for notifications when the work is ready for inspection, testing, and or startup.

Additional questions have been received for this RFP and will be answered in Addendum Two.

3. Attachments

The following attachments are now added to the RFP:

a. A_400505_ExposedPipeInstallTable (Two Pages)
b. Glasco Submittal Package (152 Pages)

Offerors must acknowledge receipt of this addendum prior to the submittal deadline.

The proposal documents require acknowledgment individually of all addenda to the drawings and/or specifications. This is a **mandatory requirement** and any proposal received without acknowledgment of receipt of addenda may be classified as not being a responsive proposal.

End of Addendum

TABLE 400505-A - PROCESS PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test	Remarks
Bypass	8”	PVC	n/a	n/a	SCH 80	SW/Flg	HYD (25psi)	Visual observation joints and welds for leaks.
UV	6”	PVC	n/a	n/a	SCH 80	SW/Flg	HYD (25psi)	Visual observation joints and welds for leaks.

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI		Polyvinyl Chloride	PVC
Cast Iron	CI		Chlorinated Polyvinyl	CPVC
Carbon Steel	CS		Polyethylene	PE
Stainless Steel	SS		High Density Polyethylene	HDPE

C. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Bell and Spigot	BS		Flanged	Flg
Restrained Bell and Spigot	RBS		Butt Weld	BW
Push-on Joint	POJ		Lap Weld	LW
Restrained Push-on Joint	RPOJ		Butt Fusion Weld	BFW
Mechanical Joint	MJ		Solvent Weld	SW
Restrained Mech. Joint	RMJ		Sleeve-type Flexible Coupling	SLFC
Soldered	Sd		Split Flexible Coupling	SPFC
Brazed	Bz		Plasticized PVC Coupling	PPVC
Threaded	Thd		Grooved or Shouldered End Coupling	GSEC
Press Fitting	PF		Flanged Adapter	FA ,

D. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ( )		Disinfection and Bacteriological Testing	DBT
Process Air Pipe Test (test pressure in psig)	PA ( )		Examination of Welds	EW
Chlorine Pipe Test	CL		Exfiltration Test	EX
			No Test Required	NR

UV DISINFECTION PROJECT PROPOSAL

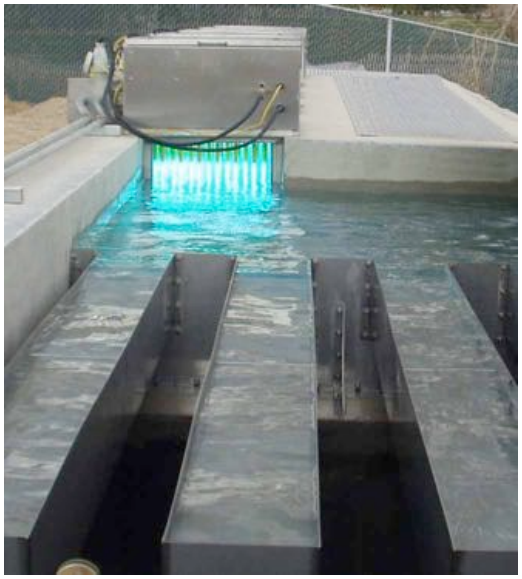
Vertical system is designed for 30" water level.

Project Name:	Thorne Bay WW
Proposal Number:	ATD-02082017-1
Date:	September 5, 2017

Prepared by:	**Adam Donnellan**
Email	adam@glascouv.com
Phone	201 785-4357

Represented by:	**Josh Queen**
Company	Goble Sampson
Email	**jqueen@goblesampson.com**
Mobile	**303.815.8257**
Address	**goblesampson.com**

Project Type:	**Wastewater**
Type	Open channel
Orientation	Vertical
System Name	VCS-40-HO
Lamp Technology	Low pressure high output
Flow rate range	0.42 MGD with 100% redundancy



BENEFITS OF VERTICAL VCS-40-HO

- 10 years of successful installations
- Energy efficient low pressure high output lamps – 13,000 hours
- Economical lamp costs
- All connections above water – no underwater seals
- Flow pacing by turning sections of lamps on and off
- Single module acts as redundant
- Automatic cleaning

SPECIFIC EQUIPMENT

- 30" water level
- Two (2) Vertical Modules
- Automatic quartz cleaning system
- UV Monitoring
- Level control weir

By Others

- Inlet isolation gate
- Integration

Design Information

DESIGN OVERVIEW

Application	Wastewater
Peak flow	420,000
Average flow	140,000
Minimum flow	0.0 US MGD
Location	Outdoors

Water Quality	
UV transmission %	65%
Influent counts	200,000 fc/100 ml
Water temp.	33-90° F
TSS	<30 mg/l
BOD	<30 mg/l
Discharge permit	<200 fc/100 ml
Design UV dosage	>50,000 uWs/cm2 @ end of lamp life

Dimensions	
Channel length	As shown
Channel width	24”
Channel height	40”
Water level	29”
Weir box	
Power Distribution Center	36” x 36” x 12” NEMA 4x stainless steel

EQUIPMENT OVERVIEW

Model Name	VCS-40-HO
System type	Vertical
Configuration	Open Channel
Lamp type	Low pressure high output 85 watts
Lamps per module	40
Channels	1
Modules per channel	2
Lamps per channel	80
UV monitoring	0-100% - 4-20 ma
Auto quartz cleaning	Pneumatic
Lamp status	Green LEDs
Remote control	H/O/A
Voltage	120-277 Volt
kW/hr	3.4 kW
Weight	300 lbs

Integration	
UV output	4-20 mA from UV
Flow signal	4-20 mA to UV
Basic PLC	AB Micrologix
Remote control	H/O/A

Recommendations, Clarifications & Exceptions

The modules will need to be removed from the channel for periodic maintenance or storage. We recommend a hoist or crane to accomplish this. Hoist can be provided by Glasco, but will need to be discussed with engineer.

If the system will be put in direct sun, then a pole structure or cover should be put over the remote electrical enclosure to prevent heat load. The structure also allows operators to work on system in inclement (rain/snow) weather.

Scope of Engineering

The following documentation will be provided by Glasco UV at the time of submittal:

> Installation Operation and Maintenance manual, layout drawings, P+ID drawings, ladder logic diagrams, terminal block diagrams, Warranty requirements, long term storage requirements, bills of materials, equipment descriptions, equipment brochures, head loss calculations, UV DIS calculations, equipment installation lists and other relevant documentation.

Scope of Supply

Qty	Description
Two (2)	VCS-40-HO Vertical modules with automatic cleaning and low-pressure high output lamps.
One (1)	Power Distribution Center / System Control Center (PLC), NEMA 4X modified Type 304 SS wall mounted enclosure.
One (1)	Automatic quartz cleaning system center with air compressor with additional components for maintaining pressure regulated and dry air.

Spares

Four (4)	UV Lamps
Four (4)	Quartz sleeves
Four (4)	Ballasts
Four (4)	Wiper rings
Three (3)	Operation Manuals

Items not included in our scope

a) Ventilation/air conditioning of shelter for electrical cabinet(s) to maintain indoor temperature below 104 F (if applicable; see actual temperature limit for control cabinet).
b) Structure above UV modules to protect from direct heat as well as from inclement weather.
c) Mechanical installation labor for installing equipment, cabling and instrumentation.
d) Lightning surge protection and electrical ground connection.
e) Valves for isolation of individual systems for dose pacing and/or maintenance/cleaning purposes
f) Unloading of components supplied by GLASCO UV.
g) Placement in storage of all components supplied by GLASCO UV.
h) All required equipment, labor, analysis, etc. for any on-site biological performance tests that may be required (regular support for operational tests is provided.
i) Supply and installation of electrical conduit and wiring for power supply and controls of UV system.
j) Any civil and/or mechanical work required to support or install the UV system or its associated controls. This includes concrete pads.
k) Power surge protection and lightning strike protection devices to be provided by contractor.
l) All transformers, circuit breakers and disconnect devices prior to the UV system enclosures are to be provided by electrical contractor (in some cases the transformer is provided by Glasco).
m) Labor and installation of UV modules, electrical enclosures, compressor and PLC.
n) Contractor to supply stainless steel anchor bolts for component installation.
o) Sun shields for all electrical enclosures. This is to prevent thermal gain resulting from exposure to direct sunlight. (Not needed if installed indoors)
p) If supplied, remote signal communication to the SCADA system including language/protocol conversion software and hardware as required. Data retrieval of information from the PLCs is the responsibility of the SCADA system provider or integrator. This includes integration of flow signals.

Warranty

The warranty period is 18 months from date of delivery and 12 months from date of the Certification of Substantial Completion whichever comes first. It covers all failures due to defects in material and/or workmanship excluding consumables (see separate lamp and ballast warranties below).

This warranty shall not apply to any failure or defect which results from the Equipment not being operated and maintained in strict accordance with instructions specified in Glasco UV's Instructions Manual or which results from mishandling, misuse, neglect, improper storage, improper operation of the Equipment with other equipment furnished by the Customer or by other third parties or from defects in designs or specifications furnished by or on behalf of the Customer by a person other than Glasco UV. In addition, this warranty shall not apply to Equipment that has been altered or repaired after start-up by any one except:

- Authorized representatives of Glasco UV, or
- Customer acting under specific instructions from Glasco UV.

Customer must notify Glasco UV in writing within 5 days of the date of any Equipment failure. This notification shall include a description of the problem, a copy of the operator's log, a copy of the Customer's maintenance record and any analytical results detailing the problem. If Customer has not maintained the operator's log and maintenance record in the manner directed in the Operation and Maintenance manual, or does not notify Glasco UV of the problem as specified above, this warranty may, in Glasco UV's discretion, be invalid.

Customer will fully cooperate with Glasco UV, in the manner requested by Glasco UV, in attempting to diagnose and resolve the problem by way of telephone support. If the problem can be diagnosed by telephone support and a replacement part is required, Glasco UV will either, at Glasco UV's expense, ship a repaired, reworked or new part to the Customer who will install such part as directed by Glasco UV or will direct Customer to acquire, at Glasco UV's expense, such part from a third party and then install such part as directed by Glasco UV.

This warranty is the exclusive remedy of the Customer for all claims based on a failure of or defect in the Equipment, whether the claim is based on contract (including fundamental breach), tort (including negligence), strict liability or otherwise. This warranty is lieu of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or fitness for a particular purpose shall apply to the Equipment.

Lamp Warranty

Each low pressure, high output lamp is guaranteed for 13,000 hours operating time under normal operating conditions. Normal operating conditions include:

- On/off cycles max. 4 per 24 operating hours,
- Voltage fluctuations according to DIN IEC 38.

In case of premature lamp failure, the client is requested to send the lamp back to Glasco UV together with the information of UV unit serial number, hours run and on/off cycles. Glasco UV then offers the following:

- Lamp failure before 9,000 h: Glasco UV will send a replacement lamp free of charge,
- Lamp failure after 9,000 h: Glasco UV will issue a credit proportional to the hours not used.

Upon return to our facilities in Mahwah, NJ, we will dispose/recycle all used and failed lamps at no charge to the client.

GLASCO UV

Terms & Conditions

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from acceptance, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.

10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

11. Reservation Clause. Buyer acknowledges that Seller is required to comply with applicable export laws and regulations relating to the sale, exportation, transfer, assignment, disposal and usage of the Equipment provided under this Agreement, including any export license requirements. Buyer agrees that such Equipment shall not at any time directly or indirectly be used, exported, sold, transferred, assigned or otherwise disposed of in a manner which will result in non-compliance with such applicable export laws and regulations. It shall be a condition of the continuing performance by Seller of its obligations hereunder that compliance with such export laws and regulations be maintained at all times. BUYER AGREES TO INDEMNIFY AND HOLD SELLER HARMLESS FROM ANY AND ALL COSTS, LIABILITIES, PENALTIES, SANCTIONS AND FINES RELATED TO NON-COMPLIANCE WITH APPLICABLE EXPORT LAWS AND REGULATIONS.

12. Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of New Jersey without regard to its conflict of laws provisions.

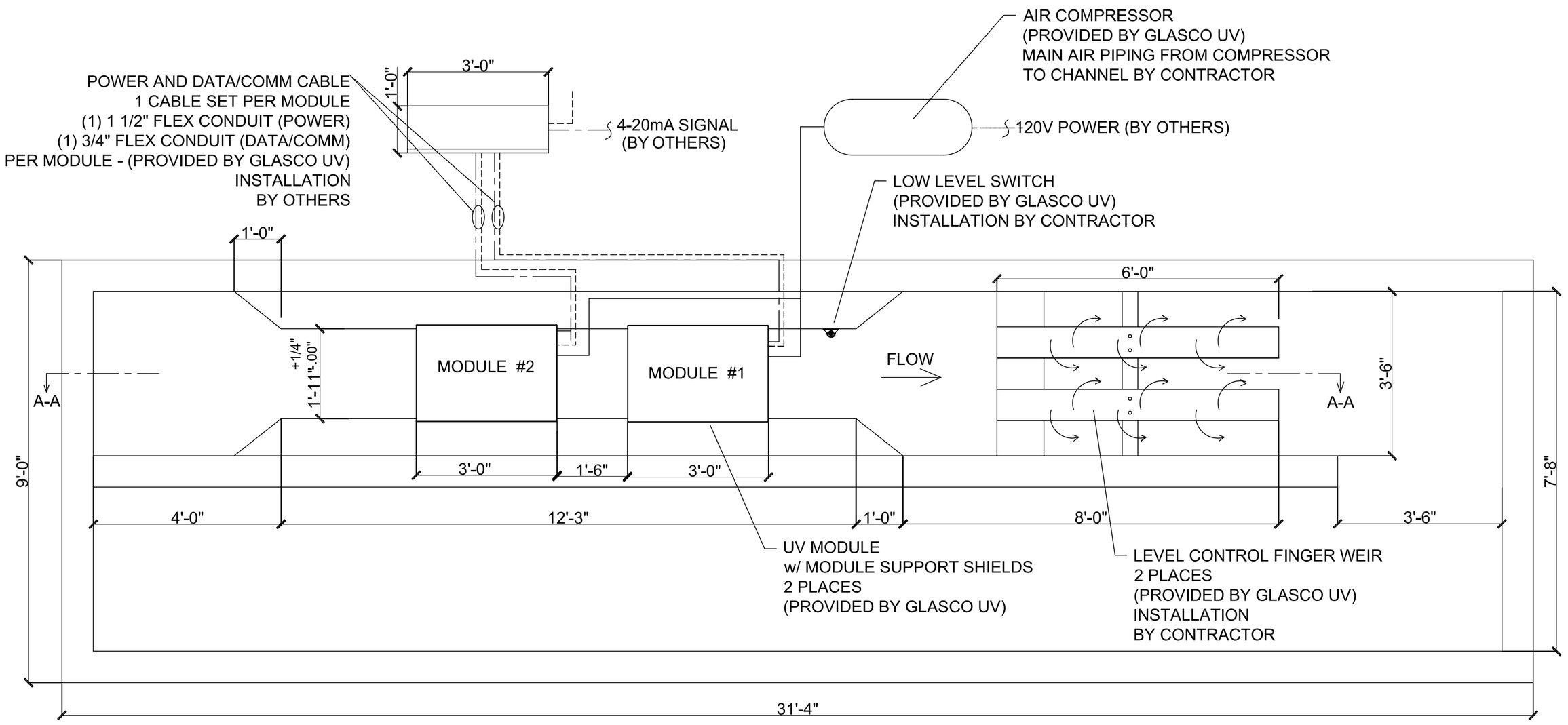
REV	DESCRIPTION	DATE	APPROVED

LEGEND

COMMUNICATIONS

POWER

AIR



UV EQUIPMENT PLAN VIEW

NOTES:

1. FOR ADDITIONAL INFORMATION AND DETAILS PLEASE CONTACT GLASCO UV.

Glasco UV
126 Christie Avenue. Mahwah, NJ 07430
PH: 201-934-3348 FX: 201-934-3388
WWW.GLASCOUV.COM

PROJECT

FINISH

MATERIAL

TOLERANCES UNLESS OTHERWISE SPECIFIED
.X ± ±.030
.XX ± ±.015
.XXX ± ±.005
ANG ± ±-
DO NOT SCALE DRAWING

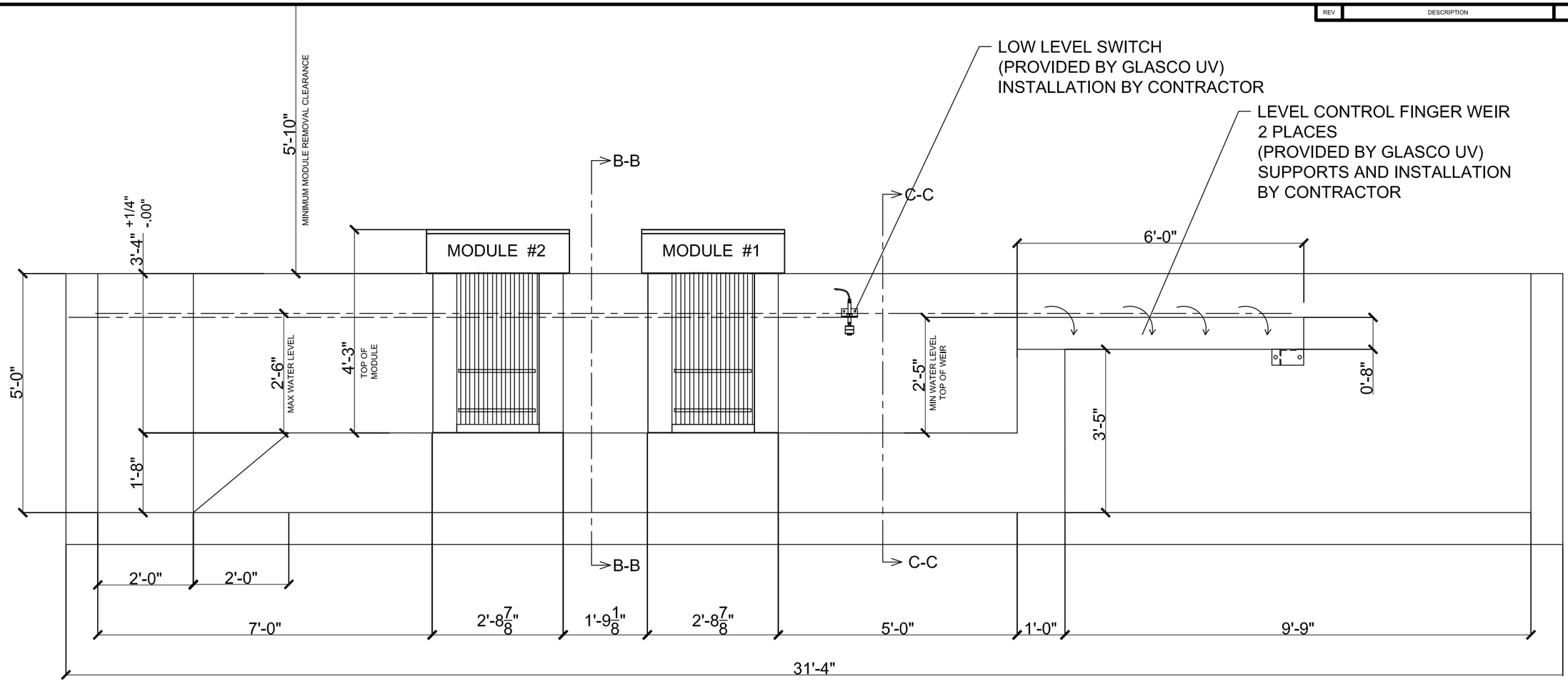
DWN	SM	12/8/14
APVD	SM	12/8/14

TITLE: UV EQUIPMENT LAYOUT

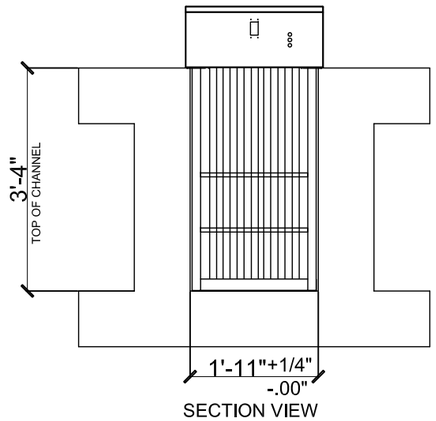
SIZE: D | DWG. NO. | REV: -

SCALE: N/A | SHEET 1 OF 2

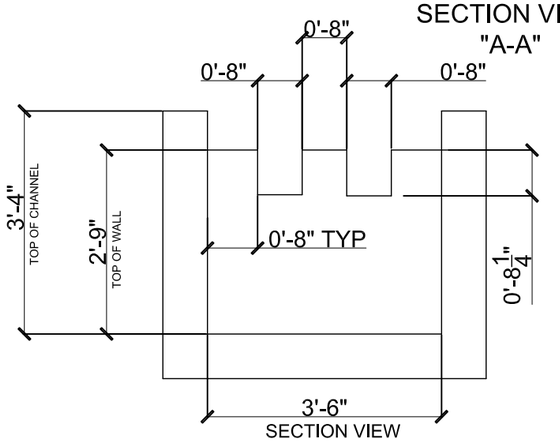
REV	DESCRIPTION	DATE	APPROVED



SECTION VIEW
"A-A"



SECTION VIEW
"B-B"



SECTION VIEW
"C-C"

WEIR FINGERS NOT SHOWN FOR CLARITY
CONCRETE DIMENSIONS REQUIRED AS SHOWN

NOTES:

1. FOR ADDITIONAL INFORMATION AND DETAILS PLEASE CONTACT GLASCO UV.

Glasco UV
126 Christie Avenue. Mahwah, NJ 07430
PH: 201-934-3348 FX: 201-934-3388
WWW.GLASCOUV.COM

PROJECT

FINISH

MATERIAL

TOLERANCES UNLESS OTHERWISE SPECIFIED
.X = ± .030
.XX = ± .015
.XXX = ± .005
ANG = ± -
DO NOT SCALE DRAWING

DWN	SM	12/8/14
APVD	SM	12/8/14

TITLE
UV EQUIPMENT LAYOUT

SIZE D | DWG. NO. | REV -

SCALE N/A | SHEET 2 OF 2

GLASCO UV WILL PROVIDE A VCS-40-HO x 2 UV SYSTEM AS PER THE FOLLOWING:
September 5, 2017
ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. GLASCO UV will furnish all materials, equipment and appurtenances required to provide an open channel low-pressure high output vertical ultraviolet (UV) wastewater disinfection system. System has automatic quartz cleaning.

System will be VCS-40-HO-LB. UV disinfection system will be complete and operational with controls and accessories as shown and as specified. The UV equipment will be capable of treating the wastewater with the characteristics outlined to meet the permitted discharge limitations.

B. GLASCO UV will provide

1. Two (2) Vertically oriented UV modules. Each module will have 40 low-pressure high output lamps. Module has UV monitoring system.
2. **PLC will be capable of** taking a 4-10mA water level signal and have the displays programmed for pacing by level, in units of feet (0-12 feet by tenths),
3. Fixed level control weir
4. Spare parts
5. Start up testing, personnel training
6. Automatic quartz cleaning

C. GLASCO UV will provide:

System commissioning and installation inspection
Systems start up
Operator training

D. Work by contractor:

1. Foundations, concrete channels, conduits, handrails and stairs.
2. Installation.
3. Main electrical power supply
4. Control wiring and installation for remote signals.
5. Piping, channel drains and valves.
6. Walkway Grating.
7. Channel Isolation Gates and motorized gate actuators.
8. Lifting crane and hoist (1 ton minimum).
9. Interconnect conduits between the wireway and the PDDC.

1.2 QUALITY ASSURANCE

A. All SYSTEM components will be supplied to the CONTRACTOR by GLASCO UV.

B. Glasco UV has 15 years experience in furnishing UV systems of similar design to the equipment specified herein. As part of their submittal package, the EQUIPMENT SUPPLIER shall submit following documentation:

    1. Glasco has UV systems of similar design have been in successful operation for at least ten (10) years in at least 100 separate installations.

C. The SYSTEM will be designed, fabricated, assembled and tested by Glasco Ultraviolet. The system shown on the Drawings is the VCS-40-HO-2 system as manufactured by Glasco Ultraviolet.

D. Glasco UV complies with applicable provisions and recommendations of the following, except as otherwise shown or specified.

    1. American Society for Testing Materials (ASTM)
    2. National Electric Code (NEC)
    3. National Electrical Manufacturer's Association (NEMA)
    4. Occupational Safety and Health Association (OSHA)
    5. "Municipal Wastewater Disinfection" US EPA Design Manual, EPA/625/1-86/021
    6. American Welders Society (AWS)
    7. Underwriter's Laboratories (UL)

    Also:
    1. U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA)

    2. US EPA (1986) Design Manual EPA/625/1-86/021

    3. American National Standards Institute (ANSI)

    4. American Society for Quality Control (ASQC)

    5. American Society of Mechanical Engineers (ASME)

    6. American Society for Testing Material (ASTM)

    7. American Water Works Association (AWWA)

    8. NEMA 250 (2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

    9. NEMA C82.4 (2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

    10. NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements

    11. NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

        Standard Methods for The Examination of Water and Wastewater, 20th addition

E. MANUFACTURER'S REPRESENATIVE

    1. The services of a full-time employee of the EQUIPMENT SUPPLIER will be provided on the project site as the EQUIPMENT SUPPLIER representative. The representative has

complete knowledge of the SYSTEM including proper installation, operation and maintenance.

2. The EQUIPMENT SUPPLIER'S representative will inspect the installation and supervise any required modifications, additions, or other changes required to allow the EQUIPMENT SUPPLIER to certify that the complete installation is appropriate and is expected to operate as expected.
3. The EQUIPMENT SUPPLIER'S representative will instruct the OWNER and ENGINEER'S personnel on the operation and maintenance of the SYSTEM. The instruction shall include classroom training on UV Technology and the specific installation, and field training on proper operation and maintenance procedures, along with complete demonstration of the same.
4. The EQUIPMENT SUPPLIER'S representative will provide minimum services in accordance with the following table:

Purpose	No. of Days
Startup and Functional Testing	1
Operator Training	1

5. The number of days indicated above is provided on an 8-hour day on-site basis.

1.3 SUBMITTALS

A. The following has been submitted for review:

1. Dimensioned drawings specific to the plant have been attached on 11" x 17" paper.
2. Dimensioned drawings of the channel have been attached.
3. All items to be installed by the contractor have been integrated.
4. Anchor bolt layouts for installing the various components have been shown.
5. Wiring diagrams for the main power as well as the various connections are outlined in the attached drawings.
6. Schematics and operational information on the air compressor for the automatic cleaning system have been attached.
7. Operation manual has been attached.
8. List of recommended spare parts has been attached.
9. All spare parts are available to the end user from our Mahwah, NJ headquarters.
10. Testing reports will be provided with the equipment.
11. All appropriate testing to the equipment will be overseen by factory.
12. Storage information has been included in the O&M.
13. There are no special tools required for this project.
14. Glasco will provide all required start up, installation support and training as outlined in specification.
15. Warranty is outlined in the O&M manual.
16. Quality control reports will be provided with the equipment.

B. Design Data

1. Glasco UV has over 100 Vertical installations. Since 2001, Glasco has been the leading American UV company providing vertical solutions.

C. The manufacturer has provided 3 copies of shop drawing submittals; these shall include interconnections and interface requirements, dimensions and locations of all major elements of the UV system and critical clearance requirements. Once approved no changes will be made without the written consent of the engineer and the UV equipment supplier. Information will include the following:

1. Complete description in sufficient detail to permit a thorough comparison with the appropriate specification.

2. Major component dimensions and installation requirements.

3. Descriptive summary of the UV system provided.

4. Electrical and major component layouts. Headloss calculations demonstrating compliance with the specified hydraulic characteristics.

5. UV dosage calculations. Dose calculations.

6. Preliminary UV equipment O&M manuals prepared for this project.

D. Operation and Maintenance Manuals

Final Operation and Maintenance (O&M) manuals for this specific project will be submitted to the Engineer upon approval of shop drawings and delivery of the equipment. The O&M manuals shall include instructions on equipment storage, installation, start-up, and operation and maintenance, together with a thorough troubleshooting guide and recommended spare parts list.

1.4 SPARE PARTS AND SPECIAL TOOLS

A. Included in the proposal, the EQUIPMENT SUPPLIER shall furnish spare parts required to ensure adequate operation of the SYSTEM. Spare parts shall include as a minimum:

1. A number of spare lamps equal to four (4).
2. A number of spare quartz sleeves equal to four (4).
3. A number of spare wiper rings equal to four (4).

B. One (1) Operators Kit including one (1) UV face shield, one (1) set of gloves and one (1) Lime-A-Way cleaning solution

C. The EQUIPMENT SUPPLIER shall furnish all special tools required for the proper installation, operation and maintenance of any component of the SYSTEM.

D. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the CONTRACTOR at the completion of the contract.

1.5 DESIGN CRITERIA

A. Glasco UV is providing a low-pressure high output system for disinfection of wastewater as outlined in the design.

1.	Design Peak instant flow:	420,000 GPD
2.	Average flow:	140,000 GPD
3.	Minimum flow:	0.0 MGD
4.	Total Suspended Solids:	30 mg/l
5.	Biological Oxygen Demand:	30 mg/l
6.	Effluent temperature range:	33 to 80 F
7.	End of lamp life:	13,000 hours (90% output of new lamp)
8.	UV Transmittance at 254 nm:	65%
9.	Maximum mean particle size:	30 microns
10.	Maximum weight of module:	<500 lbs
11.	Minimum UV dose:	30 mJ/cm2
12.	Effluent standard to be achieved	<200 fecal coliform per 100 ml on a 30-day geometric mean of daily samples and sampling location immediately downstream of the UV reactor.

B. DIMENSIONS

Width:	30”
Depth:	30”

C. Effluent Depth will be 29”

D. The system should have the following:

1.	Number of channels:	1
2.	Number of modules per channel:	2
3.	Number of total modules:	2
4.	Number of lamps per module:	40
5.	Lamps per channel:	80
6.	Number of PDC/SCCs:	1
7.	Number of UV monitors:	2
8.	Number of UV weirs:	1 sized for 500,000 GPD.

1.6 PEFORMANCE REQUIREMENTS

A. System Performance

1. The end of lamp life UV dose produced by the system shall not be less than 30,000 uWs/cm_2 in an effluent with 65% UV transmittance @ 253.7-nm. Lamp output must be at least 80% of initial level after 13,000 hrs of operation and with no fouling on the quartz sleeves.

2. The system design is based on the following criteria:

a. UV transmission (T10)	65%
b. UV Lamp End of Life Factor	90%
c. Quartz Sleeve Fouling Factor	0.90

d. Max UVC conversion (UV lamp watts to UVC) 35%

3. The actual retention time of the effluent within the system determined by hydraulic analysis shall be less than 1.0 times the theoretical retention time but no less than 0.9 times the theoretical retention time.

4. Total headloss for each channel will not exceed 0.5 inches, this being confirmed by measurements in the field after start-up.

B. Energy and Lamp Conservation (automatic quartz cleaning)

1. The UV control system will automatically turn on and off appropriate segments in relation to variations in plant flow. The signal, provided by others, shall be 4-20 ma or similar approved method.

2. The UV system design allows the operator an option to operate the UV system in either manual or automatic modes.

2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General

1. The UV disinfecting system will be furnished complete with vertical UV modules, stainless steel mounting brackets, stainless steel wire ways with communication and electrical ports, power distribution centers, automatic level controller, UV intensity monitoring system and automatic wiping system.

An Allen Bradley PLC will be provided to perform flow pacing in relation to a 4- 20mA plant flow signal.

2. All metal components exposed to or in contact with plant effluent, including all anchoring hardware, will be Type 304L or 316L SS. All materials exposed to UV light shall be unaffected by prolonged exposed to same and shall be Type 304L or 316L SS, Type 214 quartz, Viton, EPDM or Teflon.
All metal components not in contact with plant effluent and/or UV light will be Type 304L SS.

3. The UV system will be able to continuously provide disinfection while replacing UV lamps, quartz sleeves, and ballasts and while cleaning the UV lamp sleeves.

2.2 UV LAMPS

A. Glasco will provide low-pressure high output (GHO36T5L style) lamps for this project.

The UV lamps being provided have the following characteristics:

1. 90% of the UV emission will be in the 254 nm range.
2. The minimum UV intensity will be 370 microwatts per square cm at a distance of 1 meter.
3. Maximum power consumption on the 85-watt lamps.
4. The UV lamps have a rated UV output of 27.0 UVC watts.
5. The UV lamps have an arc length of 29”, which will be submerged to insure proper disinfection.
6. Lamp life is 13,000 hours.
7. The UV lamp bases will be constructed of metal and ceramic, which are resistant to UV light and ozone.

B. UV LAMP GUARANTEE:

1. UV supplier warrants that after 13,000 hours of operation the average UV lamp output will be no less than 90% of a new lamp (after 100 hours initial burn-in).

2. The number of UV lamps required will be as determined sufficient by the UV manufacturer to meet the required disinfection standard and the minimum UV dosage specified.

3. The UV lamps will be warranted for 13,000 hours of useful life and the warranty is to be pro-rated against actual lamp use.

2.3 UV LAMP SLEEVES

Sleeves will be clear fused quartz circular tubing as by GE Type 214. Sleeves will be rated for transmittance of 94 percent or more and sleeve will not be subject to solarization over its life. One end of each sleeve will be closed and the other end sealed by a lamp end seal and compressed O-ring. The closed end of the sleeve will be held in place by means of a retaining O-ring. The sleeve will not come in contact with any steel in the frame.

The size of the quartz material will be 25 mm x 28 mm.

2.4 UV LAMP MODULE

a. The UV module shall be fitted in a vertical position within the effluent flow channel.
    i. The UV lamps will be symmetrically centered on 3" centerline spacing to maximize the dosage of UV radiation seen by the wastewater effluent.

b. Each UV module consists of forty (40) lamps with each lamp placed in their individual quartz sleeve. In the event that a quartz sleeve breaks no other lamps will be exposed to the effluent.

c. Each module is constructed from Type 316 stainless steel and with a modified NEMA 4X rating. The module is electropolished.

d. Modules are constructed in a manner not to allow UV light to radiate above the channel when the lamp modules are energized and fully immersed in the effluent. Modules shall be designed such that operating personnel at the plant can change the lamps and quartz sleeves with other modules in the channel still operating.

e. The modules shall be directly wired to the power center in a UL watertight flexible conduit. Each channel shall require stainless steel wireways as provided by the UV manufacturer.

f. The modules will be removed by lifting out of channel by hoist as supplied by others.

g. Modules do not need to be removed from the effluent in order to change lamps or service ballasts.

h. The open end of the lamp sleeve is sealed by means of a UV resistant polymer, which will thread onto a sleeve cup and shall compress the external Oring sleeve seal.

i. The sleeve nut does not require special tools for removal.

j. Automatic Cleaning System has been provided.

    1. The UV module shall have an automatic quartz wiping system to allow the protective sleeves to be cleaned on a predetermined basis.

    2. Wiping system is air driven and is constructed of Type 316 stainless steel (piston and wiper blades).

    3. The cleaning system is pneumatically driven. A solenoid valve located within

the UV module will control the cleaning stroke.

2.5 UV MONITORING

A. Each module will have one (1) UV intensity sensor.

B. The sensor will be enclosed in a watertight stainless steel probe that will be placed into its own Quartz sleeve.

C. Sensor is able to be removed without system shut down to inspect.

D. The sensor will be solar blind and shall measure only the germicidal spectrum wavelength (254 nm).

E. The UV intensity shall be displayed in the UV module window kit through a digital meter with a 0 to 100% output reading.

2.6 Air Compressor

A. Glasco will provide an air compressor to actuate the automatic cleaning system.

B. Air compressor will be oil lubricated type.

C. Air compressor shall be sized for a minimum air flow of 5 cfm @ 40 psi.

D. Air compressor will be independently powered by the customer.

E. Control of the air compressor will be via pressure switch mounted on the air receiver.

F. Air outlet will be ¼" FNPT.

G. Air compressor will be v-belt driven.

H. Accessories
   1. Air Receiver
      a) Air receiver will be 13 gallon, cast iron construction.

   2. Motor
      a) Motor will be 2 HP, 120 VAC, 50/60hz, 1ph – 15 amps

   3. The air compressor discharge piping shall include:

      a) ASME safety valve
      b) Festo Filter/Regulator
      c) Norgren Excelon 74 Desiccant Compressed Air Dryer

2.7 Level Control Weir

A. Glasco will provide a level control weir to be manufactured from Type 304 stainless steel.

B. The effluent water level shall be maintained at 29.5" (+/- 1.5").

2.8 ELECTRICAL

A. The UV disinfection system will be divided into electrical sub-systems.

B. The channel will be powered from a Power Distribution Center (PDC). Contractor shall bring protected power to the PDC. Power requirements:

Circuit Breaker for 3 Modules:

Option 1: Three phase @ 240, 40 AMP 3 pole Breaker
Option 2: Single Phase @ 240, 60 AMP 2 pole Breaker.

C. The air compressor shall be powered by directly from PDC.

D. UV Module Power

1. Each module has electronic ballasts in the top of the module.

a. Each electronic ballast control, operate and display information on low pressure high output lamps.
b. Ballasts are UL listed and operate the lamp at 120-240 V 50/60 Hz.
c. Ballasts are wired using quick connects and are readily removable from the electrical enclosure.

2. Maximum power consumption per module is 3.4 kW.

2.9 NSTRUMENTATION AND CONTROLS:

A. Power Distribution Center (PDC)

1. One Power and Data Distribution Center (PDDC) complete with PLC and HMI will be provided per channel.

2. The wall/floor mounted PDDC shall be NEMA 4X and will be conveniently located as shown on the drawings. The minimum size of the PDC shall be 60 inches in height, 36 inches width, and 12 inches depth. NEMA-3R with forced ventilated enclosures, which allow introduction of outside air, shall not be acceptable unless equipped with an active air filtration system or automatic signal to advise operators when replacement of filter is required.

3. Power will enter the PDC and terminate in a load center. One or more load centers shall be mounted inside the PDC.

4. Each UV lamp module will be protected by a panel mounted thermal magnetic circuit breaker device per NEC Code. These circuit breakers will be mounted in the Power Distribution Center (PDC) or the plant Motor Control Center (MCC) specified elsewhere. Each circuit breaker shall provide visual trip indication, be capable of regular testing. To ensure safe operation, ground fault circuit detection systems, which permit remote reset, will not be used.

B. Operator Interface Description

1. The Operator Interface shall be PLC based. The Programmable Logic Controller (PLC) shall be an Allen Bradley MicroLogix 1400, with a programmable NEMA 4X rated Rohtek Touch Screen which shall be mounted in the panel door. The PLC will communicate with each UV module via a code operated switch mounted within the DCS using an RS232/485 serial interface.

System operating information will be displayed on the screen in both color graphic and text format. The information must be continuously updated. As a minimum the following information shall be displayed in the main screen simultaneously: Number of channels/rows/banks/modules in service, UV intensity, communication link status, system flow pace mode (hand or auto) and UV lamp status.

2. System command, control and status shall be accomplished through the Panelview main screen display. In the event of a fault the alarm color display will change from green to red until the alarm has been manually or automatically cleared.

3. Alarms shall, as a minimum, include:

    a. Module Communication failure
    b. UV Intensity Failure
    c. Flow signal loss
    d. Cleaning system failure

4. The alarm display will identify the affected module and then the actual component.

5. The Automatic Cleaning system shall be controlled and monitored by the PLC. Automatic control of the wipers shall be based on time; the operator shall be able to alter the interval between cleaning cycles.

6. Sections of modules will turn on/off ½ banks as the water level in the effluent EQ basin/wet well rises. The flow pacing will actually be based on a 4-10mA water level signal as provided to the UV system for pacing by level, in units of feet (0-12 feet by tenths).

2.10 SPARE PARTS AND SAFETY EQUIPMENT

1.	Lamps	4
2.	Sleeves	4
3.	Ballasts	2
4.	Wiper seals	4
5.	Wiper rings	16
6.	Operators kit	1

3 EXECUTION

3.1 SHIPPING AND EQUIPMENT DELIVERY

A. All equipment and materials shall be inspected against approved Shop Drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to GLASCO for replacement or repair.

B. The CONTRACTOR will handle and store the equipment and materials in a dry location and protect them from the elements according to the manufacturer's instructions

3.2 COMMISSIONING AND START UP

A. Glasco UV will inspect equipment installation, piping and wiring to ensure proper installation of each component in accordance with approved submittals. CONTRACTOR shall make at its own cost any modifications required to meet GLASCO's installation recommendations. A written statement certifying that the equipment has been properly installed and interconnected shall be provided by GLASCO.

B. Glasco UV will coordinate commissioning of the system and verify that each component of the UV System is ready for operation. UV System commissioning will include testing and calibration of each component of the system. A written statement certifying that the UV System has been commissioned and is ready for operation shall be provided.

C. Glasco UV will coordinate initial UV System start-up to ensure operating procedures are followed in accordance with approved submittal's instructions manuals.

D. Glasco UV will provide start up.

3.3 TRAINING

A. Glasco UV will provide operator training at the site for a period no less than one (1) 8-hr day. Training will include operation, maintenance and trouble shooting for each component of the UV System.

3.4 WARRANTY

A. The UV System will be free from defects in materials and workmanship for a period of 24 months from Final Acceptance of the system.

B. Lamps will be warranted for a period of 13,000 hours operating time under normal operating conditions.

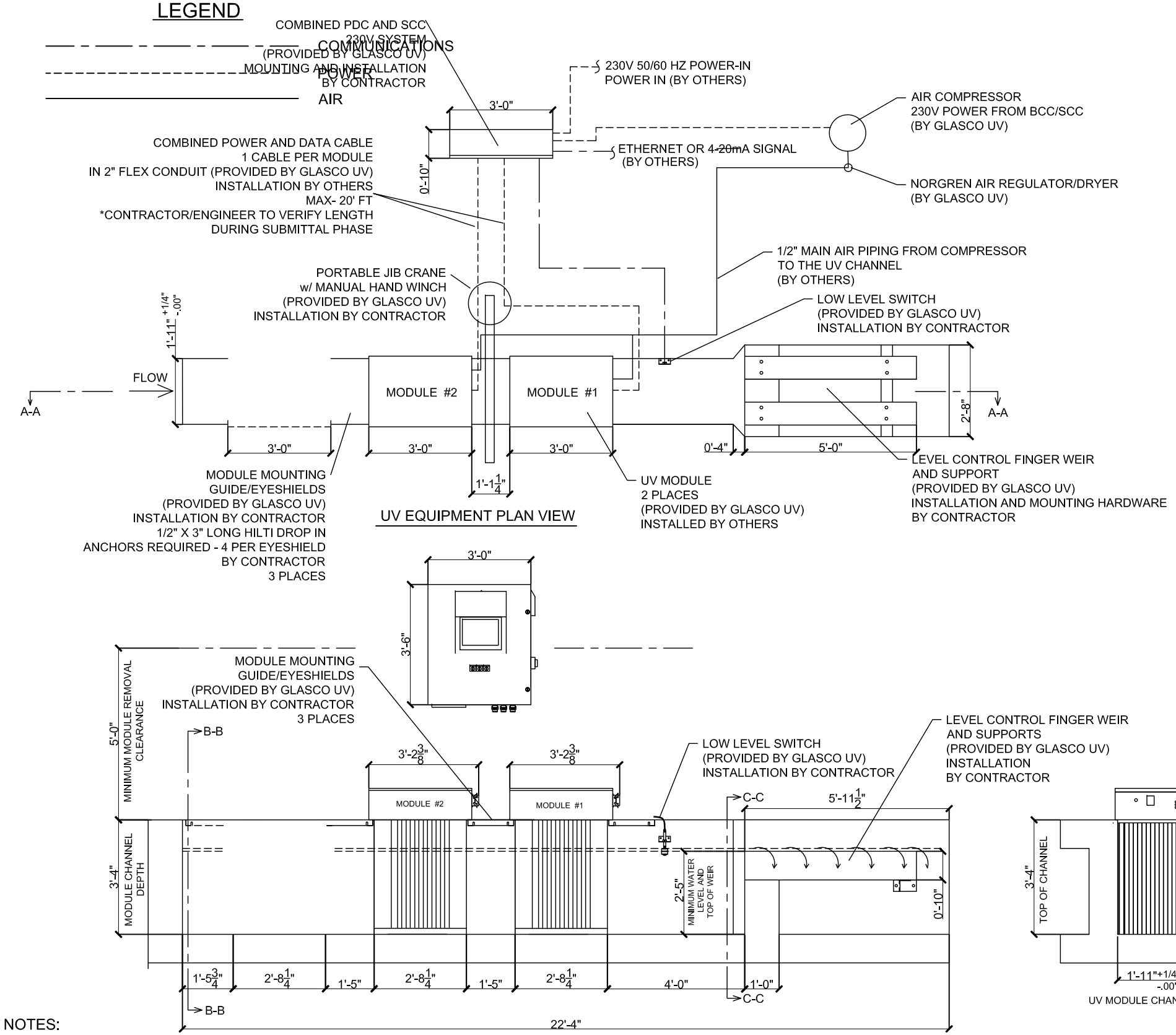
1. The lamp warranty will cover the full replacement cost for the first 1,000 hrs of operation.
2. The lamp warranty will cover the lamp replacement cost on a prorated basis after 1,000 hrs operation.

END

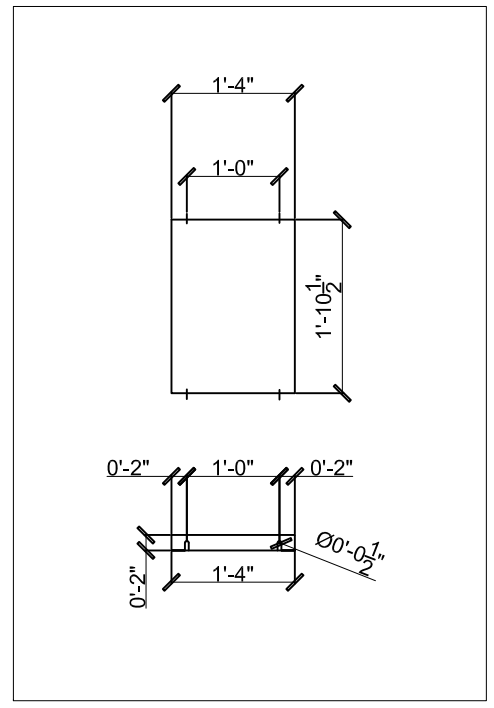
REV	DESCRIPTION	DATE	APPROVED

LEGEND

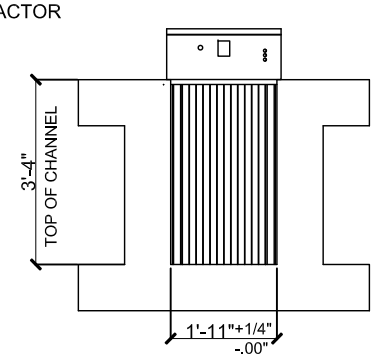
COMBINED PDC AND SCC 230V SYSTEM COMMUNICATIONS (PROVIDED BY GLASCO UV)
MOUNTING AND INSTALLATION BY CONTRACTOR — POWER
AIR



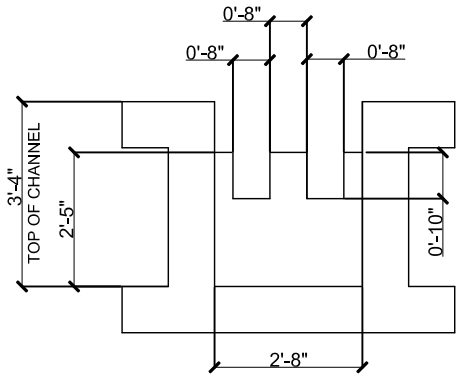
UV EQUIPMENT PLAN VIEW



MODULE MOUNTING GUIDE/EYESHIELD
DIMENSIONAL DETAIL
SEE NOTE #2



UV MODULE CHANNEL AREA



WEIR FINGER NOT SHOWN FOR CLARITY
CONCRETE DIMENSIONS REQUIRED AS
SHOWN

NOTES:

1. FOR ADDITIONAL INFORMATION AND DETAILS PLEASE CONTACT GLASCO UV.
2. MODULE GUIDE RAILS/EYESHIELDS TO BE INSTALLED IN CHANNEL BY DROPPING INTO PLACE OVER CONCRETE DROP-IN ANCHORS PROVIDED BY GLASCO UV. 1/4" CLEARANCE TO BE LEFT BETWEEN ALL MODULES AND RAILS/EYESHIELDS. ONE UV MODULE SHOULD BE USED TO LOCATE AND PROPERLY INSTALL UV MOUNTING RAILS/EYESHIELDS.

Glasco UV
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WWW.GLASCOUV.COM

PROJECT	FINISH	TITLE	UV EQUIPMENT LAYOUT
TOLERANCES URLESS OTHERWISE SPECIFIED .X ± ± .030 .XX ± ± .015 .XXX ± ± .005 ANG ± ± -	MATERIAL	SIZE D	DWG. NO. GLOW-VCS-40-HO-X3 REV -
DO NOT SCALE DRAWING	DWN SM 3/13/17	SCALE N/A	SHEET 1 OF 1
	APVD SM 3/13/17		

GLASCO UV

WASTEWATER TREATMENT PLANT
VC-40-HO-LB
INFORMATION, INSTALLATION, OPERATION & MAINTENANCE MANUAL

VERTICAL OPEN CHANNEL
UV WASTEWATER DISINFECTION

TABLE OF CONTENTS

1. OPERATION & MAINTENANCE USER MANUAL ORGANIZATION

The O&M manual is organized in a way to provide as much information as possible. We have put the SAFETY information first and then provided a basic overview of UV technology and how it works.

We have “front loaded” other information that we believe is important to the day to day operation.

Some important information (start up and shut down sequences) have been put to the back due to the fact that the installation and start up will be performed by Glasco and the Contractor.

2. IMPORTANT INFORMATION

Work Safe!

The equipment, while sophisticated, has been designed for simple and easy operation. In keeping with this philosophy, this user manual has been written to simplify all steps in the procedures that follow.

As a reminder, all local safety codes and regulations should be followed. As with servicing all wastewater plant equipment, ensure that your safety clothing and your tools are in good working order. In addition and a helpful reminder: be careful of slip, fall, overhead and trip hazards around the plant.

In order to protect end users and operators from injury, safety precautions must be followed. This Installation, Operation and Maintenance Manual outlines important safety issues. The following WARNING SYMBOLS will be found throughout the manual to alert the end users to take important precautions:

INFORMATION. This symbol signifies helpful information.

CAUTION This symbol indicates a potentially dangerous situation. Failure to adhere to this warning may lead to serious injury and or death.

ELECTRIC SHOCK. This symbol signifies electricity is present and that caution should be taken to help prevent serious injury and or death.

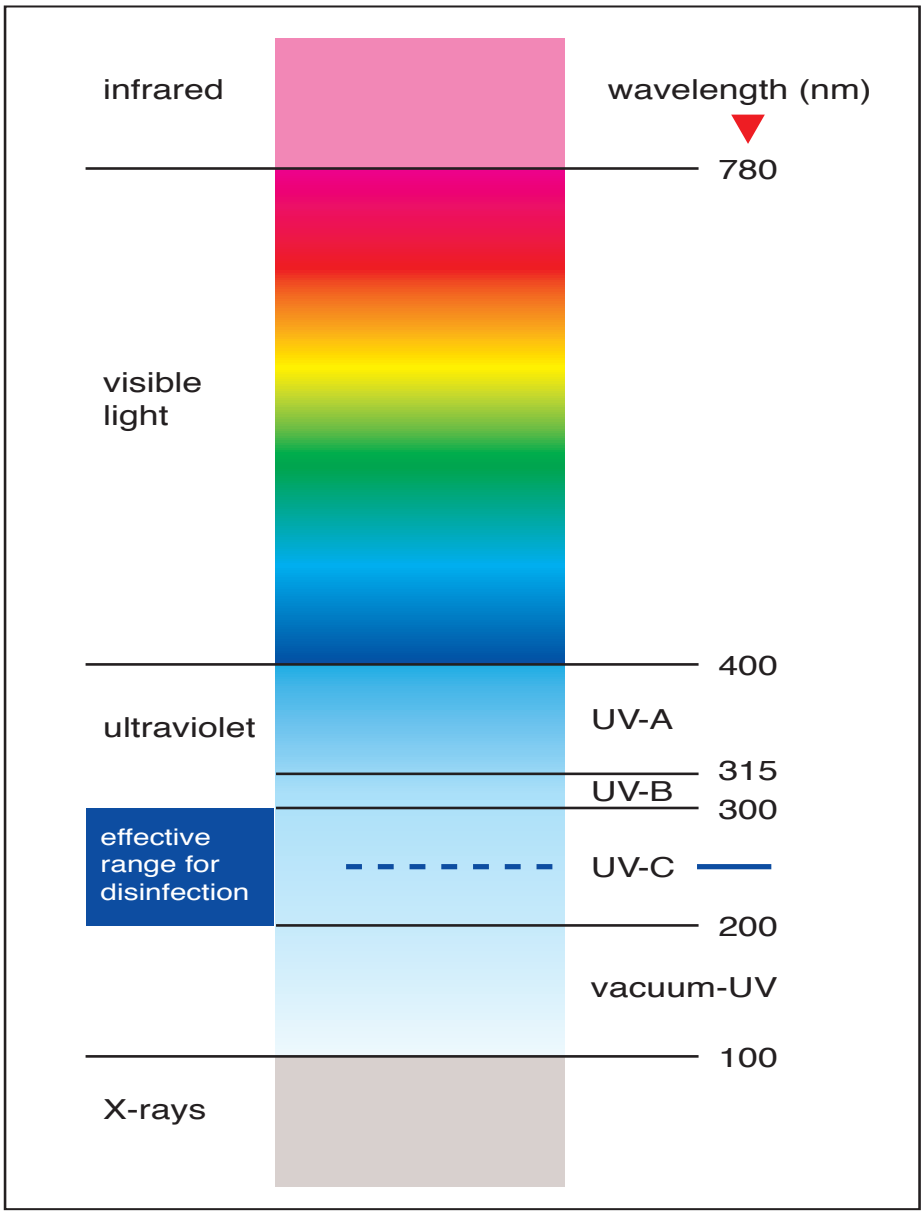
EYE PROTECTION. This symbol indicates that eye protection must be worn to protection from UV light as well as debris.

HAND PROTECTION. This symbol signifies that hand protection must be worn to protect the lamps from skin oils as well as protect the operator from UV light and sharp materials caused by a broken lamp/quartz. A broken quartz sleeve is very sharp and can cause serious injury and or death.

3. About Ultraviolet (UV) Disinfection

The technology uses ultraviolet UV light to target and disable disease-causing microorganisms (pathogens).

Over 100 years ago, scientists discovered that if you exposed pathogens to UV light, their reproduction was limited. The UV light source that they used, resided in the UVC range of the light spectrum. Specifically, they discovered that light in the 254 nanometer (nm) range was the most effective wavelength.



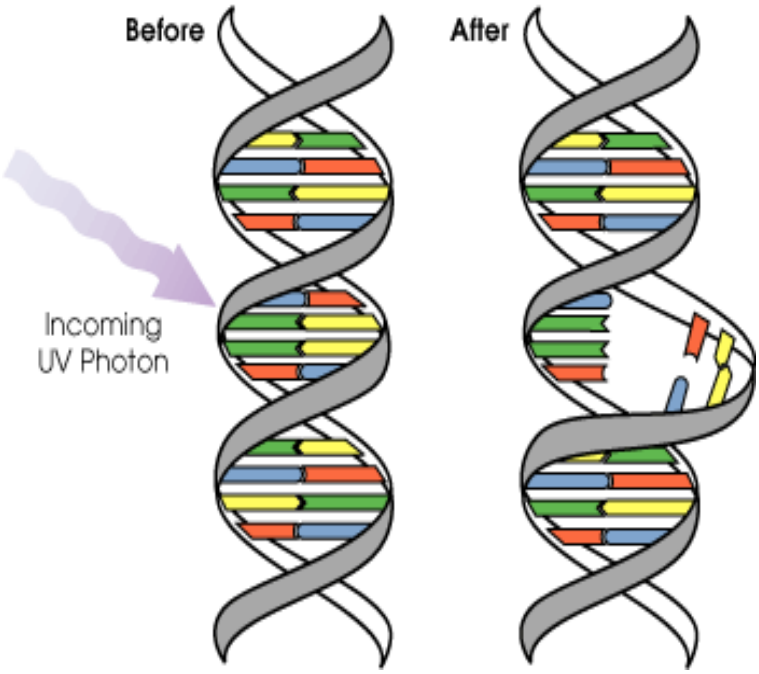
The actual UV light is invisible to the naked eye. The light that you do see coming from the modules is the visible portion of the spectrum. Please note just because the lights are “ON”, it does not indicate that they are producing actual UVC light. Use your UV monitoring system and lamp life tracking to insure that the UV lights are working at optimum performance.

When many pathogens are exposed to UV light, their cells become damaged and this damage inhibits reproduction. The UV light, produced by a special UV lamp, damages the cell's DNA and RNA and once damaged, they are unable to replicate. This physical process renders them harmless.

Technical Explanation: "The inactivation of microorganisms by ultraviolet radiation is a physical process, relying on the photochemical changes brought about when far-UV radiation is absorbed by the genetic material of the cell (deoxyribonucleic acid, or DNA). The wavelengths for optimum effectiveness correspond, as expected, to the maximum absorption spectrum for nucleic acids, between 250 and 265 nanometers (nm).[1]"

3.1. How UV Disinfection Works

Wastewater enters the channel. Once inside, it is exposed to UV light. The UV lamp used for germicidal disinfection produces a majority of its light in the 254-nm wavelength. At this wavelength, UV light damages the DNA of bacteria, protozoa, viruses, molds, algae and other microbes. This includes fecal coliform and such waterborne diseases as: E-coli, hepatitis, cholera, dysentery, typhoid fever as well as many others.



The actual lamps are housed in quartz sleeves (look like long test tubes). These sleeves not only help maintain maximum operating temperature, but also prevent the lamps from coming in contact with the water. These need to be cleaned on a regular basis.

While in the channel, the wastewater is exposed to doses of UV energy. Simply put, UV dose = lamp intensity multiplied by residence time. It is usually represented in microwatt seconds per square centimeter (mWs/cm2). Time is calculated as the hydraulic residence time in the UV system. The intensity is a function of the lamp type, the arrangement of lamps, the energy absorbing elements in the water that absorb or interfere with light before it reaches the targeted microorganism. The measurement of absorbing material is referred to as UV transmission (UVT). This is expressed as a %. Most plants average 65%.

[1] EPA Ultraviolet Disinfection Technology Assessment EPA 832-R-92-004 September 1992.

Transmission numbers change according to the plant process. For instance, a membrane or sand filter may provide 80% UV transmission.

Common doses for treating wastewater: 15,000 uWs/cm2 - 1,000/100ml, 30,000 uWs/cm2 - 200/100 ml, 45,000 - 125/100 ml, 60,000 uWs/cm2 - 23/100 ml and 100,000 uWs/cm2 - 2.2/100 ml.

Since the UV disinfection process does not add chemicals or change the physical or chemical properties of the effluent, the wastewater is ready for discharge when it leaves the system.

3.2. Advantages

There are many advantages to this type of disinfection: no need for toxic and expensive chemicals; fast treatment; low maintenance and simple and extremely low cost operation.

3.3. Applications and Limitations

While UV disinfection is well suited for wastewater treatment, it is important to monitor the water quality and system performance.

One must look for situations that inhibit UV light from penetrating the water. Turbidity – the state of water when it is cloudy from having sediment stirred up – will interfere with the transmission of UV energy and decrease the disinfection efficiency.

In cases where the water has high iron or manganese content, is cloudy or has other organic or chemical impurities, it may be necessary to improve the pre-treatment process or increase the UV dosage. Once this has been addressed, UV disinfection will be effective in destroying microorganisms.

The quality of the effluent entering UV system needs to be monitored. Effluent that is outside of the design parameters may cause permit violations, which can lead to fines.

Primary concerns relate to the UV transmittance **(UVT)** of the water and the Total Suspended Solids **(TSS)**. While turbidity can impact UV system efficiency, UVT and TSS are the primary measurements.

UVT is the measurement of UV absorbing materials in the water. The levels are determined by using a 254 nm spectrophotometer to compare distilled water (100%) to an effluent sample through a 1 cm path. Many plants average 65%, but higher and lower values are not uncommon. The UVT% measurement is one of the primary numbers used to design a system so it is of great importance to ensure that the plant operates within design parameters.

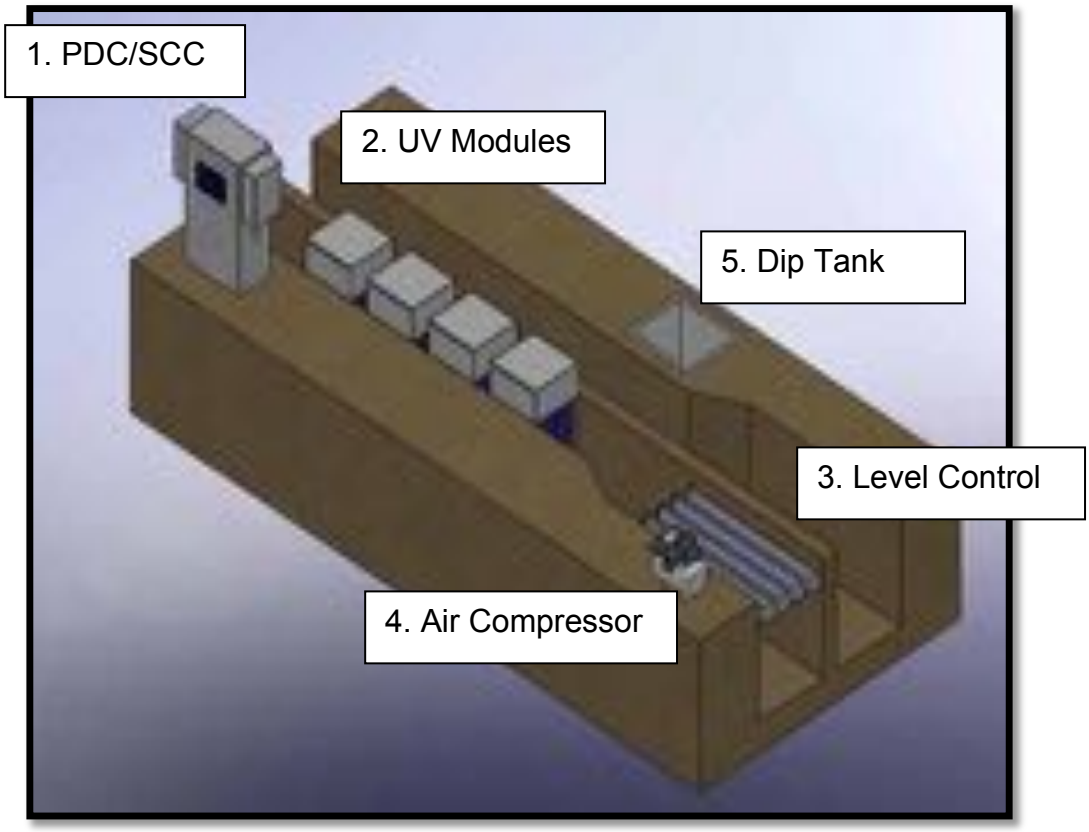
Changes in wastewater UVT can be due to industrial wastes, breakdown in upstream processes or high mineral content (iron).

TSS is the measurement of solids in the water that will interfere with the delivery of UV light. Most plants have to meet a certain permit level (i.e. 30 mg/l) in order to satisfy the discharge permit. The solids, which vary in size, not only prevent proper UV light transmission, but actually house pathogens. The TSS number is impacted by the upstream processes (filter, membrane, clarifiers, etc.).

In addition to the above issues, the UV system needs to be cleaned on a periodic basis based on effluent conditions.

4. About Vertically Oriented UV Disinfection Systems - Typical

System consists of the following main equipment: **1.** Power Distribution Center (PDC) / System Control Center (SCC), **2.** UV Modules with Modular Support Systems, **3.** Level Control Weir, **4.** Air Compressor for the automatic quartz cleaning system and optional equipment like **5.** Dip Tank.



4.1. Operational Overview

1. Protected power is brought to the Power Distribution Center (PDC)/ System Control Center. Power requirements vary from project to project. The PDC sometimes houses a Programmable Logic Control (PLC) system. The complexity of the PLC will vary from project to project. Basic controls take a flow signal from the plant and turn modules (1/2s) of modules on and off. More complex PLCs track lamps on an individual basis. Plant can take information from PLC and or UV meters and monitor remotely.

2. Modules connect to the PDC via multi pin wire harnesses. UV monitoring systems also connect directly from the module to the PDC. Air connections are included on the modules. Air is connected to these ports to operate the mechanical wiping system.

3. A level control weir (finger weir) keeps the water at a constant level regardless of flow. This keeps the lamps covered in water.

4. Lamps need to be changed approximately every year (14 months). This can be accomplished with the module in the channel.

5. Modules can be removed from the channel for inspection, additional cleaning (hose or dip tank) or off season storage.

4.2. UV Module

The UV Unit (Module) is comprised of the following major components: UV Module Box, Stand, Wiper, Ballasts, Quartz sleeves and UV Lamps. The UV Module Box houses the ballasts, instrumentation, and heatsink. The Stand supplies support to the Unit. Wipers are used to clean the quartz crystal sleeves. The lamps are arranged within the Unit, arrayed to provide the best contact time and dose of UV radiation. Quartz sleeves are used to protect the lamps and provide proper transmittance of radiation.

Typical Module

Note: Module top must be locked in place so that it does not fall on the operator*. *Modules are top heavy so be sure to protect workers and workspace.

4.3. Module Support Systems

The Module Support System (MSS) is designed to guide and support the UV Units. Once installed, the Module and MSS combined create the Reactor Module (Module). Process water is directed in the channel to the UV Module.

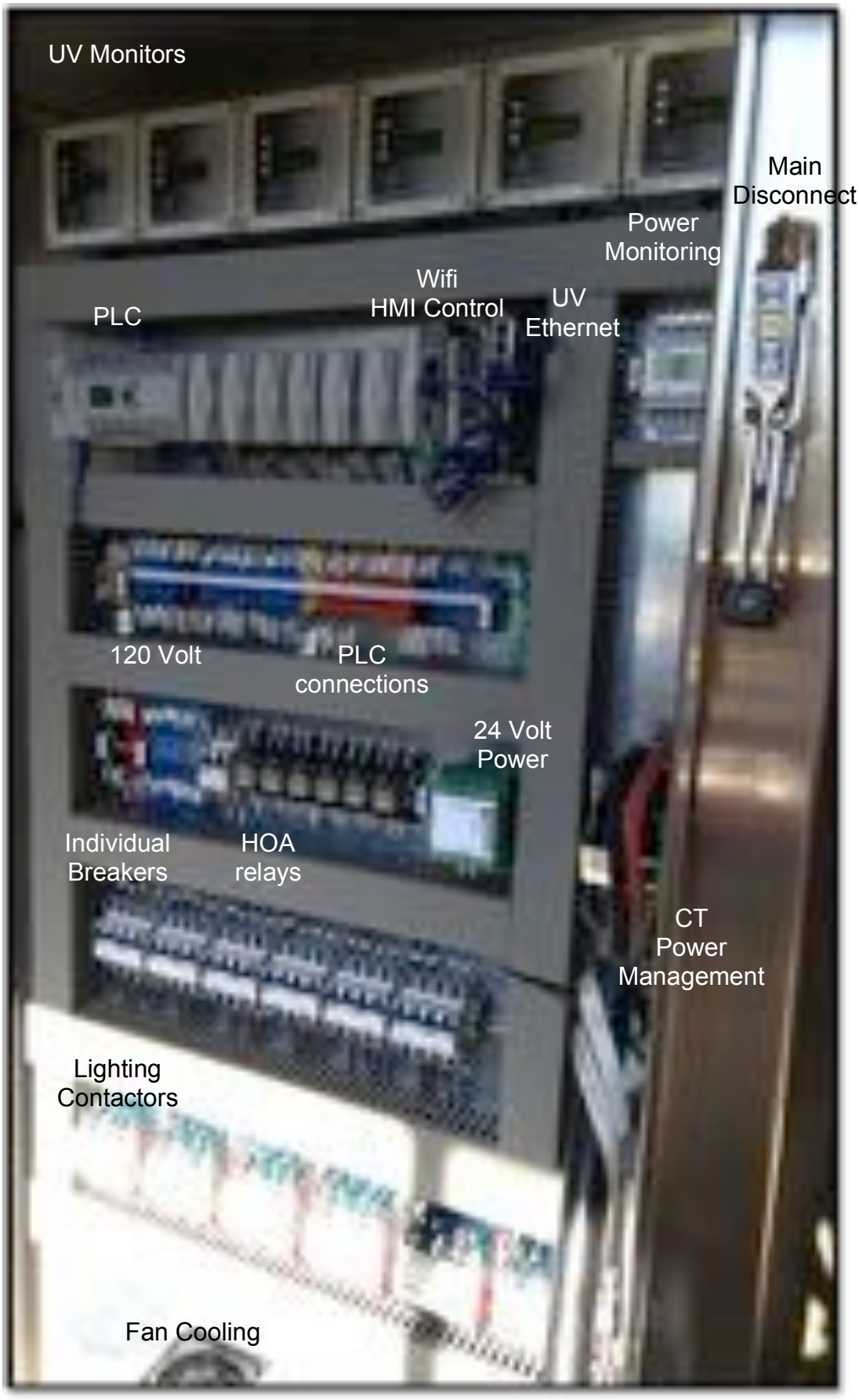
Channels shown without modules installed

4.4. Power Distribution Center / System Control Center (PDC/SCC)

Power Distribution Center (PDC) is designed to provide power to the modules and for controlling Lamp array Banks. Breakers and contactor are contained within the PDC/SCC.

The UV monitoring systems and Allen Bradley PLC are housed in the PDC and the OUI (operator user interface) will display operation for troubleshooting and control. The PLC O&M is attached.

Typical



Inside the PDC

4.4.1. Main Disconnect, Module Breakers and Contactors

The door handle engages the main breaker.

Breakers for Modules (1/2) Typical

4.5. PLC Hardware - TYPICAL

The PLC is supported and protected by the following internal devices:

Allen Bradley PLC, WiFi, UV Ethernet, Plant Ethernet

24 Volt Power Supply

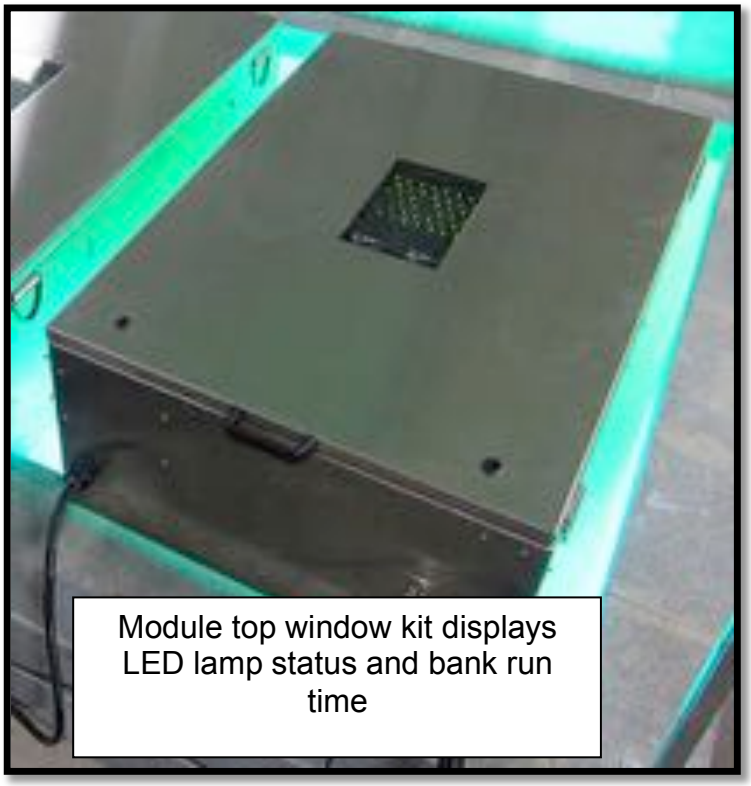
WiFi Connect

OUI

PLC Wiring Typical

4.6. Module's System Utilities

Each module connects to the PDC/SCC for Power, Data, low level and Air. The PDC needs to be located within connection distance. Measure first before placing PDC/SCC.



Module Connections and Low Level Connector

4.6.1. Low Level Float Switch (optional)

In some installations, there may be a connection for the low level float switch. The float switch will extinguish the lamps in the event of low level. This protects the lamps from burning in air and fouling the quartz sleeves.

5. Information to Know Prior to Installation

Your Vertical Ultraviolet (UV) wastewater disinfection system has been tested at Glasco UV's manufacturing facility. In order to ensure that you work safely and that the system works at optimum performance, please follow the instructions and recommendations outlined in this manual.

5.1. !Warnings!

UV light is extremely harmful to eyes and skin. Do not look directly at the light or expose your skin for any prolonged time. Use protective clothing and eyewear (UV resistant) when servicing equipment. Always disconnect power to your unit or module before servicing.

If accidentally exposed to UV light for an extended period, immediately seek medical attention.

When handling lamps and quartz, use gloves to prevent them from becoming dirty. If they do, wipe them with denatured alcohol. Oils, dirt and scratches will block UV light.

When installing the quartz sleeves and O-rings, be careful not to crack the quartz. The broken glass-like material is sharp and can cause serious injuries and or death. In addition, do not use tools to tighten the compression nuts – only hand-tighten.

5.2. UV Effectiveness

Your disinfection system needs to be maintained. We recommend that you change the lamp yearly and change the quartz every three to five years.

We also recommend a quartz-cleaning schedule to maintain system effectiveness. Operators can use cleaning agents such as Lime Away or a citric acid to remove build-up on the quartz sleeve.

Fouled or scratched quartz sleeves **will** lead to higher fecal counts.

Failure to do periodic maintenance **will** impact your unit's effectiveness.

5.3. System Design

Your UV system has been designed based on certain information regarding plant-operating conditions. All changes in plant conditions will impact the UV system.

Since plant operating conditions are subject to change, please insure that all significant changes to flow rates (minimum, average and maximum), transmission or total suspended solids are brought to your representative's or Glasco ' attention.

5.4. Plant Design Information

Design Criteria:

1. Peak flow: 14.0 US MGD
2. Average flow Max Month: 5
3. Total Suspended Solids: 30 mg/l
4. Effluent temperature range: 45 to 80 F (0.5 to 29 C)
5. End of lamp life: 9,000 hours (90% output of new lamp)
6. UV Transmittance at 254 nm: 65%
7. Maximum mean particle size: 30 microns
8. Maximum weight of module: <1000 lbs
9. Number of UV channels: 1 with 6 modules
10. Minimum UV dose: 30 mJ/cm2
11. Effluent standard to be achieved <126 per 100 ml fecal coliform on a 30-day geometric mean of daily samples and sampling location immediately downstream of the UV reactor.

5.5. Electrical Requirements

The electronics have been designed to work with a variety of power supplies. Since the unit is susceptible to power fluctuations, we recommend that the system be kept off any lines where there are surges. This includes pumps or motors. If there are fluctuations, please use a surge suppressor.

 All ballasts will be labeled indicating the required power. Unlike pumps or motors, your UV disinfection system is sensitive to spikes. If the plant uses a back up generator, please ensure that the UV system is powered off before starting or stopping generator. Dips or spikes can damage the ballasts.

5.6. Inspection

Insure that lamps and quartz have not been broken. It is recommended that you use gloves when handling lamps and quartz sleeves to prevent them from becoming dirty.

A warranty has been included. Please fill out the warranty and send back to manufacturer or dealer.

5.7. UV Lamp Disposal

UV lamps need to be recycled like fluorescent lamps because they contain mercury. Please follow your local recycling laws. Please visit www.lamprecycle.org to find a recycler in your area. In the event that you are unable to find a disposal location, please contact manufacturer's representative.

6. EQUIPMENT OVERVIEW

Glasco UV's has provided a **vertical** ultraviolet (UV) channel wastewater disinfection system with an air driven automatic quartz cleaning system for treating effluent with the characteristics provided previously.

Typical Plant Layout

7. SYSTEM COMPONENTS

You will have received the following components:

Self-cleaning vertical module. Each module contains: one UV monitor, automatic wiping system, integral ballast cooling system and leg mounted electronic ballasts.

UV modular support systems including cradle and docking station to attach to the concrete channel.

Power Distribution Center (PDC) / System Control Center (SCC)

Stainless steel level control system

Air compressor for automatic quartz cleaning system

*Inspect all parts to insure that they have arrived complete and undamaged.

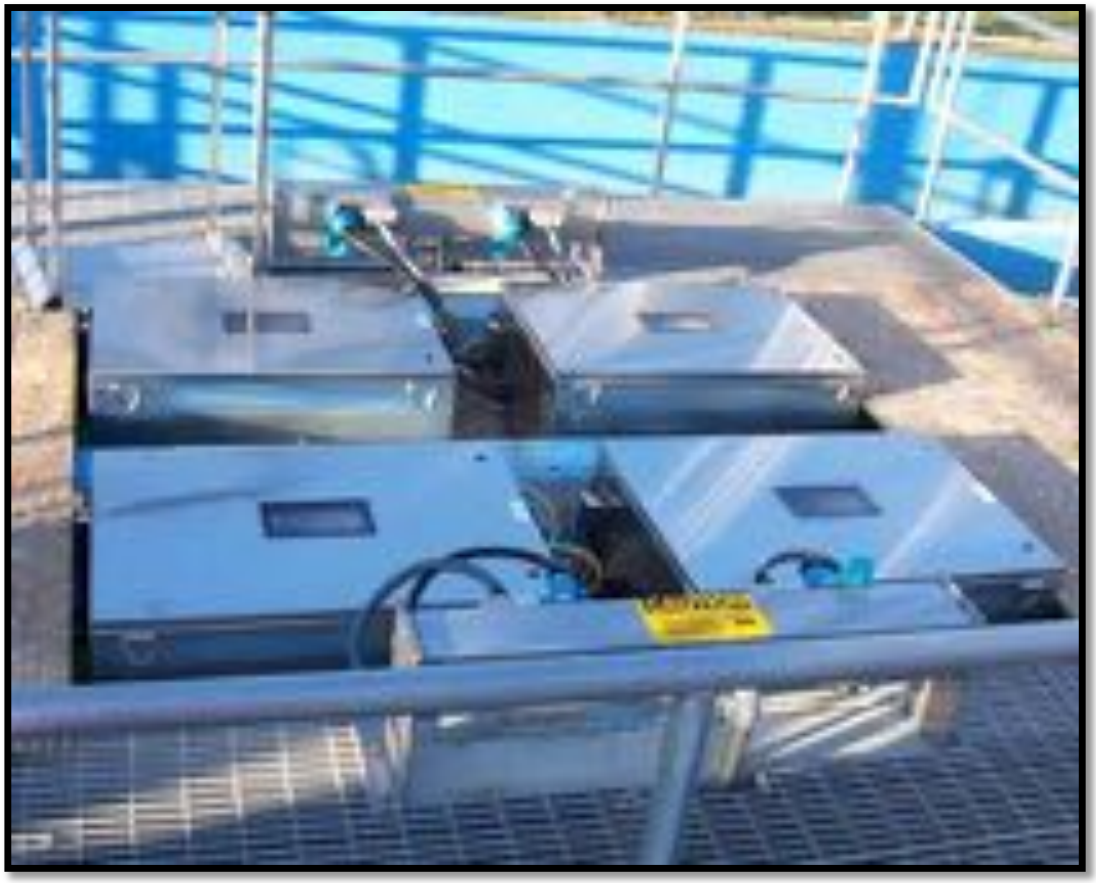


Photo of Vertical Installation

8. START UP PREPARATION (Understanding Operation)

Prior to introducing wastewater in the UV Disinfection System, installation and checkout of all equipment is necessary. When the installation phase of the project is completed, the checkout phase begins.

To ensure that the system is ready for start-up, mechanical and electrical check out of the system shall include (as applicable) completion of the Commissioning and Start-Up Check Lists.

Please provide at least three (3) weeks advance notice prior to actual startup and technical advisory. Contact Glasco UV to schedule a service technician.

Operators must study this entire section as well as be intimately familiar with the operating information presented in the Sequence of Operations before attempting to operate this system.

The startup and operation of the water treatment equipment involves the use of Ultraviolet Radiation.

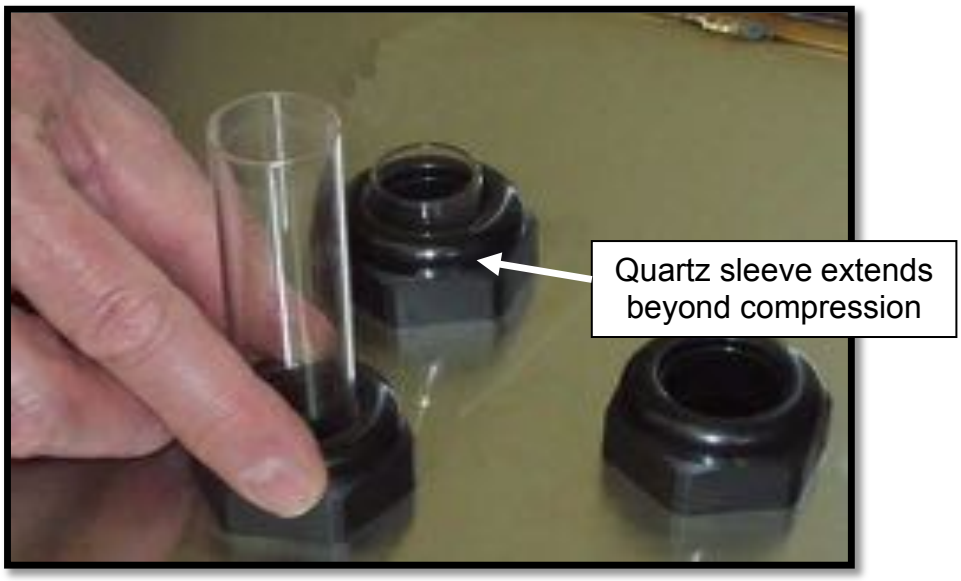
Operators must read and understand Safety Precautions **before** operating this equipment.

8.1. Primary Start Up (Installing Quartz and Lamps)

8.1.1. Quartz Sleeve Installation (Sleeves may have been supplied pre installed)

Loosen the black compression nut, but do not remove it from the nipple. Insert the domed end of the sleeve into the compression fitting. Lubricate the sleeves, wiper rings and bottom grommet plate with clean water (spray with a hose). This allows the sleeve to pass through the wiper rings without dragging on the dry rubber wiper rings and sit firmly in place in the lower grommet.

Once the domed end is resting in the grommet plate located in the module base, hand-tighten the compression fitting providing a watertight seal. Be careful not to crack the quartz sleeves during installation. In addition, do not use tools to tighten the compression nuts – only hand-tighten.



8.1.2. UV Lamp Installation

Take the lamp and hold the wire leads. Insert the lamp into the quartz sleeve pin socket end up. Using the wire harness, slowly and gently lower the lamp until it sits in the bottom of the quartz.

Lamp in Quartz Sleeve

Plug in lamp connector

Once resting in the sleeve, plug connector into bus bar. These bus bars are movable to help in lamps installation.

8.2. GENERAL OPERATING INFORMATION

During startup and normal operation, operators should refer to the project drawings for information on Equipment and instrument locations.

Ensure the Disinfection Treatment System has been installed in accordance to manual.

All process specifications must be maintained within the design specifications listed. The equipment upstream and downstream of the UV Disinfection Treatment System must be able to produce or handle the influent and effluent process stream listed.

Operators are responsible for sampling and testing the system process stream, as required.

Routine maintenance and repair of the system should be performed in accordance with the instructions in this manual and the vendor literature manuals.

8.2.1. SYSTEM SETPOINTS (PLC based)

Reference the set points included in the latest revision of the Sequence of Operations. These set points should be verified during startup and may change based on changes in the Design Basis, the influent stream composition, testing mode, or operational history. All changes made to the set points should be recorded.

8.2.2. PRE-TREATEMENT CHECKLIST

This subsection is intended to provide the operator with a general pre-treatment checklist prior to start-up, servicing, and/or operation of the UV Disinfection Treatment System. As the operator gains experience with the system, additional items may be added.

NOTE *This list is not intended to be all-inclusive but identifies critical items, which require checking.*

Wear proper personnel protective clothing and equipment.

Be aware of all safety hazards (physical and chemical). Read section on Safety Precautions carefully prior to system start-up and operation.

- Ensure Channel is clear of any debris and oils that may damage or affect UV Lamps.
- Ensure all elevation dimensions for weirs and UV equipment are correct per Layout Drawings.
- Ensure UV Lamps and quartz are accounted for and ready for installation
- Ensure wipers are unrestricted from motion.
- Ensure all manual valves are in their correct system operating positions.
- Ensure that all system control panels are closed.
- Ensure all utility flow, temperature, and pressure requirements are met.
- Ensure proper power is provided to all system equipment and panels.
- Ensure all set points are properly set according to the information provided in the Sequence of Operation.

- Ensure that the PLC is fully functional and communicating with the field installed instrumentation, local control panels, and plant DCS.

Once this preliminary checklist has been verified, the system is ready for start-up, maintenance, or operation. It is recommended that the operator initially become familiar with the system by locating the various controls and valves and becoming familiar with equipment.

8.3. SYSTEM STARTUP General Start-Up Procedures

This subsection presents the general operational procedures for the Ultraviolet Disinfection System.

These procedures are designed to simplify start-up and shutdown procedures to enable the operator to devote the majority of the time observing and recording system performance and key parameters for disinfection treatment.

- Make sure all of the commissioning procedures have been completed.
- Make sure that all fuses are installed in the control panels.
- Calibrate all of the instruments on the system using the instructions in the Vendor Literature

Manuals and Sequence of Operation.

- Ensure that all utilities have been provided.

8.3.1. Manual Valve Status

Prior to system startup, all manual valves should be checked to ensure correct position. Valves in the system can generally be grouped into “type” based on function. These types of valves and their startup position follow. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist. Normal operating positions for each manual valve is provided on the P&I Diagrams. The operator should reference these drawings in addition to this list when placing the valves in their correct position.

Manual Sampling valves	CLOSED
Drain valves	CLOSED
Bypass valves	CLOSED
Main Process valves	OPEN
Utility Supply valves	OPEN
Instrument Isolation valves	OPEN

8.3.2. System Startup Sequence

Prior to initiating the system startup sequence, the various system components and equipment shall be placed in the proper operating mode. Generally, all system equipment switches shall be selected to AUTO.

The initial startup of the UV Disinfection System will be conducted by operators under Glasco direction and supervision. Glasco will provide supervision during the day shift only. Glasco will provide written instructions for the night shift operators. Glasco Startup personnel will remain available by phone during night operations.

Recommended UV Disinfection Treatment System Startup procedures are as follows:

- Once all necessary inspections and commissioning procedures have been completed, the UV Disinfection Treatment System can be started and operated as described in this section.

- Operators must study this entire section before attempting to operate the system.

Operators must read and understand Safety Precautions and all associated O&M Equipment safety documentation before operating this equipment.

Contact with electricity can cause burns, cardiovascular failure, or death. Follow the precautions given in manual concerning electricity.

Calibrate all instruments in the system using the instructions in the O&M manual vendor literature.

8.3.3. Utility Systems

- Verify that the compressed air pressure is between 40 and 65 psig.
- Verify all electrical systems are fully operational, safe, and match requirement per single line diagrams.

8.3.4. Compressed Air System

- Read the manufacturer's literature for the Compressed Air System Equipment.
- Read the manufacturer's literature for the In-Line Air Dryer.
- Read the manufacturer's literature for the In-Line Pressure Regulator.
- Confirm the manual valves are in the correct position per the P&I Diagrams.
- Confirm Pressure regulator set point is in the correct position per the P&I Diagrams.

8.3.5. UV Modules

- Confirm all UV Module are installed properly.
- Confirm location of Communication and Power cables per General Layout Drawing.

8.3.6. Verify Connection of all Communication/Power cables Module(s) to Wiretray(s).

- Verify SCC HOA Switch to OFF.
- Fill Channel with process water until low level alarm is OFF.
- Install UV Quartz Sleeves and Lamps.
- Verify UV Box Lids are locked.
- Connect Communication Cables to corresponding location per General Layout Drawing.
- **Connect Power Wire to corresponding location per General Layout Drawing.**
- Place the Lead UV Units required in AUTO/START and the backup in the STANDBY position at the PLC OIT.

8.3.7. UV Module Wiper

- Verify Setpoints match those listed in the Sequence of Operation and the PLC OIT.
- Manually Cycle one Wiper to ensure no restrictions in wiper sequence.

8.4. SYSTEM RESTART AFTER A STANDBY SHUTDOWN

The procedures and Operator observations after a short term shutdown proceed in the same order and steps as the initial startup procedures described in with the following exceptions:

The Operator should simply observe the operation of this equipment for any abnormal conditions.

8.5. SHORT TERM AND LONG TERM SHUTDOWN

The purpose of this subsection is to provide general information for short term and long term shutdown of the UV Disinfection Treatment system. In addition to the steps provided below, additional steps may be required for complete shutdown of the system such as diversion of

wastewater flow and shutdown of required utilities. In addition, reference should be made to the vendor literature for specific and detailed shutdown procedures.

8.5.1. Short Term Shutdown

- Short term shutdown as described in this section is defined as lasting anywhere from several hours to two days (such as over a weekend).
- In preparation for a short term shutdown, stop all incoming flows to the UV Channel.
- Force wipe each Bank within the channel by selecting the WIPE pushbutton in the OIT.
- Channels should be drained as far as the low level alarm. Once drained to this level, ensure drain valve is in the CLOSED position. UV Units should remain ON until such time that the low level alarms turns them OFF.
- Place the HOA switch to the OFF Position at this time. The UV Modules should be shut down in the same sequence as the startup procedures described.
- During the system short term shut down, all manual valves should be checked to Ensure correct position. Valves in the system can generally be grouped into “type” based on function. These types of valves and their short term shut down position follow. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Manual Sampling valves	CLOSED
Drain valves	CLOSED
Bypass valves	CLOSED
Main Process valves	CLOSED
Main Utility Supply valves	CLOSED
Instrument Isolation valves	CLOSED

- During the system short term shut down, equipment should be set in the following operational mode. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Air Compressor	OFF
UV Units	OFF

8.5.2. Long Term Shutdown

- Long term shutdown as described in this section is defined as a period of time where the intent is to leave the WWTP system out of service due to plant maintenance requirements or lack of treatable product.

- In preparation for a long term shutdown, stop all incoming flows to the UV Channel.

- Force wipe each Bank within the channel by selecting the WIPE pushbutton in the OIT.

- Open Drain Valve to completely drain the Channel(s). UV Units should remain ON until such time that the low level alarms turns them OFF.

- Place the HOA switch to the OFF Position at this time. The UV Modules should be shut down in the same sequence as the startup procedures.

- During the system long term shut down, all manual valves should be checked to ensure

correct position. Valves in the system can generally be grouped into “type” based on function. These types of valves and their short term shut down position follow. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Manual Sampling valves	CLOSED
Drain valves	CLOSED
Bypass valves	CLOSED
Main Process valves	CLOSED
Main Utility Supply valves	CLOSED
Instrument Isolation valves	CLOSED

- During the system long term shut down, equipment should be set in the following operational mode. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Air Compressor	OFF
UV Units	OFF

9. MAINTENANCE AND TROUBLESHOOTING

While the UV Disinfection Treatment System does not require a great deal of routine or periodic servicing, certain maintenance procedures are required to guarantee continued satisfactory operation. Listed in this section are components that may be used with this system and the general inspection and maintenance procedures to be adhered to.

Because of the complexity of many of the instruments and mechanical components used with this system, no attempt is made here to give specific instructions for maintenance or repairs of these components. The purpose of this section is to alert operators and maintenance workers of general areas where maintenance is required.

For specific and detailed maintenance procedures for vendor components, refer to the Vendor Literature.

If an approved plant-maintenance schedule exists and is followed regularly, such a schedule may be used as a substitute for many of the maintenance procedures given in the vendor literature.

NOTE *ANY PLANT-MAINTENANCE SCHEDULES AND PROCEDURES MUST, HOWEVER, EQUAL OR EXCEED THOSE RECOMMENDED BY THE INDIVIDUAL COMPONENT MANUFACTURERS.*

Unless an approved plant-maintenance schedule exists, be certain to follow the maintenance schedules recommended by the individual component manufacturers

Most maintenance procedures for the equipment can be performed using common hand tools and plumbing equipment; any special tools required for individual components must be obtained from the component manufacturers.

9.1. GENERAL MAINTENANCE GUIDELINES

- Before working on any of the components and equipment used with this system, workers must read and understand the safety-related material given in this manual.
- Maintenance procedures should be performed only by experienced technicians or maintenance workers who are familiar with the types of components and equipment used with this system.
- Operators and workers must use extreme caution when performing maintenance on vessels and other equipment. All appropriate measures must be taken to prevent falls and other accidents during maintenance procedures.

Use extreme caution when working around UV Equipment. Valve handles, pipes, and other protruding components can cause severe injury to body parts that strike them. Workers should wear UV protection, hard hats, and safety glasses and should move cautiously when working above or under piping and the equipment.

When accessing equipment above the operator's normal reach, use safe, approved ladders and/or lifting devices to reach the required areas.

Lanyards and spotters must also be used when necessary.

Use extreme caution when removing heavy UV Units from Mounting Cradles. Use supplied Spreader Bar to properly remove the UV Units.

- Before attempting to perform maintenance on system components and equipment, and especially when attempting to disassemble individual components, workers must be certain that the components are isolated from pressure, fluids, and electricity.

- Pressure-loaded devices, such as pneumatic wipers and solenoids, should be in their “relaxed” discharged state-- that is, with no compression on the piston cylinder-- to avoid the sudden and accidental motion of individual parts.

Pressure-loaded system can cause severe bodily injury if the pressure is released accidentally

- An accidental and sudden release of pressure or fluid, accidental contact with energized electrical components, or the sudden movement of equipment parts during maintenance procedures can result in severe injury to workers.

- Workers must use extreme caution when servicing automatically-controlled components of this system. Sudden and unexpected operation of components being serviced can cause severe injury to the workers involved.

- Before working on automatically-controlled components, make sure that the automatic controller is disabled to the point that it can not be used to operate remote components. Also, inform other operators and control room workers of repairs or servicing in progress.

Accidental operation of automatic components can cause equipment damage and operator injury or death

- If controller programming or program modification is being performed while system components are being serviced, disconnect the controller outputs or the individual component tubing or wiring to avoid accidental operation of those components.

- Workers who perform maintenance on the components and equipment used with this system should read and follow all instructions and procedures given in the Equipment Reference Literature.

9.1.1. MISC. COMPONENT MAINTENANCE

1. Weirs

Level control weirs are installed and then they do their job. Unfortunately, the fingers can collect debris and if water is left to sit, can be a problem spot for microorganism growth. In many cases where the flow is zero, water will sit in the fingers. This water, which does have some microorganism content, can breed pathogens. The light from the sun or the far reaching light from the actual UV channel will help their growth.

Keep these fingers clean by draining them and periodically chemically cleaning them with chlorine.

2. Piping

The pneumatic piping on the UV system vessels is to be 316 SS. If the system is operated within the temperature and pressure limitations given in this manual, little or no maintenance is required. (All pipes were design to correspond with ASME B31.1 Power Piping Codes.)

3. Solenoid Valves (automatic wiping)

Automatic control solenoid valves should provide years of trouble-free service. Approximately every six (6) months, the valves should be pressure tested to check for leakage. If leakage is found, adjustment or repair must be made following the valve manufacturer's instructions.

Follow lubrication schedule according to the manufacturer's instructions or during regular plant maintenance.

4. Hand Valves

All hand valves should be operated through their full range occasionally to be certain that they operate freely and are not stuck.

Occasional full-range operation of hand valves also helps break loose and remove any foreign material that may collect around internal valve components.

Hand valves should be lubricated regularly if lubrication points were provided by the manufacturer.

5. Pressure Regulators

Pressure regulators should be checked periodically to be sure that they are set properly.

When an air regulator uses a water or sludge trap, the trap drain valve should be opened (or drain plug removed) to drain the trap on a regular basis.

NOTE *If a regulator uses a threaded plug as a drain instead of a needle valve, shut off the air supply to the regulator before draining the regulator trap*

6. Air Dryers

In-line air Dryers should be checked periodically to be sure that they are set properly.

When desiccant trap is full, the trap drain valve should be opened (or drain plug removed) to drain the trap on a regular basis.

NOTE *If a dryer uses a threaded plug as a drain instead of a needle valve, shut off the air supply to the dryer before draining the regulator trap*

7. Leak Checking

Operators should, at all times, be alert for leaking pipes, valves, or other system components. Detecting and repairing a leak, when it is still small, may prevent lengthy downtime later and limit the duration and size of spills.

Leaks at chemical holding tanks can cause equipment damage and operator injury

8. Process Controller

No regular maintenance should be required for automatic process controllers. The controllers and panels should, however, be kept dry, cool and clean at all times.

9. Electrical Enclosures

Electrical enclosures must be checked occasionally to be sure that the doors are closed tightly and are latched or fastened properly. Water and other fluids must not enter the enclosures.

Sparks from components in control enclosures can cause explosions in hazardous atmospheres. If explosion-proof enclosures are used with this system, extra caution must be used when working with the enclosures

Be certain that all power is removed from an explosion-proof enclosure before opening it. If the enclosure is equipped with a power-door interlock, check the interlock occasionally to be sure it functions properly.

If purge-type enclosures or panel cooling systems are used with this system, be certain that the equipment is installed correctly and is operating properly.

10. Instrumentation

For maintenance, trouble-shooting, and calibration of process instruments, see the

Equipment Reference Data Books.

Sensing elements (cells) should be inspected and cleaned on a regular (scheduled) basis. Dirty or contaminated sensing elements can cause inaccurate or incorrect instrument readings.

NOTE *Many analytical instruments require special cleaning and maintenance procedures. Refer to the Equipment Reference Literature for information on these procedures.*

11. Level

Level switches and contacts must be checked and recalibrated periodically. Depending on the amount of contaminants in the feed stream, these devices may also require occasional cleaning to maintain proper operation.

12. Pressure Gauges

These require no maintenance other than making a replacement should a failure occur. Check the gauges every six (6) months against a reference gauge of known accuracy to determine accuracy.

Where diaphragm-type chemical seals are used with the gauges on this system, inaccurate gauge readings can be caused by a loss of fluid from the seal unit. Operators should be alert for leaks around the mating surfaces of the seal unit and at the gauge threads.

Maintenance workers should not disassemble a seal/gauge assembly during operation. Proper safety must be followed in ensuring no pressure is available to gauge during disassembly or removal.

13. Control Panel Maintenance

Very little maintenance is required for control panels and their components. The following is a list of general guidelines for operators to use while operating and maintaining control panels. Operators must be certain the operating conditions for microprocessor controllers are within the ranges listed in the component manuals.

Panel heaters, blowers, and coolers must be operated when necessary to protect the controller from excessive moisture and heat. As a general rule, blowers should be left on at all times. Heaters (if provided) are used as necessary to maintain the panel-interior temperatures at 75-80 deg. F.

Electric panel heaters can cause ignition of combustible materials

Do not allow combustible materials to fall or lay on electric heaters. The controllers must be

properly grounded and protected from the possibility of static-electricity discharges. Operators must monitor the condition of any controller backup battery and must replace it when necessary. Control panel doors must be kept closed at all times to prevent excessive dirt or dust from collecting inside the panel.

Check any air inlet and outlet ports at least once a week and clean them when necessary.

Do not place any items in front of air intakes that will block the free movement of air

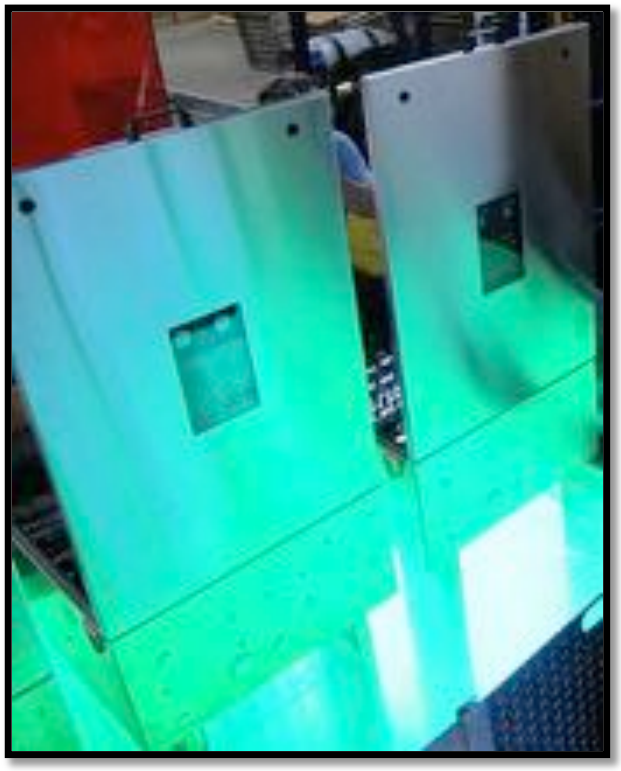
UV Box Lid must be kept closed at all times to prevent excessive dirt, dust, and moisture from collecting inside.

9.2. UV MODULE IN CHANNEL SERVICING

The UV module will require maintenance while in the channel. Prior to maintenance, power down module as per instructions in this manual. The UV module contains the UV ballasts and many items that are critical for proper system operation.

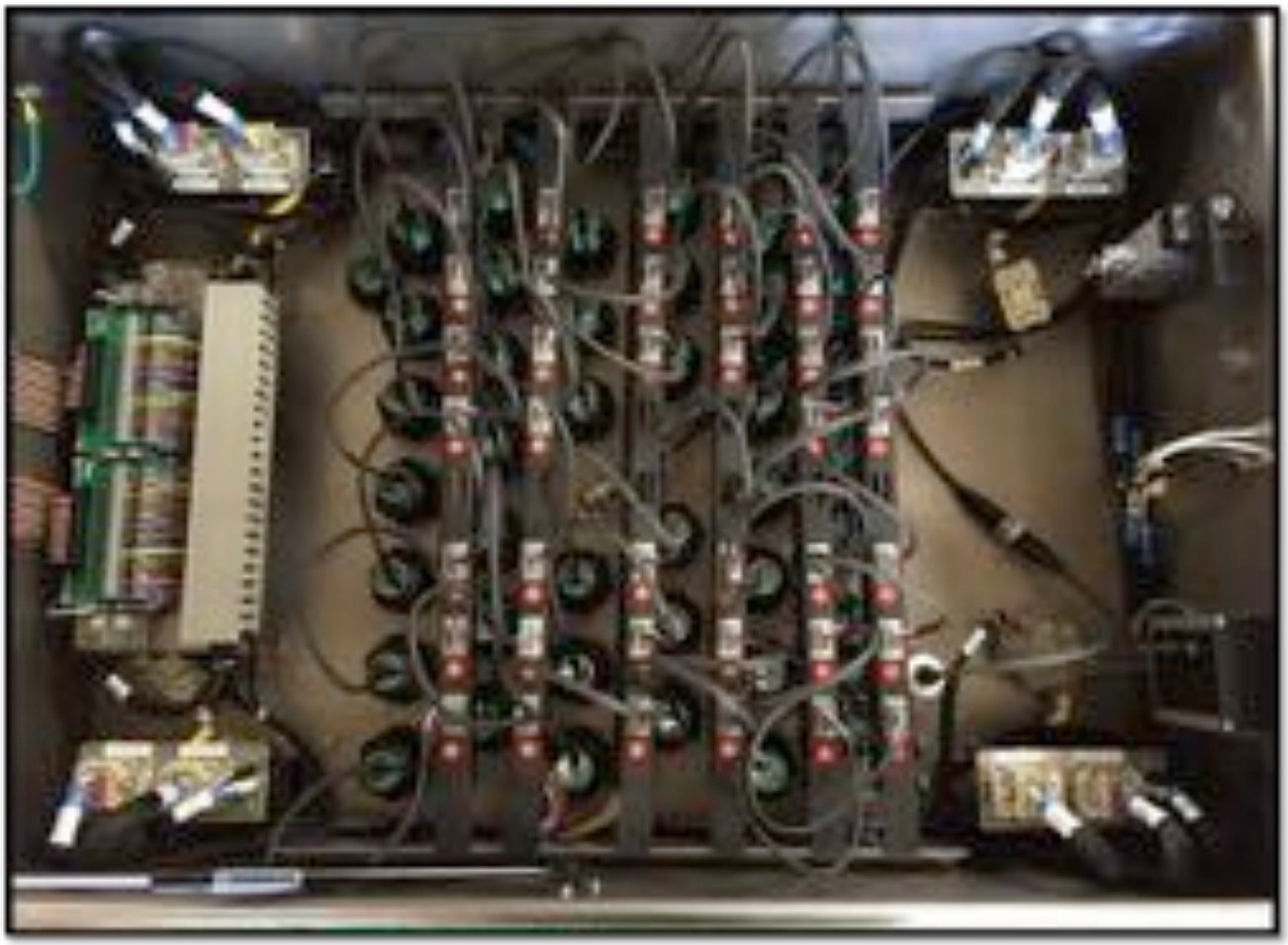
In order to keep the ballasts working at optimum performance, the ballasts need to be cooled. Glasco accomplishes this by installing the ballasts on trays into the module's legs. In the top enclosure, a de-humidifier works to remove moisture.

The ballasts are located on heat sinks which are in the legs. This system transfers the ballast heat into the legs of the module. This process uses the passing channel wastewater to dissipate the heat. The advantage of this system over fan cooling is that the modules are resistant to water infiltration.



Module with lid open and supported

Once opened and lifted, the operator will have access to the ballasts, lamps, wiper controls and UV sensor. Make sure that the lid is supported and locked. The lid is heavy and if it falls, it can cause serious injury.



Inside the UV module, you have access to the quartz sleeves and UV lamps, ballasts (in the legs of the module), the UV sensor, the wiper solenoid, the dehumidifier and various UV lamp status wiring.

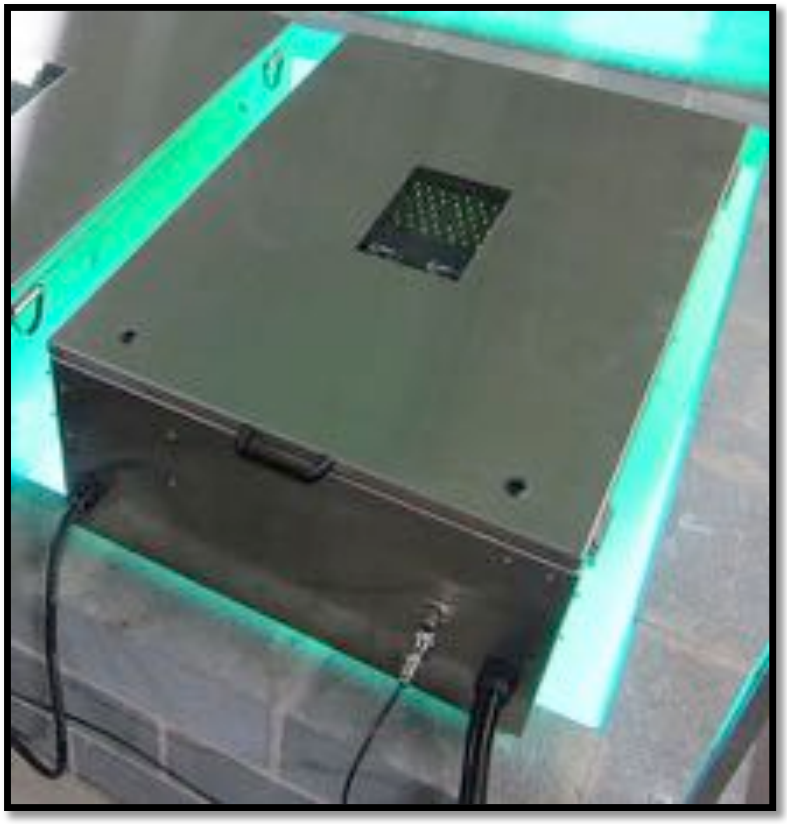
9.3. BALLAST MAINTENANCE AND REMOVAL

In order to remove the ballasts for inspection or maintenance, you will need to safely power down the system. The ballasts are easily removable from the legs. Simple disconnects allow the operator to remove the ballast tray for maintenance. Wiring diagrams are provided.

Power down. Pull to remove connectors.

Power down. Pull to remove LED connectors.

9.4. LAMP STATUS AND RUN TIME



The system allows operators to check status through the window kit on the module's top. LEDs show lamp status. Green indicates they are operating. Each ½ of the module also has a corresponding running time meter. These help operators track the run time.

9.5. UV MONITORING

UV intensity will be displayed on PLC as well as in the UV meter in PDC. The monitor measures the relative average intensity of an array of lamps. The attached sensor and monitor instructions will show you how to calibrate and use monitor. If the intensity unexpectedly falls off, the lamps should be checked to see if the sleeves need additional cleaning, that the effluent conditions have changed or the lamps need to be replaced.

The system has been factory calibrated, but may need to be re-calibrated. If you experience a problem, use the following procedures to re-install or re-calibrate the system. The sensor is located in its own dedicated quartz sleeve.

Note: calibration should be made with new UV lamps and clean quartz sleeves and should be done while water is in the channel.

UV Monitor Resides in the PDC

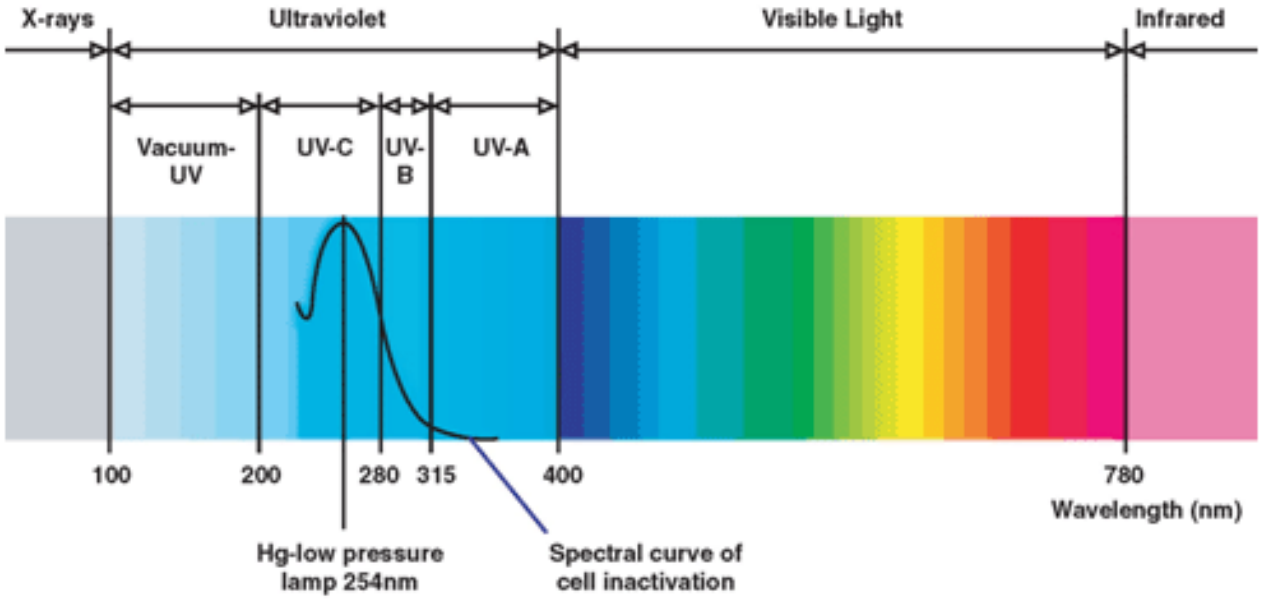
Ultraviolet (UV) Monitoring System
UVM-1624

Type: Digital 0-100%
Applications: Water / Wastewater
Components: UV Meter
Sensors: Various available

Theory of Operation

A UV monitoring system is designed to provide the relative UV output of a lamp. The system provides a representative overview of how the lamps are performing. Low readings may indicate that the lamp is coming to the end of life, that the quartz sleeve is dirty, that the sensor window is dirty or that there has been a change to the transmission of the wastewater.

The monitoring package is a true ultraviolet (UV) sensing system. It senses only the germicidal energy spectrum as shown on the following chart. Unlike light sensors, which register any wavelength including daylight, this is a precision instrument designed to work on a particular wavelength.



Standard low-pressure lamps produce close to 95% of its light in the 254-nanometer range. The sensor head contains a quartz-filtering device that blocks all wavelengths except those required for the destruction of microorganisms.

Alarming Capabilities

The UV monitoring system provides a 4-20 mA output.

Operation

ELECTRIC SHOCK. Indicates risk of electrical shock, which may cause serious injury and or death. While the UV monitor is a 24 Volt device, you will be working with UV lamps and water and we recommend being careful.

1. The meter face provides an “ENTER” button as well as an “UP ARROW” and a “DOWN ARROW”. The UVM-1624 is a 24 volt UV monitor. It can displays relative UV output (0-100%) or absolute UV output (W/m2). It also will display run time.

2. The UVM-1624 UV monitoring system has been factory calibrated. You will find, however, that it is necessary to Re-Calibrate it once the system is in use.

3. Factory Presets (editable):
    a. Low UV warning at 70%
    b. Low UV alarm at 50%
    c. End value 110% (limits the percentage that the UV monitor can display)

4. Recalibration *must* occur whenever a lamp change is performed (new lamp) and with the water in the system.

   a. Press and hold ENTER to enter settings menus.

   b. Press ENTER repeatedly to see a list of user definable fields.

   c. The re-calibration function focuses on finding the sensor input screen. By pressing the enter button, you will cycle through the various functions.

   d. Hit enter until “sensor input signal” is shown to be PHOTODIODE is confirmed to be set. If it is not, use UP and DOWN to select PHOTODIODE. (depending of the type of unit you have purchased) Your unit is equipped with a PHOTODIODE or a DIGITAL sensor your monitor will have a label on its face indicating which of the two you have to select at this stage.

   e. Press ENTER and you will see the end value (%). We recommend setting to 100%. To adjust, use the up and down arrows. Once selected, hit enter.

   f. You will be brought to another function screen. The Adjust screen also you to confirm your changed settings. Toggle to Yes or No and hit Enter.

   g. The UV meter will read “scanning” and it will confirm the new settings. Once scanned, hit enter to get to the next function.

   h. The next functions will allow the user to select Alarm and Pre Alarms at certain %. Once entered, you will be brought to another screen “CONFIG”.

   i. Simply allow it to run and it will set the system.

The UV Monitor can be a standalone product or can be located in a Ballast Control Center. When performing re-calibration or other trouble shooting operations, please be careful as UV system operates at 120 volts or 230 volts.

Programmable Functions

There are many settings that can be programmed into your UVM-1624.

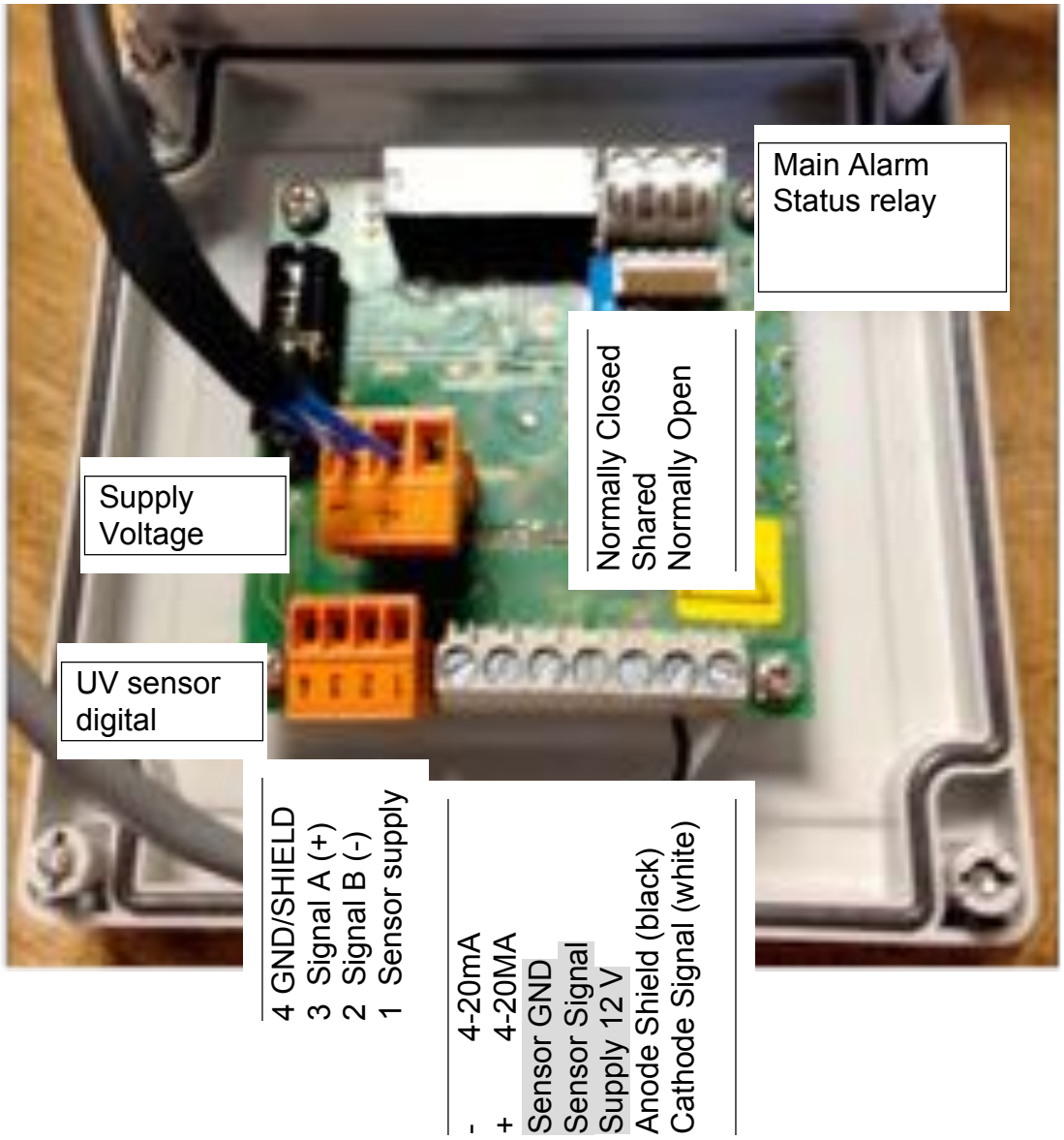
Basic settings: language, date, time, lock code and display contrast.

Operation settings: start up delay, lamp replacement time.

Settings: sensor type, measurement unit, reference value, alarm setpoints

Statistics: on/off cycles, lamp hours and total monitor operation hours

Utilities



The UV monitor allows the end user to use various sensors. It also allows for the end user to take a signal (4-20mA) or dry contacts for remote monitoring.

TECHNICAL

Supply Voltage	24V DC, 1 W
Operating Temperature	max 45C (113F)
Ambient Temperature	0-40 C (32-104F)
Running time of clock battery	8 years
Operating Status	LCD – 2 line alpha numeric
Status LCD Colors	Green, Yellow, Red
Languages available	English, Germany, French

The UV sensor comes with a complete assembly. This is comprised of the UV sensor, a stainless steel rod, a Teflon holder and a 2-pin connection. The assembly can be ordered as a complete package or if more suitable, a replacement sensor can be supplied.

Sensor Probe Assembly

9.6. UV MODULE OUT OF CHANNEL SERVICING

Servicing the UV Unit for cleaning will require the use of a spreader bar.

- Manually force wipe the UV Unit ready for cleaning by selecting the pushbutton in the OIT screen or force wipe at the solenoid in the module.
- Shut down the UV Unit Bank by first running the Sequence for the Secondary Bank to run.
- Once Lamps for the UV Unit shut off, place the HOA switch for the relative Bank in the OFF position.
- Let UV lamps cool down
- Position the Spreader bar above the UV Unit to match lifting hinges.
- Slowly remove UV Unit to halfway position in Cradle.
- Disconnect the Power and Communication cable and attach to the top of UV Box.
- Close isolation valve for air piping and disconnect tubing to UV Box.
- Completely lift the UV Unit from the Channel and hose down (DO NOT use pressure washer as pressure may break the Quartz Sleeves).
- Position and carefully lower the UV Unit.

9.6.1. UV Lamp Maintenance

No maintenance is required for UV Lamps during operation. Only during replacement should UV Lamps be properly installed and verified to ensure lamps are clean and installed properly. Gloves should always be worn when handling UV Lamps.

Take the lamp and hold the end with the pins. Insert the lamp into the quartz sleeve pin socket end up. When the lamp- end extends a few inches above the quartz sleeve, you will need to attach the socket. Using the wire harness, slowly and gently lower the lamp until it sits in the bottom of the quartz sleeve.

9.6.2. UV Quartz Sleeve Maintenance

No maintenance is required for UV Quartz Sleeves during operation. Upon servicing UV Module for cleaning, hose down Quartz Sleeve array outside of the channel to remove any large debris. Once UV module has been clean via the Cleaning Tank, hose down again prior to placing UV Unit in the Channel. Inspect Quartz for hairline fractures and cleanliness. If broken, follow installation guidelines to ensure Quartz Sleeves are clean and installed properly. Gloves should always be worn when handling UV Quartz Sleeves.

Loosen the black compression nut, but do not remove it from the nipple. Insert the domed end of the sleeve into the compression fitting. Lubricate the sleeves, wiper rings and bottom grommet plate with clean water (spray with a hose). This allows the sleeve to pass through the wiper rings without dragging on the dry rubber wiper rings and sit firmly in place in the lower grommet.

Once the domed end is resting in the grommet plate located in the module base, hand-tighten the compression fitting providing a watertight seal. Be careful not to crack the quartz sleeves during installation. In addition, do not use tools to tighten the compression nuts – only hand-tighten.

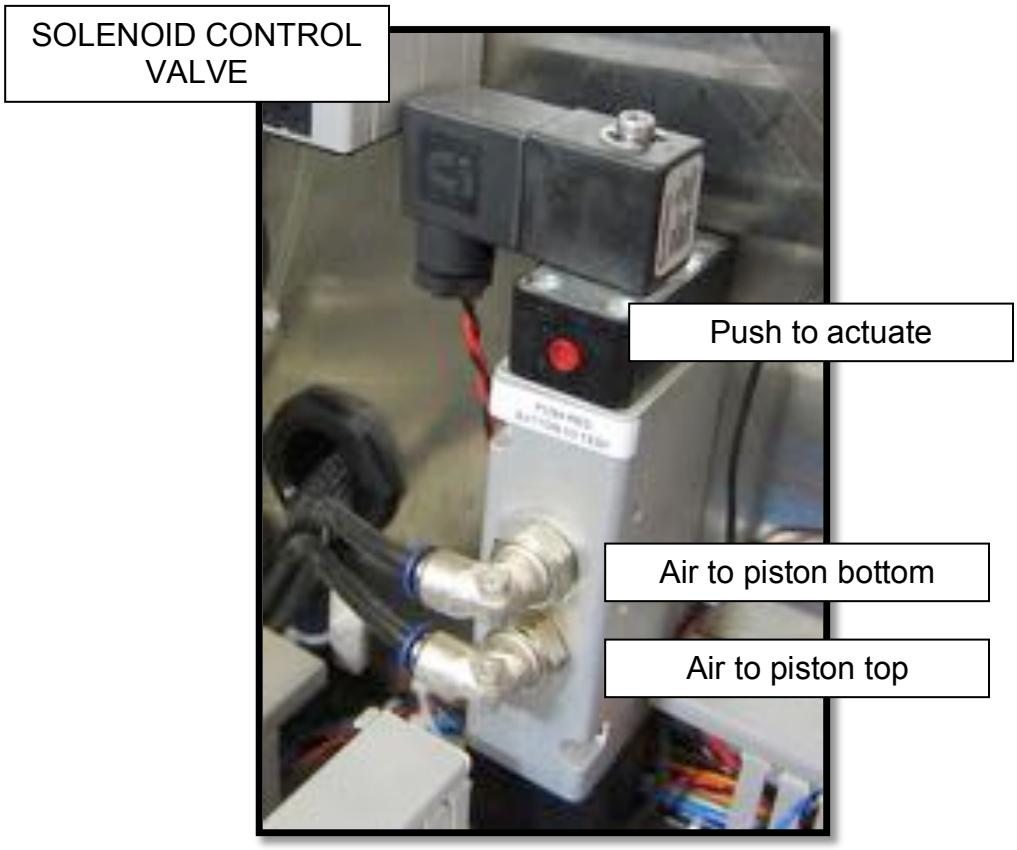
9.6.3. UV Wiper Maintenance

Wipers require little to no maintenance during operation. Upon servicing UV Module out of the channel, the UV Wipers should be checked to verify all Wiper Rings are present in all wiper plate holes. Should Wiper Rings be missing or damaged, record location of gasket and replace washers by following instructions in Troubleshooting section.

The cleaning system operates from of a timer. The frequency of the cleaning cycle can be adjusted by accessing the timer. PLC.

The automatic wiping system will require a dedicated air compressor. Depending on the system, the wiper will be controlled via a timer (see instructions below) or via a PLC.

Compressed air is supplied to the piston via a solenoid control valve (SCV) located inside the top of the module. Flexible hosing is mated to the stainless steel tubing, which feeds air to the piston. There are three air-ports located on the SCV. The center one is for supply and the outer two are for exhaust. The outer ports supply air to either side of the double acting pneumatic cylinder during cycling of the wiping mechanism.



Manual Actuation of Wiper

The solenoid valve has a “red” button, which will allow for manual operation of the cleaning system. To actuate, simple depress with a screw driver and the wiper will actuate.

9.7. Quartz Sleeve Cleaning

From time to time, it will be necessary to provide additional quartz sleeve cleaning depending on the effluent characteristics. This can be accomplished using several options:

9.7.1. Hand cleaning individual sleeves

1. Disconnect all power and cabling from the module. Using hoist carefully remove the module from the channel bracketing system. Plant operating personnel should physically help guide the module out of the system – aiding the lift operator.
2. Wear gloves and eye protection.
3. Remove an individual sleeve from the module and inspect it.
4. If dirty, spray with Lime–A-Way or mild citric acid cleaning agent and clean with a ScotchBrite pad.
5. Reinstall sleeve and perform same maintenance on other sleeves.

9.7.2. Hand cleaning sleeves while still in module

1. Disconnect all power and cabling from the module. Using hoist carefully remove the module from the channel's bracketing system. Plant operating personnel should physically help guide the module out of the system – aiding the lift operator.
2. Wear gloves and eye protection.
3. Spray quartz sleeves with Lime-A-Way or mild citric cleaning agent and clean with a ScotchBrite pad hosing off hard to reach places.
4. Inspect and return to channel.

9.8. Automatic Cleaning System Maintenance

While the cleaning system has been designed to provide maintenance free operation, from time to time you may have to perform routine preventative maintenance. The following procedures provide information on how to maintain and service the components of the cleaning system. The system's cleaning frequency is field adjustable with the use of the PLC or in some cases a simple timing mechanism.

The automated cleaning system is comprised of the following components:

1. Air piston located in the bottom of the channel
2. Air solenoid valve located in the top of the module
3. Tubing and quick connects
4. Cleaning plates with EPDM rubber wiper rings
5. Air supply (dry air 70-80 psi)

9.8.1. Wiper Ring Replacement

The disinfection system has been equipped with an air-driven quartz cleaning system. The system integrates an air piston, air supply, wiper blades, wiper rings, solenoid and timer.

The system utilizes a "quick stroke" approach. Each wiper ring "free-floats" in the wiper plate - minimizing wear. The frequency of wiper ring replacement will depend on plant conditions. To check performance, pull a few random sleeves and inspect for fouling on the module as a whole. If it appears that the rings are worn, they will need to be replaced. Typical ring replacement is approximately every two to three years of system operation.

To replace the wiper rings:

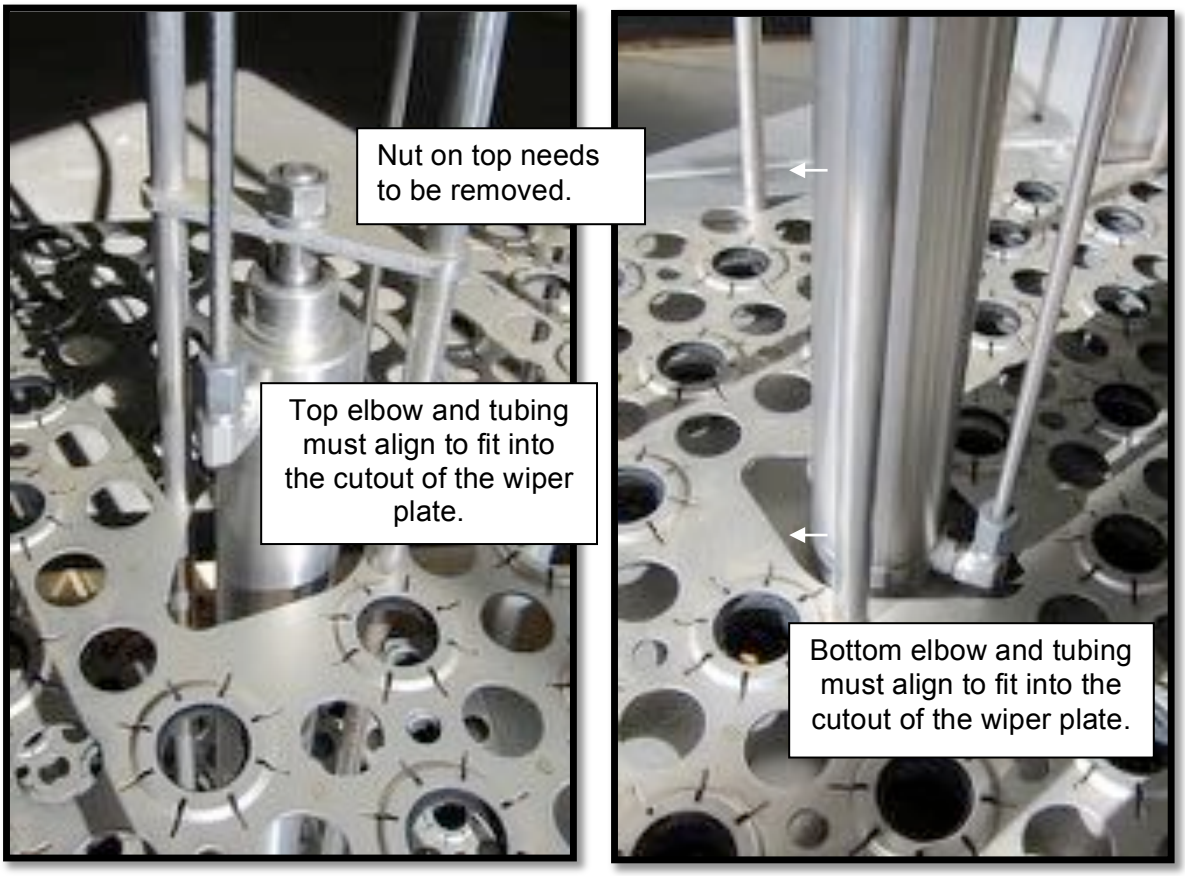
1. Disconnect power to module,
2. Remove the module from the channel
3. Remove lamps and quartz sleeves from the module
4. Remove wiper rings by hand from the holder
5. Insert new ring into the holder
6. Discard the used rings
7. Re-install quartz sleeves and lamps

EPDM Wiper Rings in Stainless Steel Holders

9.9. Piston Maintenance or Replacement

The piston screws into the bottom of the module. To remove the piston:

1. Remove the module from the channel using the module removal procedure described previously.
2. Remove the quartz sleeves
3. Loosen the air fittings at the bottom and top of the piston.
4. Loosen the air fittings at the top of the module (this will allow you to push the stainless steel tubing up into the top of the vertical box)
5. Remove the nut from the top of the piston rod. This will be connected to the wiper plate. Turn counter-clockwise
6.  Remove the nut from the bottom of the module (insure that the module is support properly as it is heavy and poses a hazard if it were to fall).
7. Inspect and replace as necessary.



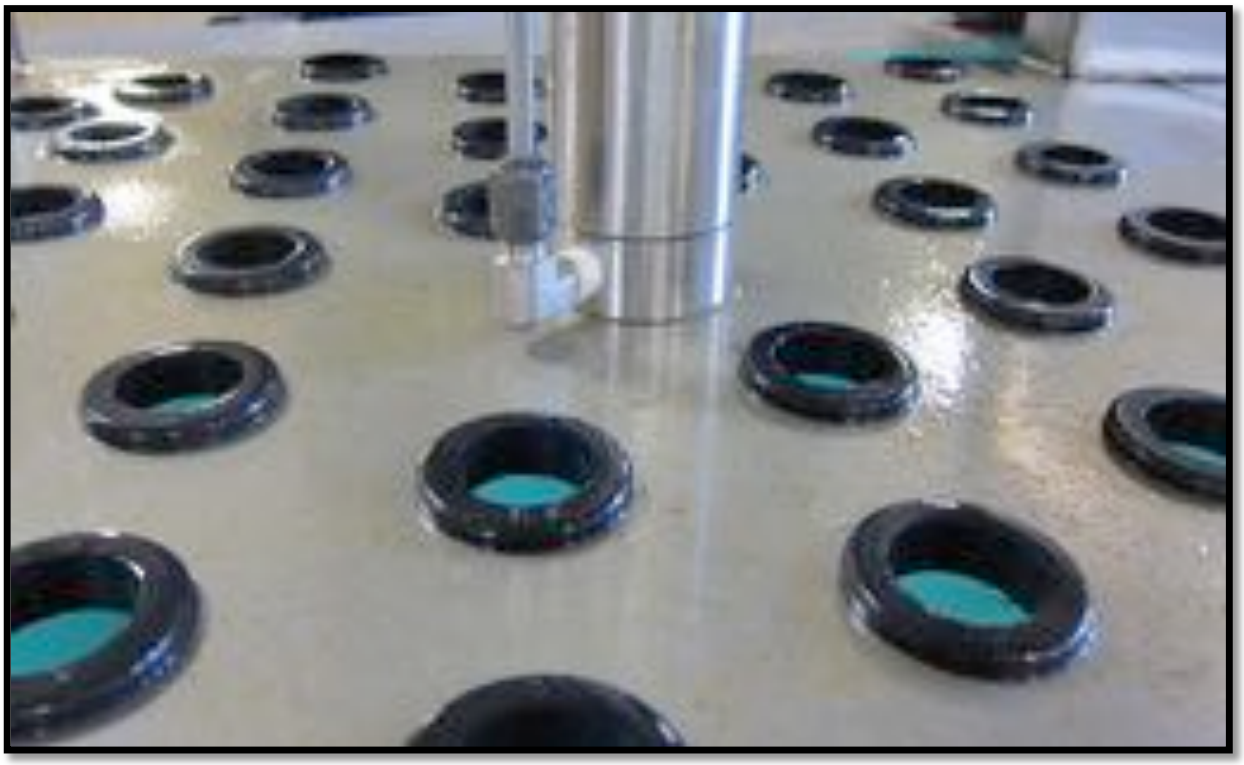
By loosening the top fittings, you will be able to slide the stainless tubing up into the top of the module and out of the actual fittings attached to the piston.

Nut needs to be loosened for piston removal.

Once the tubing has been loosened and the nut has been removed, you will need to have two (2) operators lift the wiper cage mechanism up to remove the piston.

9.10. Grommet Plate

A grommet plate is located at the bottom of the module. The plate holds EPDM grommets, which act as the holders of the dome end of the sleeves.



Grommet plate showing air connection

During operation, the compression nuts may become loose and allow the quartz to drop through the bottom plate. When removing from channel, make sure that they don't pass the bottom plate as they will break when set on a hard surface.

To replace, simply pull out and press fit in a new grommet.

9.11. Ballasts

The UV lamp ballasts are located in the actual module. They are cooled with the effluent passing by the legs as well as via a fan located in the module top.

9.11.1. UV Ballast Maintenance

The UV system has been designed to work on a constant power supply. While the ballasts are designed for harsh conditions, they are susceptible to power fluctuations. Low voltage will cause pre-mature ballast failures. The ballasts have been labeled with the voltage and cycle. It is imperative to maintain the appropriate voltage range. If you have questions, call the factory.

Failure to provide sufficient power will void the warranty.

If lamps are out, it may indicate a ballast failure. To determine whether it is a ballast problem or a lamp problem, take known working lamps and swap them with the troubled lamps. If they do not work, Properly power down the system, disconnect the associated ballast tray, install new ballast and re-install ballast tray.

The ballasts are located on a heat sink. This system transfers the ballast heat into the legs of the module. This process uses the passing channel wastewater to dissipate the heat. The advantage of this system over fan cooling is that the modules are resistant to water infiltration.

To change a ballast, disconnect power, then disconnect the pin connectors and slide the ballast tray out. Perform work and then replace.

9.12. PREVENTATIVE MAINTENANCE

In addition to the maintenance guidelines listed in the various sections, operators should be aware of further steps that can be taken to avoid specific mechanical or electrical problems. Some common problem areas are listed below.

1. **Equipment Problems**

   Always be sure to operate each piece of equipment within the ranges (pressure, temperature, etc.) specified by the manufacturer's service literature.

2. **Valve and Piping Problems**

   Make sure the valves are not opening and closing too fast; this can result in a "hammer" effect, causing leaky valves and piping. The action of automatic valves can be slowed by adjusting the air metering screws on the valve solenoids.

3. **Instrument Problems**

   Be sure the piping is braced securely enough to avoid vibration damage of instruments. Also, keep dust and water out of instruments.

4. **Disassembly and Reassembly of System Components**

When workers must disassemble and then reassemble system components, they should refer to the vendor literature for individual components. Also, the equipment lists and the schematics for this project may be helpful during these procedures.

5. Tightening of System Components

When threaded system components are installed and tightened, correct torque specifications must be adhered to. Under tightening can cause leakage and over tightening can cause stripped threads, warped parts, breakage, and leakage.

6. Sampling and Testing

Influent and effluent sampling and testing should be performed on a regular basis. Daily composite (24-hour) samples should be analyzed for all influent and effluent parameters shown in Table 1 of this manual. Glasco strongly recommends that an operating log book and data collection be kept and logs maintained on a daily basis.

7. Instruments

Instruments such as pressure gauges and dissolved oxygen cells should be cleaned, inspected, and calibrated periodically. A faulty sensing instrument may indicate a problem where one does not exist, or may not indicate a problem that does exist.

8. **Valves**

Operators must verify that all valves close completely. A valve that does not shut tightly can cause contaminants to leak into the process stream.

9. Corrosion and Contamination

Always keep control panels closed tightly to prevent the entry of dirt and fluids. Liquids must never enter control panels.

Also, be sure that instrument covers are properly installed and that conduit connections are tight. In wet environments, conduit connections should be sealed with silicon sealer.

10. Instrument Vibration

Instruments can be damaged by excessive vibrations. Instruments that are field-mounted must be installed in a location that is relatively free of vibrations and impact shocks.

When instruments are mounted on piping at the equipment, the piping must be braced securely to prevent instrument damage from vibrations and shocks caused by such problems as water hammer.

11. Instrument Calibrations

Instruments should be calibrated per the Manufacturer's recommendations periodically to avoid erroneous readings. A malfunctioning instrument may not indicate a problem that exists, resulting in equipment damage or extended downtime.

9.13. SYSTEM STARTUP General Start-Up Procedures

This subsection presents the general operational procedures for the Ultraviolet Disinfection System.

These procedures are designed to simplify start-up and shutdown procedures to enable the operator to devote the majority of the time observing and recording system performance and key parameters for disinfection treatment.

- Make sure all of the commissioning procedures have been completed.
- Make sure that all fuses are installed in the control panels.
- Calibrate all of the instruments on the system using the instructions in the Vendor Literature Manuals and Sequence of Operation.
- Ensure that all utilities have been provided.

9.13.1. Manual Valve Status

Prior to system startup, all manual valves should be checked to ensure correct position. Valves in the system can generally be grouped into "type" based on function. These types of valves and their startup position follow. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist. Normal operating positions for each manual valve is provided on the P&I Diagrams. The operator should reference these drawings in addition to this list when placing the valves in their correct position.

Manual Sampling valves	CLOSED
Drain valves	CLOSED
Bypass valves	CLOSED
Main Process valves	OPEN
Utility Supply valves	OPEN
Instrument Isolation valves	OPEN

9.13.2. System Startup Sequence

Prior to initiating the system startup sequence, the various system components and equipment shall be placed in the proper operating mode. Generally, all system equipment switches shall be selected to AUTO.

The initial startup of the UV Disinfection System will be conducted by operators under Glasco direction and supervision. Glasco will provide supervision during the day shift only. Glasco will provide written instructions for the night shift operators. Glasco Startup personnel will remain available by phone during night operations.

Recommended UV Disinfection Treatment System Startup procedures are as follows:

- Once all necessary inspections and commissioning procedures have been completed, the UV Disinfection Treatment System can be started and operated as described in this section.

- Operators must study this entire section before attempting to operate the system.

Operators must read and understand Safety Precautions and all associated O&M Equipment safety documentation before operating this equipment.

Contact with electricity can cause burns, cardiovascular failure, or death. Follow the precautions given in manual concerning electricity.

Calibrate all instruments in the system using the instructions in the O&M manual vendor literature.

9.13.3. Utility Systems

- Verify that the compressed air pressure is between 40 and 65 psig.
- Verify all electrical systems are fully operational, safe, and match requirement per single line diagrams.

9.13.4. Compressed Air System

- Read the manufacturer's literature for the Compressed Air System Equipment.
- Read the manufacturer's literature for the In-Line Air Dryer.
- Read the manufacturer's literature for the In-Line Pressure Regulator.
- Confirm the manual valves are in the correct position per the P&I Diagrams.
- Confirm Pressure regulator set point is in the correct position per the P&I Diagrams.

9.13.5. UV Modules

- Confirm all UV Module are installed properly.
- Confirm location of Communication and Power cables per General Layout Drawing.

9.13.6. Verify Connection of all Communication/Power cables Module(s) to Wiretray(s).

- Verify SCC HOA Switch to OFF.
- Fill Channel with process water until low level alarm is OFF.
- Install UV Quartz Sleeves and Lamps.
- Verify UV Box Lids are locked.
- Connect Communication Cables to corresponding location per General Layout Drawing.
- **Connect Power Wire to corresponding location per General Layout Drawing.**
- Place the Lead UV Units required in AUTO/START and the backup in the STANDBY position at the PLC OIT.

9.13.7. UV Module Wiper

- Verify Setpoints match those listed in the Sequence of Operation and the PLC OIT.

- Manually Cycle one Wiper to ensure no restrictions in wiper sequence.

9.14. SYSTEM RESTART AFTER A STANDBY SHUTDOWN

The procedures and Operator observations after a short term shutdown proceed in the same order and steps as the initial startup procedures described in with the following exceptions:

The Operator should simply observe the operation of this equipment for any abnormal conditions.

9.15. SHORT TERM AND LONG TERM SHUTDOWN

The purpose of this subsection is to provide general information for short term and long term shutdown of the UV Disinfection Treatment system. In addition to the steps provided below, additional steps may be required for complete shutdown of the system such as diversion of wastewater flow and shutdown of required utilities. In addition, reference should be made to the vendor literature for specific and detailed shutdown procedures.

9.15.1. Short Term Shutdown

- Short term shutdown as described in this section is defined as lasting anywhere from several hours to two days (such as over a weekend).
- In preparation for a short term shutdown, stop all incoming flows to the UV Channel.
- Force wipe each Bank within the channel by selecting the WIPE pushbutton in the OIT.
- Channels should be drained as far as the low level alarm. Once drained to this level, ensure drain valve is in the CLOSED position. UV Units should remain ON until such time that the low level alarms turns them OFF.
- Place the HOA switch to the OFF Position at this time. The UV Modules should be shut down in the same sequence as the startup procedures described.
- During the system short term shut down, all manual valves should be checked to Ensure correct position. Valves in the system can generally be grouped into “type” based on function. These types of valves and their short term shut down position follow. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Manual Sampling valves	CLOSED
Drain valves	CLOSED
Bypass valves	CLOSED
Main Process valves	CLOSED
Main Utility Supply valves	CLOSED
Instrument Isolation valves	CLOSED

- During the system short term shut down, equipment should be set in the following operational mode. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Air Compressor	OFF
UV Units	OFF

9.15.2. Long Term Shutdown

- Long term shutdown as described in this section is defined as a period of time where the

intent is to leave the WWTP system out of service due to plant maintenance requirements or lack of treatable product.

- In preparation for a long term shutdown, stop all incoming flows to the UV Channel.

- Force wipe each Bank within the channel by selecting the WIPE pushbutton in the OIT.

- Open Drain Valve to completely drain the Channel(s). UV Units should remain ON until such time that the low level alarms turns them OFF.

- Place the HOA switch to the OFF Position at this time. The UV Modules should be shut down in the same sequence as the startup procedures.

- During the system long term shut down, all manual valves should be checked to ensure correct position. Valves in the system can generally be grouped into “type” based on function. These types of valves and their short term shut down position follow. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Manual Sampling valves	CLOSED
Drain valves	CLOSED
Bypass valves	CLOSED
Main Process valves	CLOSED
Main Utility Supply valves	CLOSED
Instrument Isolation valves	CLOSED

- During the system long term shut down, equipment should be set in the following operational mode. Do note that this is a generalization that has a few possible exceptions. Use this list as a general checklist to develop a plant specific preoperational valve lineup list.

Air Compressor	OFF
UV Units	OFF

10. PRODUCT DELIVERY, STORAGE AND HANDLING

Glasco UV will deliver equipment and materials to the site to ensure uninterrupted progress of the work.

10.1. Initial Equipment Receipt and Inspection

Use care when moving equipment and components and when opening crates.

When each shipment is received, it must be inspected immediately for completeness and for shipping damage. A signed form of the receipt notice issued with this manual is to be return within 30 days upon equipment delivery disclosing any damages due to shipment. Should this form be return after the 30 day period, it is assumed that shipment of UV disinfection equipment to be complete and undamaged.

NOTE *Unless otherwise specified Glasco equipment is guaranteed against defective design, materials, and workmanship for eighteen (18) months from the date of shipment, or for one (1) year from acceptance of equipment. The warranty on individual component parts not manufactured by Glasco is limited to that of the manufacturers of those components.*

Record the item and crate numbers of all received pieces. Some crates will contain several different tagged items; these crates should be opened temporarily to check the different items.

Compare the item and crate numbers recorded to those shown on the shipping list supplied with the equipment, and check off each item that has been located. If items appear to be missing, contact the carrier and Glasco immediately.

NOTE *Small components that were removed from major components during preparation for shipping may not have item numbers. These untagged components can be identified by referring to the piping drawings and the part lists for this project.*

Perform a close inspection of all major components, piping and sub-components. Damage can be easily missed during a quick inspection.

Perform a close inspection of all shipping crates, boxes and loose components. Verify that no damage has occurred to these pieces.

Check for visible damage to crates, piping, and piping ends. If a crate or box appears damaged, open the crate or box and investigate further.

NOTE *Shipping damage should be promptly reported to both Glasco and the carrier to ensure repair or replacement. Avoid releasing equipment for assembly until all damage claims and/or shortage problems have been resolved.*

If the equipment is stored before assembly, reseal any crates that were opened for inspection.

10.2. Storage of Unassembled Components

Use the following instructions if the equipment will be stored before it is assembled.

NOTE *To store individual system components (such as instrumentation, quartz sleeve, lamps etc.) refer to the manufacturer's storage instructions in the vendor literature manuals.*

Complete all of the inspection procedures.

Place a copy of the marked-up shipping list and the written list of received item numbers together and store them in a safe place. If necessary, make copies of these lists and distribute them to the individuals who will be involved in the assembly of the equipment.

Use extreme caution when moving the equipment - refer to the handling procedures.

Select a storage location where all Glasco equipment can be stored in one area. Avoid separating equipment, components, and crates.

On large project sites, it is easy for small or separated components to become misplaced or lost. If the equipment must be separated, note the exact locations of all pieces on the shipping list or the written list of received pieces.

Set the skids and other components on wooden blocks to keep them out of any standing water and to protect their painted surfaces.

If possible, store the equipment indoors where it will be protected from sunlight and adverse weather conditions.

If the equipment will be stored for an extended length of time (inside or outside), cover it with plastic or canvas tarps to protect it from water, dust, paint over-spray, etc. Ensure the equipment is not stored in direct sunlight to prevent damage to internal components from excessive temperatures.

If the equipment must be stored outside, special precautions must be taken.

Items that can be damaged by water must be securely wrapped with plastic and covered with tarps.

Storing equipment in direct sunlight may result in the deterioration of equipment finishes, and glued or epoxied parts. The heat from direct sunlight can weaken or distort plastic and melt the glue used to adhere these components together.

Store the equipment in a shaded area or cover it with light-colored tarps.

If outdoor temperatures are warm, remove all vessel manhole covers to allow air circulation.

Always drain all liquids from components that must be stored in freezing temperatures. Expanding ice can damage components.

When the outdoor temperature is below 32°F (0°C), it is important to verify that components where liquid may have accumulated are completely drained (air compressor).

Precautions to be taken to allow trapped water and moisture to escape.

To store electrical panels, make sure all of the openings in the panels are sealed with tape and that the panel doors are securely closed.

When equipment has been stored in extremely hot or cold temperatures and then is moved to an assembly area, always allow the equipment temperature to stabilize before beginning assembly. This is especially important if the equipment is very cold.

When equipment is brought out of storage, retrieve the original shipping list and the written list of received pieces and double-check the components. Any pieces noted as missing at this time must be located as quickly as possible to avoid delays in assembly and startup of the equipment.

Prior to assembly of the equipment, perform a quick recheck for possible equipment damage. Use the same procedures given.

11. COMPONENT INSTALLATION – SAFETY PRECAUTIONS- PRE OPERATION

This section presents the general safety concerns pertaining to operation, installation and maintenance of the Ultraviolet Disinfection System.

The operator is responsible for reviewing, understanding, and following all applicable safety recommendations and requirements. Glasco is not responsible for the unsafe operation of or conditions within the system, or any consequences resulting from these unsafe practices. Safe operation, maintenance, troubleshooting, and housekeeping of the Ultraviolet Disinfection System and the area are the responsibilities of plant.

Sources of safety precautions, regulations, and requirements include, but are not limited to, those presented below:

- Equipment (vendor) operation and maintenance manuals
- Chemical manufacturer recommendations (from Material Safety Data Sheets - MSDS)
- Plant safety policies and procedures
- and most importantly, COMMON SENSE.

11.1. General Safety Guidelines

11.1.1. Operator Training

Equipment operators must be trained in the operation of the treatment system and in the proper handling of UV light. Only experienced operators who have studied this entire manual should be allowed to operate the equipment.

11.1.2. First Aid Equipment

First aid equipment, such as portable eyewashes and medical kits, must be available in areas where treatment chemicals are stored or used.

NOTE *Facilities such as eyewashes and showers must conform to national and local safety codes and laws*

11.1.3. Safety Wear

To comply with owner safety procedures and practices workers must wear safety glasses, face shields, respirators, and protective clothing when working with hazardous materials, such as corrosive treatment chemicals.

All measures must be taken to avoid contact between hazardous chemicals and exposed skin to UV.

11.1.4. Equipment Access

Workers must use caution when accessing equipment and loading it. All measures must be taken to prevent falls and other accidents when equipment is being installed or serviced.

Use extreme caution when working around UV disinfection equipment. Handles, wire troughs, and other protruding components can cause severe injury to body parts that strike them. Workers should wear hard hats and safety glasses and should move cautiously when working around equipment.

If equipment to be installed or serviced is above an operator's normal reach, use safe, approved ladders or lifting devices to reach the required area.

Climbing on equipment can cause worker injury or equipment damage due to falls and equipment tipping.

Never climb on equipment to reach components. Access to parts and troubleshooting are to be done properly by following guidelines.

11.1.5. Modules / MSS Loading

Special precautions are required when cradles are loaded. When a module/cradle is being loaded, workers must take all necessary measures to avoid falls.

Falls from the top of modules or channels can cause severe injury or death to workers.

Always load tanks from a secure platform or lifting device. Platforms and lifting devices must be equipped with side rails and slip-resistant surfaces where workers will stand.

All UV Disinfection Equipment is not designed to support additional weight. Standing on equipment can cause severe injury or death to workers.

Do not stand on top of a cradle while loading it. The top angle does not provide adequate footing, and the lack of handholds and the small surface area can lead to falls.

11.1.6. Channel Entry

Hazardous atmospheres and corrosive liquids in channels can cause personal injury or death.

When entering tank or channel, workers must follow all plant safety procedures and the guidelines given in this section.

NOTE ***Before entering a channel, all equipment associated with the tank or channel must be locked out of operation. For example, turn HAND/OFF/AUTO switches for modules, compressor, and other devices to the OFF position, then disconnect and lock out all power supplies.***

All incoming streams must be isolated from the channel in such a manner that fluids or gases cannot enter the channel while workers are inside. The following are common methods of isolating channels:

- Disconnect incoming piping.
- Insert a solid blank or blind in the connecting flanges or a pipe to completely block it.
- Close and lock out hand valves in the incoming streams.

NOTE ***If the channel has contained a hazardous substance, it must be rinsed thoroughly prior to entry.***

The channel must be tested to ensure that it is free from toxic vapors and has sufficient oxygen for breathing.

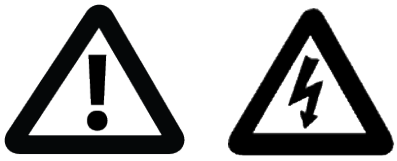
Toxic or inert gases in a confined space can cause suffocation within minutes.

Treatment chemicals entering a channel while workers are inside can cause severe injury or death.

Never enter a channel until it is known to be free of toxic gases, contains a breathable atmosphere, and is blocked off from liquid inlet streams.

11.1.7. Electricity

Operators and workers must use caution when working with control panels and other electrical components. These components must be properly wired and grounded, and should not be allowed to come in contact with process fluids or other liquids.



Electricity can shock, injure, or cause death.

Always disconnect and lockout electrical power for panels or components before performing repairs or service.

Electrical control panels and instruments must be properly grounded.

11.1.8. Air Compressor for Automatic Quartz Cleaning System

An air compressor or plant supplied air is required to run the automatic quartz cleaning system. The air needs to be 70-80 psi and be supplied with a dryer. Air compressor needs to be maintained with oil and dryer drained.

Compressors that are supplied loose (un-mounted) must be properly mounted to avoid movement and excessive vibration.

Also, all motor drive safety shields and belt guards must be properly installed, and all supplied WARNING and CAUTION signs must be maintained at the device.

Contact with rotating drive mechanisms can cause severe personal injury.

Never operate motor driven compressors without safety shields around the motor drive mechanisms.

Contact with rotating parts can cause severe injury to workers

Do not service filters, guards, or other components until the compressor is stopped and locked out of operation.

11.1.9. Automatic System Testing

An automatically-controlled UV disinfection system must be test-run without process liquids prior to the initial operation of the equipment except wiper cycling. Wipers are NOT to be test-run without clean water in the channel(s). Operators must be sure that the entire system operates properly before using process water.

11.1.10. Servicing System Components and Equipment

Before performing maintenance on system components and equipment, and especially when disassembling individual components, workers must be certain that the components are isolated from pressure, fluids, and electricity. Pneumatically loaded devices, such as wiper pistons, must be in their “relaxed” state; that is, with no compression on the pneumatic fluid, to avoid the sudden and accidental motion of individual parts.

An accidental and sudden release of pressure or fluid, accidental contact with energized electrical components, or the sudden movement of equipment parts during maintenance procedures can result in severe injury to workers.

Workers must use extreme caution when servicing automatically controlled components. Sudden and unexpected operation of components being serviced can cause severe injury to the workers involved.

Before working on automatically controlled components, make sure that the automatic controller is disabled to the point that it cannot be used to operate remote components. Close, lock, and tag valves and lockout and tag electrical motor starters and other electrical devices.

Finally, inform other operators and control room workers of repairs or servicing in progress.

Accidental and unexpected operation of remote components can cause personal injury or death.

NOTE ***If controller programming or program modification is performed while system components are being serviced, disconnect the controller output devices or the individual component tubing or wiring to avoid accidental operation*.**

Refer to the individual component literature for specific maintenance and troubleshooting guidelines.

12. EQUIPMENT INSTALLATION

The purpose of this section is to describe the general procedures for receipt, installation, and hookup of the Ultraviolet Vertical Disinfection System. This is not intended to be all-inclusive, but to provide general guidelines and the recommended sequence of activities. It is strongly recommended prior to receipt, installation, or hookup of the system equipment that section 2.0, Safety Precautions, be thoroughly reviewed. This will help ensure safe practices are observed and minimize the chance of worker injury or equipment damage.

The following information is included within this section:

- Equipment Handling Procedures
- Initial Equipment Receipt and Inspection
- Storage of Unassembled Components
- Equipment Installation Guidelines
- Installation of Peripheral
- Equipment Start-Up Preparation

12.1. EQUIPMENT HANDLING PROCEDURES

This subsection presents general handling guidelines for the UV Disinfection equipment.

12.1.1. Handling Guidelines

1. All lifting and moving procedures must be performed by experienced construction workers using standard rigging methods.

2. Before beginning any equipment handling procedures, refer to the following sections in the Occupational Health and Safety Administration (OSHA) Manual #2206: "General Industry Standards." Also, refer to any other applicable literature and information for cranes, lift trucks, and other equipment used for lifting and moving.

   Subpart N: "Materials Handling and Storage"
   Section 1910.176: "Handling Materials - General"
   Section 1910.178: "Powered Industrial Trucks"
   Section 1910.179: "Overhead and Gantry Cranes:
   Section 1919.180: "Locomotive and Truck Cranes"
   Section 1919.181: "Slings"

Damaged lifting devices can fail in service and cause severe personal injury or equipment damage.

   Never use slings or cables that are cut, frayed, or kinked. Refer to OSHA Manual #2206 for information on inspecting lifting devices for damage.

3. Make sure that all equipment used for lifting and moving is properly maintained and is in good repair.

Always inspect slings, cables, clevises, and other equipment prior to every lifting and moving event.

Cables and slings can slip out of crane hooks not equipped with safety latches. Falling loads can cause severe personal injury or equipment damage.

Never use crane hooks that are not equipped with safety latches. All lifting hooks on cranes must be equipped with spring-loaded safety latches to keep cables from slipping out of the hooks.

4. When using cables or woven straps as slings or chokers, place heavy carpeting, sections of tires, or other material between the sling and the object that is being lifted. This will help protect the sling device and the object being lifted.

5. If lifting lugs or eyelets are installed on a component, use these devices for lifting whenever possible. Do not lift a vessel or equipment skid by attaching lifting devices to piping or other components.

6. Be sure that components being lifted are balanced and will not tip or slip out of a sling. When lifting a large component, raise the object until it just clears the surface it was resting on and then stop. Observe the object to verify that it is balanced and is firmly held by the lifting devices. If there is any doubt about the safety of the lifting method, set the object down and reposition the lifting devices or else use another method.

   Use extra caution when lifting equipment skids using lift points on the skid (base). Equipment skids are often top-heavy and may tip when lifted more than a few inches off the ground.

7. When moving a component with a crane or a lift truck, keep the load as low as possible at all times. This can minimize component damage if the load tips over, slips, or falls.

   Also, keep hands and feet from under raised components. If operators must reach under a raised component to connect lifting devices or perform other work, place blocks under the component to support it.

8. When a component is connected to lifting devices and is ready to lift, a foreman or lead person should verify that all workers are clear of the lifting devices, the object, and the immediate lift area before proceeding with the lift.

   When a large component is to be lifted and moved, all workers in the general area should be warned of the lifting event and instructed to stand clear of the component and the lift area.

   When a component is lifted with a crane or fork lift, all workers must remain in the crane or forklift operator's view during the lifting operation.

9. If two or more lift points on a component are connected to a single crane or crane trolley, use cable spreader bars to prevent excessive side loads on lifting lugs, eyelets, and other lift points.

   Equipment lift points must not be subjected to side loads.

10. If a large component must be lifted more than a few inches off the ground, attach tag lines to the component. Workers can use these tag lines to stabilize and control the component while it is suspended.

11. If the equipment that is being unloaded is to be stored temporarily, follow the instructions in subsections of this manual.

12.1.2. Handling UV Modules and Electrical Panels

UV Units are top-heavy and should NOT be lifted by their bases. Units can tip causing equipment damage and worker injury.

Always use a separate cable for each lift point to prevent cable slip at the crane hoods. Keep the Units as close to the ground as possible during the lifting and moving procedures.

NOTE *Initial handling of Units should be done without lamps/quartz sleeves to prevent tipping of Unit. See UV Unit Maintenance for installation of lamps/quartz prior to startup and after installation.*

Always lift equipment Units evenly; avoid flexing. Also, keep the Units level and close to the ground as they are being moved.

Use spreader bars to eliminate excessive side-loading on lifting lugs and eyelets and to keep cables from pinching the equipment.

Use extra care when moving control panels. These panels contain delicate instruments that can be damaged by rough handling.

Finally, attach tag lines to the skid or other component if it must be lifted more than a few inches off the ground.

12.1.3. Handling Smaller Components

1. Many of the smaller components that are shipped loose for this job can be moved using fork lifts or small cranes and woven straps.

   Workers must be sure that any equipment used for moving loose components is properly maintained and is in good repair. Refer to OSHA Manual #2206 for more information on material handling and handling equipment.

2. When moving components with a forklift, be careful not to damage the components.

   Avoid "ramming" the lifting forks under pieces; use a crane or pry bar to lift the piece up enough to drive the forks under.

Be careful not to damage tubing, indicators, and other delicate devices or parts attached to larger components.

Make sure that any load on the forks is secure and balanced. When carrying pipe or pipe spools on the forks, keep the forks tilted all the way back and avoid sudden stops.

Be aware of the weight capacity of the forklift being used; do not overload the forklift.

When carrying long or wide pieces, watch carefully when making turns.

3. Use extreme caution when moving instruments or components with instruments attached. Instruments are delicate and can be damaged by dropping or bumping them.

   Be especially careful not to damage gauges or sensors attached to the instrument.

12.1.4. Handling Modular Support Systems

1. Before attempting to lift and move cradles verify that the proper lifting equipment is available.
   i. All cranes, cables, slings, and other equipment must have a rated weight capacity that exceeds the weight of an individual component being lifted.

   ii. While lifting and moving support frames, adhere to the guidelines given in subsections.

2. Also, do not weld on or above the cradles for any reason. High temperatures will damage the support cradles.

3. When moving MSS/Modules that are equipped with insulation clips or pegs, be careful not to bend or break these devices.

4. When lifting support cradles/tanks that have been positioned horizontally for shipping, a minimum of one double-trolley crane or two individual truck cranes must be used for the lifting procedure.

Never lift cradle by attaching lifting devices to non-structural components.

Use two cables for the hookup. If a single cable is looped through the crane hook, the cable may slip off center if the support frames are not balanced.

The cables used for lifting cradles should be as short as possible. If these cables are too long, the crane being used may run out of travel before the vessel is completely vertical.

Cables and slings can cause pinching and injury to hands and fingers

Make sure that worker's hands are clear of the cables and slings before taking up slack. When the cables are in position, operate the crane to take up most of the cable slack.

Extreme cable angles also affect the lifting capacity of steel cables. Refer to OSHA Manual #2206 for information on cable capacity versus lifting angle.

13. EQUIPMENT INSTALLATION GUIDELINES

All equipment and mechanical components listed on the shipping list must be installed according to the piping, wiring, and layout drawings for this project. These lists and drawings were supplied with the equipment.

The installation should be performed by qualified maintenance or construction workers in accordance with applicable plumbing, wiring, and construction codes and procedures.

For information on installing and inspecting specific components, refer to the vendor literature manuals.

13.1. General Installation Procedure (see attached drawings for PDC/SCC MSS and Weir Install)

NOTE *Below is a suggested sequence for installing the equipment for this system. This sequence may be altered depending on the conditions at the jobsite. Some of the procedures may be performed simultaneously depending on the availability of workers and operators.*

NOTE *Before proceeding with the steps in this subsection read the noted procedures specific to each piece of equipment provided in the general arrangement section of this manual.*

Care should be taken in properly hoisting Equipment into place. At any given time during installation should only (1) piece of equipment be hoisted to prevent worker injury or death.

1. Position, level and install all UV Module Support Systems as shown on the general layout drawings, paying special attention to elevations and center-to-center dimensions.

2. Equipment, which requires anchoring to the floor, will be equipped with anchor bolt holes unless otherwise noted. After positioning, aligning, and leveling each piece of equipment, anchor it to the plant floor per recommendation on general arrangements.

NOTE *Vibrations may cause equipment to "walk" if not properly anchored.*

3. If equipment do not attach easily or line up exactly, apply only a moderate amount of force to install them. Excessive force will put an unnecessarily high stress on the components, which could damage them. Should mechanical force be used to align equipment, contact Glasco first with the problem.

Proper checks are to be done to ensure materials used with anchoring/installing submerged equipment be equivalent to the material(s) of the equipment (stainless steel), or insulated to prevent galvanic corrosion.

4. Place and position all UV Unit(s) as shown on the general layout drawings, paying special attention to elevations and center-to-center dimensions.

NOTE *When installing an assembly or instrument, do not tighten the bolts and other fasteners until all of the adjacent assemblies and instruments have been attached to it. Then evenly tighten all of the assemblies and instruments at the same time*

5. This equipment was originally assembled at Glasco using the dimensions given on the design drawings. The components that were shipped loose or disassembled for shipping will fit back together more easily if the original design dimensions are adhered to during installation.

Vibration-induced movement of equipment can result in misalignment and damage to equipment.

6. Mount all loose instruments to their proper locations. Each instrument is labeled with an item number, which corresponds to the same item number on the layout drawings.

7. Be sure that all of the installed equipment is braced properly so that only a minimum amount of stress is put on the components and fasteners.

In extremely cold weather, Equipment should not be bumped or have excessive stress applied to them.

8. Position, level and install wire troughs as shown on the general layout drawings, paying special attention to end-to-end dimensions. Verify disconnects are properly spaced prior to anchoring.

9. Install enclosures as shown on the general layout drawing, and connect the necessary tubing and/or wiring from the enclosures to their designated locations.

10. If possible, panels that rest directly on the floor (no support legs) should be mounted on a slightly raised floor or pad. This will help reduce the chance of

moisture or water getting in the panel.

NOTE *When mounting a control panel on a raised pad or other structure, be sure that the height of the controls (switches, etc.) does not exceed the normal reach of operators.*

13.2. Power Distribution Center / System Control Center (PDC/SCC)

The Power Distribution Center contains the System Control Center. The PDC needs to be mounted within an appropriate distance of the modules. Protected power then has to be brought to the unit. All work should be performed by a licensed electrician and installed according to local codes.

The System Control Center is an Allen Bradley MicroLogix 1100 PLC and a displays the information on an Operator User Interface (OUI). Information may also shown on the IOS Device.

13.3. Modular Support System Installation (see attached installation drawing)

The as built drawings show placement of the MSS. The following is an overview.

The MSS is manufactured from 316L stainless steel and is comprised of the following components:

CRADLE

The cradle is to be installed across the top of the channel. It supports the weight of the module and provides a mechanism to center it in the channel.

DOCKING STATION (Base)

The docking station acts as a guide for lowering the module into the channel. It also acts as a directional plate guiding the flowing effluent into the lamps minimizing short-circuiting. The docking station is bolted to the bottom of the channel.

13.3.1. Cradle and Docking Station Installation

Determine the vertical module positions based on the information provided on submittal drawings. Select, layout and mark where the vertical modules will be positioned in the channel.

The purpose of the vertical modular support frame is to retain the lamp modules in place in the concrete channel. The top plate or cradle will span the top of the channel and provide alignment of the top of the module. The module docking station rest securely on the bottom of the channel and is installed first using stainless steel anchor bolts.

13.3.2. Installation

1. Lower the docking station and cradle assembly into the channel, level and plumb.

2. Using the docking station as a template, drill six (6) 3/8” holes into the concrete floor using a Hilti TEC-C + 3/8 – 6 bit or equivalent. Set in place using Hilti 3/8 x 2 1/4 Kwik Bolts.

3. Using the cradle as a template, drill 3/8” holes into the concrete using a Hilti TEC-C + 3/8 – 6 bit or equivalent. Set in place using four (4) Hilti 3/8 x 2 1/4 Kwik Bolts.

13.4. Weir Installation (see attached drawing)

A fixed serpentine weir has been designed to keep the UV lamps submerged regardless of flow rates and will be provided with a number of components.

Typical components:

Dam Plate: Bolted across the width of the channel (comes with angles to mount on the sides of the channel).

Fingers: Bolt onto the dam plate.

Support Structure: Bolts across the width of the channel (comes with angles to mount of the sides of the channel). This will support the ends of the fingers.

Typical Weir

The weir will need to be installed as to keep a proper water level. Too high of a water level will allow un-disinfected water to pass. Too low of a water level will allow the lamps to burn in the air and potentially foul sleeves.

13.5. UV Module Installation Procedure

Follow installation notes per Cradle general arrangement.

Cradle to be level, plumb, and anchored prior to installation of UV Unit(s).

13.5.1. UV Unit Installation Procedures

Once cradle have been properly installed. Caution should be taken upon lowering UV Unit.

NOTE *Wiring of any kind should not be done until after installation of mechanical systems.*

1. Follow lifting procedure per Handling Section to properly maneuver UV Unit(s) into place.

2. Verify cables and tubing are properly tied down to top of UV Unit Box.

3. Verify Box cable and tubing entry are facing influent side of channel. Slowly lower UV Unit(s) onto the top of the Cradle using top and central angle as guide.

4. For systems with duplex or greater Cradle sizes follow steps 1 to 3 for the secondary UV Unit(s) working from one side of the channel to the next. Additionally, secondary UV Unit(s) are to be lowered on halfway to the cradle, checked for Box clearance then lowered to base of Cradle.

5. Installation of Quartz Sleeves and UV Lamps are not to be done until START-UP where prompted. Install Quartz Sleeves into each hole located in the UV Box by first lifting the Heat Sink. Carefully lower each individual Quartz Sleeve, lining them with the wiper below. Hand-tighten each individual Strain Reliefs to ensure complete fit of Quartz Sleeves.

6. Attach wire to UV Lamps. Carefully lower lamps into Quartz Sleeves with wire connection facing up towards the UV Box. Attach Wire to Interior Box Panel.

13.6. INSTALLATION OF UTILITIES AND OTHER PERIPHERAL EQUIPMENT

This subsection covers utilities and equipment that are required to operate this system but have not been provided by Glasco.

The equipment and utilities listed here must be connected and operational before the Glasco equipment can be operated.

This includes proper coverage of the equipment and electronics from the elements and direct heat and snow load.

13.6.1. Process Feed

The quality of the feed stream must be maintained as described in Project Design.

13.6.2. Drain (For cleaning etc.)

Complete draining for tanks and channels are to be provided by client to ensure proper maintenance of equipment.

13.6.3. Tubing and Wiring

All customer-performed tubing and wiring of instruments must be completed.

13.6.4. Electrical

Proper power connections are required for controllers, lamps, etc. Refer to the Glasco wiring diagrams for specific power requirements.

13.6.5. Air

Unless supplied by Glasco; dry, oil-free plant air is required for pneumatic operation and other functions. Air must be filtered to remove moisture, oil, and particulates of 5 microns or less.

13.7. TROUBLESHOOTING

This section describes some of the common problems that can occur in the operation of water treatment systems and the steps an operator can take in finding their causes. The greatest troubleshooting tool that an operator can have is his knowledge of the system, therefore it is recommended that the operator read and be familiar with the rest of this manual prior to reading this section.

The most helpful tool in troubleshooting problems is the operator's knowledge of normal operating conditions for the system. Then if the system develops a problem the operator may notice a change in operating conditions that could help him identify the cause of the problem.

A well-kept log book of test data and results of operator observations is an invaluable tool for troubleshooting future performance problems.

Double check for symptoms to be sure that a problem really exists. An inaccurate instrument or a temporary change in feed quality or flow may indicate a problem where none exists.

Don't overlook these simple problems:

- A hand valve that was inadvertently closed
- The power turned off to the control panel
- Wires cut or hanging free
- Equipment damaged or missing
- Valve solenoids manually overridden

To troubleshoot flow blockage, examine valve positions and investigate all the equipment in that area until the source of the blockage is found.

To troubleshoot electrical problems first identify the "control flow pattern" which is the pathway that the signal takes from an input device to the controller (PLC or DCS) through the controller then from the controller to the output device. Second investigate all the components of this "control flow pattern" until the cause of the problem is discovered. Start with the easiest and most probable components such as the input and output modules. The following pages describe solutions to typical problems with our most frequently used equipment.

Each piece of equipment has specific operating parameters and hence, troubleshooting guidelines. This section does not attempt to repeat information pertinent to each piece of equipment. Rather, this section is intended to cover the integration of their equipment into an operating system. Therefore, this section will cover only control and process troubleshooting guidance.

When making adjustments to the process parameters, it is important to make only one change at a time and to allow sufficient time for the system to adapt to the change before attempting other changes.

The recommended operator responses to alarm and troubleshooting conditions are as follows:

Description	**Troubleshooting**
Water Level Low (ALARM)	● Power Off, wait, Power On
PDC Power (ALARM)	● Check PDC Connection to Main Power ● Check Power from Transformer.
Line Voltage Fail (ALARM)	● Check Voltage Setpoint. ● Check connections and terminations.
Power Surge (ALARM)	● Check Connection of Surge Protector. ● Check and replace Fuses.
SCADA Communication Fail (ALARM)	● Check Communication cable connection with SCADA. ● Verify SCADA Communication Path.
Lamp Active Hours High (ALARM)	● Sequence Secondary Bank to Run. ● Shut down Active Hour Lamp Modules and follow Maintenance instruction on Lamp Replacement.
Temperature High (ALARM)	● Sequence Secondary Bank to Run. ● Check Temperature Sensor for Setpoint. ● Check Heatsink Pump for proper connection.
UV Intensity Low (ALARM)	● Sequence Secondary Bank to Run. ● Check connections and setpoint for UV Intensity Sensor. ● Follow Maintenance procedures for UV Cleaning
Intensity Low Low (ALARM)	● Sequence Secondary Bank to Run. ● Check connections and setpoint for UV Intensity Sensor. ● Check Lamp Operability and ● Follow Maintenance procedures for UV Cleaning
UV Intensity Transmitter Failure (ALARM)	● Verify Installation per Vendor Literature. ● Check Connection to Instrument and Panel. ● Examine Unit Sensor to ensure no obstruction.
Lamp Quantity On Fault (ALARM)	● Sequence Secondary Bank to Run. ● Check connection between Lamps and Power. ● Check Lamp for breakage. Replace if Necessary. ● Check Lamp with Voltmeter to verify electrical loop. ● Check LED board for Proper connection.
Lamp Array (Group 1) Contactor Fault (ALARM)	● Sequence Secondary Bank to Run. ● Check connection between Lamps and Power. ● Check Lamp for breakage. Replace if Necessary. ● Check Lamp with Voltmeter to verify electrical loop. ● Check LED board for Proper connection.
Lamp Array (Group 2) Contactor Fault (ALARM)	● Sequence Secondary Bank to Run. ● Check connection between Lamps and Power. ● Check Lamp for breakage. Replace if Necessary. ● Check Lamp with Voltmeter to verify electrical loop.

	● Check LED board for Proper connection.
UV Lamp LED OFF	● Check LED if UV Lamp Intensity is Consistent ● Power off module at Power Distribution Center, wait, power on, observe LED(s). If the LED(s) come on and then flickers off, it means that the ballast is good and that the problem is past the ballast. ● If LED stays OFF, examine the suspected lamp(s) for damage, water infiltration, and severely blackened lamp ends. If none, power on, and observe through your UV face shield, at safe distance, if lamp actually lights. If lamp lights and LED is on, check loose electrical connection. If lamp lights and LED is still off, call Authorized Service Center for Power Center repair. ● If lamps are still off, check for bad ballast and replace.
UV Monitor Alarm	● Check panel LED to see if lamp is extinguished. ● Verify Power to Panel. ● Check Fuses in Panel. ● Check Terminations and Connections to UV Monitor. ● Verify the age of the lamp referring to lamp replacement records. ● Check the physical positioning of the UV Sensor Probe. The sensor element inside may not be “looking” in the same direction as the probe tube is pointing. The probe may have shifted within the retaining compression nut...sometimes pulled by the weight of the cable. ● Check for debris or film on the UV probe window. Clean and rough position with lamp powered off. ● Check for debris or film on quartz sleeves and clean.
UV Quartz Sleeve Break	● Isolate Channel from Flow. ● Follow short-term shutdown procedure. ● Drain Channel Completely. ● Replace Quartz Sleeve and UV Lamp. ● Follow Pre-Treatment Checklist and Start-Up procedures.
UV Wiper Not Cycling	● Check Power and Communication Cables to ensure proper connection. ● Check Air Compressor for Pressure. ● Check Air Line for Leaks. ● Check Solenoid Valve Position and connection. ● Follow instructions to remove UV Unit. Inspect wiper for any obstructions, imbalance, or damage.
UV Lamps Not On	● Sequence Secondary Bank to Run. ● Check connection between Lamps and Power. ● Check Lamp for breakage. Replace if Necessary. ● Check Lamp with Voltmeter to verify electrical loop. ● Check LED board for Proper connection.

UV PLC Not On	● Check Power and Communication Cables to ensure proper connection. ● Check Panel Fuses.
Lamp Breakage (Mercury Release)	● Elemental mercury is a volatile toxic heavy metal. Proper safety practices and procedures must be taken to prevent exposure. Should Lamp breakage occur in an enclosed building, proper ventilation is to be supplied. ● Turn HOA switch for corresponding BANK in the OFF position. ● Remove power connection to UV Lamp and Plug Quartz Sleeve to create an air tight seal. ● Remove Quartz Sleeve with UV Lamp and properly dispose per state and federal disposal requirements. ● Replace Quartz Sleeve and UV Lamp.
Flow Transmitter Failure	● Verify Installation per Vendor Literature. Check Connection to Instrument and Panel. Examine Unit Sensor to ensure no obstruction. Upstream Treatment Failure ● Isolate Channels ● Follow Long-Term Shutdown procedure until influent parameters is met.
UV Lamps Burn Out Too Quickly	● Check Incoming Power for excessive Wattage. Replace UV Lamp if Incoming Power is correct. Contact Glasco Water Technologies if problem persists. Check for lamp cycling
UV Lamp Cycles On-Off and Goes Out Before Warm-up is Complete	● Lamp is at End-of-Life. ● Follow installation procedures to replace Lamp.
GFC Breaker Off (All lamp LEDs for a module off)	● Ground fault occurred. Power the effected module off (if not still powered off by the GFI.) ● Examine cable connectors for tightness. Disconnect, cabling, clean, dry and re-connect. ● Inspect module and examine for water infiltration. If present see “Water Infiltration” trouble shooting. Reset GFI, and power on. If problem recurs, refer to Authorized Service Center for module repair.
Wiper Fails to Completely Wipe	● Air compressor set too low, needs 60 to 90 psi. Duration of upstroke may be too brief... increase this one (1) second at a time. Check for mechanical interference.
Wiper Rings Damaged or Missing	● Record Location of Washers respective to plate position and hole location. ● Place UV Unit in Channel or Cleaning tank to remove UV Lamp(s) and Quartz Sleeve where Damaged or Missing washer is located. ● Remove UV Module from Channel or Cleaning tank and replace washer(s).

Air Compressor Continuously Runs	● Check for leaks

14. WARRANTY STATEMENT

The warranty period is 18 months from date of delivery and 12 months from date of the Certification of Substantial Completion whichever comes first. It covers all failures due to defects in material and/or workmanship excluding consumables (see separate lamp and ballast warranties below). This warranty shall not apply to any failure or defect which results from the Equipment not being operated and maintained in strict accordance with instructions specified in Glasco UV's Instructions Manual or which results from mishandling, misuse, neglect, improper storage, improper operation of the Equipment with other equipment furnished by the Customer or by other third parties or from defects in designs or specifications furnished by or on behalf of the Customer by a person other than Glasco UV. In addition, this warranty shall not apply to Equipment that has been altered or repaired after start-up by any one except:

- Authorized representatives of Glasco UV, or
- Customer acting under specific instructions from Glasco UV.

Customer must notify Glasco UV in writing within 5 days of the date of any Equipment failure. This notification shall include a description of the problem, a copy of the operator's log, a copy of the Customer's maintenance record and any analytical results detailing the problem. If Customer has not maintained the operator's log and maintenance record in the manner directed in the Operation and Maintenance manual, or does not notify Glasco UV of the problem as specified above, this warranty may, in Glasco UV's discretion, be invalid.

Customer will fully cooperate with Glasco UV, in the manner requested by Glasco Water UV, in attempting to diagnose and resolve the problem by way of telephone support. If the problem can be diagnosed by telephone support and a replacement part is required, Glasco Water Technologies will either, at Glasco Water Technologies' expense, ship a repaired, reworked or new part to the Customer who will install such part as directed by Glasco Water Technologies or will direct Customer to acquire, at Glasco UV's expense, such part from a third party and then install such part as directed by Glasco UV.

This warranty is the exclusive remedy of the Customer for all claims based on a failure of or defect in the Equipment, whether the claim is based on contract (including fundamental breach), tort (including negligence), strict liability or otherwise. This warranty is lieu of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or fitness for a particular purpose shall apply to the Equipment.

14.1. LAMP WARRANTY

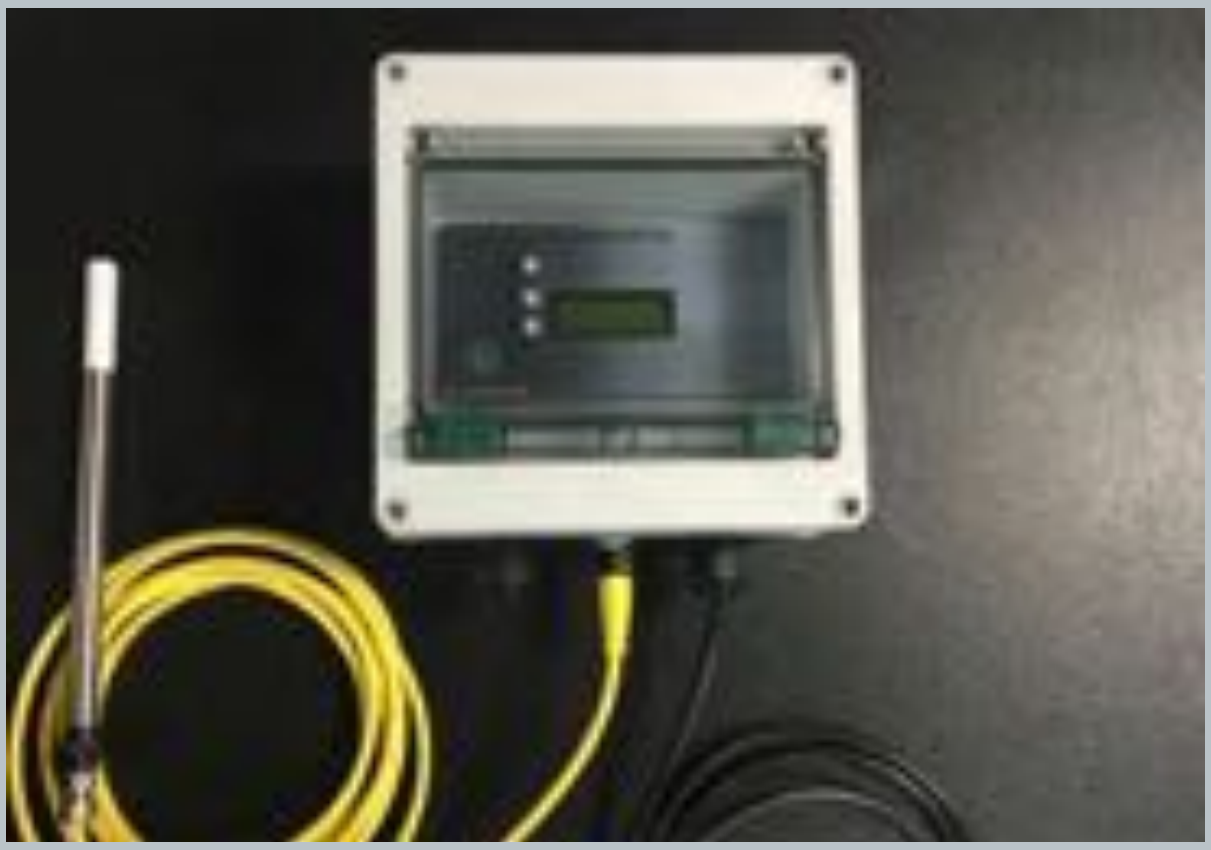
High Output Lamp
Each low pressure, high output lamp is guaranteed for 12,000 hours operating time under normal operating conditions. Normal operating conditions include:

- On/off cycles max. 4 per 24 operating hours,
- Voltage fluctuations according to DIN IEC 38.

In case of premature lamp failure, the client is requested to send the lamp back to Glasco UV together with the information of UV unit serial number, hours run and on/off cycles. Glasco Water Technologies then offers the following:

- Lamp failure before 1,000 h: Glasco UV will send a replacement lamp free of charge,
- Lamp failure after 1,000 h: Glasco UV will issue a credit proportional to the hours not used.

Upon return to our facilities in Mahwah, NJ, we will dispose/recycle all used and failed lamps at no charge to the client.



UVM-1624

GLASCO UV manufactures ultraviolet monitoring for both clean and wastewater. The UVM-1624 is a 24 Volt UV monitoring system that can work with a variety of UV sensors.

ULTRAVIOLET MONITORING

The meter can provide a relative UV output (0 to 100%) or can provide true UV output (uW).

The UVM-1624 meter provides a 4-20 mA output for remote logging. Systems that incorporate PLCs can interface with this device.

GLASCO UV

APPLICATION
Wastewater Treatment Plants

SYSTEM
Manual cleaning
Automatic cleaning

SENSORS

TECHNOLOGY
Manufactred in Germany

THE END USER

Wastewater plants that require monitoring for understanding system status as well as those that require reporting.

The UVM-1624 is standard on our wastewater treatment equipment.

The UVM-1624 can be provided as a stand alone monitoring system for existing systems no matter the Original Equipment Manufacturer.

THE CHALLENGE

UV sensors can foul due to solids and algae in the wastewater stream. The probe used to read UV output can be easily removed for cleaning. For systems that opt for automatic quartz cleaning, the UV sensor will be cleaned as part of that process.

THE SOLUTION

The “IL-LS” Series is designed in a “thin-film” manner. By closely grouping the UV lamps and their assocated quartz sleeves, the area for the liquid becomes limited and forces it closer to the UV lamps.

Unlike medium pressure systems that use very powerful UV lamps, low pressure UV lamps can be cooled and will operate at much lower skin temperatures (vs???)

System provided with shroud cooling and PLC automation.

THE RESULTS

The installed system provided the disinfection results. Customer’s benefits includes faster warm up and cool down cycles, built in redundancy with a greater number of lamps and significantly lower heat.

UV Monitor is contained in a remote NEMA 4x fiber-glass enclosure with gasketed seals. Enclosure has a port to access the 4-20 mA signal.

Sensor touches the quartz sleeves and looks at a single lamp in this configuration.

Output

%

Wm2

UV meter is field adjustable and can be re-calibrated when new lamps are installed.

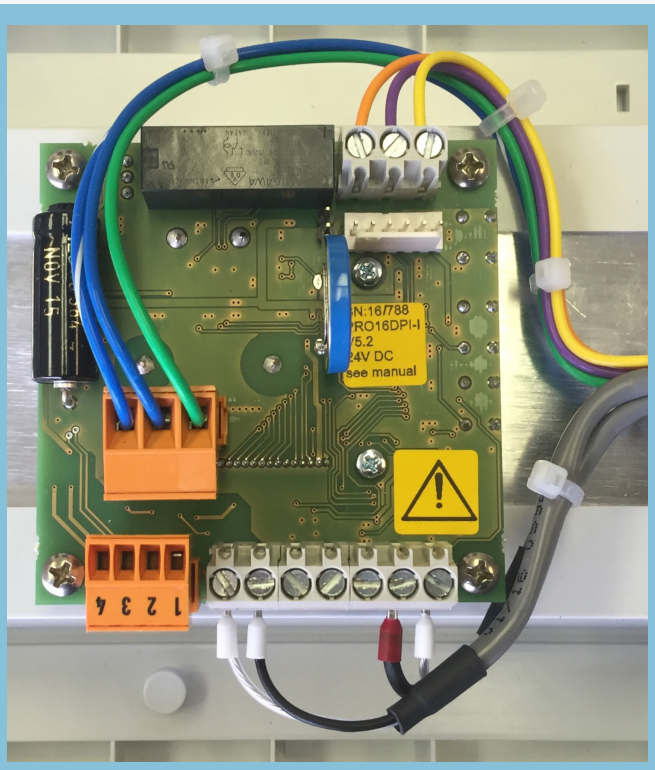
TECHNICAL DATA

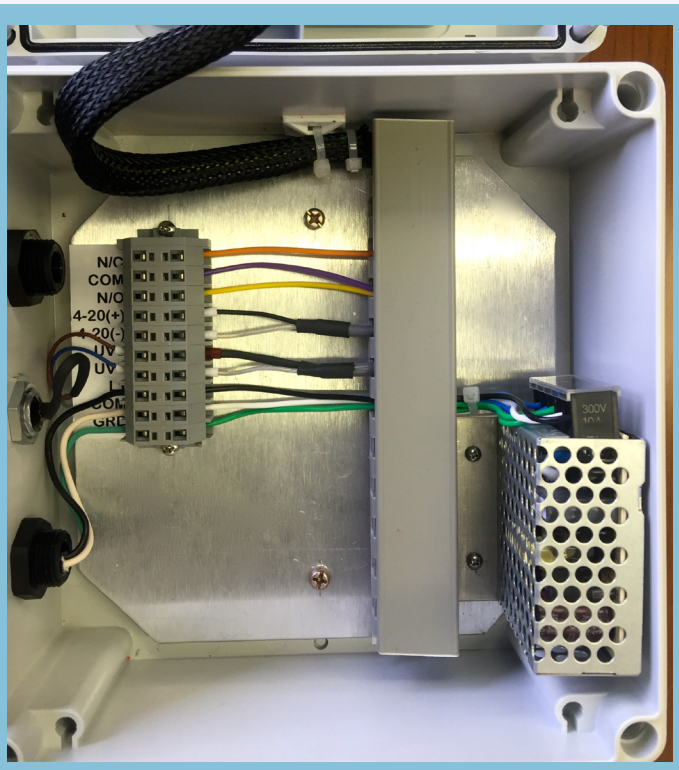
There are many settings that can be programmed into your UVM-1624.

Basic:	language, date, time, lock code and display contrast.
Operation:	start up delay, lamp replacement time.
Settings:	sensor type, measurement unit, reference value, alarm setpoints
Statistics:	on/off cycles, lamp hours and total monitor operation hours

TECHNICAL

Supply Voltage:	24V DC, 1 W
Operating Temperature:	max 45C (113F)
Ambient Temperature:	0-40 C (32-104F)
Running time of clock battery:	8 years
Operating Status:	LCD – 2 line alpha numeric
Status LCD Colors:	Green, Yellow, Red
Languages available:	English, Germany, French





Contact us at info@glascouv.com or visit glascouv.com for more information

Operator Interface User

Manual THORNE BAY DRAFT

PLC – Allen Bradley MicroLogix

System Overview

The UV disinfection system consists of an effluent channel with modules of UV lamps. Each module contains 2 groups of lamps with 20 UV lamps in each. The system control cabinet houses the lamp ballasts, power distribution equipment, system controller, operator interface, and instrumentation (UV intensity meters, lamp status LEDs, hour meters). The system is controlled by an Allen Bradley MicroLogix 1400 PLC.

Modes of Operation

The system control cabinet contains one three position selector switch for each bank which determines the operating mode of the bank. The description of each position is as follows:

HAND places the bank in manual mode. In this mode, the PLC logic is bypassed and the UV bank is turned on immediately. The system ignores the water level switches and always keeps the lamps on.

OFF turns the UV bank off.

AUTO places the system in auto mode. In auto mode, the PLC will control the UV bank operation. Unlike HAND mode, the system monitors the channel water level switch; the lamps will not turn on if the water level is low, and they will be turned off if a low water level alarm occurs while they are in operation. The system waits for a remote start request to put a bank into service. The system determines which bank to operate based on the operator's selection and the availability of the selected bank. If both banks are in auto mode, an automatic sequencing cycle is used to swap banks based upon an operator adjustable timer. The system uses bank pacing logic which will turn on both banks if the system flow exceeds an operator adjustable setpoint. Hysteresis values and timers are used to prevent unnecessary bank cycling due to unstable flow conditions.

Operator Interface Overview

The operator interface is Rohtek 7" Color Touch HMI. It communicates with the PLC over an Ethernet connection using TCP/IP. There are ten screens for the monitoring and adjustment of the UV system operation. A description of each screen is provided in the following sections.

Main Screen

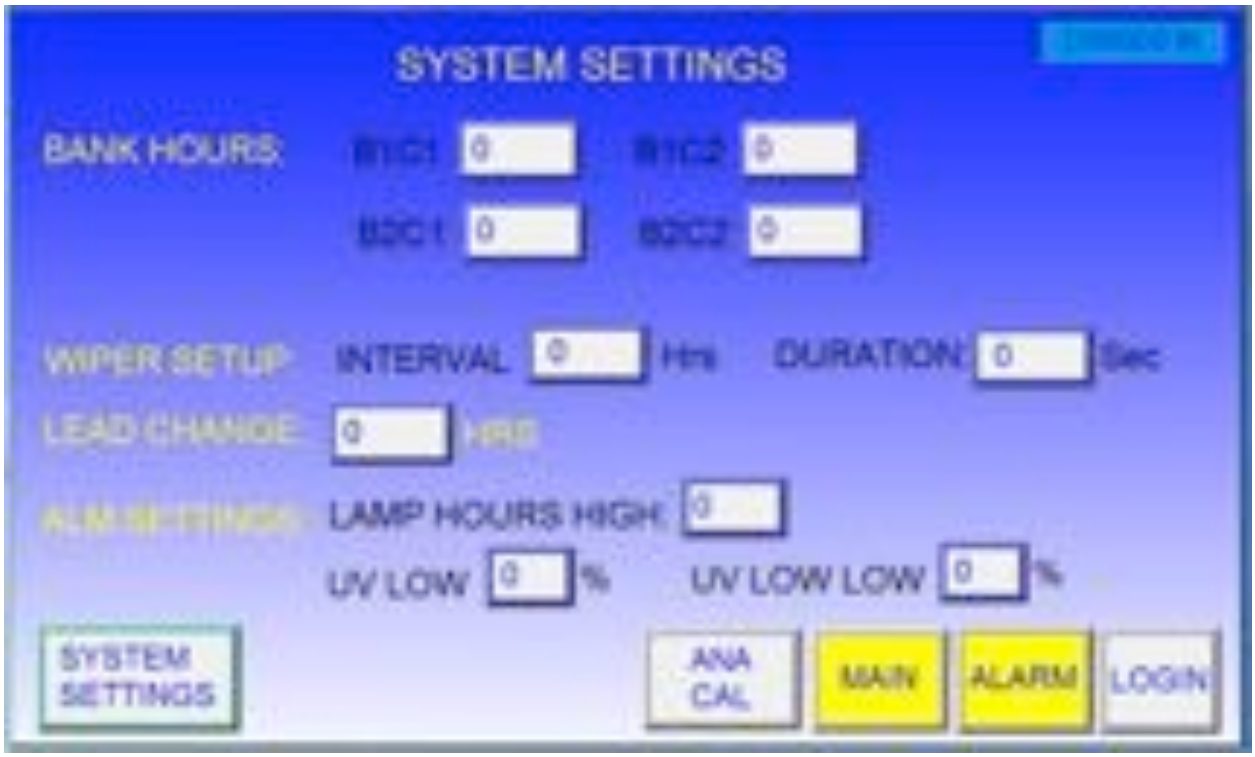
The Main screen provides an overview of the system.

The descriptions of the controls and objects on this screen are as follows:

1. Displays the flow through the system.
2. Displays the mode selector switch position for the UV bank.
3. Displays the UV intensity of the bank.
4. Pushbutton to navigate to the Menu.
5. Pushbutton to change the Forward/Reverse sequencing mode.
6. Module Alarm in alarm condition.
7. Water Level Low in alarm condition
8. Wiper status when wiper actives.
9. Bank status either ON or OFF
10. Flow Signal Status (OK/Fault

SYSTEM SETTING Screen

This screen contains the operator configurable operational setpoints.

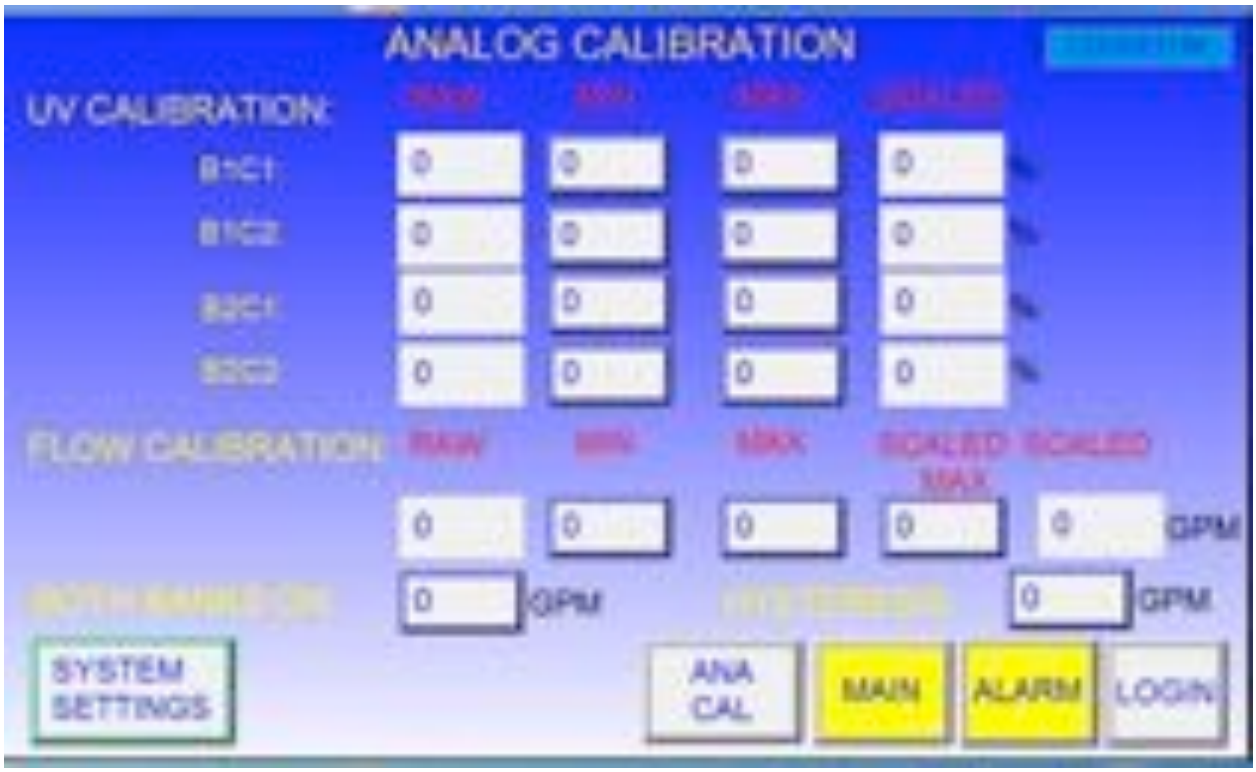


Descriptions of the objects on this screen are as follows:

- BANK HOURS: Bank hours edit
- The Wiper Setup: INTERVAL numeric entry field is used to enter the desired number of hours between automatic wipe sequences.
- LEAD CHANGE specifies the time (in hours) for the automatic changeover of the forward and reverse sequencing. For this feature to work automatically, both banks must be set to auto mode.
- The LAMP HRS HIGH is the setpoint in hours at which the bank “HIGH LAMP HOURS” alarm will be generated if any lamp within a bank reaches this cumulative number of hours in operation.
- The UV LOW is the setpoint at which a bank “UV Level Low” alarm will be generated if the UV intensity falls to this level after the warm-up time.
- The UV LOW-LOW is the setpoint at which a bank “UV Level Low-Low” alarm will be generated if the UV intensity falls to this level after the warm-up time.

Analog Calibration Screen

This screen is used to calibrate the analog signals in the system. These signals include the UV intensity of each bank and the system flow rate. A description of the values in each column is given below.

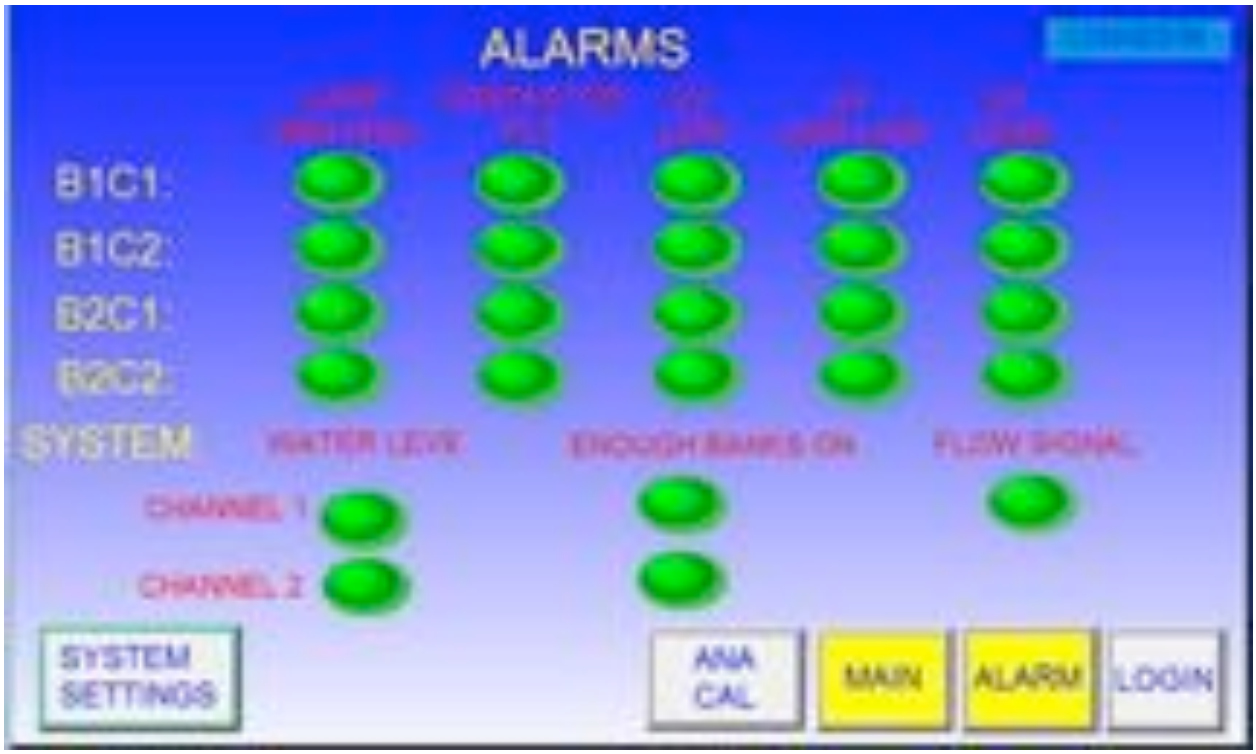


- The RAW column is an integer value representing the 4-20 mA analog signal converted to the range specified in the analog input module configuration. For a 1762-NI4 module with channels configured for current inputs, a 4 mA signal has a value of 6240 counts and a 20 mA signal has a value of 31200 counts.
- The MIN column is a number representing the minimum input scaling value. This is the 4 mA signal raw value (6240 for the input module described above). It is assumed that the transmitter 4 mA signal corresponds to a scaled value of zero.
- The MAX column is a number representing the maximum input scaling value. This is the 20 mA signal raw value (31200 for the input module described above).
- The SCALED MAX column is a number representing the maximum scaled value of the signal in engineering units. This number corresponds to the 20 mA signal from the transmitter.
- The SCALED column is the value of the input signal in engineering units based on the scaling parameters.

- BOTH BANKS ON specifies the flow setpoint in gallons per Minute(GPM) for the bank pacing logic. When the system flow exceeds this value, the PLC turns on both UV banks. Both banks will remain on until the flow has decreased below the two-bank setpoint by the hysteresis amount for approximately one minute.
    - HYSTERESIS specifies the dead-band value for the bank pacing logic. Once the PLC turns on two banks, it will keep both of them on until the flow has fallen below the two-bank setpoint by this hysteresis amount.

Note: The numbers used in the example are for the module described above. A different input module, or the same module with a different input range or configuration, may require different scaling parameters.

ALARMS



Bank Alarms: Lamp Hours High
Contact Fault
Bank UV LOW
Bank UV LOW LOW
Bank UV LOSS

System alarm display active alarms for:

WATER LEVEL LOW
FLOW SIGNAL FAULT
NOT ENOUGH BANKS ON

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Speedaire® Portable Air Compressors

Refer to Form 5S6043 for General Operating and Safety Instructions

For Warranty & Service call 1-888-606-5587
Do Not Return To Branch

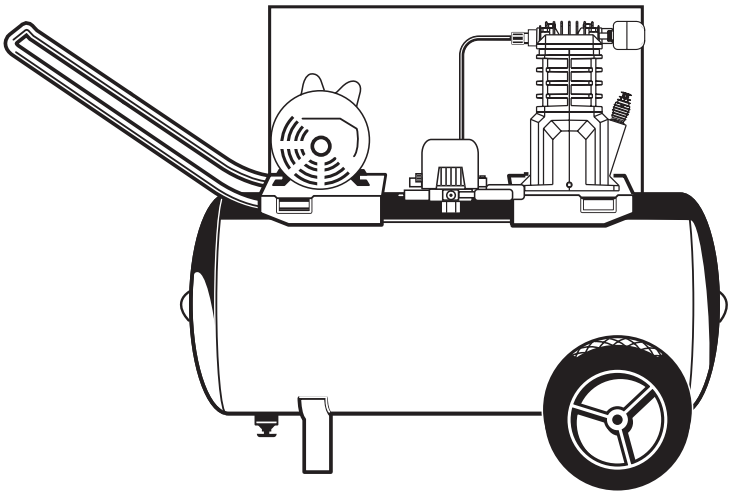


Figure 1 – Models 1NNF4, 1NNF6 and 1NNF7

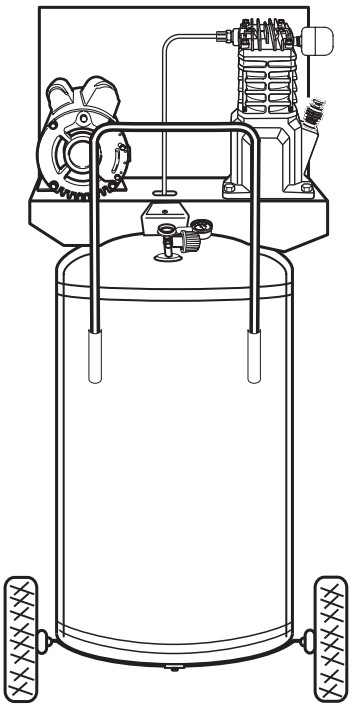


Figure 2 – Model 2MLW2

Specifications

			Free Air CFM					Dimensions (inches)			
Model	HP	Number of Cylinders	@ 90 psi	@ Max. psi	Tank Cap (Gal.)	Volts	Amps	L	W	H	Maximum Working Pressure
1NNF4	2.0	2	5.5	4.9	13	120	15	30.0	18.0	26.5	135 psi
1NNF6	2.0	2	5.5	4.9	20	120	15	33.0	19.5	31.0	135 psi
1NNF7	3.0	2	10.2	9.1	20	240	15	33.0	19.5	31.0	135 psi
2MLW2	2.0	2	5.5	4.9	26	120	15	28.5	22.6	55.0	135 psi

Form 5S6024

Printed in China
04634
0808/205/VCPVP

IN622902AV 9/08
CP107
08/08

For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
- Model number
- Serial number (if any)
- Part description and number as shown in parts list

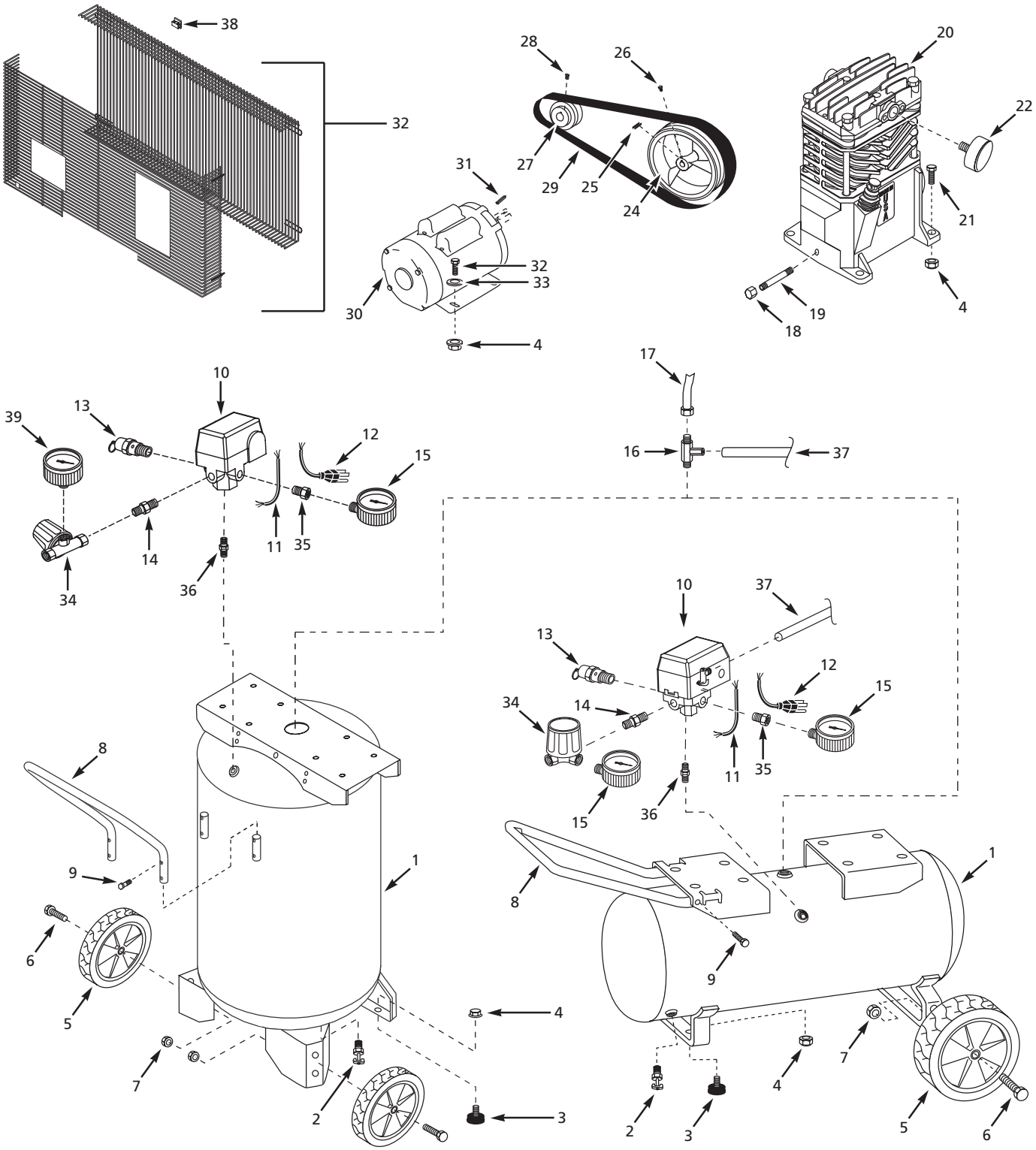


Figure 3 – Repair Parts Illustration for Models 1NNF4, 1NNF6, 1NNF7 and 2MLW2

Model 1NNF4, 1NNF6, 1NNF7 and 2MLW2

Repair Parts List for Portable Air Compressors

Ref. No.		Description	Part Number for Models: 1NNF4	1NNF6	1NNF7	2MLW2	Qty.
1		Tank	AR062200AV	AR062300AV	AR062300AV	AR062400AV	1
2		Drain cock	D-1403	D-1403	D-1403	D-1403	1
3		Rubber foot kit	HL021300AV	HL021300AV	HL021300AV	HL021300AV	2
4		5/16 inch - 18 Locknut	--	--	--	--	10
5		10 inch Wheel	▲	▲	▲	▲	2
6		Axle bolt	▲	▲	▲	▲	2
7		Hex nut	▲	▲	▲	▲	2
8		Handle	■	■	■	■	1
9		Handle screw	■	■	■	■	1
10		Pressure switch	CW217400AV	CW217400AV	CW217400AV	CW217400AV	1
11		Motor cord	EC012800AV	EC012800AV	EC012800AV	--	1
12		Power cord and plug assembly	EC012601AV	EC012901AV	EC012601AV	--	1
13		ASME Safety valve	V-215105AV	V-215105AV	V-215105AV	V-215105AV	1
14		1/4 inch Nipple	--	--	--	--	1
15		Gauge	GA016709AV	GA016709AV	GA016709AV	GA016709AV	2
16		Check valve	VT911300AV	VT911300AV	VT911300AV	VT911300AV	1
17		Discharge tube	VT910700AV	VT910700AV	VT910700AV	VT911700AV	1
18		Oil drain cap	ST150100AV	ST150100AV	ST150100AV	ST150100AV	1
19		Oil drain extension	ST083800AV	ST083800AV	ST083800AV	ST083800AV	1
20	◆	Pump	2WGX6	2WGX6	2WGX7	2WGX6	1
21		5/16 inch - 18 x 1-1/4 inch Screw	ST016000AV	ST016000AV	ST016000AV	ST016000AV	4
22		Filter assembly	VH901700AV	VH901700AV	VH901700AV	VH901700AV	1
23		Belt guard assembly	VT911000AV	VT911000AV	VT911000AV	VT911000AV	1
24		Flywheel	4B253	4B253	4B253	4B253	1
25		3/16 inch Key	KE000900AV	KE000900AV	KE000900AV	KE000900AV	1
26		3/8 - 16 x 3/4 inch Setscrew	--	--	--	--	1
27		Pulley	PU015200AV	PU015200AV	PU012600AV	PU015200AV	1
28		1/4 - 20 x 1/2 inch Setscrew	--	--	--	--	1
29		Belt	BT020400AV	BT020400AV	BT020400AV	BT020400AV	1
30		Electric motor	MC015502SJ	MC015502SJ	MC015403SJ	MC015502SJ	1
31		3/16 inch sq. x 1-1/4 inch Key	KE000903AV	KE000903AV	KE000903AV	KE000903AV	1
32		5/16 inch - 18 Hex head screw	--	--	--	--	4
33		5/16 inch Washer	--	--	--	--	4
34		Regulator	RE206203AV	RE206203AV	RE206203AV	RE206203AV	1
35		1/4 inch x 1/8 inch Reducer	--	--	--	--	1
36		1/4 inch Nipple	--	--	--	--	1
37		Unloader Tube (includes nut and ferrule)	VT911500AV	VT911600AV	VT911600AV	VT911800AV	1
38		Beltguard connector	--	--	--	VT911100AV	6
39		Gauge (back mount)	--	--	--	GA016718AV	1
△		Warning decal (3 Piece)	DK747600AV	DK747600AV	DK747600AV	DK747600AV	1
REPAIR PARTS KITS							
▲		Wheel Kit	VT910600AV	VT910600AV	VT910600AV	VT910600AV	
■		Handle Kit	VT910800AV	VT910800AV	VT910800AV	HL035600AV	

-- Not available

◆ See compressor nameplate for exact model number when ordering pump repair parts.

△ Not shown

For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
- Model number
- Serial number (if any)
- Part description and number as shown in parts list

ENGLISH

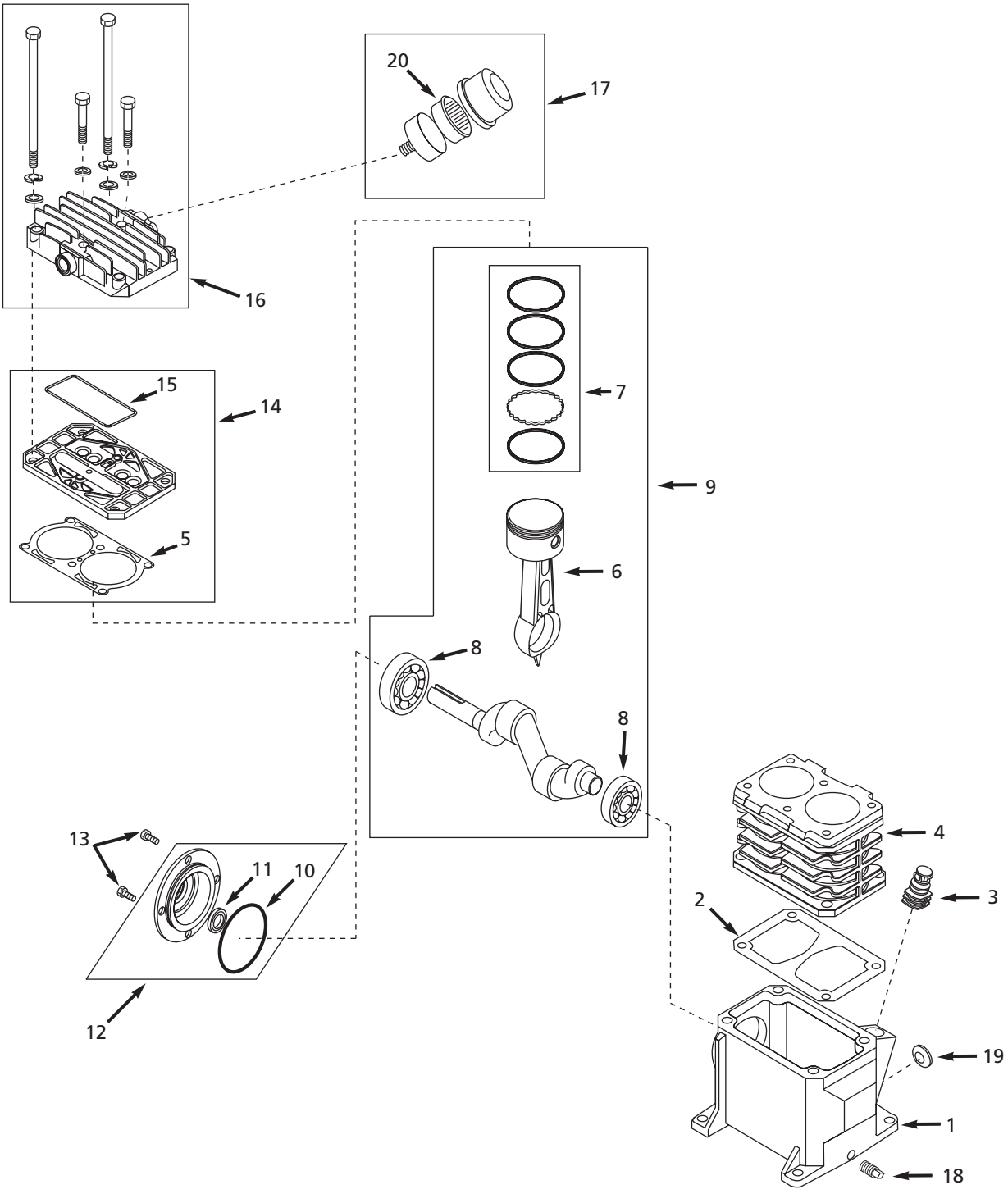


Figure 4 – Repair Parts Illustration for Pump

Pump Model 2WGX6 and 2WGX7

Repair Parts List

Ref. No.	Description	Part Number for Models: 2WGX6	2WGX7	Qty.
1	Crankcase	VT040300AG	VT040300AG	1
2	Crankcase gasket	●	●	1
3	Breather	VH901100AV	VH901100AV	1
4	Cylinder	VT040900AG	VT040750AG	1
5	Cylinder gasket	●	●	1
6	Connecting rod and piston assembly	VT042900AJ	VT042900AJ	2
7	Piston ring set	VT210401AJ	VT210401AJ	2
8	Ball bearing	ST084202AV	ST084202AV	2
9	Crankshaft, bearings, rods, piston assembly	VT040600AJ	VT040600AJ	1
10	O-ring	●	●	1
11	Oil seal	ST129700AV	ST129700AV	1
12	Bearing cap assembly	VT040200AJ	VT040200AJ	1
13	M6 x 10 mm screw	❋	❋	4
14	Valve plate assembly	VT470800AJ	VT470800AJ	1
15	Valve plate molded seal	●	●	1
16	Cylinder head and fasteners	TQ900800AJ	TQ900800AJ	1
17	Air filter assembly	VH901700AV	VH901700AV	1
18	1/8 in.-27 Oil drain plug	ST022300AV	ST022300AV	1
19	Sight glass	ST191700AV	ST191700AV	1
20	Air filter element	VH901800AV	VH901800AV	1
REPAIR PARTS KITS				
●	Gasket kit	4B252	4B252	1
❋	Standard hardware item			

ENGLISH

Speedaire® Portable Air Compressors

LIMITED WARRANTY

DAYTON TWO-YEAR LIMITED WARRANTY. *SPEEDAIRE® PORTABLE AIR COMPRESSORS, MODELS COVERED IN THIS MANUAL, ARE WARRANTED BY DAYTON ELECTRIC MFG. CO. (DAYTON) TO THE ORIGINAL USER AGAINST DEFECTS IN WORKMANSHIP OR MATERIALS UNDER NORMAL USE FOR TWO YEARS AFTER DATE OF PURCHASE. ANY PART WHICH IS DETERMINED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP AND RETURNED TO AN AUTHORIZED SERVICE LOCATION, AS DAYTON DESIGNATES, SHIPPING COSTS PREPAID, WILL BE, AS THE EXCLUSIVE REMEDY, REPAIRED OR REPLACED AT DAYTON'S OPTION. FOR LIMITED WARRANTY CLAIM PROCEDURES, SEE "PROMPT DISPOSITION" BELOW. THIS LIMITED WARRANTY GIVES PURCHASERS SPECIFIC LEGAL RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION.*

LIMITATION OF LIABILITY. *TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, DAYTON'S LIABILITY FOR CONSEQUENTIAL AND INCIDENTAL DAMAGES IS EXPRESSLY DISCLAIMED. DAYTON'S LIABILITY IN ALL EVENTS IS LIMITED TO AND SHALL NOT EXCEED THE PURCHASE PRICE PAID.*

WARRANTY DISCLAIMER. *A DILIGENT EFFORT HAS BEEN MADE TO PROVIDE PRODUCT INFORMATION AND ILLUSTRATE THE PRODUCTS IN THIS LITERATURE ACCURATELY; HOWEVER, SUCH INFORMATION AND ILLUSTRATIONS ARE FOR THE SOLE PURPOSE OF IDENTIFICATION, AND DO NOT EXPRESS OR IMPLY A WARRANTY THAT THE PRODUCTS ARE MERCHANTABLE, OR FIT FOR A PARTICULAR PURPOSE, OR THAT THE PRODUCTS WILL NECESSARILY CONFORM TO THE ILLUSTRATIONS OR DESCRIPTIONS. EXCEPT AS PROVIDED BELOW, NO WARRANTY OR AFFIRMATION OF FACT, EXPRESSED OR IMPLIED, OTHER THAN AS STATED IN THE "LIMITED WARRANTY" ABOVE IS MADE OR AUTHORIZED BY DAYTON.*

Technical Advice and Recommendations, Disclaimer. *Notwithstanding any past practice or dealings or trade custom, sales shall not include the furnishing of technical advice or assistance or system design. Dayton assumes no obligations or liability on account of any unauthorized recommendations, opinions or advice as to the choice, installation or use of products.*

Product Suitability. *Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While attempts are made to assure that Dayton products comply with such codes, Dayton cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, review the product applications, and all applicable national and local codes and regulations, and be sure that the product, installation, and use will comply with them.*

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. *A good faith effort will be made for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 U.S.A.

Excelon® design allows in-line installation or modular installation with other Excelon® products

High efficiency water and particle removal

Quick release bayonet bowl

Push to lock adjusting knob with tamper resistant accessory

Optional quarter turn manual drain

Technical data

Fluid:
Compressed air, neutral gases
NOTE: Contact technical support for use with other media.
Maximum pressure:
Transparent bowl: 150 psig (10 bar)
Metal bowl: 250 psig (17 bar)
B72G metal bowl w/ auto drain: 150 psig (10 bar)

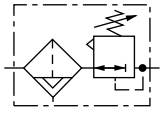
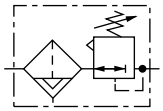
Operating temperature*:
Transparent bowl:
-30° to 125°F (-34° to 50°C)
Metal bowl:
(72) -30° to 150°F (-34° to 66°C)
(73, 74) -30° to 175°F (-34° to 80°C)
* Air supply must be dry enough to avoid ice formation at temperatures below 35°F (2°C).

Materials
B72G
Body: zinc
Bonnet: acetal (Zinc on 250 psi model)
Valve: Polypropylene and TPV
Transparent bowl: polycarbonate
Metal bowl: zinc
Liquid level indicator lens (metal bowl): transparent nylon
Element: sintered polypropylene
Elastomers: chloroprene & nitrile

B73G & B74G:
Body: aluminum
Bonnet: (73) Zinc, (74) aluminum
Transparent bowl: polycarbonate
Guarded transparent bowl: polycarbonate with aluminum
Metal bowl: aluminum
Liquid level indicator lens (metal bowl): transparent nylon (Pyrex optional)
Element: sintered polypropylene
Elastomers: chloroprene & nitrile
Valve: polypropylene and TPV

Ordering information

Models listed include PTF threads, knob adjustment, automatic drain, metal bowl with liquid level indicator, 40 µm element, relieving diaphragm, 5 to 150 psig (0.3 to 10 bar) outlet pressure adjustment range* with gauge.

ISO Symbols	Port Size	Model	Flow† scfm (dm3/s)	Weight lb (kg)
 Automatic  Manual Drain Relieving	1/4"	B72G-2AK-AE3-RMG	80 (38)	1.3 (0.59)
	3/8"	B73G-3AK-AD3-RMG	123 (58)	1.76 (0.82)
	1/2"	B73G-4AK-AD3-RMG	123 (58)	1.76 (0.82)
	1/2"	B74G-4AK-AD3-RMG	212 (100)	2.59 (1.17)
	3/4"	B74G-6AK-AD3-RMG	212 (100)	2.55 (1.16)

*Outlet pressure can be adjusted to pressures in excess of, and less than, those specified. Do not use these units to control pressures outside of the specified ranges. † Typical flow with 150 psig (10 bar) inlet pressure, 90 psig (6.3 bar) set pressure and a 15 psig (1 bar) droop from set.

Options selector

B7★G-★★★-★★★-R★★

Series	Substitute
72	2
73	3
74	4

Port size	Substitute
1/4" (72 & 73)	2
3/8" (72, 73, 74)	3
1/2" (73 & 74)	4
3/4" (74)	6

Threads	Substitute
PTF	A
ISO G parallel	G

Adjustment	Substitute
Knob	K
T-bar	T

Drain	Substitute
1/4 turn manual	Q
Auto drain*	A

*72 Series auto drain is available only with long bowl option.

Gauge	Substitute
With	G
Without	N

Outlet pressure adjustment range*	Substitute
5 to 60 psig (0.3 to 4 bar)	F
5 to 150 psig (0.3 to 10 bar)	M
10 to 250 psig (0.7 to 17 bar)**	S

Diaphragm	Substitute
Relieving	R

Element	Substitute
5 µm	1
40 µm	3

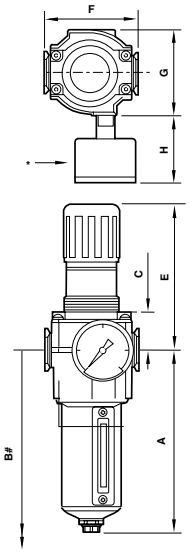
Bowl	Substitute
Metal w/ liquid level indicator (72*, 73, 74)	D
Long metal w/ liquid level indicator (72)*	E
Long transparent (72)*	L
Transparent with guard (73, 74)	P
Transparent bowl (72*, 73)	T

*Outlet pressure can be adjusted to pressures in excess of, and less than, those specified. Do not use these units to control pressures outside of the specified ranges.
** 250 psig (17 bar) outlet pressure range units are available with t-handle adjustment only and standard metal bowl options.

Accessories

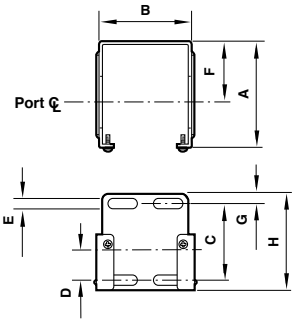
	Wall mounting bracket*	Neck mounting bracket	Gauge 0 ... 160 psig	Panel nut	Tamper resistant cover and seal wire	Pipe adapters (quantity of 1) (NPT)	Quikclamp® (quantity of 1)	Quikclamp® and wall bracket (quantity of 1)	Replacement elements
B72G	4224-50	74316-50	18-013-212	4248-89	4255-51	4215-02 (1/4)	4214-51	4214-52	5925-03 (5µm)
						4215-03 (3/8)			5925-02 (40µm)
B73G	4424-50	4461-50	18-013-209	5191-88	4455-51	4315-01 (1/4)	4314-51	4314-52	4438-01 (5µm)
						4315-02 (3/8)			4438-03 (40µm)
						4315-03 (1/2)			
						4315-04 (3/4)			
B74G	4324-50	4368-51	18-013-209	4348-89	4355-51	4315-02 (3/8)	4314-51	4314-52	4338-04 (5µm)
						4315-03 (1/2)			4338-05 (40µm)
						4315-04 (3/4)			

* Bracket kit does not include wall mounting screws.



*Optional gauge.
Minimum clearance reaquired to remove bowl.

Mounting bracket



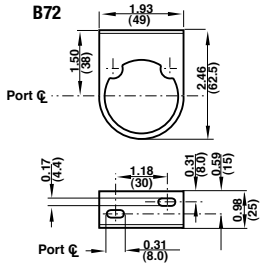
Series	A	B	C	D	E	F	G	H
72	2.36	1.65	1.54	0.73	0.16	1.50	0.24	2.01
73	2.64	2.36	1.89	0.75	0.28	1.50	0.24	2.40
74	3.11	2.72	1.97	0.79	0.20	2.01	0.24	2.40

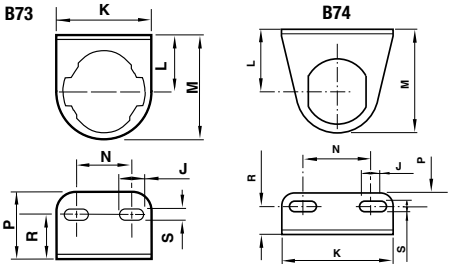
Series	Drain type	A	B	C	E	F	G	H	Panel Ø	Panel depth
72	Auto	5.51	7.52	1.02	2.87	1.97	1.89	1.38	1.57	0 to .16
	Manual	5.83	7.83	1.02	2.87	1.97	1.89	1.38	1.57	0 to .16
73	Auto	5.80	8.15	1.22	3.78	2.68	2.44	2.20	1.89	.07 to .25
	Manual	6.15	8.50	1.22	3.78	2.68	2.44	2.20	1.89	.07 to .25
74	Auto	6.35	9.06	1.22	5.00	3.15	2.91	2.20	2.05	.07 to .25
	Manual	6.95	9.69	1.22	5.00	3.15	2.91	2.20	2.05	.07 to .25

Service kits

Item	Type	Part Number
72G	Relieving	4383-500
73G	Relieving	4383-600
74G	Relieving	4383-700

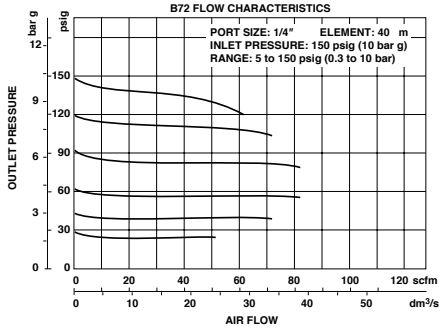
Neck mounting brackets

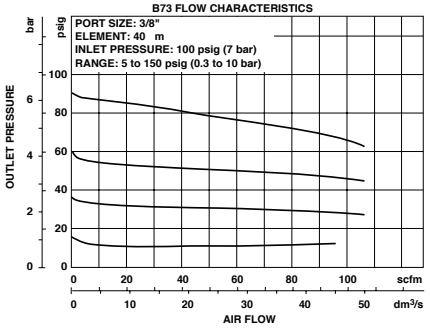


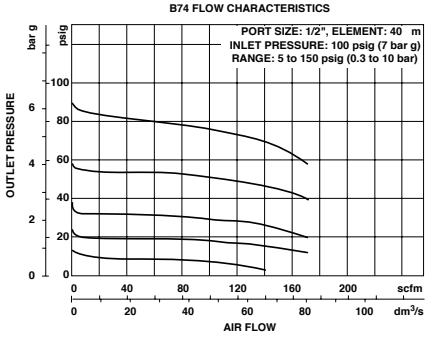


Series	J	K	L	M	N	P	R	S	T	V
72	0.31	1.93	1.50	2.50	1.18	0.94	–	0.17	0.31	0.59
73	0.67	2.52	1.50	2.76	1.50	1.50	0.98	0.28	–	–
74	0.94	3.50	2.05	3.39	2.20	1.38	0.91	0.28	–	–

Typical performance characteristics







UV Wastewater

Vertical Open Channel
Ultraviolet Disinfection

GLASCO UV

GLOW **VC** Series

Our Company

Glasco Ultraviolet has been manufacturing UV water and wastewater disinfection systems for over 50 years. We manufacture equipment for a variety of markets, industries and applications at our Northern New Jersey (USA) facility.

From our early history as a New York City based process equipment manufacturer for the food industries, to our over fifty years of ultraviolet "UV" disinfection system fabrication, Glasco has been and will continue to be a high quality supplier for all of your project needs.

In the 1940's, Glasco was committed to supporting manufacturers during the war effort. Even then, our mission was to "build and design any handling equipment made of metal that will enable you to process or fabricate more expeditiously or more efficiently".

Since the 1960's, Glasco has manufactured tens of thousands of systems that use UV light to disinfect water, air and surfaces. The UV business originally developed in the industrial marketplace as a direct result of our ability to manufacture high-grade stainless steel material handling equipment and vessels that were food and beverage grade.

Today, Glasco manufactures a complete product range of UV disinfection systems for treating both clean and wastewater for the residential, commercial, industrial and various municipal marketplaces.

Our systems integrate ultraviolet lamps to provide environmentally friendly disinfection. UVC light, defined as UV light emitted at wavelengths between 200 and 300 (254 is peak) nanometers (nm), is used as a means of disinfection by inactivating microorganisms, including waterborne pathogens. UV irradiation has been proven to be a fast, reliable, effective, economical, and environmentally friendly disinfection method and has been successfully applied worldwide for decades.

UVC lights targets the microorganisms' DNA. Exposure to UVC light prevents the microorganism from reproducing and cells that cannot reproduce cannot infect and are therefore harmless.

Glasco has integrated today's best tested technologies into our current offerings of vertically oriented open channel wastewater treatment equipment. The GLOW **VC** Series.

1. UV Disinfection

When wastewater pathogens are exposed to UV light, their cells become damaged and this damage inhibits reproduction. The UV light, produced by a special UV lamp, damages the cell's DNA and RNA and once damaged, they are unable to replicate. This physical process renders them harmless.

2. The Kill

The amount of damage is a result of the lamp's UVC intensity multiplied by the residence time. The dosage is commonly referred to as microwatts and is often expressed as mJ/cm2. Dosages of 30,000 uWs/cm2 (30 mJ) are common for meeting a 200/100 ml discharge permit.

3. Calculating Dose

There are a number of ways that the industry calculates dosage. The two primary methods are biological testing (bioassay) and mathematical calculations using light physics (Point Source Summation Method aka UVDIS) . Both offer end users with information that is important in system sizing. Each method takes into account flow rate, water transmission, lamp type and nubmer of lamps.

4. Why use UV?

UV disinfection is a well accepted method for treating wastewater. The main benefits of UV are that it is a green technology (no chemicals), that it does not require a long residence time and the technology has matured over the last 25 years. UV disinfection produces no by harmful by-products and will work on a wide range of effluent quality.

1 VCS-40-HO-30”

VCS-40-HO is designed to treat wastewater flows between 500,000 to 1,500,000 US GPD. Each module treats 750,000 GPD and has been engineered to operate in a channel that maintains a 30” water level. Lamp: Low pressure high output 80 watts.

2 VC-40-HO-60”

VC-40-HO is designed to treat wastewater flows between 1.0 to unlimited MGD. Each module treats 2+ MGD and has been engineered to operate in a channel that maintains a 60” water level. Lamp technology: Low pressure high output 155 watts.

3 VCS-40-A150-30”

VCS-40-A150 is designed to treat wastewater flows between 750,000 to 4,000,000 US GPD. The VCS-40-A150 is biologically validated to disinfect 1.5 MGD and operates in a 30” water level channel. Lamp: Low pressure high intensity amalgam 150 watts.

4 VC-40 & 48-A300-60”

VC-40-A300 & **48-A300** treat unlimited wastewater flows. The VC-40-A300 treats 4.0 MGD, while the VC-48-A300 treats 4.5 MGD and has been biologically validated. Both operate in a 60” water level channel. Lamp: Low pressure high intensity amalgam 320 watts.

Many Vertical Choices

Traditionally, vertical systems were only installed at large plants treating millions of gallons per day. These plants realized the many advantages that the vertical orientation had over traditional horizontal open channel systems. These include small footprint, efficienct flow pacing, lamp life savings and easier lamp and quartz maintenance.

Seeing that a major market segment (plants operating under 1 MGD) was not able to appreciate the benefits of a vertical oriented installation, Glasco UV designed the **VCS** line of products to work in plants that can integrate the system with 30” water.

Today, plants treating 500,000 GPD can integrate a vertical UV disinfection system.

Key Benefits

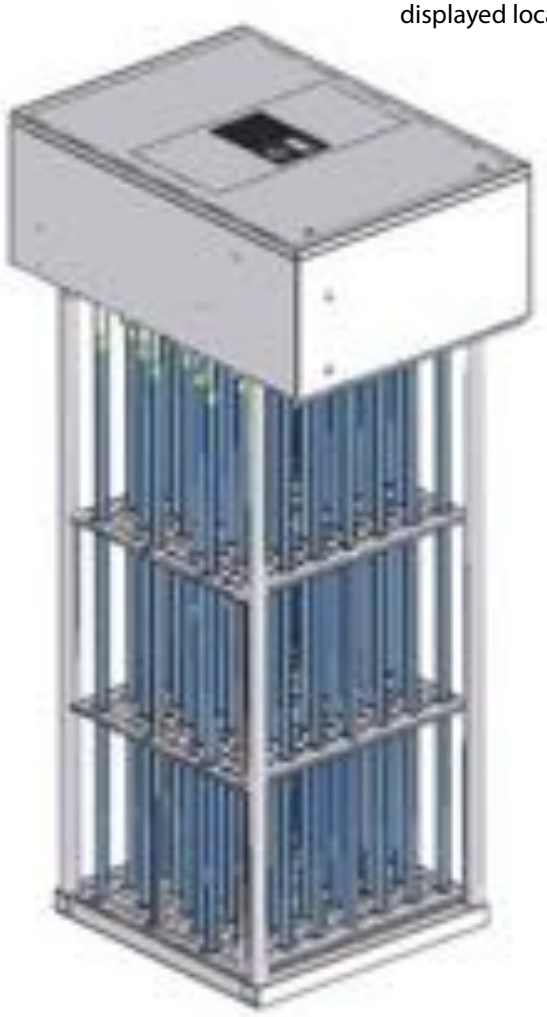
- Compact installation footprint
- All lamp seals above the water
- Easy lamp change
- Flow paced by turning lamps on and off - saving energy and lamp life.
- Staggered lamp design provides mixing
- Multi-lamp UV monitoring
- Automatic quartz cleaning
- Select models bioassayed at UV Validation and Research Center of New York, Johnstown, NY
- Hydraulically tested and profiled
- Environmental Technology Verification (ETV) test performed for NSF International (NSF) and the United States Environmental Protection Agency (EPA)

Automatic Quartz Cleaning System

Modules come standard with an automatic quartz cleaning system. The pneumatically driven piston uses a quick stroke approach to remove materials from the sleeves before they have the ability to build up and foul. System can use a standalone air compressor or have air supplied by the plant.

Ultraviolet Monitoring

Modules incorporate a UV light sensor and monitoring system . The sensor is placed in its own dedicated quartz sleeve, which is cleaned as part of the automatic wiping system. The sensor reads 360 degrees of UV light and provides an output from 0-100%. Information is displayed locally and remotely.



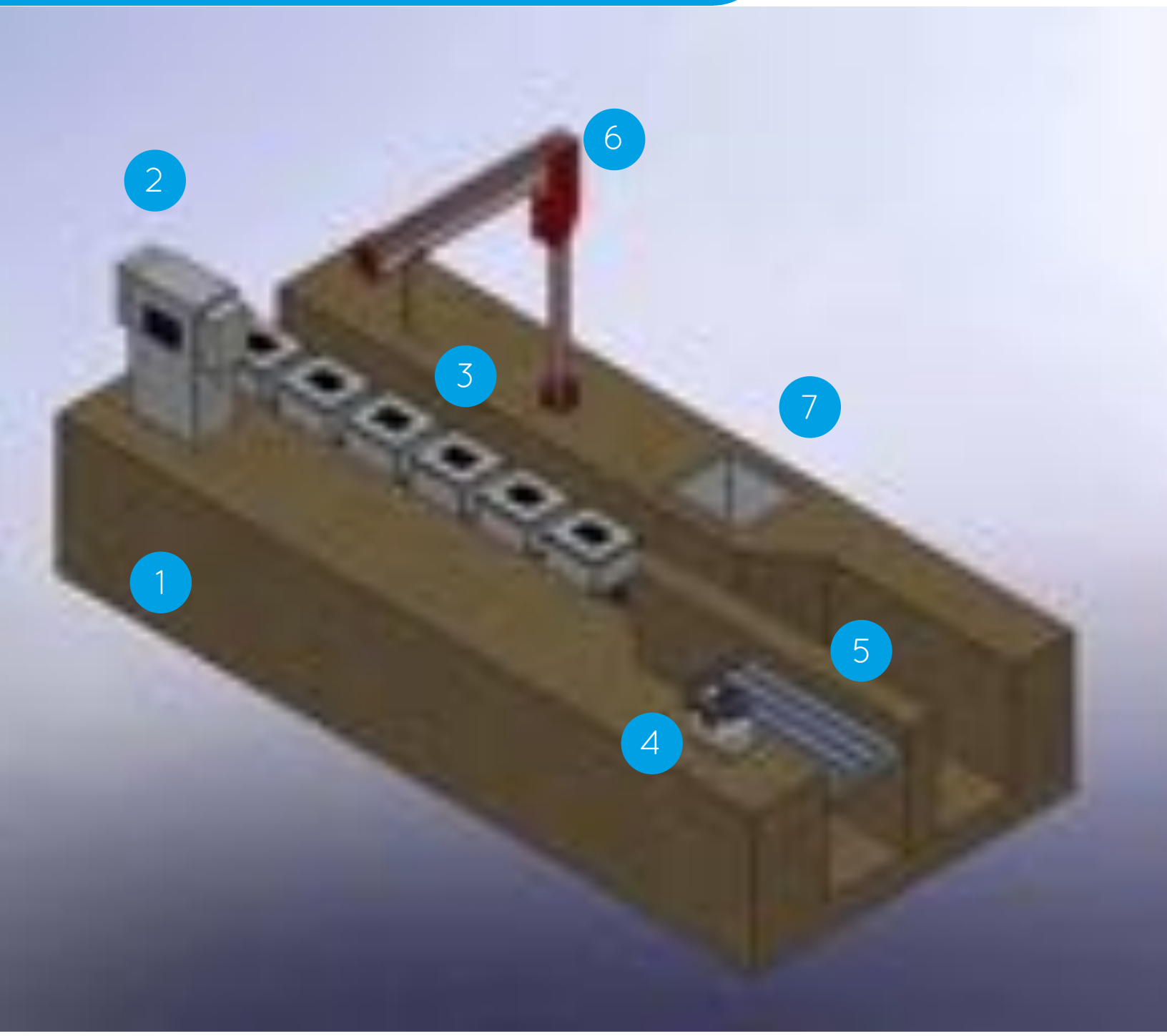
Lamp and System Maintenance

The ability to change lamps without removing the module or undoing any underwater seals, is one of the biggest benefits of the vertical installation. Operators have to simply open the module, unplug the lamps, pull them out, install the new lamps and close lid. This procedure is much easier and many times faster than re-lamping horizontal systems.

Controls and Displays

At a minimum, each vertical module will display lamp operating status, run time and UV output. For larger projects, a PLC can be provided for remote monitoring on a lamp by lamp basis, flow pacing based on a 4-20 mA signal from plant flow meter and automatic operation.

GLOW Vertical Plant Overview



1. Concrete Channel
2. PDC / SCC
3. Modules
4. Automatic Clean
5. Level Control
6. Hoist
7. Dip Tank

About UV lamp technology

Not all lamps or UV systems are created equal. Manufacturers will tout the benefits of their lamp type.

The main UV lamps being used are low pressure (standard, high output and amalgam) and medium pressure.

The difference between low pressure and medium pressure is one of efficiency. Low pressure UV lamps produce the majority (90%+) of their output in 254 nm range. Medium pressure UV lamps produce a significant amount less (15%).

Low pressure lamps are rated by their watts. Standard output is 65 W, High Output is 155 W and Amalgam lamps come in various outputs ranging from 270 to 1000 Watts.

Lamps produce 35% of their output in UVC watts and will typically last between 9,000 - 12,000 hours.

Vertical Operation

Modules are lowered into their stainless steel support systems via a hoist. Once in place, the module's utilities (power, data and air) are connected to the Power Distribution Center (PDC) and System Control Center (SCC).

As the wastewater enters the channel, portions of the modules will turn on in relationship to a flow signal. This allows the plant to use only the required lamps which saves energy and costs associated with lamp replacements.

The staggered vertical lamp array provides for mixing and redundancy. The level control system insures that the wastewater is properly exposed to lethal doses of UV light.

The quartz sleeves and UV sensor are automatically cleaned on a periodic basis. The protective sleeves are wiped to prevent build up from adhering to the quartz.

Operators inspect the system to ensure that the lamps are functioning and that they are still producing actual UV light. Lamp out and low UV output indicators and alarms will direct operators to the service issue.

Modules are removed from the channel for seasonal storage or for supplemental hosing or citric acid dipping.

Service

VCS-40-HO	
Number of lamps	40 x 80 Watts
Power	3.4 kW
Voltage	120-277 50/60 Hz
Flow rate	750,000 GPD
Dosage	30 mJ @ 65% UVT
Headloss	1/4" (1" at 1.5 MGD with 2 modules)
Water level	30"
Channel width	22.5"
Channel height	30"
Module weight	250 lbs

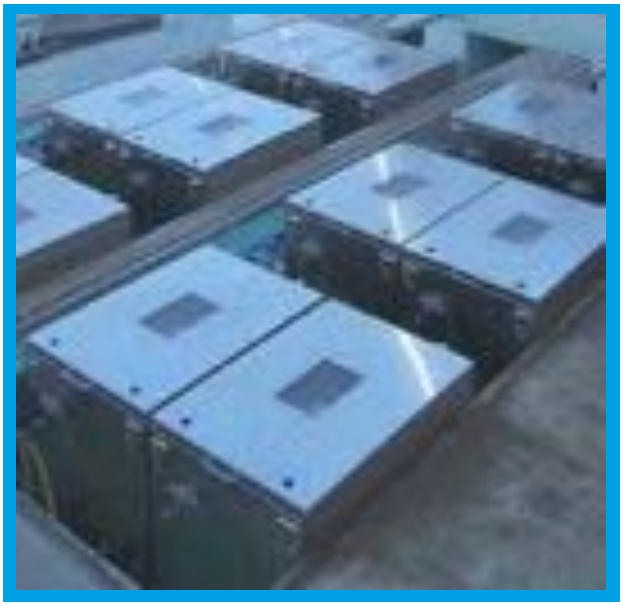
The **VCS-40-HO** is our offering for lower flow rates (<750,000 per module) and is designed to treat a 30" water level . The system has been designed for wastewater plants that would normally only have the option for horizontal installations.

Systems are good for smaller towns, industries, mobile home parks and new developments.

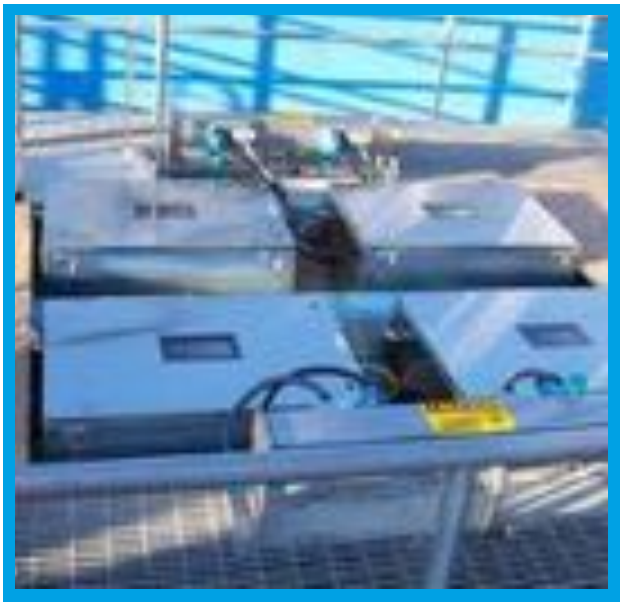
The **VC-40-HO** is our offering for plants exceeding 1.0 MGD and is designed to treat a 60" water level . The system has been designed for wastewater plants that have the ability to use a deeper channel.

Systems are good for mid to large size wastewater treatment plants.

VC-40-HO	
Number of lamps	40 x 155 Watts
Power	6.2 kW
Voltage	120-277 50/60 Hz
Flow rate	2.0 MGD
Dosage	30 mJ @ 65% UVT
Headloss	1/4" (1.5" at 4.0 MGD with 2 modules)
Water level	60"
Channel width	22.5"
Channel height	68"
Module weight	350 lbs



VCS-40-A150	
Number of lamps	40 x 150 Watts
Power	7.0 kW
Voltage	230 50/60 Hz
Flow rate	1.5 US MGD
Dosage	30 mJ @ 65% UVT
Headloss	1/2" (3" at 3 MGD with 2 modules)
Water level	30"
Channel width	22.5"
Channel height	30"
Module weight	250 lbs



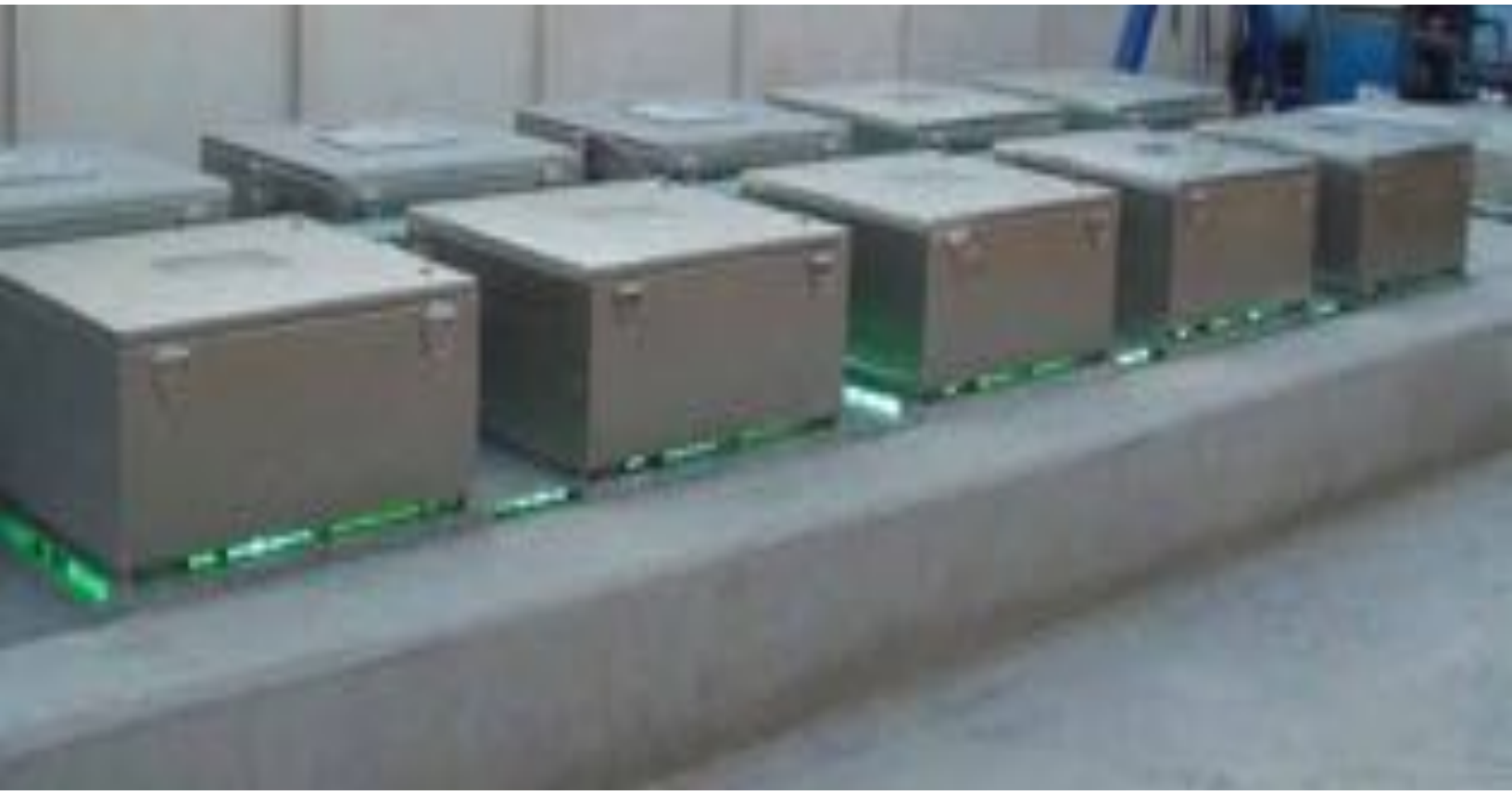
The **VCS-40-A150** is our biologically validated vertical amalgam based offering exceeding 1.0 MGD and is designed to treat a 30" water level .

The **VCS-40-A150** has been validated in cooperation with the NSF and the US EPA's Environmental Technology Verification Program (ETV). This program allows performance verification of innovative environmental technologies.

The **VC-48-A300** large flow vertical amalgam disinfection system was validated in conformance with current UV validation protocols, including NWRI/AwwaRF UV guidelines for Drinking Water and Water Reuse (2003) by HydroQual at the Johnstown NY Validation Center.

The results of the T1 and MS2 Reduction Equivalent Dose (RED) was established over an operating range of 50% to 80% UVT and flow rates from 0.4 to 8 MGD.

VC-48-A300	
Number of lamps	48 x 320 Watts
Power	15.4 kW
Voltage	230 50/60 Hz
Flow rate	4.5 MGD
Dosage	30 mJ @ 65% UVT
Headloss	1/4" (1.5" at 4.0 MGD with 2 modules)
Water level	60"
Channel width	30"-33"
Channel height	68"
Module weight	450 lbs



Installations and Design

Experience

Today, Glasco supports hundreds of our wastewater plants around the world from our NJ USA based manufacturing facility.

We constantly strive to improve our technologies and have been at the forefront of the technology for the last 10 years.

We constantly test and integrate the best components from around the world to manufacture our vertical UV disinfection systems.

Our vertical amalgam based systems have been biologically validated to the most current standards by HydroQual at the Johnstown NY UV Validation Center.

- 2001 installed the first vertical 30" high output system
- 2003 installed the first vertical amalgam installation in US - 10 years of succesful operation on a water re-use plant. USA.
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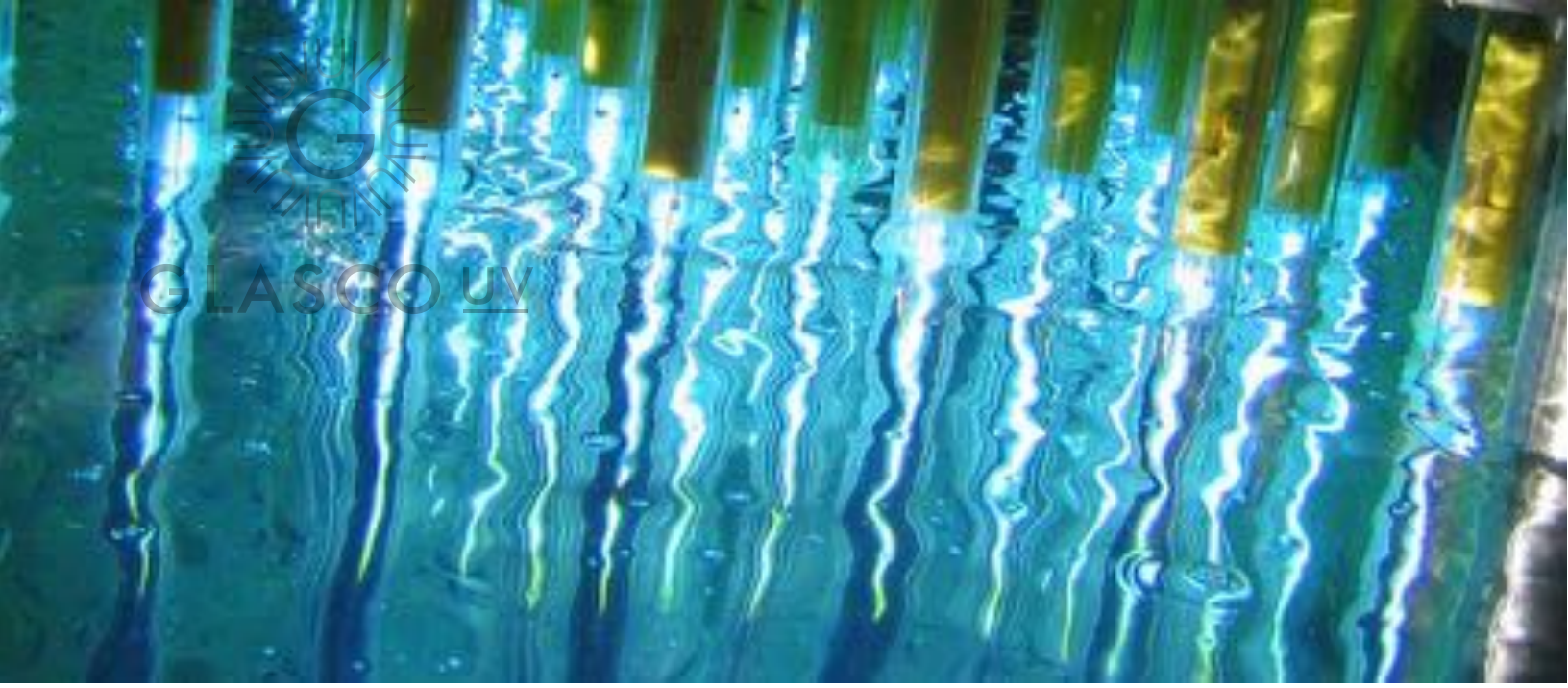
UV Wastewater

Vertical Open Channel
Ultraviolet Disinfection

GLASCO UV



GLOW **VC** Series

Our Company

Glasco Ultraviolet has been manufacturing UV water and wastewater disinfection systems for over 50 years. We manufacture equipment for a variety of markets, industries and applications at our Northern New Jersey (USA) facility.

From our early history as a New York City based process equipment manufacturer for the food industries, to our over fifty years of ultraviolet "UV" disinfection system fabrication, Glasco has been and will continue to be a high quality supplier for all of your project needs.

In the 1940's, Glasco was committed to supporting manufacturers during the war effort. Even then, our mission was to "build and design any handling equipment made of metal that will enable you to process or fabricate more expeditiously or more efficiently".

Since the 1960's, Glasco has manufactured tens of thousands of systems that use UV light to disinfect water, air and surfaces. The UV business originally developed in the industrial marketplace as a direct result of our ability to manufacture high-grade stainless steel material handling equipment and vessels that were food and beverage grade.

Today, Glasco manufactures a complete product range of UV disinfection systems for treating both clean and wastewater for the residential, commercial, industrial and various municipal marketplaces.

Our systems integrate ultraviolet lamps to provide environmentally friendly disinfection. UVC light, defined as UV light emitted at wavelengths between 200 and 300 (254 is peak) nanometers (nm), is used as a means of disinfection by inactivating microorganisms, including waterborne pathogens. UV irradiation has been proven to be a fast, reliable, effective, economical, and environmentally friendly disinfection method and has been successfully applied worldwide for decades.

UVC lights targets the microorganisms' DNA. Exposure to UVC light prevents the microorganism from reproducing and cells that cannot reproduce cannot infect and are therefore harmless.

Glasco has integrated today's best tested technologies into our current offerings of vertically oriented open channel wastewater treatment equipment. The GLOW **VC** Series.

1. UV Disinfection

When wastewater pathogens are exposed to UV light, their cells become damaged and this damage inhibits reproduction. The UV light, produced by a special UV lamp, damages the cell's DNA and RNA and once damaged, they are unable to replicate. This physical process renders them harmless.

2. The Kill

The amount of damage is a result of the lamp's UVC intensity multiplied by the residence time. The dosage is commonly referred to as microwatts and is often expressed as mJ/cm2. Dosages of 30,000 uWs/cm2 (30 mJ) are common for meeting a 200/100 ml discharge permit.

3. Calculating Dose

There are a number of ways that the industry calculates dosage. The two primary methods are biological testing (bioassay) and mathematical calculations using light physics (Point Source Summation Method aka UVDIS) . Both offer end users with information that is important in system sizing. Each method takes into account flow rate, water transmission, lamp type and nubmer of lamps.

4. Why use UV?

UV disinfection is a well accepted method for treating wastewater. The main benefits of UV are that it is a green technology (no chemicals), that it does not require a long residence time and the technology has matured over the last 25 years. UV disinfection produces no by harmful by-products and will work on a wide range of effluent quality.

1 VCS-40-HO-30”

VCS-40-HO is designed to treat wastewater flows between 500,000 to 1,500,000 US GPD. Each module treats 750,000 GPD and has been engineered to operate in a channel that maintains a 30” water level. Lamp: Low pressure high output 80 watts.

2 VC-40-HO-60”

VC-40-HO is designed to treat wastewater flows between 1.0 to unlimited MGD. Each module treats 2+ MGD and has been engineered to operate in a channel that maintains a 60” water level. Lamp technology: Low pressure high output 155 watts.

3 VCS-40-A150-30”

VCS-40-A150 is designed to treat wastewater flows between 750,000 to 4,000,000 US GPD. The VCS-40-A150 is biologically validated to disinfect 1.5 MGD and operates in a 30” water level channel. Lamp: Low pressure high intensity amalgam 150 watts.

4 VC-40 & 48-A300-60”

VC-40-A300 & **48-A300** treat unlimited wastewater flows. The VC-40-A300 treats 4.0 MGD, while the VC-48-A300 treats 4.5 MGD and has been biologically validated. Both operate in a 60” water level channel. Lamp: Low pressure high intensity amalgam 320 watts.

Many Vertical Choices

Traditionally, vertical systems were only installed at large plants treating millions of gallons per day. These plants realized the many advantages that the vertical orientation had over traditional horizontal open channel systems. These include small footprint, efficienct flow pacing, lamp life savings and easier lamp and quartz maintenance.

Seeing that a major market segment (plants operating under 1 MGD) was not able to appreciate the benefits of a vertical oriented installation, Glasco UV designed the **VCS** line of products to work in plants that can integrate the system with 30” water.

Today, plants treating 500,000 GPD can integrate a vertical UV disinfection system.

Key Benefits

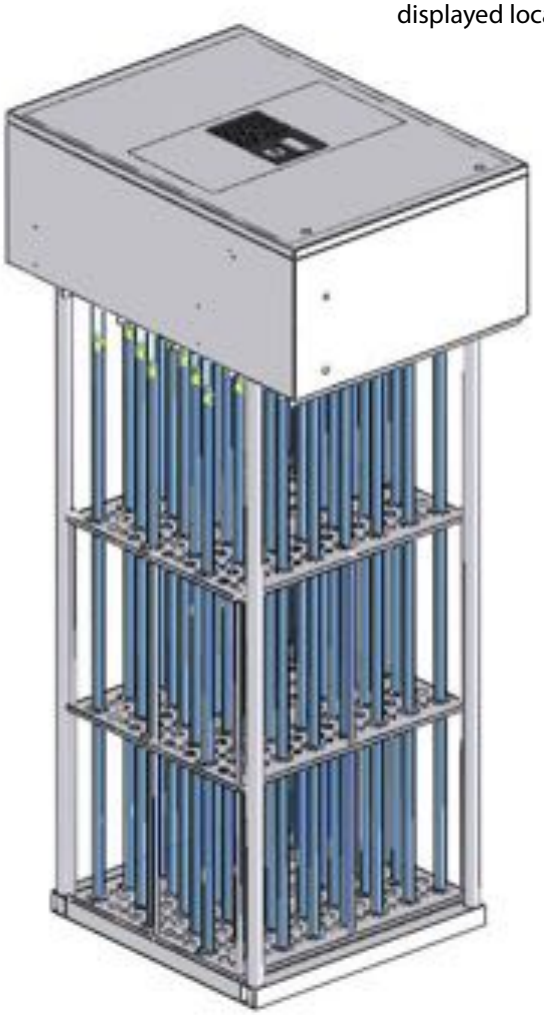
- Compact installation footprint
- All lamp seals above the water
- Easy lamp change
- Flow paced by turning lamps on and off - saving energy and lamp life.
- Staggered lamp design provides mixing
- Multi-lamp UV monitoring
- Automatic quartz cleaning
- Select models bioassayed at UV Validation and Research Center of New York, Johnstown, NY
- Hydraulically tested and profiled
- Environmental Technology Verification (ETV) test performed for NSF International (NSF) and the United States Environmental Protection Agency (EPA)

Automatic Quartz Cleaning System

Modules come standard with an automatic quartz cleaning system. The pneumatically driven piston uses a quick stroke approach to remove materials from the sleeves before they have the ability to build up and foul. System can use a standalone air compressor or have air supplied by the plant.

Ultraviolet Monitoring

Modules incorporate a UV light sensor and monitoring system . The sensor is placed in its own dedicated quartz sleeve, which is cleaned as part of the automatic wiping system. The sensor reads 360 degrees of UV light and provides an output from 0-100%. Information is displayed locally and remotely.



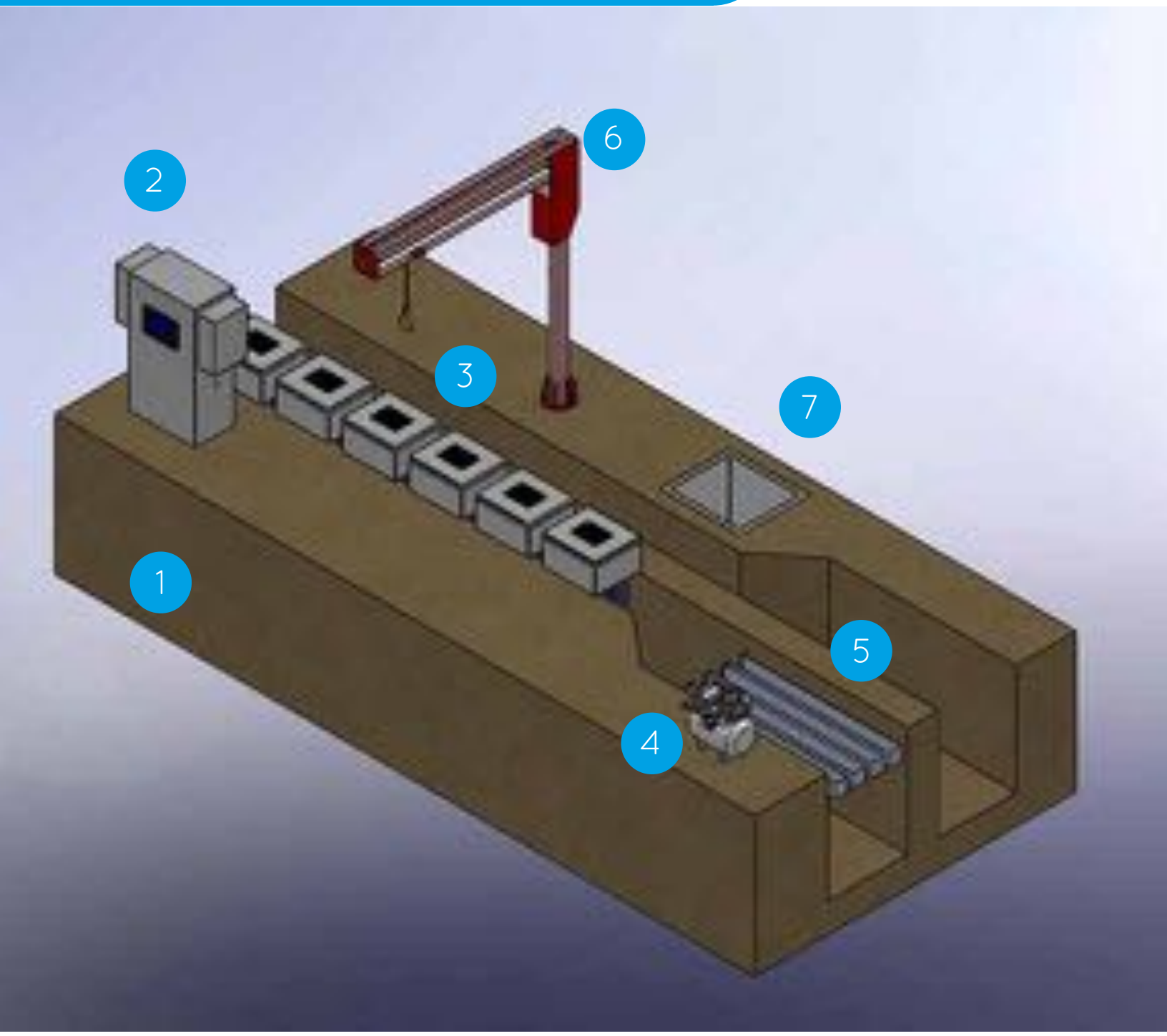
Lamp and System Maintenance

The ability to change lamps without removing the module or undoing any underwater seals, is one of the biggest benefits of the vertical installation. Operators have to simply open the module, unplug the lamps, pull them out, install the new lamps and close lid. This procedure is much easier and many times faster than re-lamping horizontal systems.

Controls and Displays

At a minimum, each vertical module will display lamp operating status, run time and UV output. For larger projects, a PLC can be provided for remote monitoring on a lamp by lamp basis, flow pacing based on a 4-20 mA signal from plant flow meter and automatic operation.

GLOW Vertical Plant Overview



1. Concrete Channel
2. PDC / SCC
3. Modules
4. Automatic Clean
5. Level Control
6. Hoist
7. Dip Tank

About UV lamp technology

Not all lamps or UV systems are created equal. Manufacturers will tout the benefits of their lamp type.

The main UV lamps being used are low pressure (standard, high output and amalgam) and medium pressure.

The difference between low pressure and medium pressure is one of efficiency. Low pressure UV lamps produce the majority (90%+) of their output in 254 nm range. Medium pressure UV lamps produce a significant amount less (15%).

Low pressure lamps are rated by their watts. Standard output is 65 W, High Output is 155 W and Amalgam lamps come in various outputs ranging from 270 to 1000 Watts.

Lamps produce 35% of their output in UVC watts and will typically last between 9,000 - 12,000 hours.

Vertical Operation

Modules are lowered into their stainless steel support systems via a hoist. Once in place, the module's utilities (power, data and air) are connected to the Power Distribution Center (PDC) and System Control Center (SCC).

As the wastewater enters the channel, portions of the modules will turn on in relationship to a flow signal. This allows the plant to use only the required lamps which saves energy and costs associated with lamp replacements.

The staggered vertical lamp array provides for mixing and redundancy. The level control system insures that the wastewater is properly exposed to lethal doses of UV light.

The quartz sleeves and UV sensor are automatically cleaned on a periodic basis. The protective sleeves are wiped to prevent build up from adhering to the quartz.

Operators inspect the system to ensure that the lamps are functioning and that they are still producing actual UV light. Lamp out and low UV output indicators and alarms will direct operators to the service issue.

Modules are removed from the channel for seasonal storage or for supplemental hosing or citric acid dipping.

Service

VCS-40-HO	
Number of lamps	40 x 80 Watts
Power	3.4 kW
Voltage	120-277 50/60 Hz
Flow rate	750,000 GPD
Dosage	30 mJ @ 65% UVT
Headloss	1/4" (1" at 1.5 MGD with 2 modules)
Water level	30"
Channel width	22.5"
Channel height	30"
Module weight	250 lbs

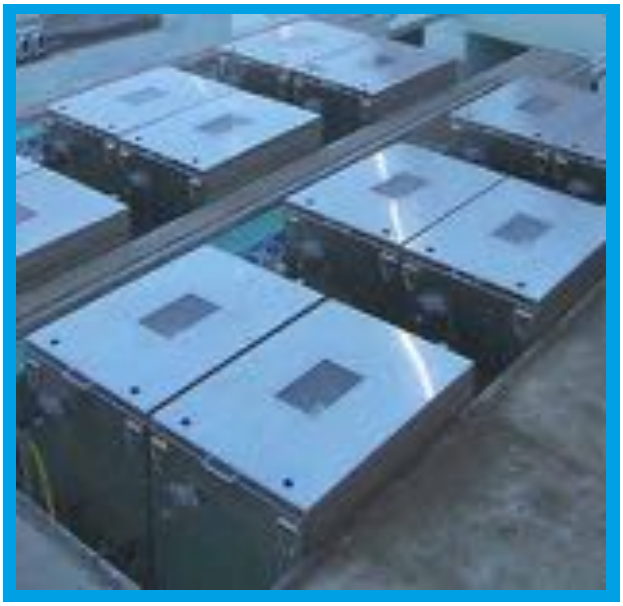
The **VCS-40-HO** is our offering for lower flow rates (<750,000 per module) and is designed to treat a 30" water level . The system has been designed for wastewater plants that would normally only have the option for horizontal installations.

Systems are good for smaller towns, industries, mobile home parks and new developments.

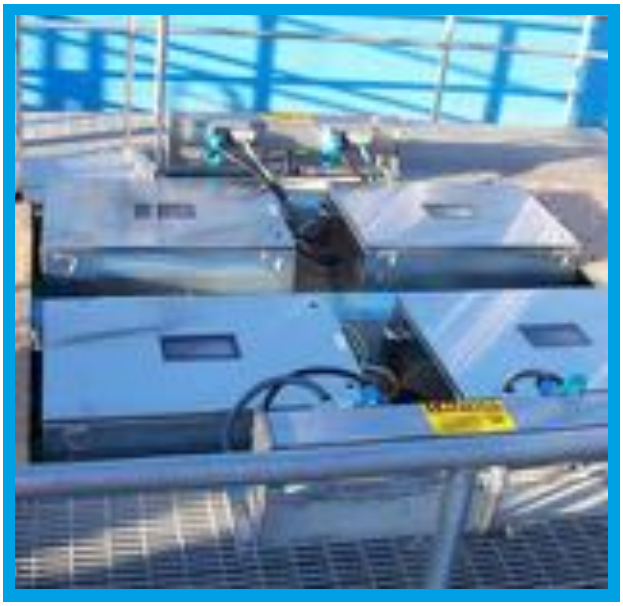
The **VC-40-HO** is our offering for plants exceeding 1.0 MGD and is designed to treat a 60" water level . The system has been designed for wastewater plants that have the ability to use a deeper channel.

Systems are good for mid to large size wastewater treatment plants.

VC-40-HO	
Number of lamps	40 x 155 Watts
Power	6.2 kW
Voltage	120-277 50/60 Hz
Flow rate	2.0 MGD
Dosage	30 mJ @ 65% UVT
Headloss	1/4" (1.5" at 4.0 MGD with 2 modules)
Water level	60"
Channel width	22.5"
Channel height	68"
Module weight	350 lbs



VCS-40-A150	
Number of lamps	40 x 150 Watts
Power	7.0 kW
Voltage	230 50/60 Hz
Flow rate	1.5 US MGD
Dosage	30 mJ @ 65% UVT
Headloss	1/2" (3" at 3 MGD with 2 modules)
Water level	30"
Channel width	22.5"
Channel height	30"
Module weight	250 lbs

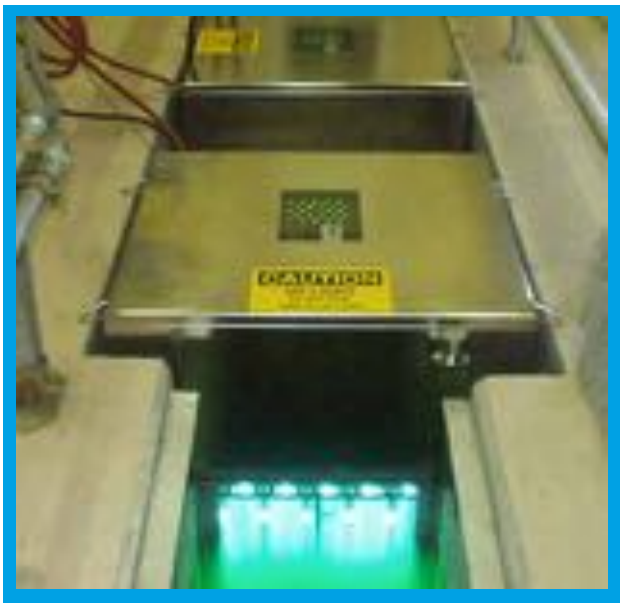


The **VCS-40-A150** is our biologically validated vertical amalgam based offering exceeding 1.0 MGD and is designed to treat a 30" water level .

The **VCS-40-A150** has been validated in cooperation with the NSF and the US EPA's Environmental Technology Verification Program (ETV). This program allows performance verification of innovative environmental technologies.

The **VC-48-A300** large flow vertical amalgam disinfection system was validated in conformance with current UV validation protocols, including NWRI/AwwaRF UV guidelines for Drinking Water and Water Reuse (2003) by HydroQual at the Johnstown NY Validation Center.

The results of the T1 and MS2 Reduction Equivalent Dose (RED) was established over an operating range of 50% to 80% UVT and flow rates from 0.4 to 8 MGD.



VC-48-A300	
Number of lamps	48 x 320 Watts
Power	15.4 kW
Voltage	230 50/60 Hz
Flow rate	4.5 MGD
Dosage	30 mJ @ 65% UVT
Headloss	1/4" (1.5" at 4.0 MGD with 2 modules)
Water level	60"
Channel width	30"-33"
Channel height	68"
Module weight	450 lbs

Installations and Design

Experience

Today, Glasco supports hundreds of our wastewater plants around the world from our NJ USA based manufacturing facility.

We constantly strive to improve our technologies and have been at the forefront of the technology for the last 10 years.

We constantly test and integrate the best components from around the world to manufacture our vertical UV disinfection systems.

Our vertical amalgam based systems have been biologically validated to the most current standards by HydroQual at the Johnstown NY UV Validation Center.

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