RK2 SYSTEMS

PRO-TECT UV

Efficient, Intuitive, And Practical UV Solutions

RK2 Systems
Aquatic Life Support

PRO-TECT UV SYSTEMS

BY RK2

Pro-Tect UV Systems feature durable, non-corrosive schedule 80 PVC reaction chambers. The schedule 80 PVC is more robust when compared to HDPE or polypropylene models and offers significant cost reduction when compared to 316 Stainless Steel. Pro-Tect UV systems are rated for operating pressures of up to 150 PSI*. The "L" shaped design used allows for proper hydraulic mixing inside the UV reacation chamber and optimizes the UV dose.

Pro-Tect UV systems utilize a single end lamp and quartz sleeve access that simplify maintenance and reduce over all cost associated with operating a UV system. Changing lamps and sleeves has never been easier. A quick "no tool needed" design allows for easy removal of lamp cables with without the risk of twisting cables and causing damage. A special fitting allows the lamp cable to remain in place while the lamp nut is spun. A simple o-ring seal allows for easy changing of sleeves without the risk of breaking by removing thick walled rubber gaskets that tend to become brittle and stick to the sleeve. With Pro-Tect UV systems you'll no longer need to worry about proper lamp placement. The distance from the cable crimp to the lamp connector are pre-set at the factory, allowing for proper placement of the lamp everytime.

All Pro-Tect UV systems feature an over temperature safety cutoff. What makes Pro-Tects' temperature sensor different is that unlike other models with sensors in the main portion of the body or vessel, our sensor is located in the lamp bulkhead or endplate. Locating the sensor in the endplate protects critical sealing components from overheating and failing due to the close proximity of the lamp filament (hottest part of the system).

Pro-Tect UV HMI Controllers are manufactured using non-corrosive thermoplastic or fiberglass enclosures. Our HMI contollers have a NEMA Type 12 rating and are 508A UL listed. Pro-Tect's HMI control packages are user friendly and feature a color touch screen display showing basic operating status of the UV system and alerts users to any problems related to the UV system. Both the standard HMI and Pro Series packages include the over tempature safeycutoff as standard options.Upgrading to the optional HMI Pro series control package expands the capabilities of your Pro-Tect UV system. The HMI Pro series offers a larger color touch screen display and more advanced monitoring and control options.

PRO-TECT UV FEATURES

PRO-TECT UV FEATURES

• Corrosion Proof Schedule 80 PVC- stronger and can handle higher pressures when compared to HDPE and polypropylene reactors.

• Single end lamp and sleeve access makes for easy maintenance

• Correct, repeatable lamp placement 100% of the time

• Standard over temperature safety cutoff switch- turns the lamps off when water reaches 120F, preventing damage from overheating.

• Temperature sensor location- located in lamp endplate, the hottest part of uv reaction chamber.

• American made Low Pressure Amalgam (ALH) and High Output (HLH) UV lamps. These lamps are designed for 12,000 hours of continuous use and are 80% efficient after 12,000 hours

• Electric Ballasts are matched to the performance of the required lamp for optimal UV-C output and longest useful lamp life.

Standard HMI Controller Features

- 3.5" x 3.5" Color touch screen display
- Lamp Monitoring: Status and alarm
- Input voltage monitor and alarm
- Reactor water temperature monitor, alarm, and safety cutoff
- Power supply enclosure temperature monitor and alarm
- Alarm output relay

Pro Series HMI Controller Features

- 4.3" x 4.3" or 5" x 5" Color touch screen display (Depending on number of lamps)
- Lamp Monitoring: Status and alarm
- Input voltage monitor and alarm
- Reactor water temperature monitor, alarm, and safety cutoff
- Power supply enclosure temperature monitor and alarm
- Alarm output relay
- UV Intensity monitor with UV Sensor
- Remote On/Off capability

UV INFORMATION

Know What You Are Purchasing - All Quotes Are Not Equal

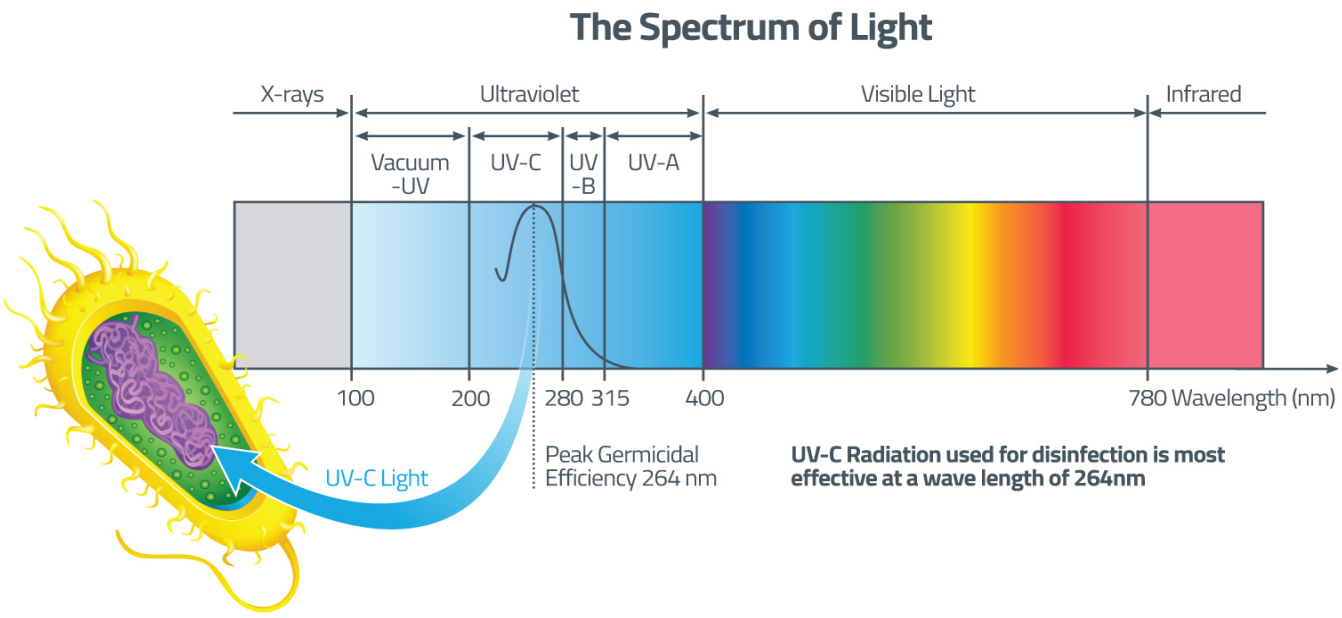
One of the primary jobs the sales and marketing team at RK2 has with relation to UltraViolet (UV) water treatment systems-is customer education. 'Why is that?' you may ask. Unfortunately, while the concept of UV treatment appears simple, the actual application of the technology is anything but. In fact, capable OEM suppliers take great care to ensure that the customer is able to meet their actual treatment needs, in all practical operational scenarios, today, and as the system ages. In many cases a potential customer may notice that one quote for a UV product may come in at a significantly higher cost than that of another. Good news, right? Lowest bid wins!

Well, perhaps the company that provided the lowest bid wins, but the real loser may be the customer. In the UV treatment industry, as in many others, it is the hidden or unknown factors that can greatly impact whether your system actually delivers the intended UV dose, or 'treatment', or not. In fact, UV water treatment is such a complex technology that the USEPA and other regulatory bodies worldwide have standardized sizing and application regulations for municipal drinking water and waste water.

While aquaculture does not abide by regulations per se (there are regulated aquaculture applications in some countries), capable OEM suppliers use these regulations as guidelines to ensure that the customer has the treatment they require when they purchased their UV system-to ensure adequate protection of their investments at all times.

UV treatment - Basics you need to know about UV-C and UV Dose
As with any technology, fundamental knowledge is key to understanding the products you purchase. As a customer, being an expert in a given technology is not required. However, the more knowledge you have, the more likely you are to be a satisfied customer. To that end, it may be helpful to explain some of the key areas of interest with regards to UV water treatment.

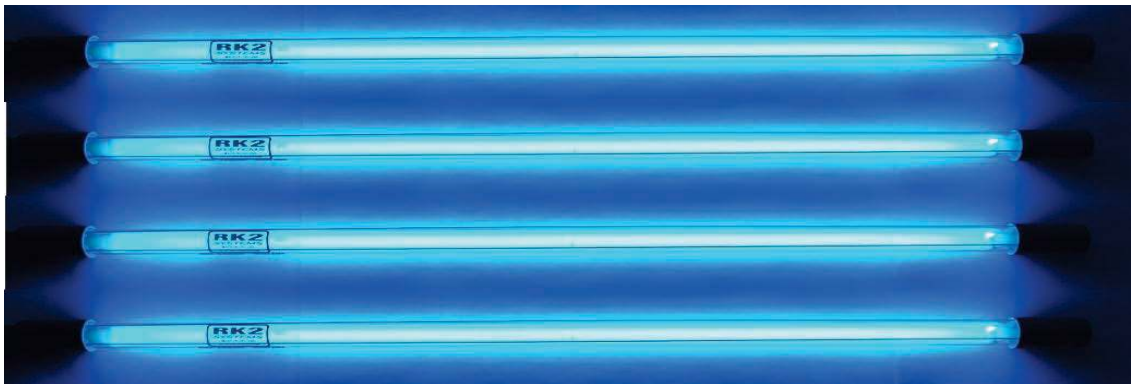
UV Spectrum - There are four primary parts of the UV spectrum: UV-A and UV-B can make it through the earth's atmosphere. UV-C and UV Vacuum are blocked by the earth's atmosphere. In disinfection typically only UV-C is used.



UV INFORMATION

UV-C Intensity - The amount of UV-C light that is emitted by a light source is called the 'lamp intensity'. This is typically listed as mW/cm2. UV-C for disinfection is usually measured only at the wavelength of 254 nm and is not visible to the human eye.

Types of Lamps- There are three primary types of light sources used in aquaculture UV water treatment.



Low-Pressure and Low-Pressure High-Output lamps - These are the most efficient lamps at about 35 percent, or even more. However, these lamps are also relatively low power, so more lamps are required for a given application. In addition, these lamps are more sensitive to changes in water temperature - water temperatures must be taken into account by the system designers. This type of lamp is typically very reliable. These lamps are considered to be monochromatic, as the useful UV-C output is almost all at 254 nm. These lamps like to run at about 40°C for maximum output.

Amalgam Lamps - These are the primary 'go to' lamps in many treatment systems. In addition to high efficiency in the 33-to-35 percent range, they have relatively high intensity, and great reliability. These lamps like to run at roughly ~110°C for maximum output. All of these factors allow for an efficient, thermally stable and relatively compact system design.

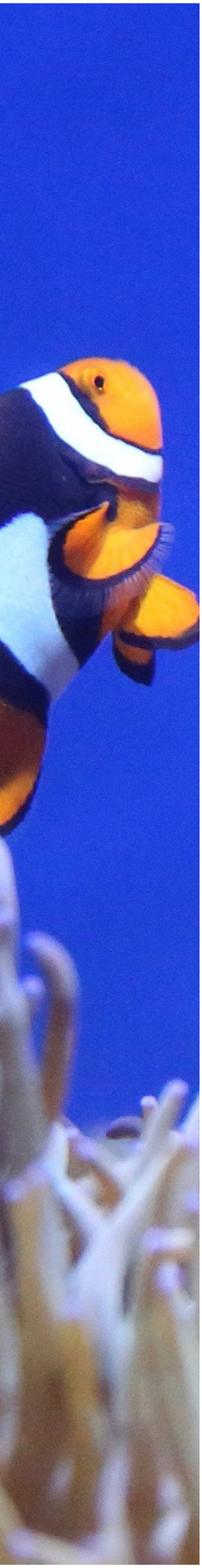
Medium-Pressure (high-pressure) Lamps - Oversimplifying, medium-pressure lamps are basically low-pressure lamps with more mercury and driven with much higher currents and voltages. When mercury lamps are overdriven, they do not glow anymore, they create an arc. These arcs emit 254nm predominately, but also emits many other wavelengths. Some of these wavelengths are in the useful 220 nm to 280nm range-remember our inactivation curve? At 254nm these lamps are only about 8% efficient, however, if considering the range of 220-to-280nm for inactivation they are about ~11 percent efficient. In addition, medium-pressure lamps like to run at about 600 to 900°C. That is very hot. As well, these lamps operate at higher voltages and currents, which again can create some challenges to system designers. So why use them you may ask? They are very powerful for a given lamp arc length.

No other water treatment lamp can match medium-pressure lamps in raw intensity. A very intense lamp can mean a system that has very few lamps and is very compact. They do waste much more electrical power than the other lamp types, however, and are much more difficult to engineer to be reliable.

System Design

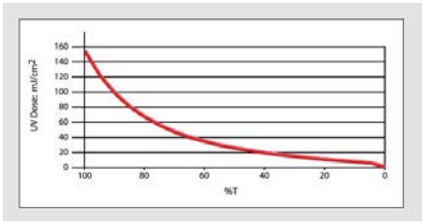
So now that we know that dose is intensity x time, and we understand light sources, we can design our system, right? Sort of. The dose can be delivered is various ways. A low system intensity (few lamps) and with a low flow rate can achieve the target dose. However, if a higher flow rate is required, more intensity is required to achieve the same dose as the targeted organism is typically in the UV system for a shorter period of time. We can either add more lamps or select a more powerful lamp. So now we can select the best lamp type, and number of lamps needed, in order to achieve the dose required in the most reliable, low cost and practical way possible? But, no, we can't yet. We must first take into account other factors, such as the UVT or light transmittance of the water at the wavelength the lamps operate at - 254nm. Visual light transmittance is not UVT.

UV INFORMATION



UVT, What is That?

UltraViolet Transmittance, usually referred to as UVT, is the percentage of light at 254nm that can go through a 1cm water layer of the water in question. While many factors can affect system design, UVT is probably the most misunderstood factor, and one of the biggest influences on system design. It is also one of the biggest factors that, if not accurately determined and accounted for, can cause the UV system to not be able to deliver the dose required. UVT is basically the measure of how much other elements in the water absorb UV-C. If this UV-C is absorbed by non-target organisms, it cannot do the work. UVT is measured with a specialized meter.Here is a rough analogy - If you are trying to read a poster just in front of you at night, but the light comes from across your yard from the top of a light standard, you will need a certain amount of visible light to be able to read it. If, however, there is in addition a light fog present, you will need much more light to be emitted. The fog is preventing your light source from doing the job intended-you need more light in order to complete the same task.



Turbidity is not UVT

While turbidity may affect UVT, it is related to visible light transmission ; remember , UVT is only related to the transmittance of photons in water at 254nm. Even visually clear water may have low
UVT, dependent on the contaminants present.

EOLL, Not Another Acronym!

As mentioned, when designing a UV system, the output of the lamp is used to determine the dose. Experienced and principled suppliers always design their UV systems based on the output of the lamp at the listed End-Of-Lamp-Life (EOLL), which is described in lamp hours. A 12,000-hour lamp, for example, has its UV-C output measured at that time for system design and sizing purposes.

By designing a UV system with EOLL UV-C output values, the engineer is then confident that the lamp, and thereby the system, will always deliver the minimum, or more, intensity and subsequent dose required.

Past the rated lamp lifetime, the dose requirement may not be met as the lamp UV-C output will be less than required. Typically, UV-C lamp output at end of lamp life is about 80-to-90 percent, as compared to a new lamp. This number however is not very important as the system design takes this into account- you will always have the required intensity, or more, if you change your lamps at end-of-lamp-life. UV-C output degradation is considered to be fairly linear over the lamp lifetime. Buyer Beware!

A system quote that comes in with very few lamps, as compared to other quotes, is likely not designed with end of-lamp- life taken into account. This means that, while you may receive proper dose at the beginning of lamp life, as soon as hours are accumulated on the lamps and output begins to drop, your system will not be providing the required dose!

If you targeted a three-log reduction of a specific organism you will receive that when the lamps are brand new, but as soon as the lamps age at all you will be delivering less than that requirement. Systems with EOLL taken into account will always deliver the minimum required dose or more.

UV INFORMATION

Sleeve Fouling

Fouling on the quartz lamp sleeve can block the passage of UV-C light. It can be biological or mineral- based. If you do not service your system as required, you are effectively reducing your applied UV-C intensity as it is blocked from getting to the water. Principled system designers add a small fouling

So, what is required information when ordering a UV treatment system?

Your application - Single pass, multi-pass (recirculation), etc.

Flow Rates - Normal, peak, do you have times with no flow? Do you ever flow water through the unit at higher than disinfection flow rates?

Target Organisms - Organisms of concern, UV-C delivered dose requirements.

Water Quality - UVT, turbidity.

Water temperature - Minimum and maximum required and present.

Installation Location - Indoors, outdoors, space availability for maintenance, i.e. lamp removal
Lamp or System Orientation - Vertical or horizontal.

The above information is the basic information required in order to design a UV system for your application. You supplier will also have other questions they can assist you in answering and will also help you to understand the 'why' behind your system design - as well as the 'what'.

RK2 Systems Is Customer Focused

Previously, we have discussed how to properly size and design a UV treatment system. RK2 can also help you determine, clarify and solidify the factors that will drive the system design. Did you know that many of these factors can change throughout the year? Care is taken to ensure that you, the customer, will have a UV system that protects your investment.

But what about service and support? One of the keys to a satisfied customer market is the support after the sale. Be it maintenance support, parts or just advice about the use and care of your UV system, a good supplier will always be there in a timely way to help you.

PATHOGEN CHART

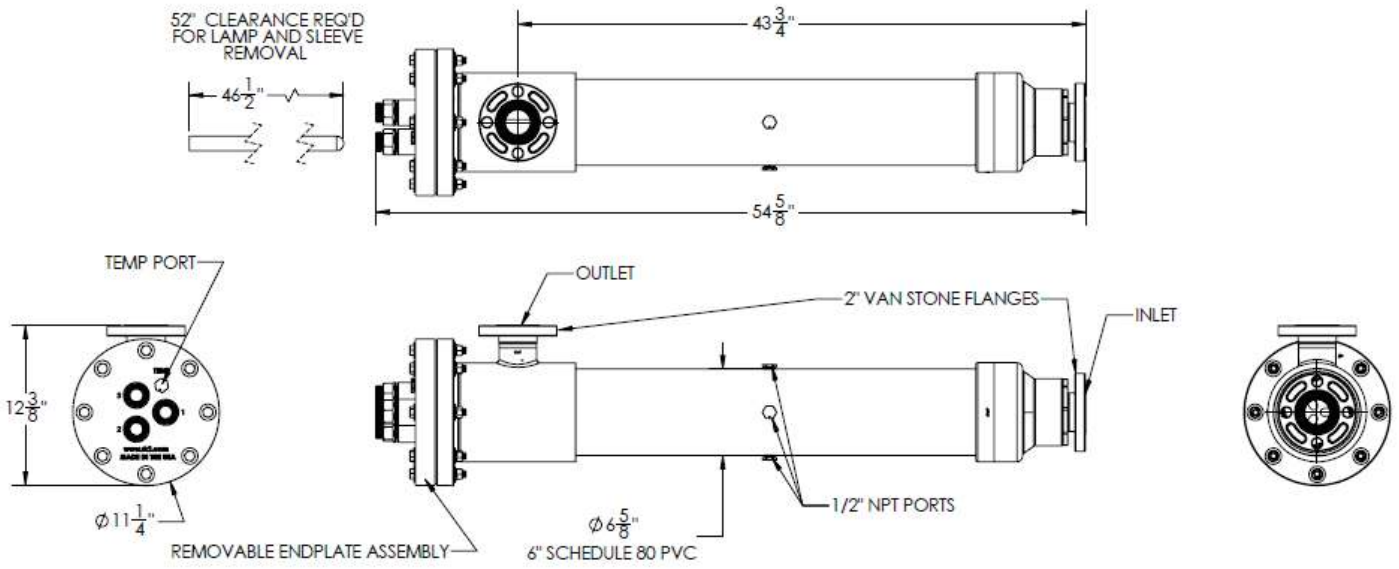
ALGAE	UV DOSE
Chlorella vulgaris	22 mJ/cm2
BACTERIA	**UV DOSE**
Aeromonas salmonicida	3.6 mJ/cm2 (log-3)
Pseudomonas fluorescens (fin rot)	11 mJ/cm2 (log-3)
Listeria monocytogenes	16 mJ/cm2 (log-5)
Streptococcus sp. (seawater)	20 mJ/cm2
Bacillus subtilis (spores)	22 mJ/cm2 (log-3)
Vibrio anguillarum	30 mJ/cm2
Yersinia ruckeri	30 mJ/cm2
BKD (Bacterial Kidney Disease)	60 mJ/cm2 (estimate)
Flavobacterium psychrophilum (Salmonid Bacterial Coldwater Disease)	126 mJ/cm2
Vibrio sp. (oyster)	155 mJ/cm2
PROTOZOA	**UV DOSE**
Sarcina lutea (Micrococcus luteus)	26 mJ/cm2 (log-3)
Ceratomyxa shasta	30 mJ/cm2 (log-3)
Perkinsus marinus (dermo disease)	30 mJ/cm2
Trichodina sp.	35 mJ/cm2 (log-3)
Myxobolus cerebralis (TAMs, Whirling Disease)	40 mJ/cm2
Ichthyophthirius multifiliis (freshwater white spot)	100 mJ/cm2
Amyloodinium ocellatum	105 mJ/cm2
Trichodina nigra	159 mJ/cm2
Cryptocaryon irritans (marine white spot)	280 mJ/cm2
Costia necatrix	318 mJ/cm2 (log-3)
VIRUS	**UV DOSE**
KHV (koi herpesvirus)	4 mJ/cm2
ISA (Infectious Salmon Anemia)	8 mJ/cm2
CCV (Channel Catfish Virus)	20 mJ/cm2
IHNV (Infectious Hematopoietic Necrosis/CHAB)	20 mJ/cm2
OMV (Oncorhynchus masou Virus)	20 mJ/cm2
IHNV (Infectious Hematopoietic Necrosis/RTTO)	30 mJ/cm2
VHS (Viral Hemorrhagic septicemia)	32 mJ/cm2
CSV (Chum Salmon Virus)	100 mJ/cm2
AHNV (Atlantic Halibut Nodavirus)	105 mJ/cm2
IPNV (Infectious Pancreatic Necrosis Virus)	246 mJ/cm2

Log-1 = 90%, Log-2 = 99%, Log-3 = 99.9%, Log-4 = 99.99%, Log-5 = 99.999%

UV doses not accompanied by a specific log value, should be considered a minimal dosage. The listed data was collected from various sources and RK2 Systems, Inc. does not accept any responsibility for the accuracy of this information. This information is meant to be

PRO-TECT UV MODELS ALH4 SERIES

The ALH4 series is our "L" configuration using 130 watt amalgam lamps. They are designed for medium to moderate flow applications that may require a smaller footprint. These models use shorter 130 watt amalgam lamps. Amalgam lamps offer approximatley twice the UV-C output compared to that of high output lamps used in our HLH series.

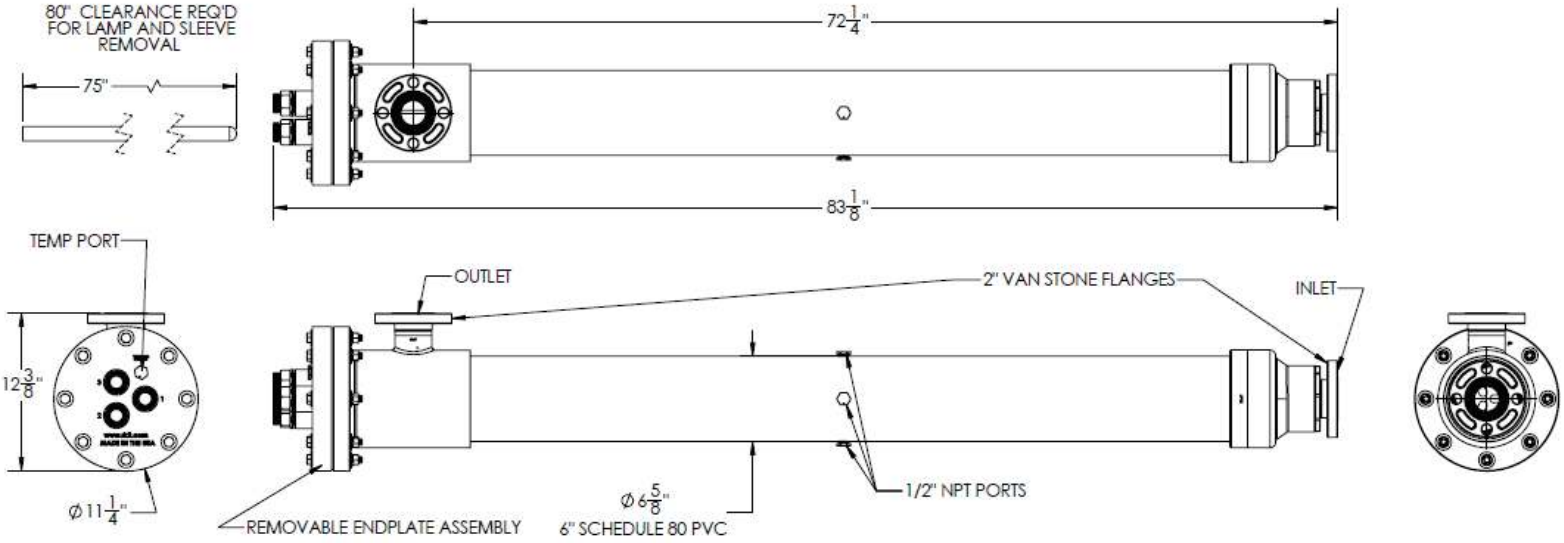


Model	Lamps#/ Watts	Input Watts	UVC Output	UV Vessel Dimensions AxBxC	Inlet/Outlet Sizes	Max PSI/BAR	Power Supply Dimensions HxWxD	Max Amps @ 120/230 VAC	Control Options	30 mJ/cm2 GPM/LPM	180 mJcm2 GPM/LPM
ALH41D6-XXX	1/130	130	40	56" x 6" x 47"	2", 3", 4"	150/10.3	16" x 14" x 8.4"	2.1/1.0	Basic HMI and HMI Pro Series	66/255	11/42
ALH42D6-XXX	2/130	260	80	56" x 6" x 47"	2", 3", 4"	150/10.3	16" x 14" x 8.4"	3.9/2.0	Basic HMI and HMI Pro Series	112/434	18/72
ALH43D6-XXX	3/130	390	120	56" x 6" x 47"	2", 3", 4"	150/10.3	16" x 14" x 8.4"	5.8/2.9	Basic HMI and HMI Pro Series	161/624	27/104
ALH43D8-XXX	3/130	390	120	62" x 8" x 51"	3", 4", 6"	150/10.3	16" x 14" x 8.4"	5.8/2.9	Basic HMI and HMI Pro Series	228/883	38/147
ALH44D8-XXX	4/130	520	160	62" x 8" x 51"	3", 4", 6"	150/10.3	20.2" x 16.3" x 8.4"	7.5/3.7	Basic HMI and HMI Pro Series	296/1,147	49/191
ALH45D8-XXX	5/130	650	200	62" x 8" x 51"	3", 4", 6"	150/10.3	24.6" x 20.2" x 10.6"	9.4/4.7	Basic HMI and HMI Pro Series	346/1,341	58/223
ALH46D10-XXX	6/130	780	240	64" x 10" x 51"	4", 6", 8"	120/8.3	24.6" x 20.2" x 10.6"	11.2/5.6	Basic HMI and HMI Pro Series	480/1,860	80/310
ALH47D10-XXX	7/130	910	280	64" x 10" x 51"	4", 6", 8"	120/8.3	24.6" x 20.2" x 10.6"	13.3/6.5	Basic HMI and HMI Pro Series	564/2,185	94/364
ALH47D12-XXX	7/130	910	280	69" x 12" x 51"	6", 8"	90/6.2	24.6" x 20.2" x 10.6"	13.3/6.6	Basic HMI and HMI Pro Series	648/2,511	108/418
ALH48D12-XXX	8/130	1,040	320	69" x 12" x 51"	6", 8"	90/6.2	30.5" x 24.1" x 12.6"	15.0/7.5	Basic HMI and HMI Pro Series	763/2,956	127/493

PRO-TECT UV MODELS

ALH6 SERIES

The ALH6 series is our “L” configuration using 320 watt amalgam lamps. These models are designed for moderate to high flow applications and for when space is not a concern. The amalgam lamps used offer approximatley twice the UV-C output compared to that of high output lamps used in our HLH series. Generally speaking our ALH6 series will also require less lamps when compared to our ALH4 series models due to the larger 320 watt lamp used.

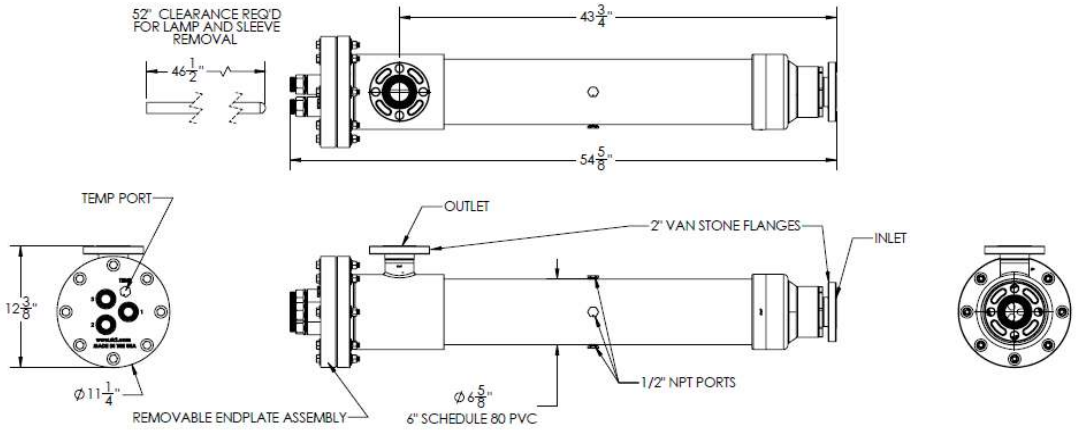


Model	Lamps#/ Watts	Input Watts	UVC Output	UV Vessel Dimensions AxBxC	Inlet/Outlet Sizes	Max PSI/BAR	Power Supply Dimensions HxWxD	Max Amps @ 120/230 VAC	Control Options	30 mJ/cm2 GPM/LPM	180 mJcm2 GPM/LPM
ALH61D6-XXX	1/320	320	98	85" x 6" x 76"	2", 3", 4"	150/10.3	24.6" x 20.2" x 10.6"	3.2/1.6	Basic HMI and HMI Pro Series	165/639	27/106
ALH62D6-XXX	2/320	640	196	85" x 6" x 76"	2", 3", 4"	150/10.3	24.6" x 20.2" x 10.6"	6.0/3.0	Basic HMI and HMI Pro Series	276/1,070	46/178
ALH63D6-XXX	3/320	960	294	85" x 6" x 76"	2", 3", 4"	150/10.3	24.6" x 20.2" x 10.6"	9.0/4.5	Basic HMI and HMI Pro Series	392/1,519	65/253
ALH63D8-XXX	3/320	960	294	86" x 8" x 76"	3", 4", 6"	150/10.3	24.6" x 20.2" x 10.6"	9.0/4.6	Basic HMI and HMI Pro Series	587/2,275	98/379
ALH64D8-XXX	4/320	1,280	392	86" x 8" x 76"	3", 4", 6"	150/10.3	24.6" x 20.2" x 10.6"	12.0/6.1	Basic HMI and HMI Pro Series	744/2,883	124/480
ALH65D8-XXX	5/320	1,600	490	86" x 8" x 76"	3", 4", 6"	150/10.3	24.6" x 20.2" x 10.6"	15.0/7.5	Basic HMI and HMI Pro Series	848/3,286	141/548
ALH66D10-XXX	6/320	1,920	588	88" x 10" x 76"	4", 6", 8"	120/8.3	30.5" x 24.1" x 12.6"	18.0/9.1	Basic HMI and HMI Pro Series	1,198/4,642	200/773
ALH67D10-XXX	7/320	2,240	686	88" x 10" x 76"	4", 6", 8"	120/8.3	30.5" x 24.1" x 12.6"	230 VAC 11.0	Basic HMI and HMI Pro Series	1,405/5,442	234/907
ALH67D12-XXX	7/320	2,240	686	90" x 12" x 76"	6", 8"	90/6.2	30.5" x 24.1" x 12.6"	230 VAC 11.0	Basic HMI and HMI Pro Series	1,611/6,243	268/1,040
ALH68D12-XXX	8/320	2,560	784	90" x 12" x 76"	6", 8"	90/6.2	30.5" x 24.1" x 12.6"	230 VAC 13.0	Basic HMI and HMI Pro Series	1,839/7,126	306/1,188

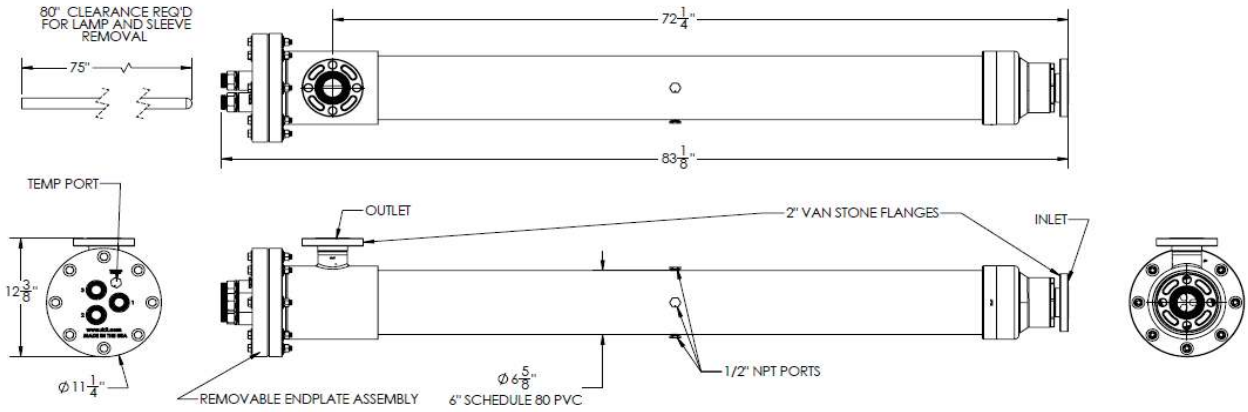
PRO-TECT UV MODELS

HLH3 & HLH5 SERIES

Our HLH series is offered in our HLH3 and our HLH5 series models. These units use 80 watt and 150w high output lamps respectively. These units should be used in applications the require low to moderate flow applications with low UV dose requirements.



Model	Lamps#/ Watts	Input Watts	UVC Output	UV Vessel Dimensions AxBxC	Inlet/Outlet Sizes	Max PSI/BAR	Power Supply Dimensions HxWxD	Max Amps @ 120/230 VAC	Control Options	30 mJ/cm2 GPM/LPM	180 mJcm2 GPM/LPM
HLH32D6-XXX	2/80	160	40	56" x 6" x 47"	2", 3", 4"	150/10.3	14" x 12" x 8.4"	3/1.5	Basic HMI and HMI Pro Series	81/314	13/52
HLH33D6-XXX	3/80	240	80	56" x 6" x 47"	2", 3", 4"	150/10.3	14" x 12" x 8.4"	4.0/2.0	Basic HMI and HMI Pro Series	119/461	20/77
HLH34D6-XXX	4/80	320	120	56" x 6" x 47"	2", 3", 4"	150/10.3	16" x 14" x 8.4"	5.0/2.5	Basic HMI and HMI Pro Series	155/600	26/100



Model	Lamps#/ Watts	Input Watts	UVC Output	UV Vessel Dimensions AxBxC	Inlet/Outlet Sizes	Max PSI/BAR	Power Supply Dimensions HxWxD	Max Amps @ 120/230 VAC	Control Options	30 mJ/cm2 GPM/LPM	180 mJcm2 GPM/LPM
HLH52D6-XXX	2/150	300	160	85" x 6" x 76"	2", 3", 4"	150/10.3	14" x 12" x 8.4"	3.75/1.8	Basic HMI and HMI Pro Series	174/675	29/113
HLH53D6-XXX	3/150	450	200	85" x 6" x 76"	2", 3", 4"	150/10.3	14" x 12" x 8.4"	5.5/2.7	Basic HMI and HMI Pro Series	250/969	41/162
HLH54D6-XXX	4/150	600	240	85" x 6" x 76"	2", 3", 4"	150/10.3	16" x 14" x 8.4"	7.5/3.7	Basic HMI and HMI Pro Series	331/1283	55/214

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