

Ultraviolet Air Disinfection Equipment

For HVAC Systems

**Commercial and
Industrial
Applications**

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Ultravation™
Ultraviolet Technology

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Ultraviolet disinfection
equipment can solve AC coil
mold problems cost effectively...

A close-up, black and white photograph of HVAC coils, showing the intricate grid pattern of the metal fins. The lighting creates strong shadows and highlights, emphasizing the texture and depth of the coils.

HVAC + UV = enhanced IAQ

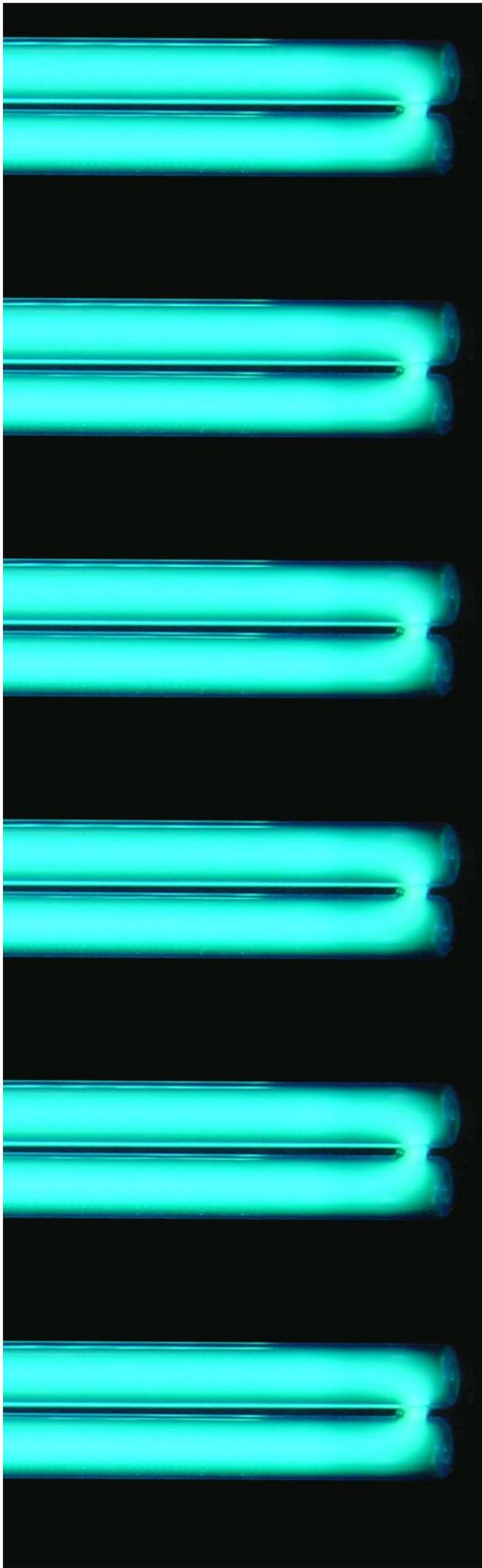
The issues related to maintaining indoor air quality (IAQ) have become more apparent and more serious in recent years. It is now well established that in structures where groups of people congregate, and where the air is continually re-circulated, microorganism counts steadily increase—even where filtration is installed (many organisms are small enough to pass through filters). As contamination from inorganic and organic substances have been identified, and building construction techniques have improved, the role of the heating and ventilation system has become increasingly important in providing not just temperature controlled air, but “quality”, healthful air.

The germicidal properties of ultraviolet light can be applied to dramatically reduce airborne biological contamination, providing relief from the health problems caused by poor IAQ. Without UV, the HVAC system itself can facilitate the growth of microorganisms—especially mold, a major allergen—and then distribute the organisms very effectively. UV will not only counteract these HVAC problems, it will in fact reverse the system’s unintended role as distributor of pathogenic microorganisms. UV will transform the system into an effective microorganism *eliminator*, turning it into a *positive* contributor to healthfulness of indoor air. The benefits of properly addressing these IAQ issues can be substantial, making a significant and even major improvement in the welfare and the productivity of personnel.

There is another very important benefit of applying UV technology in HVAC systems: the performance efficiency gained through the UV treatment of AC coils. Consistent irradiation of the coils with UV prevents biological contamination that increasingly inhibits thermal transfer, and can cause changes in pressure differentials. A return on investment in UV can be quickly shown when the energy and maintenance savings are considered.

The expertise at Ultravation comes from more than 30 years of experience in the application of ultraviolet light for disinfection and other applications in manufacturing. Our products are designed to optimize the effectiveness of the UV application through obtaining—and maintaining—the highest UV level of disinfection at the lowest cost of ownership, and through advanced design to facilitate installation and lamp changes.

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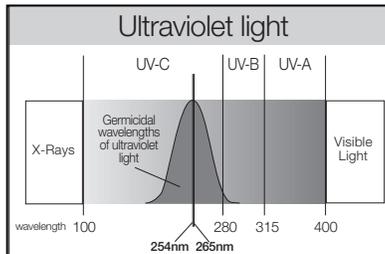


The Science of Ultraviolet™

Ultraviolet Light

Ultraviolet light (UV) is electromagnetic energy, the same as visible light. However, UV wavelengths are not visible. The spectral range of ultraviolet radiation is, by definition, between 100 and 400 nm (1 nm = 10⁻⁹m). The UV spectrum is arbitrarily subdivided into three bands, as follows:
 UV-A (long-wave) from 320 to 400 nm
 UV-B (medium-wave) from 280 to 320 nm
 UV-C (short-wave) from 100 to 280 nm

The UV used in tanning is UV-A and sometimes UV-B. It is important to note that UV at wavelengths below 240 nm forms ozone (O₃) which is toxic. While ozone may enhance the airstream disinfection efficiency of ultraviolet, it is not recommended for

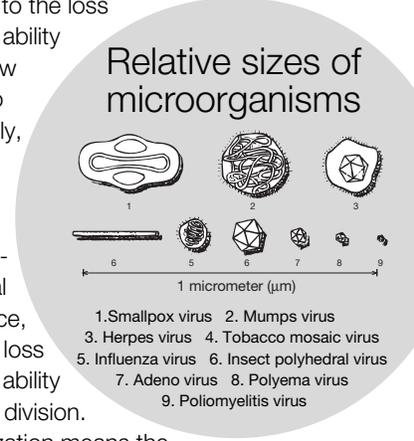


general use because the adverse impact on health it creates in its own right. Ultraviolet UV equipment does not emit UV in a range that will create ozone. It is specifically limited to the UV-C germicidal wavelengths. All UV lamps generate a range of frequencies that include some visible wavelengths, but majority of the light emitted from a quality lamp is ultraviolet—and has its greatest intensity at 254nm—virtually identical to the optimum germicidal wavelength.

Microorganisms

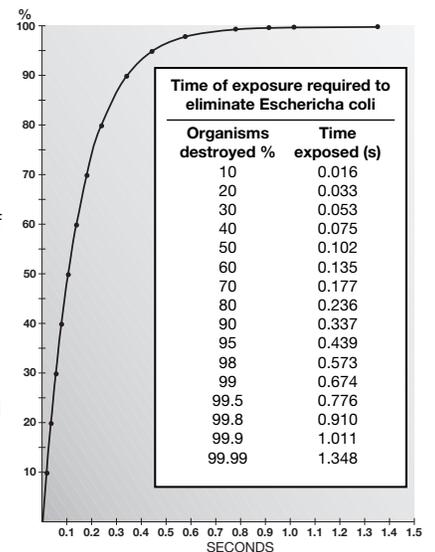
Microorganisms are primitive forms of life. Their small dimensions not only constituted the original reason for classifying them separately from animals and plants but is also relevant to their morphology, the activity and flexibility of their metabolism, and their ecological distribution. They include protozoa, bacteria, molds, yeasts and viruses. The diameter of most bacteria is between 0.2 and 1.5µm (1µm = 0.001mm); some species may amount to 30µm. The diameter of yeasts and protozoa is

mostly less than 10µm; and molds vary considerably. Viruses are non-cellular particles that require living cells for their reproduction. They are smaller than bacterial forms. Cellular death in the case of microorganisms refers to the loss of the ability to grow and to multiply, or, in terms of experimental practice, to the loss of the ability of cell division. Sterilization means the killing of all microorganisms.



Germicidal action

The UV radiation emitted by a source is expressed in watts (W). The irradiation density is expressed in watts per square meter (W/m²). For germicidal action an adequate dose is crucial. The dose is the irradiation density multiplied by the time (t) in seconds and expressed in joules per square metre (J/m²). Therefore one joule equals one watt during one second (1J= 1 W/sec).



The Science of Ultraviolet™

UV Application in Commercial HVAC systems

Configuration

The most important factors in determining the configuration and sizing of a UV system are:

- Goals for the application of ultraviolet irradiation
- Air temperature range at lamp locations
- System air velocity

Coil irradiation

The prevention of bio-growth on the AC coil is usually a primary goal when considering installing UV in an HVAC system. In this application, the benefits are two-fold. First, the dramatic reduction of mold (one of the most common allergens and a serious source of building damage), and second, the contribution to system efficiency, lowering the operating cost

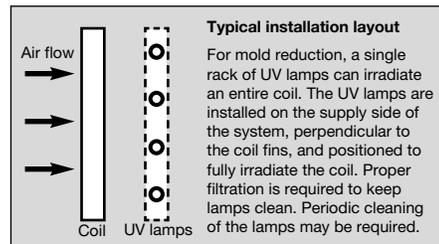
Air velocity as it relates to coil irradiation is considered for its effect on the surface temperature of the UV lamps. Higher velocities will lower lamp temperatures and must be factored in when a system is sized and specified.

Ultravation UVMatrix™ SI equipment, because of its higher intensity levels does not require UV reflectors. The result is minimized turbulence, impact on system pressure and noise levels, and with irradiation extending in all directions from the UV lamp, does offer a nominal level of air stream disinfection. The impact of the equipment on pressure levels can be determined by comparing the surface area of the lamps facing the coil to the surface area of the coil itself. The difference in the area, factoring in the curve of the lamps, normally indicates that any resistance to air flow is not significant.

Air stream disinfection

Air stream disinfection reduces airborne pathogens including common cold, influenza and more serious illnesses such as tuberculosis and Legionella. A standard level of disinfection is considered achieved when the inactivation rate reaches 90%. At this level the probability of infection is very low. It is accomplished through proper UV system sizing which includes factoring in the recirculation of air through the HVAC system, which continually re-exposes contaminants. Ultravation UVMatrix™ AS air stream disinfection equipment is designed to meet the goals of the toughest air disinfection challenges. Exceeding 90% inactivation may require additional UV equipment due to the exponential relationship between time exposed and deactivation percentages (see chart, previous page). The strategy for installation and number of lamps

continued next page



of the HVAC system, including energy savings and reduced cleaning and maintenance requirements

Air temperature is a consideration when specifying a coil irradiation UV system, as the temperature inside the lamp is directly related to the UV output obtained. Ultravation's T3™ technology addresses this issue by enclosing the UV lamp in a protective quartz glass shield, raising the surface temperature of the lamp temperature and providing the necessary UV dose. Ultravation UVMatrix™ SI AC coil irradiation equipment is designed to operate continuously, applying UV whether the AC system is in operation or not. When the HVAC system is not in operation, the air temperature rises and/or the velocity diminishes. At this point the UV dose on the coil—which is never limited by a time factor—will climb to a level far exceeding that necessary for bio-growth elimination.



Ultravation™
UVMatrix™-SI Series™
for HVAC coil irradiation

The Science of Ultraviolet™

UV Application in Commercial HVAC systems

continued from previous page

needed would be carefully planned for installation in the HVAC system or possibly applied through other methods.

In general, air stream disinfection is accomplished in a building with a strong consideration for the period of microorganism exposure to lethal UV. The three main factors, temperature, velocity and exposure time must all be analyzed when sizing a system.

Air temperature, although an important consideration, should not lead to the installation of air stream UV disinfection in the HVAC system

return, where the air is at its highest temperature. Positioning the equipment in the supply stream is generally recommended, as supply air is normally filtered. This provides two benefits: minimizing lamp cleaning and airstream particulates that may block UV rays providing shielded passage to microorganisms that may be attached.

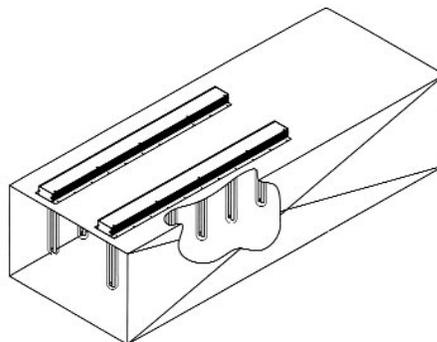
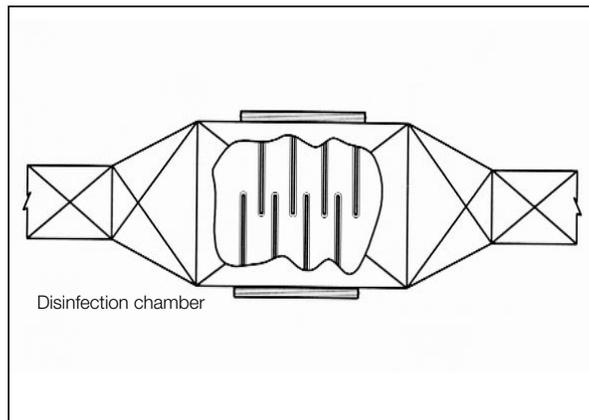
Air velocity, when considered for air stream disinfection, affects not only lamp temperature, but contaminant exposure time. It is desirable from both standpoints to minimize the air velocity where UV is applied. In most cases, needed exposure time is

accomplished through the number of lamps installed. In others, due to space and other considerations, a "disinfection chamber" is constructed that accommodates available space and reduces velocity to achieve a desired exposure time.

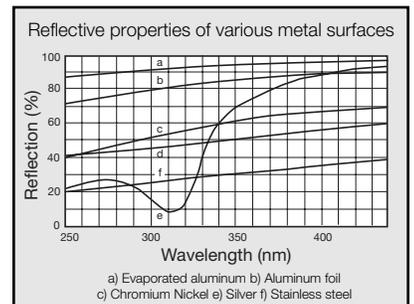
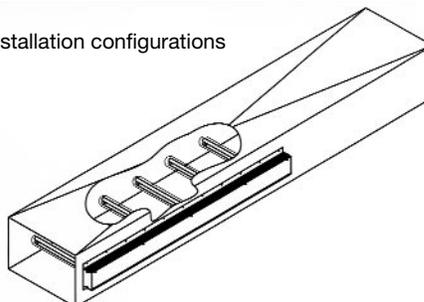
Reflectance of the surrounding materials affects the UV dose. A high reflectance to visible radiation does not necessarily mean a high reflectance to 254 nm UV. In some cases, a disinfection chamber lined with reflective material may be implemented to achieve the desired dose.



*Ultravation™ UVMatrix™-AS Series™
for air stream disinfection*



Typical installation configurations



UVMatrix™ SI

UV Disinfection for Commercial HVAC Systems Coil Irradiation

Benefits of Coil Irradiation

- Bio-growth prevention
- Allergy relief
- Efficiency optimization
- Elimination of coil cleaning as result of bio-contamination
- Airstream disinfection (residual)

UV eliminates mold on AC coils

Mold can be a serious problem for allergy sufferers—and a drain on HVAC efficiency. Ultraviolet UVMatrix™ SI systems for commercial and industrial HVAC, deliver the highest level of performance and safety in UV air disinfection. Their design reflects Ultraviolet's in-depth knowledge of ultraviolet light—and how it is optimized for HVAC coil disinfection.

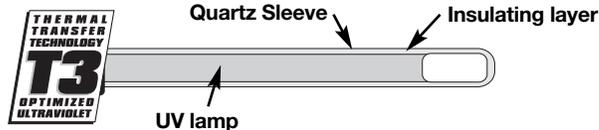
UVMatrix SI—Unprecedented installation flexibility

UVMatrix SI systems employ an innovative system (patent pending) that makes them easily adapted to variations in HVAC physical installation characteristics—with *no compromise in UV irradiation*. When unusual dimensions are encountered UVMatrix SI racks simply adjust to the custom width of the system.



T3™ Enhanced UV Lamps

Ultraviolet T3™ thermally optimized germicidal UV lamps are standard, allowing much higher UV lamp output in cold air conditions. Lamps are easily changed with no quartz replacement required.



ESP™ Electronic-Smart Power

UVMatrix-SI systems utilize discrete ESP™ electronic auto-voltage sensing power supplies with no more than two lamps per power supply module—eliminating the possibility of complete loss of disinfection due to UV system trouble. An optional set of remote alarm contacts will help protect against an extended lamp out condition. ESP™ optimizes lamp performance because it operates at frequencies far exceeding a standard magnetic ballast. Its exceptional stability of voltage and current flow maximizes lamp output and lamp life. In a lamp-out situation, it automatically protects itself from an un-loaded condition.

Auto-voltage sensing

ESP™ simplifies installation still further, because with a single connection—regardless of voltage—the system automatically adjusts to voltages ranging from 120 to 277 VAC 50/60Hz with no step-down transformers or switches.

Additional features...

- Low power consumption
- 3 year UV system warranty
Covers entire unit except lamp(s).
- One year UV lamp warranty
- T3 enhanced lamp systems for large air handlers utilize **Philips** premium UV lamps—the world's lowest mercury content lamp.

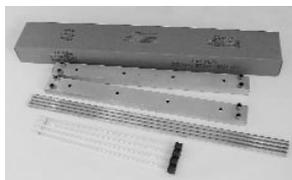
Ultraviolet **T3™** lamps are very easy to replace (9000 hour (approx 12 month) replacement schedule recommended). Lamps easily remove from unit with no system disassembly is needed.

Ultraviolet™
Ultraviolet Technology

Patent Pending



Ultraviolet™
UVMatrix™-SI Series™
for HVAC coil irradiation



Units are shipped in compact packaging, and are easy to assemble and install.





UVMatrix™ AS

UV Disinfection for Commercial HVAC Systems

Airstream Disinfection

Benefits of air stream disinfection

- Improvement of indoor air quality through the reduction of airborne pathogens
- Allergy relief
- Odor reduction (when due to bio-contamination)

UV can substantially reduce the spread of airborne illness

Indoor air that is continuously re-circulated through 254nm UV light will often show a dramatic reduction in the count of bacteria and other microorganisms. Standard systems are sized to reduce a target organism by 90%. Ultraviolet **UVMatrix™ AS** systems for commercial and industrial HVAC, are designed specifically for airstream disinfection, with design emphasis on achieving a balance between intensity and exposure time. Their design reflects Ultravation's in-depth knowledge of ultraviolet light—and how it is optimized for airstream applications.

UVMatrix AS— Easy to configure for any HVAC installation

UVMatrix AS systems have lamp arrays engineered to optimize disinfection capability, and can be installed in single or multiple unit configurations.

Philips Compact Twin UV Lamps with T3™ enhanced performance

Air stream disinfection requires higher UV intensities due to shorter micro-organism exposure times. The UVMatrix™ AS series UV lamp design starts with Philips patented compact-twin UV lamps, which provide the highest UV intensity for small areas (such as HVAC duct work). We then apply Ultravation T3™ design, enclosing the lamps in UV transparent quartz, which optimizes lamp temperature. This increases UV intensity under typical operating conditions by approximately 30%. The result is unprecedented disinfection performance for HVAC air stream applications! Further, T3™ is a sealed design that allows lamps to be changed with no loss of air pressure.

ESP™ Electronic-Smart Power

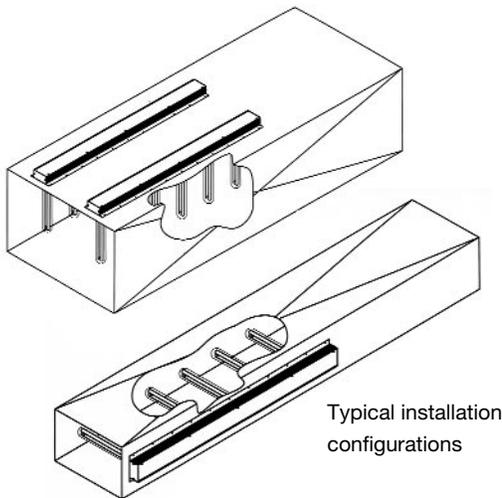
UVMatrix™ AS systems utilize discrete ESP™ electronic auto-voltage sensing power supplies with no more than two lamps per power supply module—eliminating the possibility of complete loss of disinfection due to UV system trouble. An optional set of remote alarm contacts will help protect against an extended lamp-out condition. ESP™ optimizes lamp performance because it operates at frequencies far exceeding a standard magnetic ballast. Its exceptional stability of voltage and current flow maximizes lamp output and lamp life. In a lamp-out situation, it automatically protects itself from an un-loaded condition.

Auto-voltage sensing

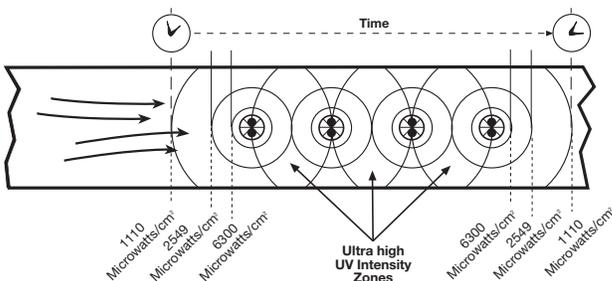
ESP™ furthers simplicity in installation with a single connection—regardless of voltage—the system automatically adjusts to voltages ranging from 120 to 277 VAC 50/60Hz with no step-down transformers or switches.

Additional features...

- Low power consumption
- 3 year UV system warranty
Covers entire unit except lamp(s).
- One year UV lamp warranty
- **Philips** premium UV lamps—the world's lowest mercury content lamp—less than 5mg per lamp.



Typical installation configurations



A high percentage of microbes may be eliminated in a single pass through the ultraviolet light. However, the actual number inactivated is dependent on the time of exposure to UV. As air is re-circulated through the HVAC system, surviving organisms receive additional ultraviolet exposure.

All Ultravation air disinfection systems are fitted with the high performance **ESP™** electronic power supply

Typical UV ballasts use 50+ year old technology to drive lamps, using crude components. These inefficient designs are directly affected by line voltage and current fluctuations, passing these sometimes harsh conditions through the UV lamp.

ESP™ features the latest circuit design technology, enabling it to deliver much better performance characteristics—including:

- **Auto line voltage sensing**

ESP™ automatically adjusts to every standard voltage—from 120 to 277 VAC 50/60Hz with no step-down transformers or switches.

- **Ultra stable current**

Automatically compensates for line fluctuations keeping the UV lamp current and voltage stable, resulting in lamp operation consistently at peak disinfection performance.

- **More efficient**

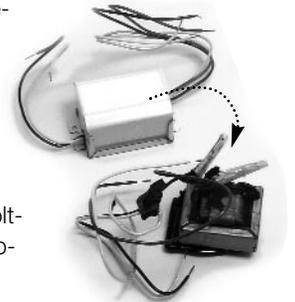
ESP™ power supplies run cooler and use less power, reducing electricity costs.

- **Auto protection circuitry**

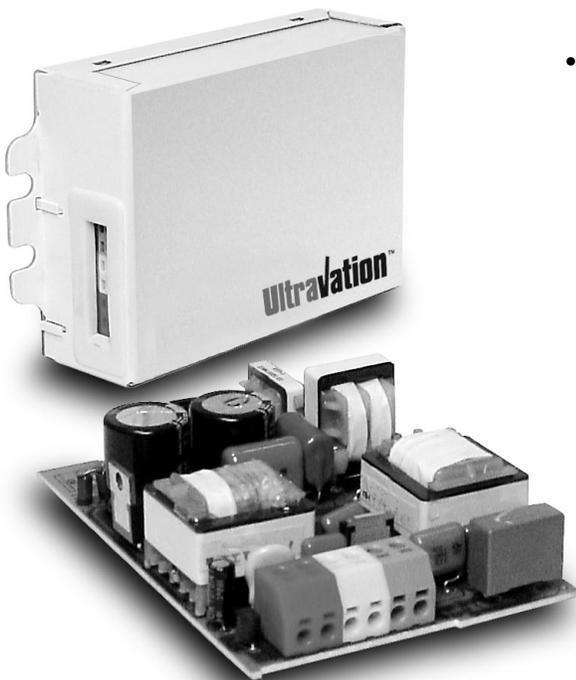
Self protects in case of lamp out or other abnormal condition.

- **Agency approvals**

UL listed
CSA and NRTL/C listed



Out-dated ballast technology



T3™ Advanced Lamp Technology



T3™ Thermal Transfer Technology™ UV lamps for UVMatrix™ SI and AS Equipment

UV intensity diminishes as lamp surface temperature goes down. This has been a primary obstacle when applying UV for air conditioning coil irradiation. Ultravation T3™ germicidal UV lamps enclose a Philips premium UV lamp inside a special UV transparent quartz glass sleeve (standard glass filters out UV).

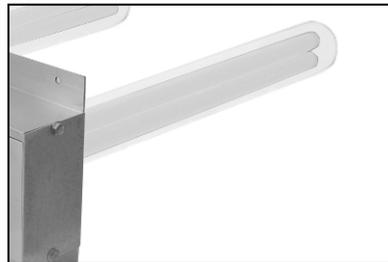
The quartz sleeve provides an insulating layer, allowing the lamp to operate at a higher temperature. The result is much higher UV output lamp output in the cold air conditions of an HVAC plenum, and UV dose is optimized. Lamps are easily removed and replaced with no quartz replacement required.

Non-Ozone producing

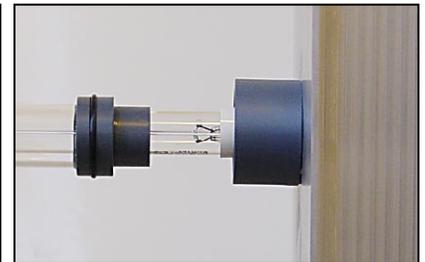
Just as 254nm wavelength of UV is germicidal, the 185nm wavelength reacts with the air to produce ozone. Ozone is an irritant and is toxic in large doses. Philips developed a special, patented lamp composition that effectively filters the 185nm wavelength, while allowing the 254nm wavelength to pass through.

Environmentally friendly

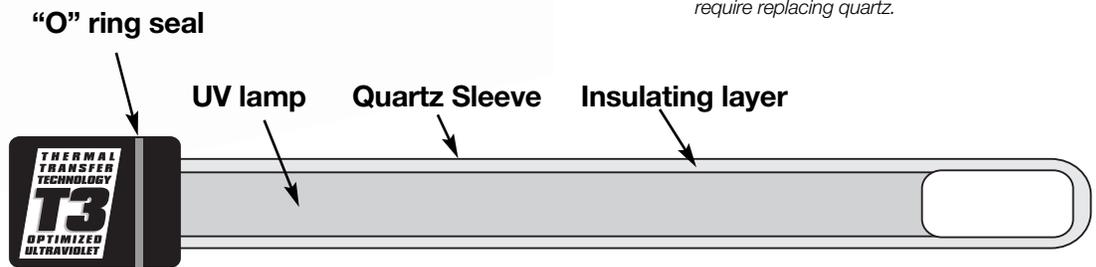
UV lamps operate on the same principle as everyday fluorescent lamps, by passing electrical current through a mercury vapor stream. Conventional UV lamps may qualify as hazardous waste due to their mercury content, which can reach 50 mg. Philips leads the industry technologically and environmentally, by producing high performance UV lamps that use far less mercury—no more than 5mg per lamp.



T3 design with Philips Compact Twin Lamps



UVMatrix-SI lamp connector design with "O"-ring air seal. Easy lamp changes do not require replacing quartz.



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