

## Trane's Position on UV-C Lights

Note: The following Trane corporate position statement was issued on October 6, 2008.

Trane monitors technologies that offer the potential to improve indoor air quality and reduce HVAC operating energy costs in buildings. One technology receiving attention the last few years is C-band ultraviolet light (UV-C) applied within air handling systems for the purpose of controlling microbial growth. While many manufacturers, dealers, and contractors broadly promote the use of UV-C across all markets and system types, Trane has taken a more cautious approach and has only supported UV-C lights in situations where they can be factory-engineered for the specific application. Trane believes that when misapplied, UV-C lights can create a safety hazard to those operating and maintaining the equipment and can reduce the reliability and longevity of the HVAC system.

UV-C technology being applied in HVAC systems today carries a broad range of performance and value claims, many of which we believe have not been adequately validated. Trane supports the science that indicates that in sufficient dose (time and intensity), UV-C energy can inactivate (kill) microorganisms. In applications where sufficient residence times exist, such as on stationary surfaces, it is possible and practical to deliver a 'killing' dose of UV energy to the organism. However, we believe delivering sufficient dosage of UV energy to bacteria and fungi, especially those in spore form, entrained in high velocity duct systems is difficult and in most cases impractical.

Over the last few years, the claimed value and benefits of UV-C have moved away from occupant health benefits to keeping equipment clean and maintaining HVAC system efficiency. Based on the independent scientific data available at this time, we believe the ability of UV-C to maintain system efficiency is generally overstated and has not been validated through third-party testing. For this reason Trane makes no claims or predictions as to the effectiveness of UV-C for this purpose and does not recommend it as a substitute or enhancement to traditional coil maintenance.

Based on these findings and observations, Trane will continue to provide UVC light systems as a factory-engineered option on air handling equipment where it can be done safely, where it will not impact equipment reliability, and where it brings true value to our customers. This includes careful sizing of lamps for surface irradiation, electrical interlocks and safety signage at all equipment entry locations, and substitution or shielding of susceptible polymeric materials in the vicinity of the lamps, specifically, electrical wiring, circuit boards, gasketing, and sealants. We caution contractors and owners who pursue field installation of UV-C to work with the original equipment manufacturer to make sure the personal safety and equipment reliability risks are managed. Also, to receive the expected value from the UV-C system, the end-user must fully understand the maintenance requirements of the system, which includes periodic lamp cleaning and replacement, and the

environmentally responsible disposal of the discarded lamps due to their mercury content.

Trane recognizes there are situations where UV-C can be justified and in those cases we recommend that the application of the technology be reviewed on a project-by-project basis to determine its ability to deliver the expected value to the customer. Trane believes the best way to provide good IAQ in buildings is to design, operate, and maintain HVAC systems properly and to keep air distribution systems as clean and dry as possible.

Trane encourages and supports further research and study on the efficacy of UV-C technology as well as any other technologies intended to improve IAQ and HVAC system performance. Trane will continue to be an industry leader on IAQ issues and invites its customers, business partners, and associates to learn more about IAQ issues at [www.trane.com](http://www.trane.com).

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What does the three rack system provide that the single rack system does not, and which do we need?

A single rack system has been shown to provide up to a 2/3rds overall reduction in a treated occupied space. A multiple rack system gives you an added layer of protection and duplicates the DoD and RTI reduction rates in single pass efficiencies achieved in lab testing. A single panel setup duplicated the chamber testing at RTI. Both versions have been used in force protection.

How readily would our HVAC system receive a retrofit for the Genesis-would we need to relocate people, etc. in order to install?

Our system must be installed after filtration in the HVAC system. In many cases there is ample room in the air handler itself. It may also be installed in the supply duct. Installing Genesis in the HVAC system is similar to adding a filter rack in the air stream. 115 or 208 voltage must be supplied to the system. It is not necessary in most cases to relocate the occupants of the space to complete the install.

Do you have examples of other federal agencies that have installed these systems?  
Any installed because of H1N1?

Yes, here is a list of some of the Federal and State jobs we have completed or are in progress.

Corp of Engineers Regional Office San Antonio, Texas Fort Sam Houston	Federal Law Enforcement Training Center (FLETC) Artesia, New Mexico Building 28 Training and Command Center
Federal Law Enforcement Training Center (FLETC) Artesia, New Mexico Physical Training Building	Joint Reserve 914 Airlift Wing Fire and Crash Rescue Station Niagara Falls, New York
Student Pipeline Dormitory Goodfellow AFB San Angelo, Texas Physical Training Building	School Age Facility Goodfellow AFB San Angelo, Texas
El Paso VA Health Care Clinic El Paso, Texas Ernesto Bloburg 915-564-7988	Laughlin AFB PT Building Del Rio, Texas
Laughlin AFB Fuel Systems Building Del Rio, Texas	US Postal Service Sundown, Texas
San Francisco Airport T2 Terminal San Francisco, California	Lackland AFB Army Veterinary Corps
Big Springs VA Hospital Big Spring, Texas	Grand Junction VA Hospital Grand Junction, Colorado
TTUHSC - Medical School Lubbock, Texas	University of Louisville Hospital Louisville, Kentucky

H1N1 applications have only recently surfaced. Yes, we have sold equipment to school districts and medical clinics for this expressed purpose. The primary concerns being airborne biologics with many people being in a confined space.

Also, would you please give a summary description of the recommended Genesis system - what it is, what it does, and why it is more effective and practical than UV-C lights for our specific application.

Filtration: Without filtration, the catalyst will become overloaded and cease to be effective. The catalyst MUST be downstream of the filtration. Genesis recommends MERV 13 or greater.

UV-C Lamps: The lamps are used specifically for energy purposes. The TiO<sub>2</sub> becomes excited under the UV irradiation, creating a "field" of hydroxyl radicals. These radicals break down molecules and damage the DNA beyond repair. As a fringe benefit, the UV that escapes the catalyst can be used for surface disinfection or coil irradiation.

Catalyst media: This media is impregnated with TiO<sub>2</sub>. It is formed into a 6" thick module to increase the residence time. By adding more catalyst in the direction of airflow, it is possible to increase residence time, allowing larger particles to be broken down further.

Lamps alone are not effective in a fast-moving airstream. Here are our calculations for Airhandler 7:

Return side dimensions: 20' x 16'  
400 FPM = 6.67 FPS  
Supply duct = 100" x 80"  
2,016 FPM thru supply duct = 33.6 FPS

This works out to be 112000 CFM thru the air handler.

Consider *Aspergillus niger* (black mold). The k-value to destroy this mold with 90% confidence is 0.00000128 cm<sup>2</sup>/mW\*s (Kowalski 2006). Consider lamps with an intensity of 10,000mW/cm<sup>2</sup> 12" away (very high intensity lamps!).

Time to Destroy = 1/(k \* I)  
Time = 1/(0.00000128 \* 10,000)  
Time = 78.125 seconds

This is fine for surface cleaning. If your mold is growing on a surface, it will take only 78 seconds to kill. However, in an airstream, this proves difficult.

How far does a particle travel in an airstream in 78 seconds?

In the airhandler:

Distance traveled = Time \* Speed  
= 78.125S \* 6.67 FPS  
= 520' in direction of airflow

The airhandler is not that long, let's try the ductwork.

Distance traveled = Time \* Speed  
= 78.125S \* 33.6 FPS  
= 2,625' in direction of airflow

Not many jobs have ½ mile of ductwork.

Now, we have to light the ductwork to keep 10,000mW/cm<sup>2</sup> on the particle. First, assume we can find a 10,000mW/cm<sup>2</sup> lamp, 48" long. This will allow 12" spacing between lamps.

4 lamps across the section, 6 lamps high = 24 lamps in one array. Install this array for every foot of ductwork.

24 lamps per foot \* 2625 feet = 63,000 48" lamps. These run at 1 amp each, so count on 63,000A @ 120v all day long, so  $A * V = 7,560,000$  Watts.

Cost per Day to run @ 6.26 cents per KWh - \$11,360 for 1 single AHU. There is no payback time on this.

For a 3 rack Genesis unit (18" total), the cost per day is \$11.24. This is a much better use of energy and money compared to lamps alone.