



VIRTUAL SIGNATURE SERIES

UVGI HVAC REBATE FOR YOUR BUSINESS



FOR SRP REFERENCE ONLY - DO NOT REPRODUCE

PROGRAM MANAGERS

SRP Business Solutions



Joseph Degraft-Johnson

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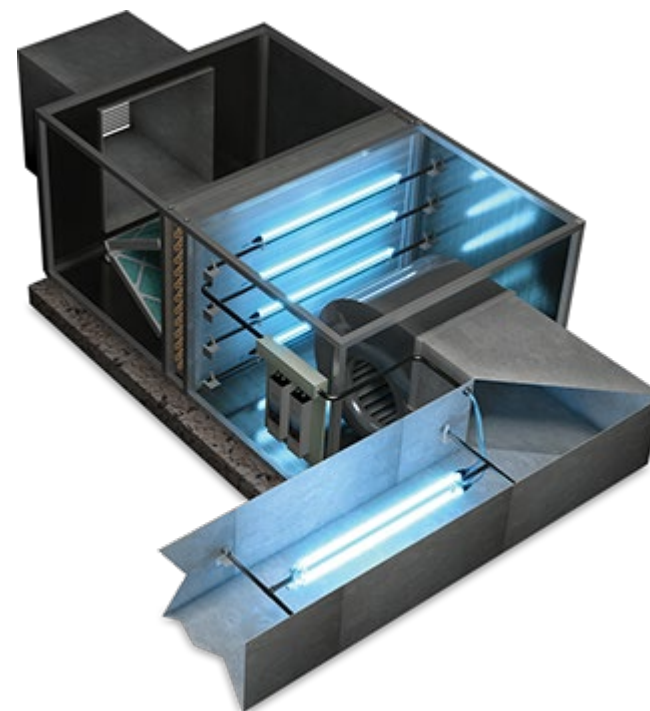




SRP BUSINESS SOLUTIONS IN-DUCT AIR UVGI REBATE

Rebate: \$30 per Ton

- Submit a rebate application with an invoice and manufacturer spec sheet after the new system is installed
- Send documents to savewithsrpbiz@srpnet.com



Source: <https://www.freshaireuv.com/commercial-hvac/>





SRP's Goal in offering a Rebate

Goals

- ✓ Help customers address indoor air quality concerns in an energy-efficient manner, in relation to the COVID-19 Pandemic
- ✓ Safe technology installation
- ✓ Provide rebate assistance to reduce implementation costs in a time of need
- ✓ Leverage a trade ally network that can support installations across a variety of customer segments

Limitations

- ✓ SRP programs focus on technologies with proven performance track records. Some technologies in the market today lack the depth of research to prove their safety, effectiveness and market support.
- ✓ SRP rebates target permanently installed technologies versus mobile technologies
- ✓ Existing HVAC systems are generally not designed to support advanced filtration systems



PRESENTERS

SRP Business Solutions



Peter Hamstra

Nexant, - SRP's Program Administrator
Senior Project Engineer



Dave Noel

Nexant - SRP's Program Administrator
Program Outreach Manager



Program Administrator



AGENDA

1

What is UVGI?

2 Maintenance & Safety Recommendations

3

Air Cleaning Considerations

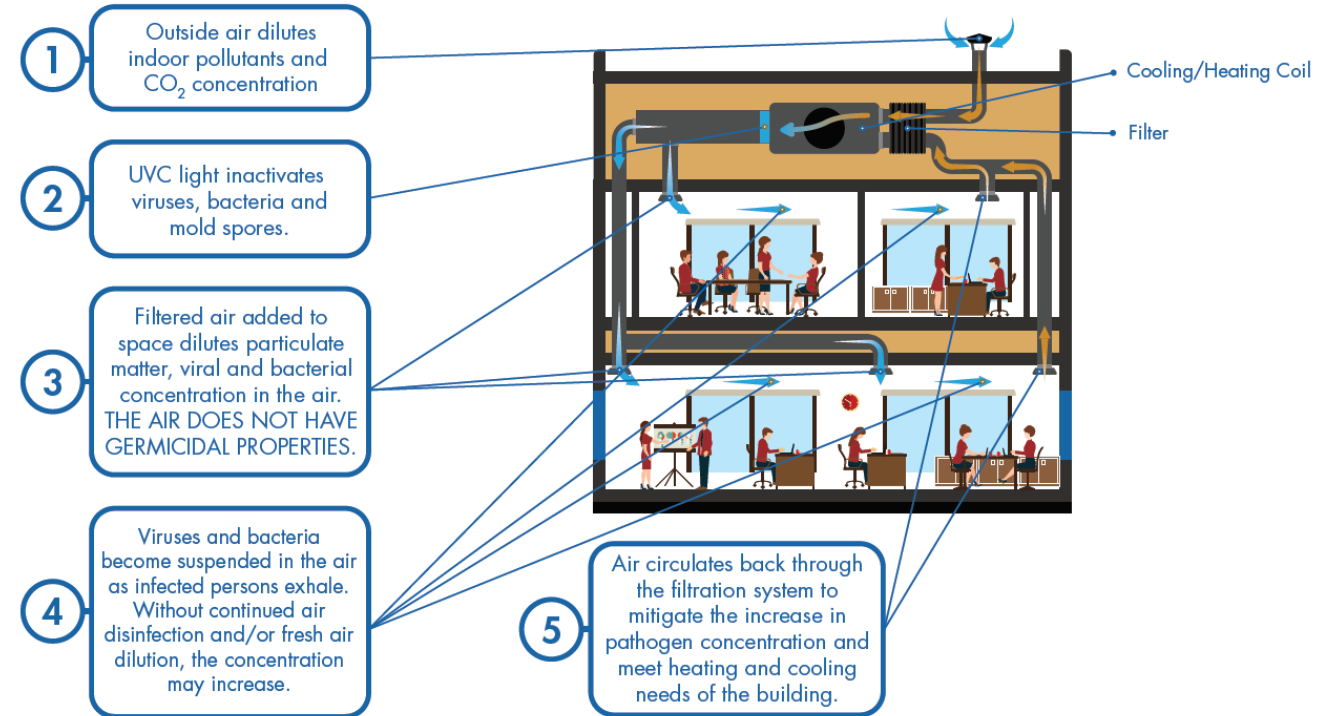




Peter Hamstra
Nexant, Inc.
Senior Program
Engineer

WHY USE UV GERMICIDAL IRRADIATION?

- “UVGI can also mitigate the spread of other harmful microbes such as the influenza family of viruses and many common cold viruses.
- Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of HVAC systems can reduce airborne exposures.”
- – ASHRAE



Source: <https://www.ashrae.org/technical-resources/filtration-disinfection>



UVGI PROVEN RECORD

- 1st airborne tests: 1935
- Progressed from light curtain concept to upper room UVGI to in-stream UVGI
- Historic use:
 - Historically used to mitigate TB transmission and Measles transmission
 - Used in areas of high pathogen transmission (Emergency Rooms & Hospitals)
 - Used in waste water & domestic water sanitization
 - Used in manufacturing processes for sterilization
- Track Record: nearly a century of science, testing & use

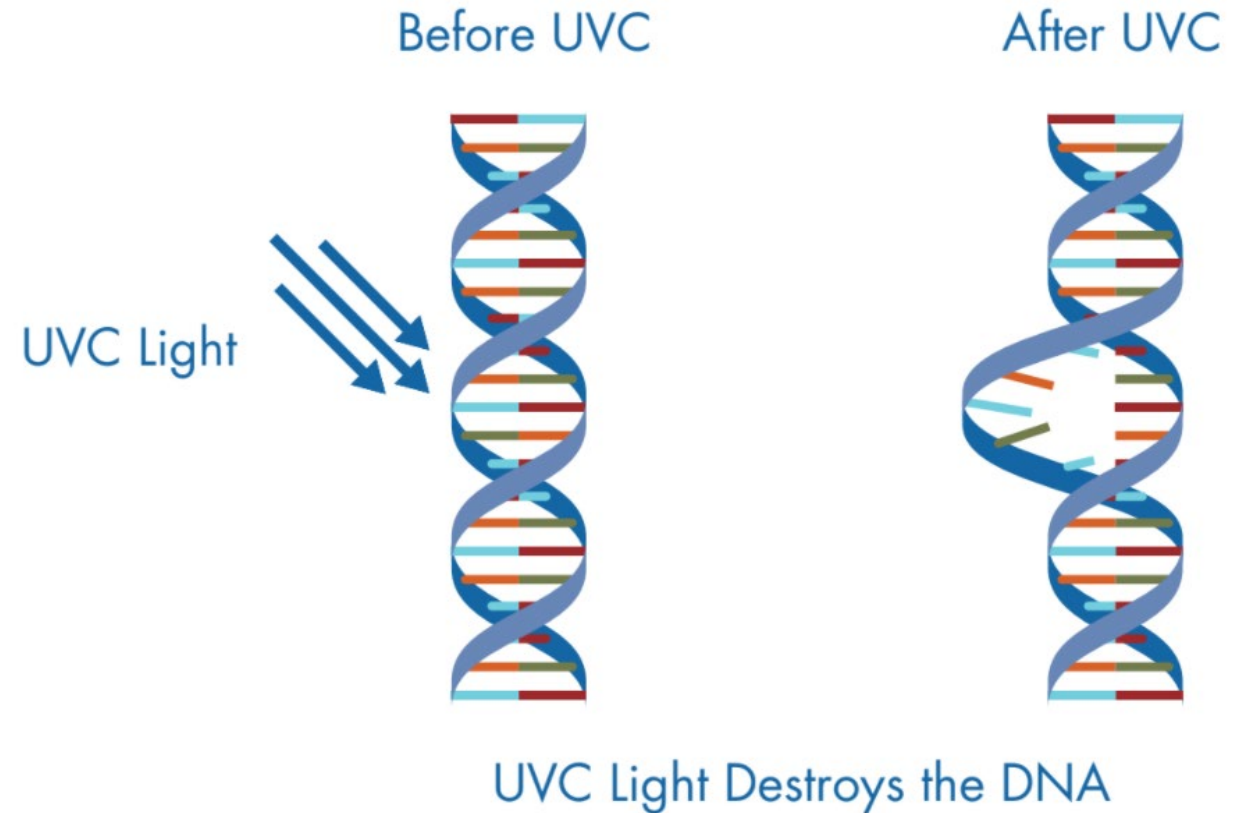
Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2789813/#:~:text=Investigations%20of%20the%20bactericidal%20effect,UVGI%20to%20prevent%20such%20spread>



HOW DOES LIGHT KILL PATHOGENS?

UV crosslinks two neighboring pyrimidine bases

That “kink” causes an error on the DNA



Long-wave
315 to 400 nm

Medium-wave
280 to 315 nm

Short-wave
200 to 280 nm

< 200 nm

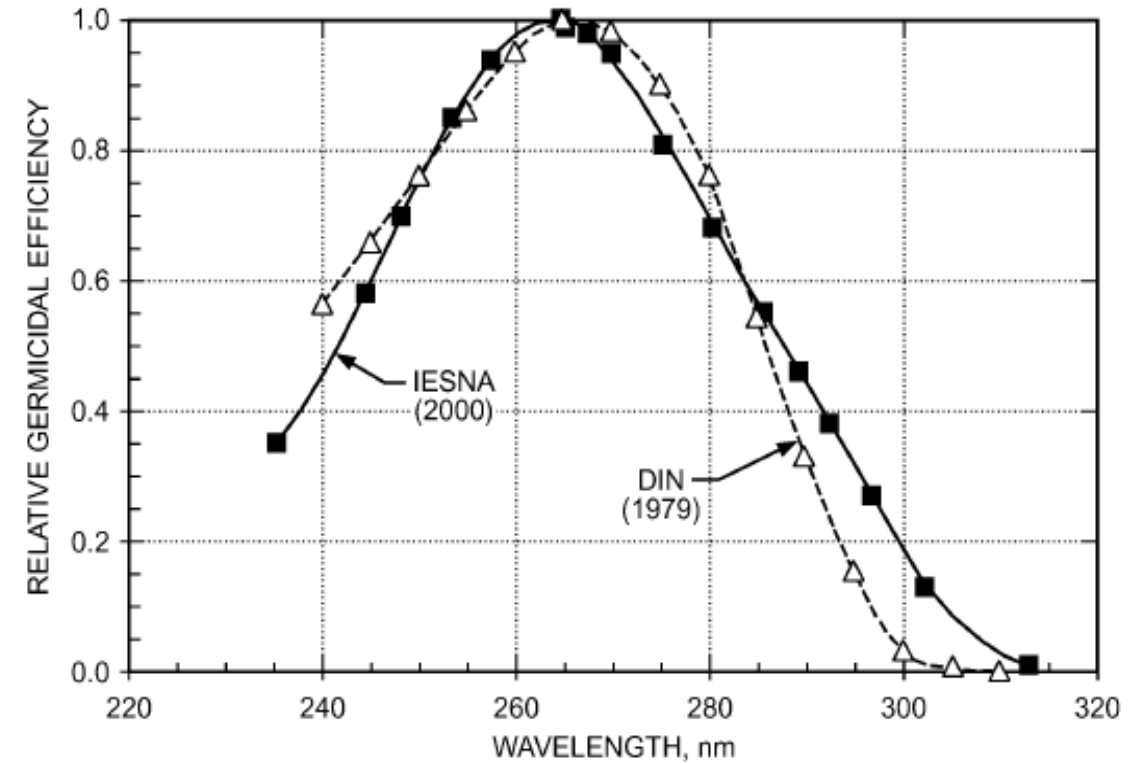
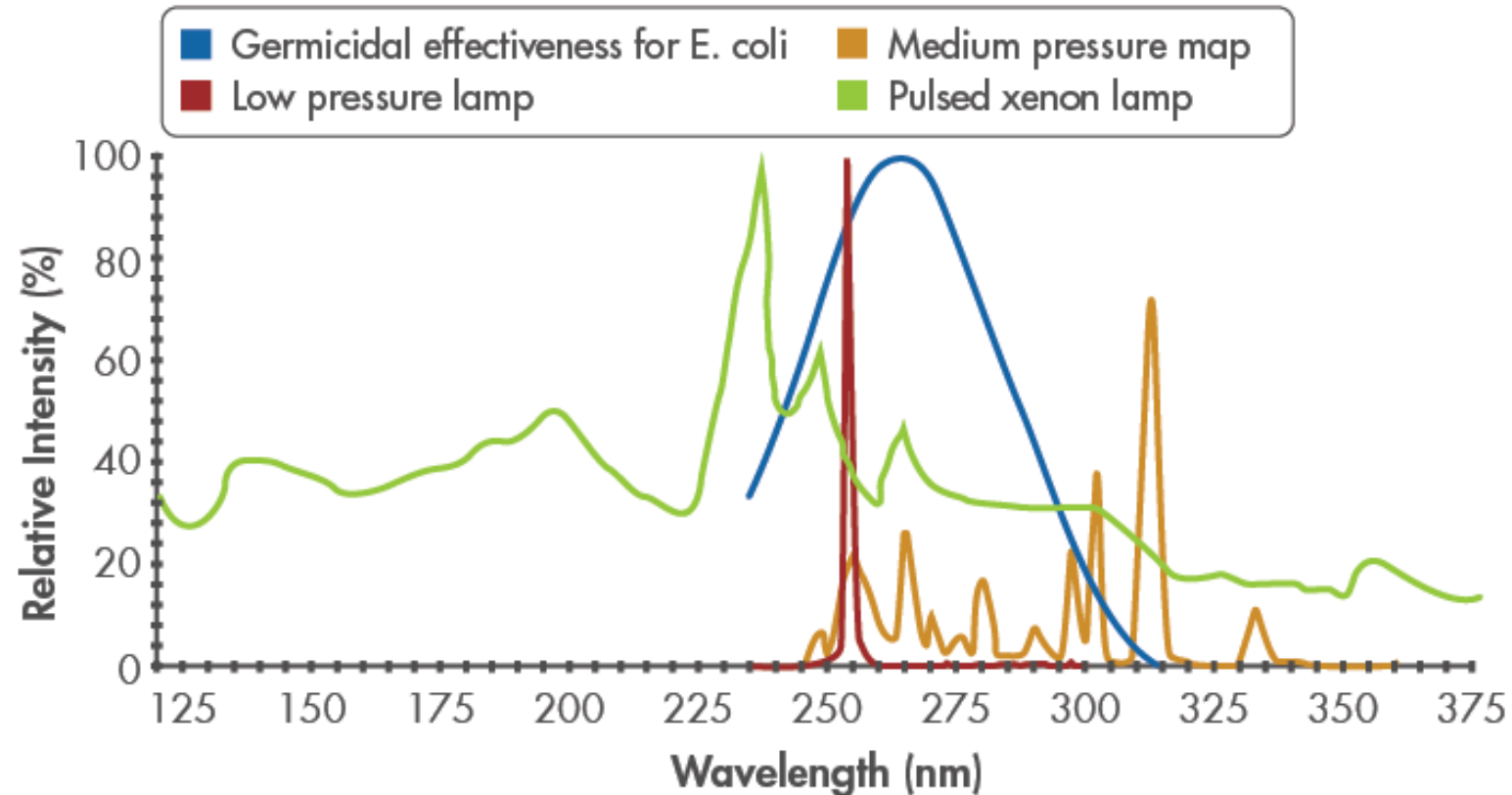


Fig. 1 Relative UV-C Germicidal Efficiency

Source: ASHRAE 2016 HVAC Systems & Equipment Handbook - Chapter 17



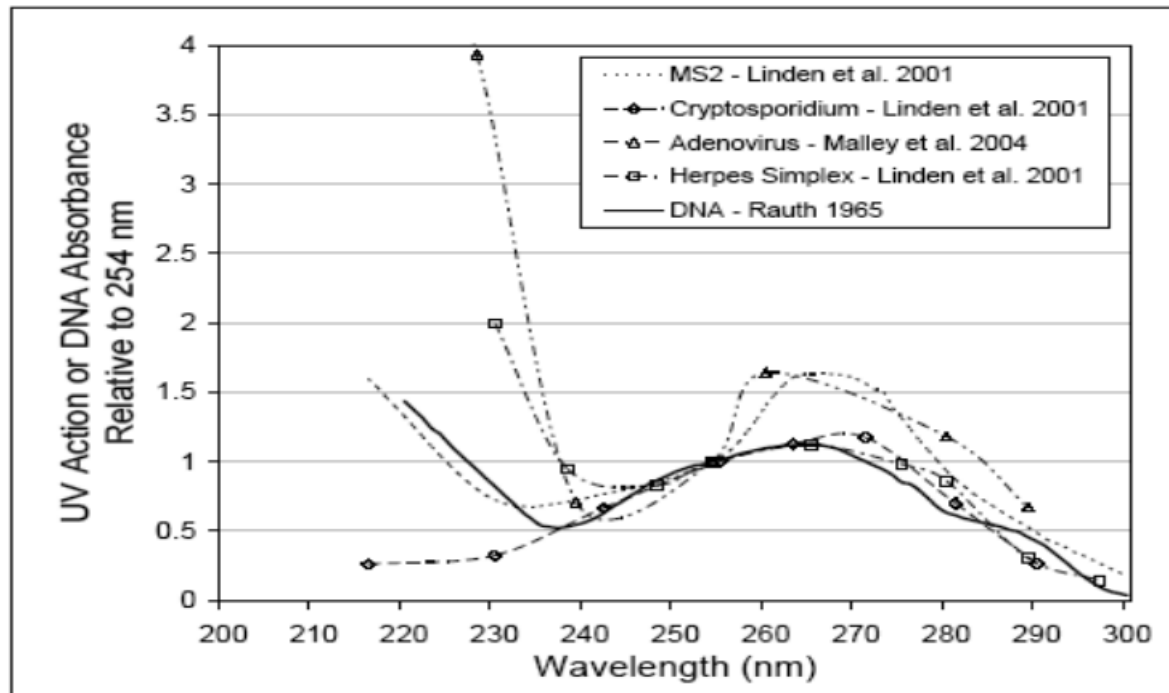
UV-C EFFECTIVENESS



Source: International Journal of Food Science and Nutrition Engineering p-ISSN: 2166-5168 e-ISSN: 2166-5192
2018; 8(3): 60-71
doi:10.5923/j.food.20180803.02



UV-C EFFECTIVENESS



Source: Adapted from Rauth (1965), Linden et al. (2001), and Malley et al. (2004)

Most susceptible

Viruses

Vegetative Bacteria

Mycobacteria

Bacterial Spores

Fungal Spores

Least susceptible

ASHRAE – HVAC Applications 2019 Chapter 62 – “ULTRAVIOLET AIR AND SURFACE TREATMENT”

Source: Chatterley, Christie. (2009). UV-LED Irradiation Technology for Point-of-Use Water Disinfection. Proceedings of the Water Environment Federation. 2009. 10.2175/193864709793848176.



KEEP IN MIND

To be effective, it requires high UV doses to inactivate microorganisms on-the-fly as they pass through the irradiated zone due to limited exposure time.



ASHRAE RECOMMENDATIONS

UVGI Implementations:

- ✓ Minimum target UV dose of 1,500 $\mu\text{W}\cdot\text{s}/\text{cm}^2$ (1,500 $\mu\text{J}/\text{cm}^2$)
- ✓ Systems typically designed for 500 fpm moving airstream.
- ✓ Minimum irradiance zone of two feet
- ✓ Minimum UV exposure time of 0.25 second.

Source: <https://www.ashrae.org/technical-resources/filtration-disinfection>



ASHRAE RECOMMENDATIONS

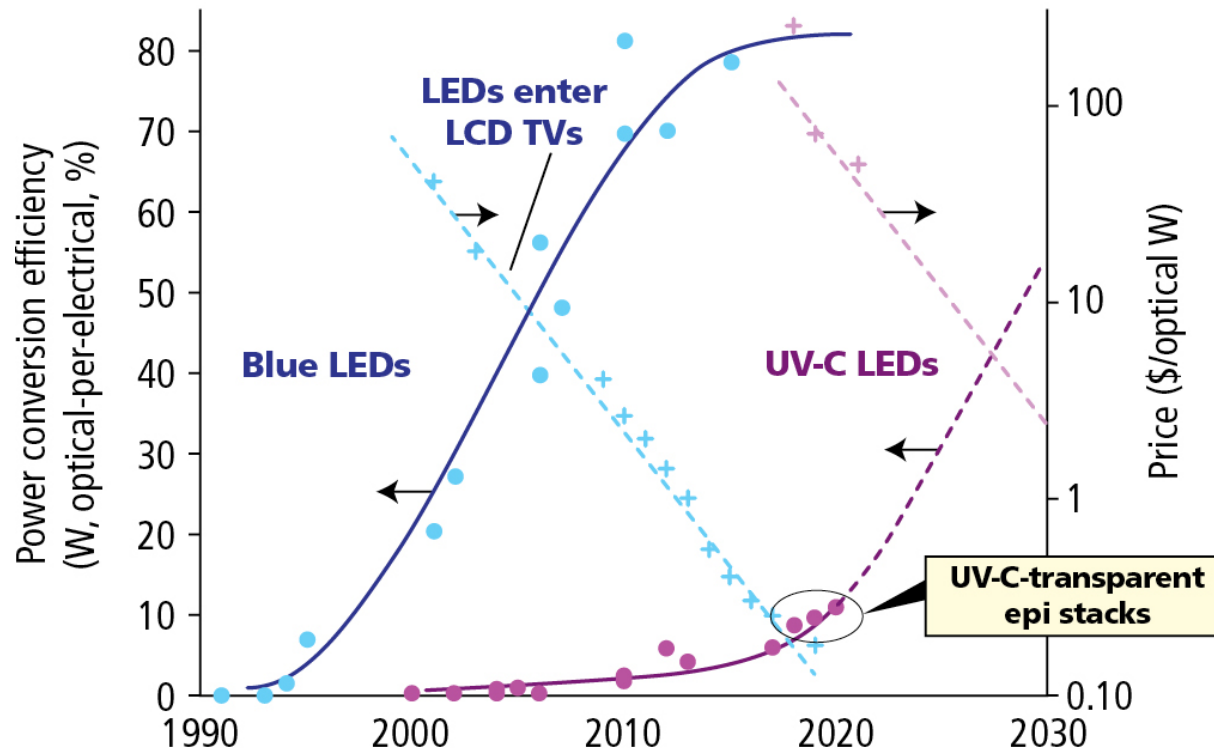
Should always be coupled with mechanical filtration:

- ✓ MERV 8 filter for dust control
- ✓ Highest practical MERV filter recommended
- ✓ Enhanced overall air cleaning with increased filter efficiency

Source: <https://www.ashrae.org/technical-resources/filtration-disinfection>



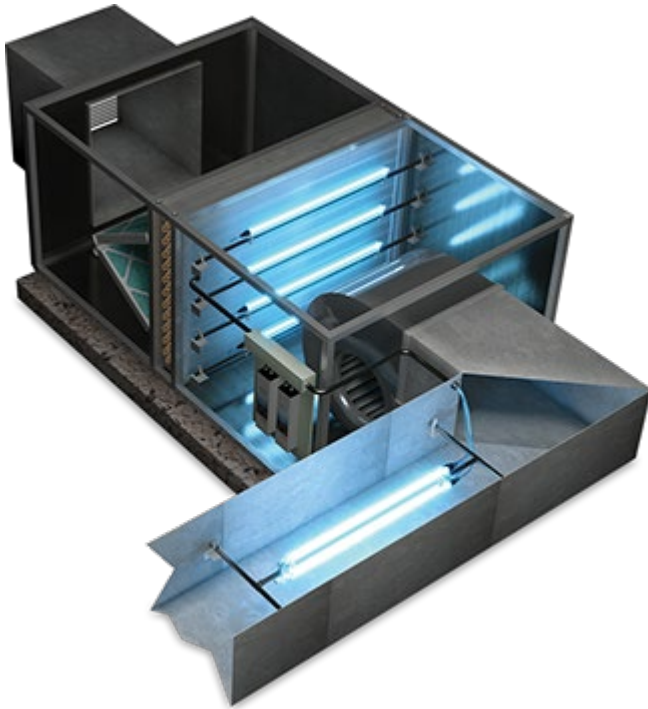
WHAT ABOUT UV-C LED?



“Once a solid-state technology can compete with tube-based lamps on a cost-of-ownership basis, the preferred solution is undeniable, and the story of how blue LEDs replaced CCFLs will play out again as UV-C LEDs replace Hg lamps in myriad applications, and enable new applications that Hg lamps never could have fulfilled.”

Source: www.ledsmagazine.com/leds-ssl-design/article/14178371/technology-roadmap-shows-uv-c-leds-are-on-the-rise

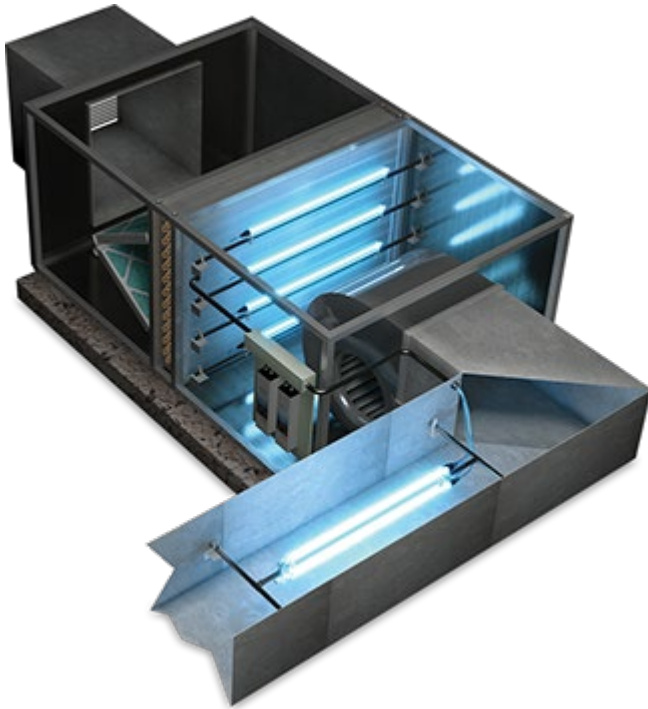
INSTALL LOCATION & CONTROLS



- Constant Flow – no protection is given when the air is not being exchanged
- UVGI should always be on when any air is being supplied.
- SRP requires that the UVGI system be installed at the unit coils or in the main supply air stream before any branches.
- Maintain normal RH levels: 40% - 50%

Source: <https://www.freshaireuv.com/commercial-hvac/> <https://www.cdc.gov/niosh/docs/2009-105/pdfs/2009-105.pdf?id=10.26616/NIOSH PUB2009105>

Rebate Requirements



- ✓ Direct evaporative coolers are not eligible
- ✓ Must be installed in such a way that no occupants are exposed to UV radiation
- ✓ Installed in-duct
- ✓ UVGI system must be able to provide sufficient UV-C irradiance & exposure time to the supply air stream of AC unit

Source: <https://www.freshaireuv.com/commercial-hvac/>



Dave Noel
SRP Business Solutions
Outreach Manager



Source: ASHRAE 2019 HVAC Applications Handbook - Chapter 62



LONG-TERM MAINTENANCE

- ✓ **Lamp Life:** 1 Yr rating (~ 9,000 Hrs) or 2 Yr rating (~18,000 Hrs)
- ✓ The effective (useful) life of a UVGI lamp is rated at 20% decline in the UV output.
- ✓ Check for UV degradation of materials for leakage
- ✓ Synthetic filters should not be exposed to UV radiation



UV EXPOSURE RISK

Exposure

- Exposure to UV-C energy can cause eye and skin damage.
- Inflammation of the cornea (Photokeratitis)
- Inflammation of the ocular lining of the eye (Keratoconjunctivitis)
- Skin Burns
- **International Agency for Research on Cancer**
 - Exposure can cause cancer
- **CDC** – Exposure is reasonably anticipated to be a human carcinogen

Symptoms

- May not be evident until several hours after exposure
- May include an abrupt sensation of sand in the eyes, tearing, and eye pain, possibly severe.
- Symptoms usually appear 6 to 12 hours after UV exposure.
- Symptoms are fully reversible and resolve within 24 to 48 hours.
- **Does not cause/induce tanning



Personal Protective Equipment (PPE)

Safety First: Know your PPE

- ✓ • UV-C blocking Eyewear
- ✓ • UV-C blocking clothing & gloves



Gloves



Glasses

Source: ASHRAE 2019 HVAC Applications Handbook - Chapter 62



SAFETY PRACTICES

Fully Enclosed

- Prevent UV exposure
- Eliminate UV light leakage to outside of HVAC unit
- Prevent unauthorized access to exposed panels & chambers
- People should never be exposed to energized UV lamps

Safe Access

- Label exposed panels & chambers with warnings
- Prioritize positive disconnection devices over switches
- Opening panels should automatically de-energize UV equipment
- lock-out function to prevent accidentally turning on/off
- View port made with UV-C absorbing material

Safe Storage

- UV lamps must not be stored in the same room as general room lighting lamps
- Storage room must only be accessible by authorized persons
- Stored lamps should be clearly labeled with both identification labels and warning labels
- Properly dispose of used lamps to prevent mercury contamination or accidental usage.

Source: ASHRAE 2019 HVAC Applications Handbook - Chapter 62



ADDITIONAL AIR CLEANING SOLUTIONS

Physical Solutions

- HEPA Filters
- Electronic Air Filters
- Gas-Phase Air Cleaners
 - Generally Ineffective for viral removal
- Outside Air Dilution

Reactive Cleaning Systems

- Photocatalytic Oxidation (PCO)
- Dry Hydrogen Peroxide (DHP)
- Ionization systems
 - Bipolar Ionization
 - Corona Discharge
 - Needlepoint Ionization
 - Other Ion/Reactive Oxygen Air Cleaners
- Ozone & Vaporized Hydrogen Peroxide (VHP)
 - Ineffective at safe levels

Other UV-C

- Upper Room UVGI
- Surface cleaning UVGI
- UV-C Portable Room Decontamination

Source: <https://www.ashrae.org/technical-resources/filtration-disinfection>

PHYSICAL SOLUTIONS – OUTSIDE AIR DILUTION

CDC Recommendations

- Use max possible outside air (temp/humidity permitting)
- Increase supply air flow
- Disable demand controlled ventilation (DCV)
- Consider if natural ventilation will improve air conditions (opening windows & doors)
- Use improved filtration that won't significantly diminish air flow
- Consider daily pre-occupancy air purges

Use regardless of other measures taken

<https://www.cdc.gov/coronavirus/2019-ncov/community/office-buildings.html>

Air Exchange Efficiency

Table 4. Particle removal efficiency for various rates of air change per hour (ACH) in a perfectly mixed room ($K = 1$)

ACH	Removal efficiency at one hour (%)*
1	63.2
2	86.5
3	95.0
4	98.2
6	99.75
12	99.9994
20	99.99999

*Given by $100 \times (1 - 0.368^A)$, where A = air change per hour.



OTHER UV-C – UPPER ROOM UVGI

CDC

- Supplemental technique in commonly occupied spaces
- Must measure lower-room occupied space level radiation to ensure occupant safety.
- Generally a proven technology (focus on TB)
- Risk of occupant exposure (Note: This is why SRP has chosen to support in-duct systems rather than upper room systems.)
- Continuous mitigation of air in occupied spaces
- Must be properly shielded

<https://www.cdc.gov/coronavirus/2019-ncov/community/office-buildings.html>

ASHRAE

- Dose: > 10 $\mu\text{W}/\text{cm}^2$ (Average **30 - 50** $\mu\text{W}/\text{cm}^2$) (Much less than in-duct UVGI)
- UV fixtures mounted in occupied spaces at heights of 7 feet and above.
- Consider when:
 - No mechanical ventilation
 - Limited mechanical ventilation
 - Congregate settings and other high-risk areas
 - Economics/other
- Requires low UV-reflectivity of walls and ceilings
- Ventilation should maximize air mixing
- Use supplemental fans where ventilation is insufficient

<https://www.ashrae.org/technical-resources/filtration-disinfection>



OTHER UV-C – SURFACE CLEANING UVGI

Surface cleaning UVGI

- Only for Surface Decontamination
- Cannot be used in occupied spaces
- Portable
- Exposes all materials in room to UV radiation degradation
- Sometimes in manufacturing of products



<https://www.ashrae.org/technical-resources/filtration-disinfection>





COST – ASHRAE (2009)

In-Duct Air UVGI

Annual energy cost @ \$0.10/kWh =
\$0.22/m² (\$20.44/1000 ft²)

Annualized Life-cycle cost: \$7.97/m²
(\$740.44/1000 ft²)

Upper Room UVGI

Annual energy cost @ \$0.10/kWh =
\$0.11/m² (\$10.22/1000 ft²)

Annualized Life-cycle cost: \$21.53/m²
(\$2,000.20/1000 ft²)

High Filtration

Annual MERV 12 filter cost: \$1.08/m²
(\$100.34/1000 ft²)

Annualized Life-cycle cost: \$19.27/m²
(\$1,790.24/1000 ft²)

Source: ASHRAE 2019 HVAC Applications Handbook - Chapter 62 – Page 62.10





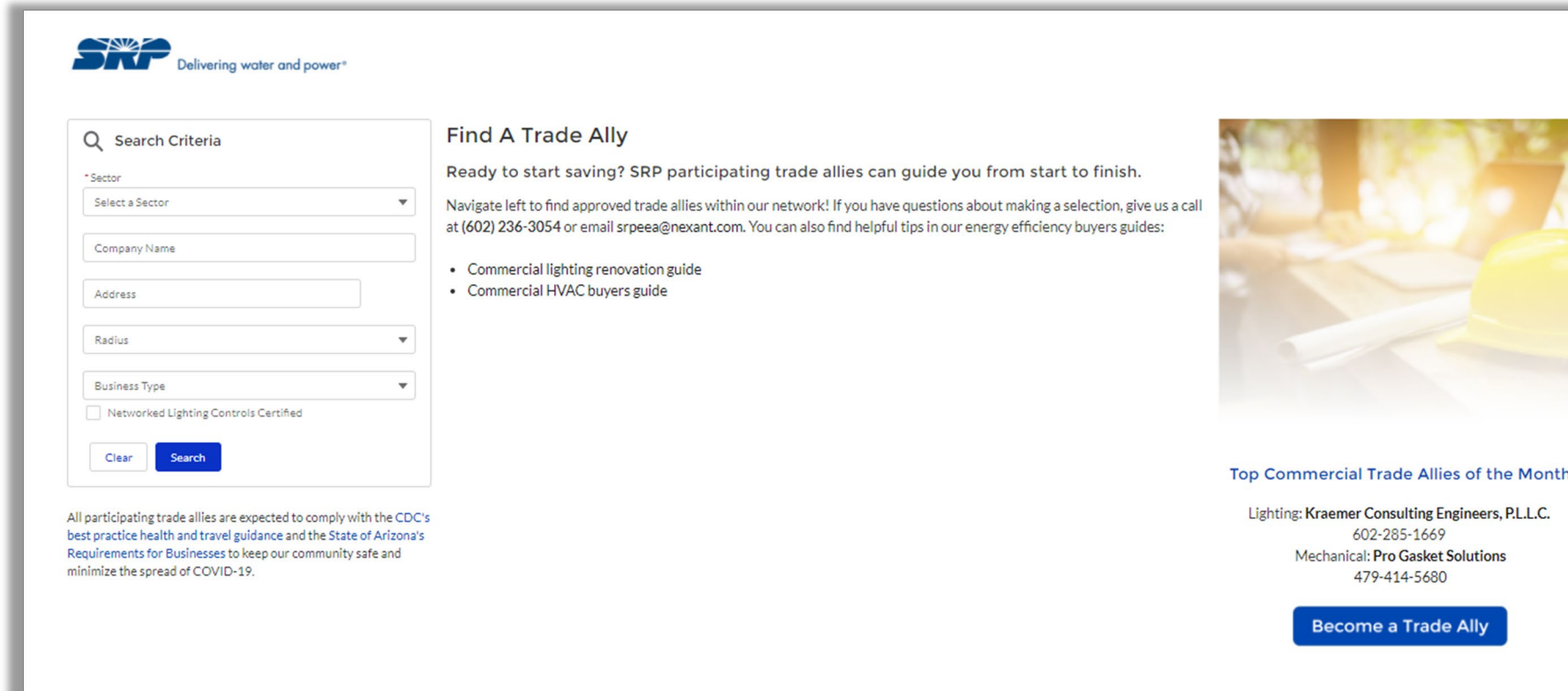
- Address Highest Risk areas first
 - Spaces with significant population mixing
 - Spaces with large foot traffic
 - Spaces with high occupant density
- Consider the specific risk factors of those spaces
 - How is the ventilation in the space?
 - Is contact high or for extended periods?
 - Which technologies will meet the demands of the space best?



SRP's Find-A-Contractor

Contractors that install UVGI will be listed soon!

Go to: www.savewithsrpbiz.com Click on: "Rebates & Incentives: and choose "Find a contractor"



The screenshot shows the SRP website's "Find A Trade Ally" section. On the left is a search criteria form with fields for Sector, Company Name, Address, Radius, and Business Type, along with a checkbox for "Networked Lighting Controls Certified" and "Clear" and "Search" buttons. Below the form is a disclaimer about CDC and Arizona state requirements for COVID-19. The main content area is titled "Find A Trade Ally" and includes a paragraph about the benefits of trade allies, contact information for questions, and a list of guides. To the right is an image of a construction site with a yellow hard hat. Below the image is a section for "Top Commercial Trade Allies of the Month" listing Kraemer Consulting Engineers, P.L.L.C. for lighting and Pro Gasket Solutions for mechanical. A "Become a Trade Ally" button is at the bottom right of the main content area.

SRP Delivering water and power®

Find A Trade Ally

Ready to start saving? SRP participating trade allies can guide you from start to finish.

Navigate left to find approved trade allies within our network! If you have questions about making a selection, give us a call at (602) 236-3054 or email srpeea@nexant.com. You can also find helpful tips in our energy efficiency buyers guides:

- Commercial lighting renovation guide
- Commercial HVAC buyers guide

Top Commercial Trade Allies of the Month

Lighting: Kraemer Consulting Engineers, P.L.L.C.
602-285-1669
Mechanical: Pro Gasket Solutions
479-414-5680

[Become a Trade Ally](#)

All participating trade allies are expected to comply with the CDC's best practice health and travel guidance and the State of Arizona's Requirements for Businesses to keep our community safe and minimize the spread of COVID-19.





WHAT DOES THE FUTURE HOLD?

- Conjectures
 - The UVGI market will mature and costs will decrease
 - UV LEDs will follow the same trajectory as visible light LEDs
 - Governing bodies will require 'pandemic response systems' for facilities
- Conclusions based on conjectures
 - UVGI systems likely will be required for certain facility spaces in the future
 - Building Automation Systems will be required to have 'Pandemic Mode'
 - Pathogen mitigation will become an inherent aspect of HVAC design



QUESTIONS?

Contact Information:

SRP Business Solutions

Call: (602) 236-3054

Email: savewithsrpbiz@srpnet.com

Additional Resources:

[ASHRAE - Filtration & Disinfection](https://www.ashrae.org/technical-resources/filtration-disinfection)

<https://www.ashrae.org/technical-resources/filtration-disinfection>

[CDC - Office Buildings](https://www.cdc.gov/coronavirus/2019-ncov/community/office-buildings.html)

<https://www.cdc.gov/coronavirus/2019-ncov/community/office-buildings.html>

Learn more at savewithsrpbiz.com/uvgi



Program Administrator

