VIRTUAL SIGNATURE SERIES
UVGI HVAC REBATE FOR YOUR BUSINESS
PROGRAM MANAGERS
SRP Business Solutions

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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

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Senior Project Engineer

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Nexant - SRP’s Program Administrator
Program Outreach Manager
AGENDA

1. What is UVGI?
2. Maintenance & Safety Recommendations
3. Air Cleaning Considerations
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
What is UVGI?

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
What is UVGI?

Long-wave
315 to 400 nm

Medium-wave
280 to 315 nm

Short-wave
200 to 280 nm

< 200 nm

Source: ASHRAE 2016 HVAC Systems & Equipment Handbook - Chapter 17
What is UVGI?

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
What is UVGI?

UV-C EFFECTIVENESS

Most susceptible

- Viruses
- Vegetative Bacteria
- Mycobacteria
- Bacterial Spores
- Fungal Spores

Least susceptible

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

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 µW•s/cm² (1,500 µJ/cm²)
- 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-uvc-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%

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/
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

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


Air Exchange Efficiency

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

<table>
<thead>
<tr>
<th>ACH</th>
<th>Removal efficiency at one hour (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63.2</td>
</tr>
<tr>
<td>2</td>
<td>86.5</td>
</tr>
<tr>
<td>3</td>
<td>95.0</td>
</tr>
<tr>
<td>4</td>
<td>98.2</td>
</tr>
<tr>
<td>6</td>
<td>99.75</td>
</tr>
<tr>
<td>12</td>
<td>99.9994</td>
</tr>
<tr>
<td>20</td>
<td>99.99999</td>
</tr>
</tbody>
</table>

*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

ASHRAE

- Dose: > 10 μW/cm² (Average 30 - 50 μW/cm²) (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)

<table>
<thead>
<tr>
<th>Method</th>
<th>Annual Energy Cost @ $0.10/kWh</th>
<th>Annualized Life-cycle Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In-Duct Air UVGI</strong></td>
<td>$0.22/m² ($20.44/1000 ft²)</td>
<td>$7.97/m² ($740.44/1000 ft²)</td>
</tr>
<tr>
<td><strong>Upper Room UVGI</strong></td>
<td>$0.11/m² ($10.22/1000 ft²)</td>
<td>$21.53/m² ($2,000.20/1000 ft²)</td>
</tr>
<tr>
<td><strong>High Filtration</strong></td>
<td>$1.08/m² ($100.34/1000 ft²)</td>
<td>$19.27/m² ($1,790.24/1000 ft²)</td>
</tr>
</tbody>
</table>

*Source: ASHRAE 2019 HVAC Applications Handbook - Chapter 62 – Page 62.10*
Air Cleaning Considerations

**STRATEGY**

- 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”
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

CDC - Office Buildings

Learn more at savewithsrpbiz.com/uvgi