VIRTUAL SIGNATURE SERIES

UVGI HVAC REBATE FOR YOUR BUSINESS

PROGRAM MANAGERS

SRP Business Solutions

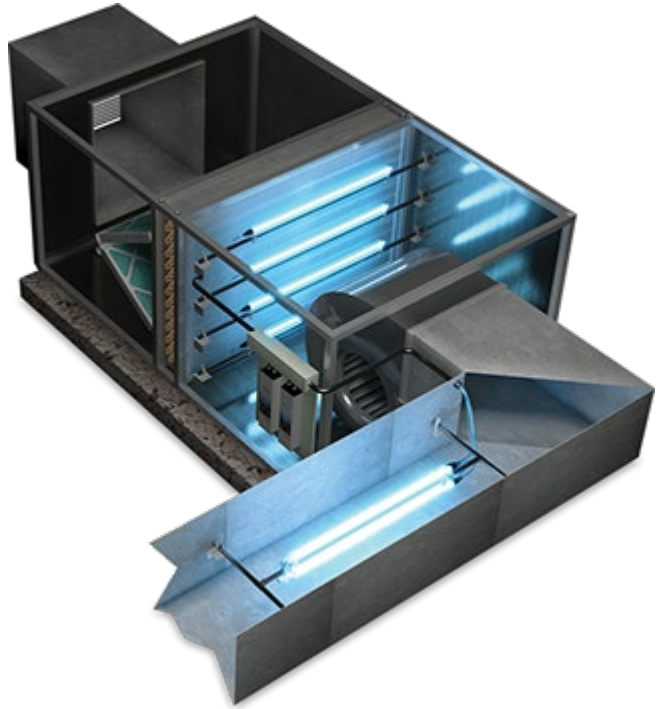
Joseph Degraft-Johnson
Salt River Project
Senior Market Analyst

Mike Green
Salt River Project
Senior Program Manager

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/

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

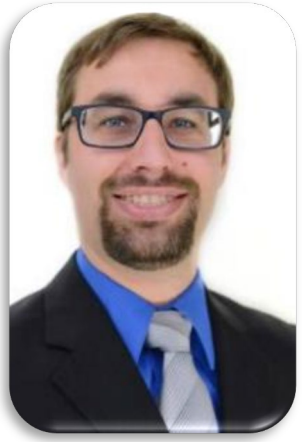
Limitations

- 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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

PRESENTERS

SRP Business Solutions



Peter Hamstra
Nexant, - SRP's Program Administrator
Senior Project Engineer

Dave Noel
Nexant - SRP's Program Administrator
Program Outreach Manager

Nexant
Program Administrator

SRP®

AGENDA

1 What is UVGI?

2 Maintenance & Safety Recommendations

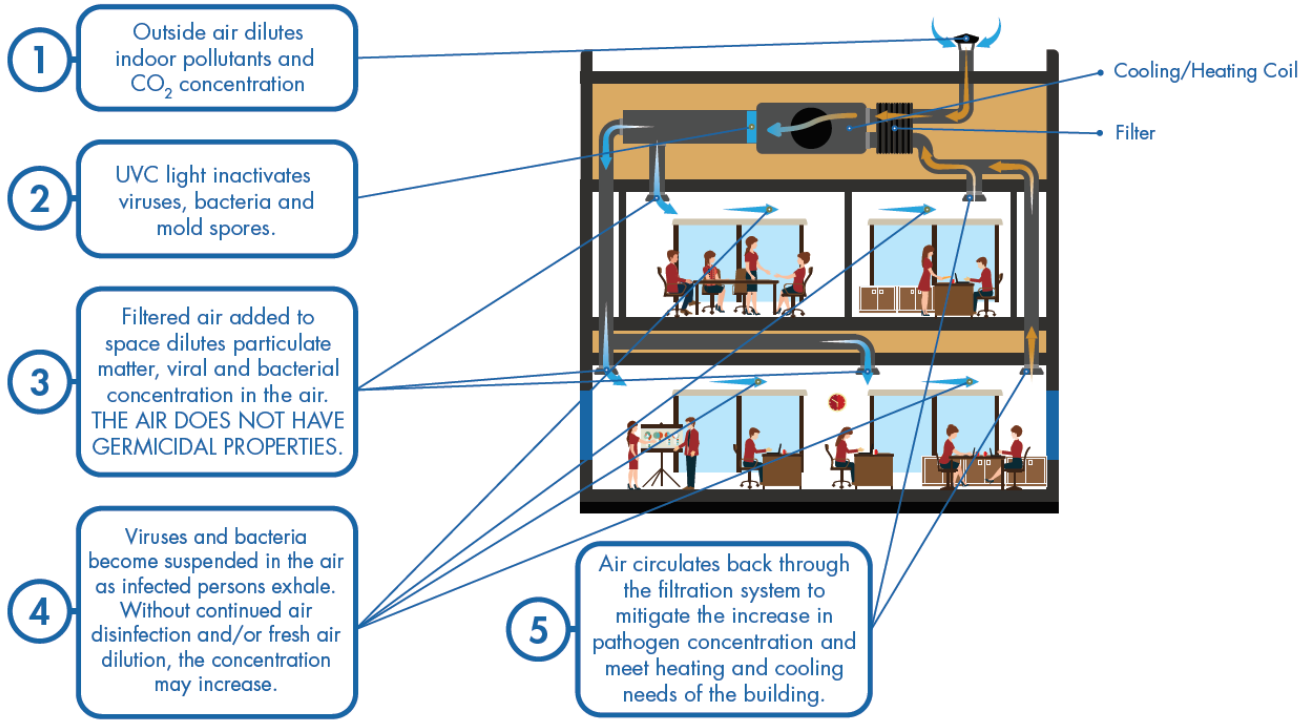
3 Air Cleaning Considerations

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

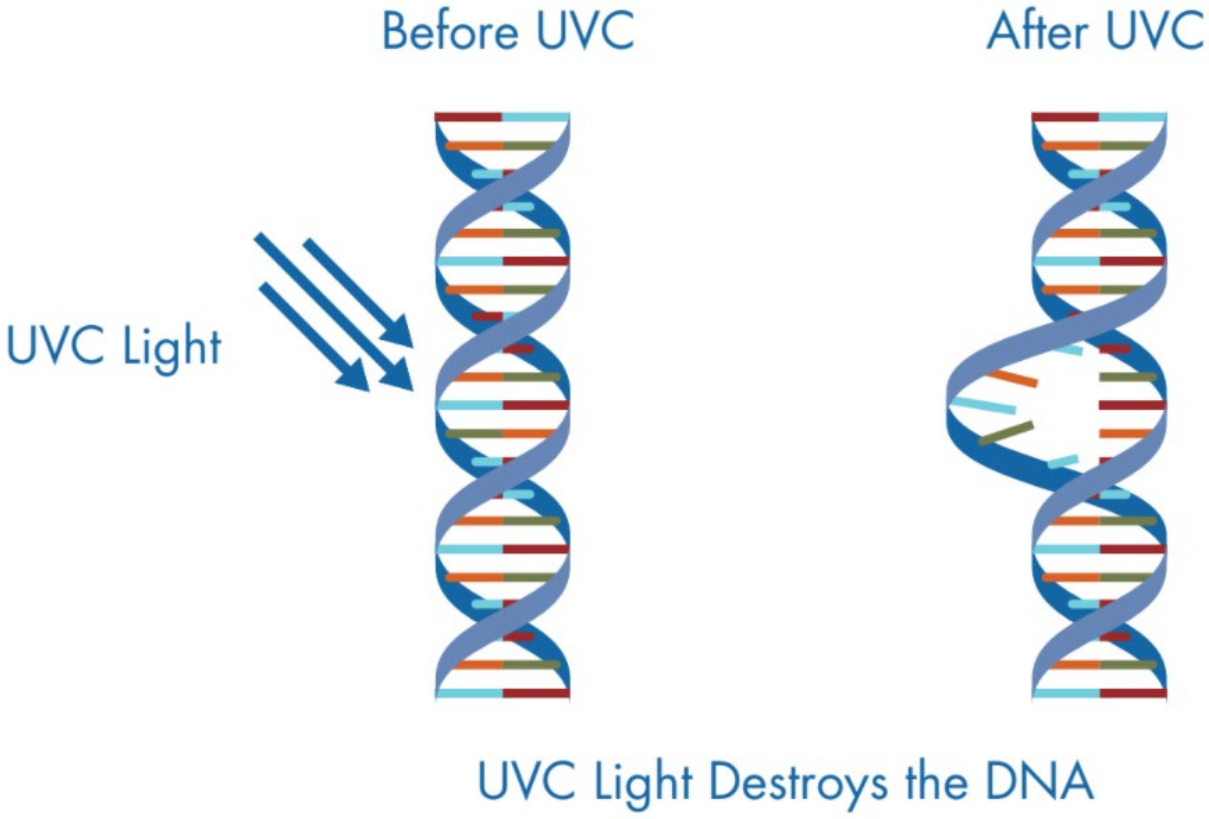
- 1st airborne tests: 1935
- Progressed from light curtain concept to upper room UVGI to in-stream UVGI
- Historic use:
  - Historically used to mitigate TB transmission and Measles transmission
  - Used in areas of high pathogen transmission (Emergency Rooms & Hospitals)
  - Used in waste water & domestic 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 prymidine 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

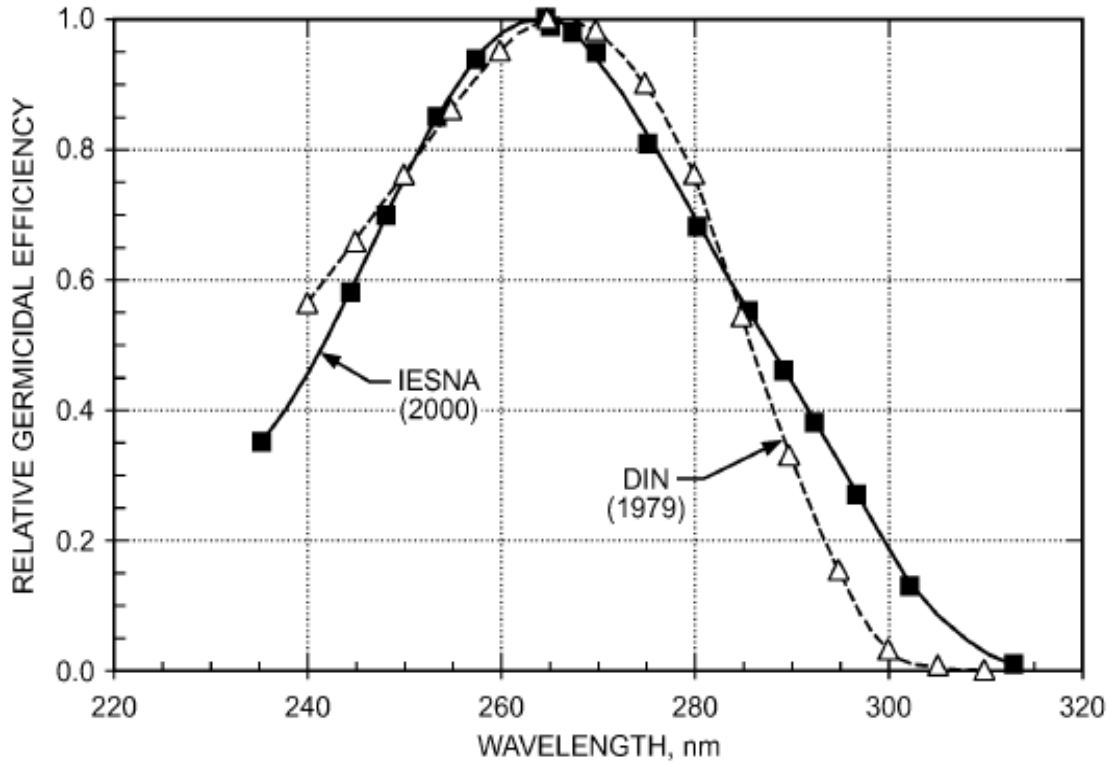
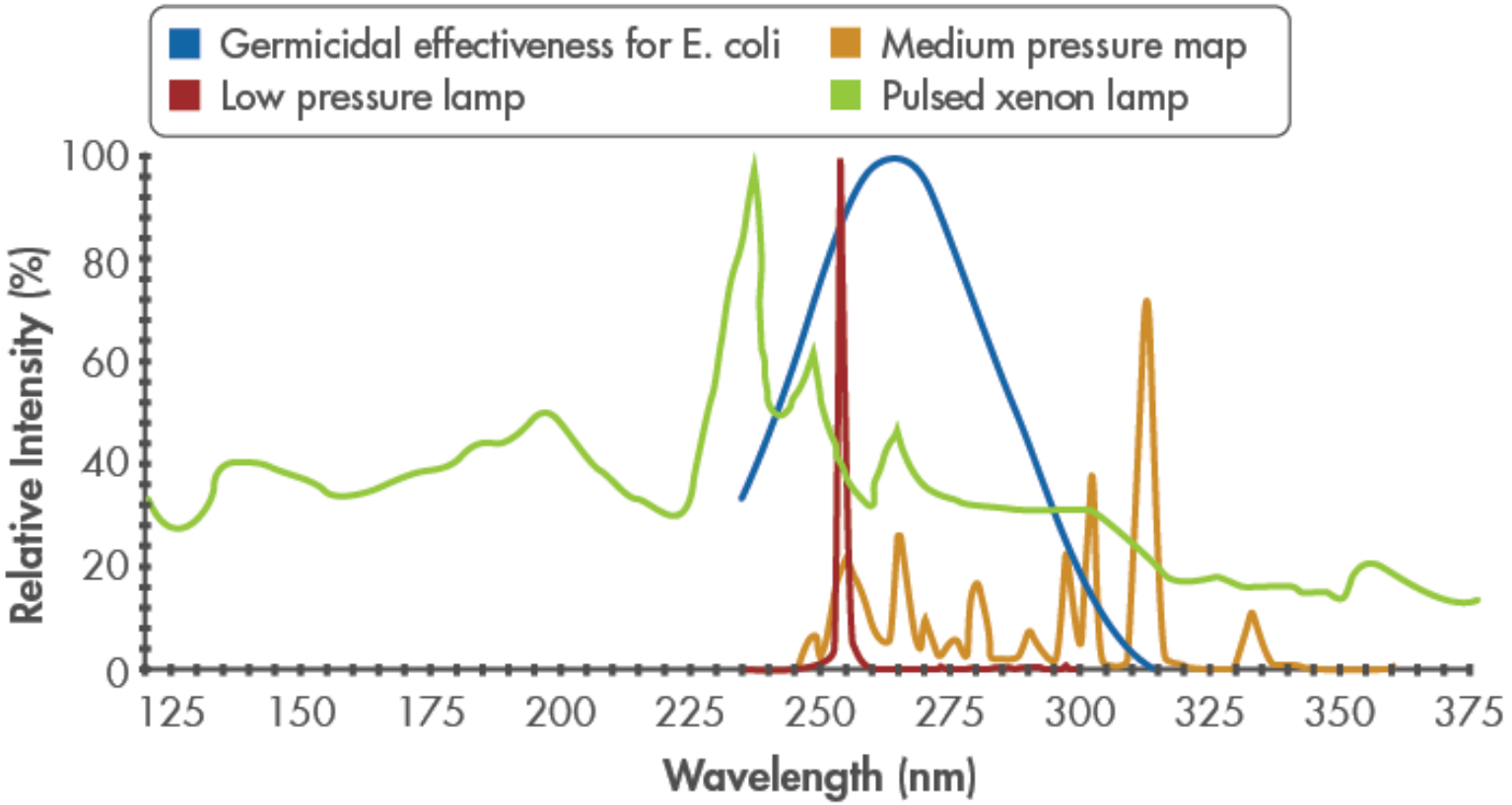


Fig. 1 Relative UV-C Germicidal Efficiency

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

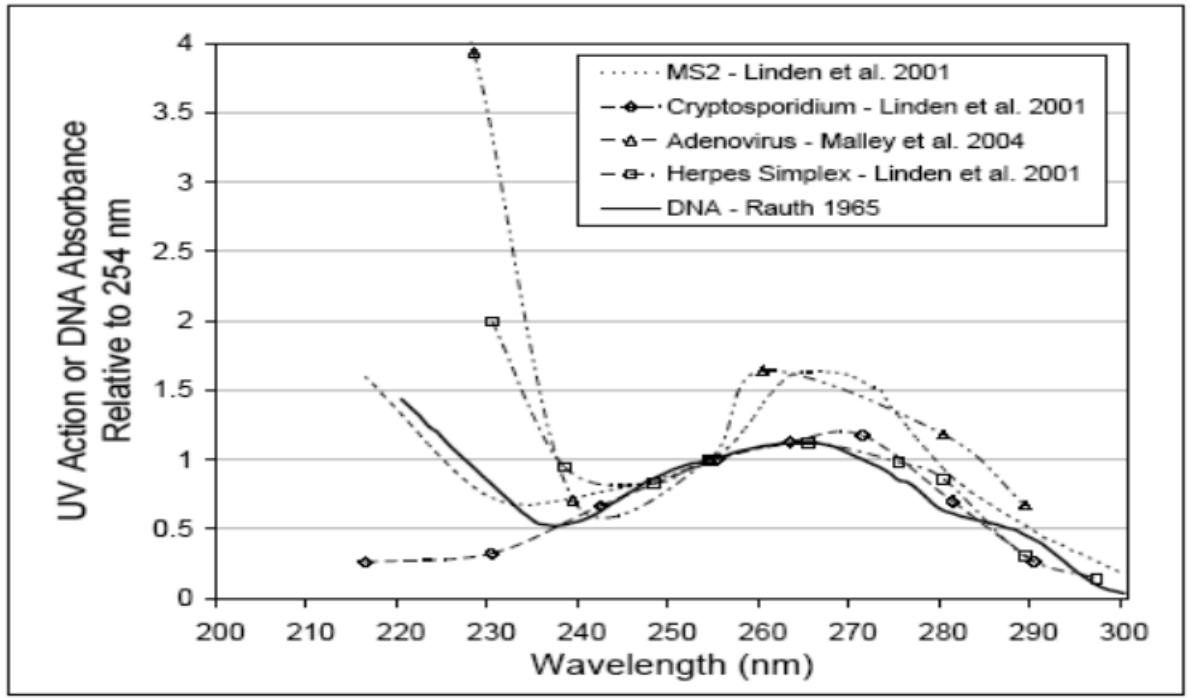
UV-C EFFECTIVENESS



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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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.

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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.

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

ASHRAE RECOMMENDATIONS

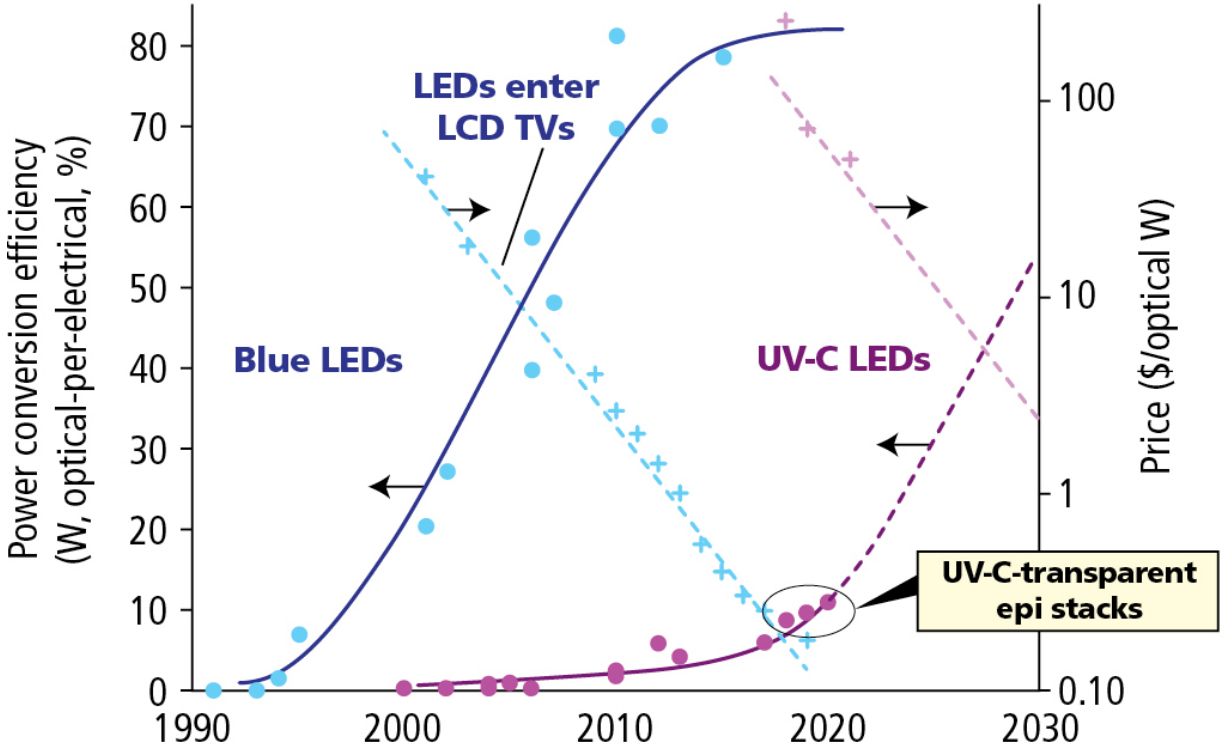
Should always be coupled with mechanical filtration:

- 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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

WHAT ABOUT UV-C LED?

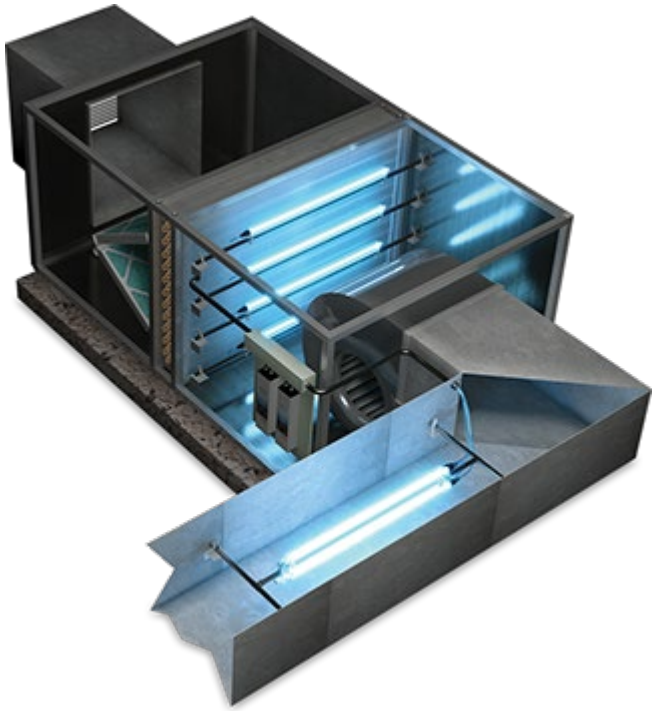


"Once a solid-state technology can compete with tube-based lamps on a cost-of-ownership basis, the preferred solution is undeniable, and the story of how blue LEDs replaced CCFLs will play out again as UV-C LEDs replace Hg lamps in myriad applications, and enable new applications that Hg lamps never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

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

INSTALL LOCATION & CONTROLS

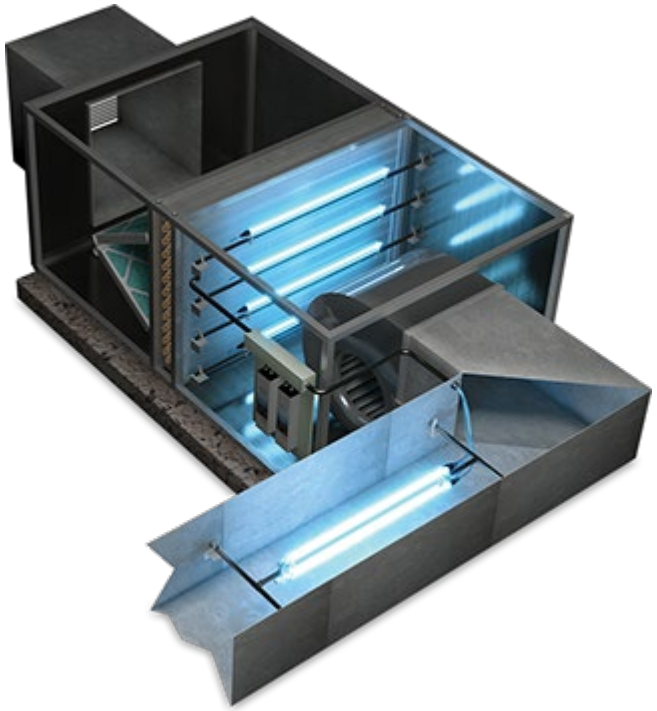


- Constant Flow – no protection is given when the air is not being exchanged
- UVGI should always be on when any air is being supplied.
- SRP requires that the UVGI system be installed at the unit coils or in the main supply air stream before any branches.
- Maintain normal RH levels: 40% - 50%

Source: https://www.freshaireuv.com/commercial-hvac/ https://www.cdc.gov/niosh/docs/2009-105/pdfs/2009-105.pdf?id=10.26616/NIOSHPUB2009105

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

Rebate Requirements



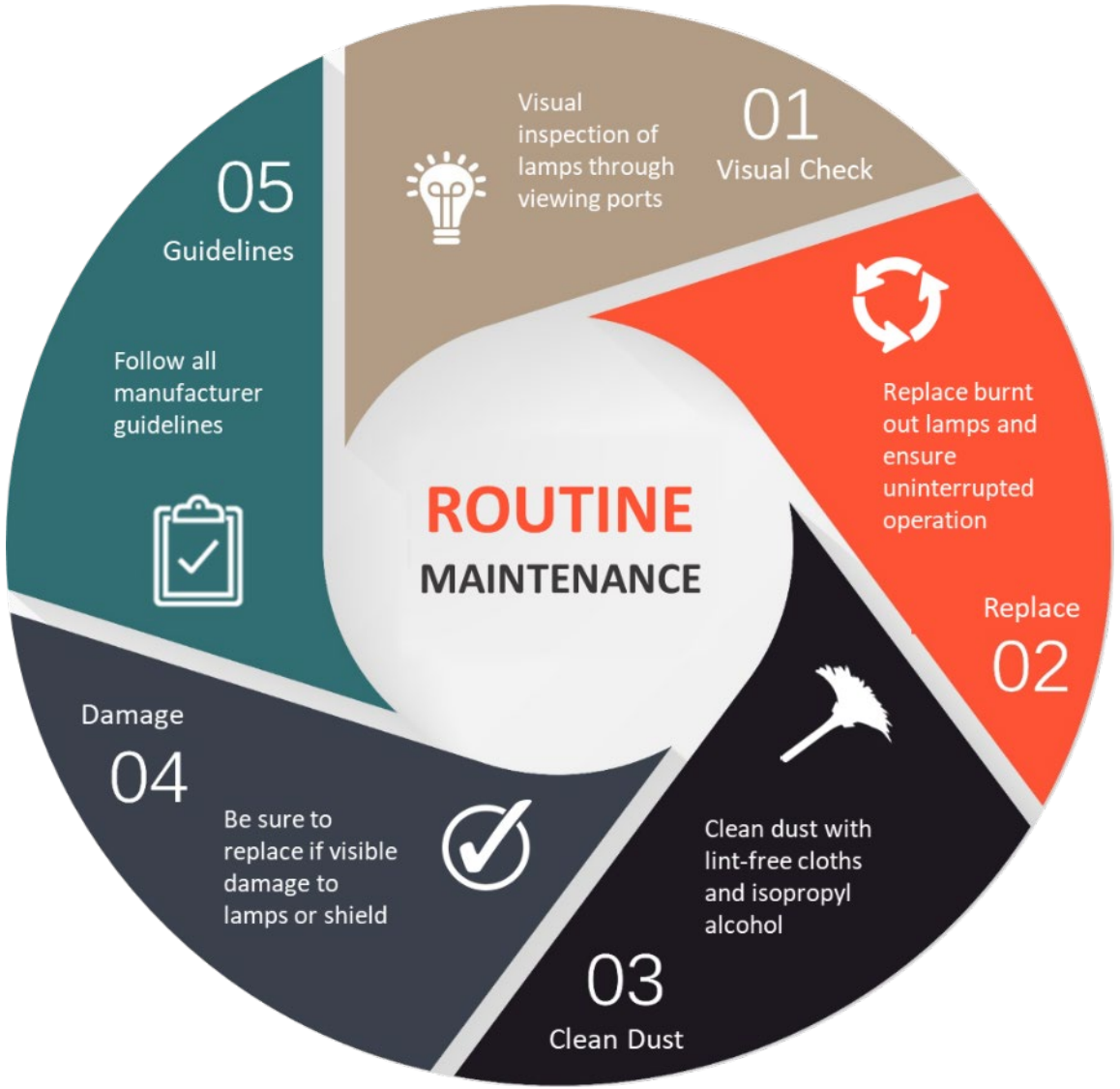
- Direct evaporative coolers are not eligible
- Must be installed in such a way that no occupants are exposed to UV radiation
- Installed in-duct
- UVGI system must be able to provide sufficient UV-C irradiance & exposure time to the supply air stream of AC unit

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

Maintenance & Safety Recommendations

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

Source: https://www.cdc.gov/niosh/docs/2009-105/pdfs/2009-105.pdf?id=10.26616/NIOSHPUB2009105

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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.

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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 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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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	Upper Room UVGI	High Filtration
Annual energy cost @ $0.10/kWh = $0.22/m2 ($20.44/1000 ft2)	Annual energy cost @ $0.10/kWh = $0.11/m2 ($10.22/1000 ft2)	Annual MERV 12 filter cost: $1.08/m2 ($100.34/1000 ft2)
Annualized Life-cycle cost: $7.97/m2 ($740.44/1000 ft2)	Annualized Life-cycle cost: $21.53/m2 ($2,000.20/1000 ft2)	Annualized Life-cycle cost: $19.27/m2 ($1,790.24/1000 ft2)

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

STRATEGY

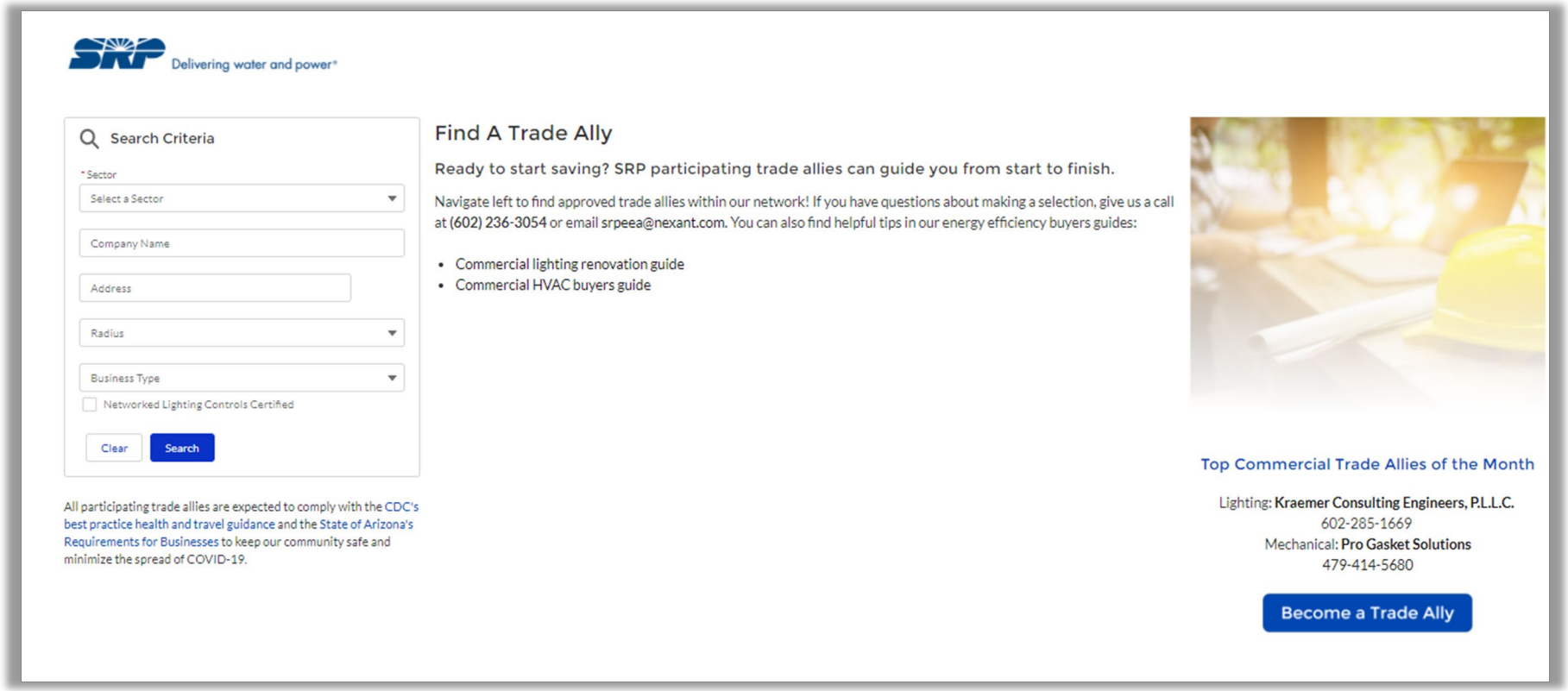
- Address Highest Risk areas first
  - Spaces with significant population mixing
  - Spaces with large foot traffic
  - Spaces with high occupant density
- Consider the specific risk factors of those spaces
  - How is the ventilation in the space?
  - Is contact high or for extended periods?
  - Which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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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"



FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE

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

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

Learn more at savewithsrpbiz.com/uvgi

Nexant

Program Administrator

SRP®

FOR SRP REFERENCE ONLY _ DO NOT REPRODUCE