SECTION 230566 - ANTIMICROBIAL ULTRAVIOLET LAMP SYSTEMS FOR HVAC

Revise this Section by deleting and inserting text to meet Project-specific requirements.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Antimicrobial UV-C lamp systems for large air-handling units.

Antimicrobial UV-C lamp systems for packaged air-handling units.

Controls.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
				2. UV-C: Ultraviolet-C short-wave spectrum.
				3. UV-C Lamp System: Unit including UV lamp, power supply, housing, and supports.
				4. UVGI: Ultraviolet germicidal irradiation.
			1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

Product description with complete technical data, performance data, and product specification sheets.

Operating characteristics; electrical characteristics; and furnished accessories indicating process operating power, distribution range, control signal over range, default control signal with loss of power, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

Installation instructions, including factors affecting performance.

* + - * 1. Shop Drawings: For each UV-C lamp system.

Include plans, elevations, sections, mounting, and attachment details.

Include details of UV-C lamp system assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Include diagrams for power, signal, and control wiring.

* + - 1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For lamp systems to include in operation and maintenance manuals.

Provide a list of all lamp and fixture types used on Project.

* + - 1. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

UV-C Lamps: [**10 for every 100**] <**Insert quantity**> of each type and rating installed. Furnish no fewer than one of each type.

* + - 1. WARRANTY

When warranties longer than one year are required and would exceed the "one-year period for correction of Work," verify with Owner's counsel Representative that warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

* + - * 1. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

Verify available warranties and warranty periods.

Warranty Period, System: [**Five**] <**Insert number**> years from date of Substantial Completion.

Warranty Period, Lamp: [**One**] <**Insert number**> year(s) from date of Substantial Completion.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

UV-C lamp systems in this Section are used to irradiate surfaces inside air-handling units in order to control microbial growth on surfaces, in particular on cooling coils and drain pans. See the Evaluations for a discussion on benefits of UVGI in HVAC systems.

* + - 1. PERFORMANCE REQUIREMENTS
				1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

"ASHRAE 62.1 Compliance" Paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainable design may require compliance with requirements in ASHRAE 62.1, including requirements for controls, surfaces in contact with the airstream, particulate and gaseous filtration, humidification and dehumidification, drain pan construction and connection, finned-tube coil selection and cleaning, and equipment access. Verify, with manufacturers, the availability of units with components and features that comply with these requirements.

* + - * 1. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

Retain "ASHRAE Compliance" Paragraph below to require compliance with ASHRAE test methods. Verify with manufacturer.

* + - * 1. ASHRAE Compliance:

Test UV-C lamp systems according to ASHRAE 185.1, "Method of Testing UV-C Lights for Use in Air-Handling Units or Air Ducts to Inactivate Airborne Microorganisms."

Test UV-C lamp systems according to ASHRAE 185.2, "Method of Testing Ultraviolet Lamps for Use in HVAC&R Units or Air Ducts on Irradiated Surfaces."

* + - 1. MANUFACTURERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13168) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[American Ultraviolet](http://www.specagent.com/Lookup?uid=123457115995).

[Carrier Corporation](http://www.specagent.com/Lookup?uid=123457115993).

[UV Resources](http://www.specagent.com/Lookup?uid=123457115992).

Approved equivalent.

* + - * 1. Source Limitations: Obtain from single source from single manufacturer.
			1. ANTIMICROBIAL UV-C LAMP SYSTEMS FOR LARGE AIR-HANDLING UNITS

Retain this type of UV-C lamp system for large air-handling units and plenums located indoors or outdoors, with the UV-C lamp system installed inside the unit within the airstream. For large system air-handlers, consider staggered coils, drain pan locations, and space limitations inside the air-handling unit. Verify size and selection with manufacturer. Large systems are generally 240,000 Btu/h (70 kW) and larger.

* + - * 1. Description: UV-C lamp system consisting of power supply, power supply housing, wiring, UV lamp(s), lamp plug, lamp plug protector, encapsulated lamp, and lamp holder.

Power supply is installed interior or exterior to air handler within a power supply housing noted below or within a NEMA enclosure.

* + - * 1. Power Supply: UL listed, single phase, 120 or 277 V ac, 50 or 60 Hz, with a programmed rapid start.

Power Factor: High power factor, Class P, Sound Rated A, Type 1 Outdoor, and with inherent thermal protection and without polychlorinated biphenyl.

Operating Temperature: From [**34 to 194 deg F**] <**Insert operating temperature(s)**>.

Wiring Harness: Plug and play.

Power Consumption: Maximum of [**15 W/sq. ft.**] <**Insert value**>.

Electrical Connection: Single electrical connection[**with service disconnect**].

Lamps should be encapsulated and coated to protect the system, space, and installer from residues of a broken UV lamp such as inert gas, mercury, and glass. Lamps should have their characteristics and ratings visibly printed on all lamps.

* + - * 1. UV-C Lamps: Encapsulated lamps, with lamp wattage and model number visibly printed on all lamps, less than 8 Mg of mercury in each lamp. UV-C lamps do not produce ozone.

Quantity and Type: [**One 145-W UV-C lamp**] [**One 75-W UV-C lamp**] <**Insert value and type of lamps**>.

Output: UV-C energy, primarily at the 253.7-nm wavelength with a 360-degree energy distribution.

Operating Temperature: From [**34 to 158 deg F**] <**Insert operating temperature(s)**>, 100 percent relative humidity, at any velocity.

Lamp Protection: Hermetically sealed with a thin layer of UV-C-transmissible fluorinated ethylene propylene to provide protection against lamp breakage and to ensure lamp contents from a broken lamp are contained.

Lamp Life: Minimum of [**9000 hours**] <**Insert time**> with greater than 85 percent of initial output at end of lamp life.

Each housing shall be capable of properly holding, grounding, and wiring one, two, four, or six power supplies to protect against electrical shock and moisture, as well as RF and EMI leaks.

* + - * 1. Power Supply Housing: Galvanized-steel, 20-gauge, powder-coated finish, for installation inside or outside of air-handling units or plenums.

Power Supply Capacity: [**One**] [**Two**] [**Four**] [**Six**] <**Insert number**>.

Provide a suitable separate NEMA enclosure, for field installation of power supply, on the exterior of an outside air-handling unit.

* + - * 1. Wiring Loom: UV-C-resistant jacket materials with internal aluminum/Mylar shield.

Conduit: Loom covered with UL flexible metal conduit, galvanized.

* + - * 1. Lamp Plug, Holder, and Lamp Clamp: Four-pin type accommodates a single-ended high output lamp.

Lamp Plug and Holder Construction: UV-resistant materials designed to connect lamp to the plug.

UL Listing: Listed and labeled to UL.

Lamp Clamp Construction: UV-resistant materials to ensure a watertight connection. A seal between the single-ended UV lamp and the lamp plug prevents electrical shock, connection shorts, and lamp or power supply failure, from lamp pin oxidation or arcing.

Position: Adjustable positioning of lamp holder and lamp clamp.

* + - * 1. Lamp Holsters: Dual lamp holsters permanently affixed within the irradiated cavity to interior surface of an air-handling unit or to vertical supports.

Lamp Holster Construction: UV-C-resistant materials for fastening strength.

Positioning: Flexible lamp positioning allows ease of lamp removal.

* + - 1. ANTICMICROBIAL UV-C LAMP SYSTEMS FOR PACKAGED AIR-HANDLING UNITS

Retain this type of UV-C lamp system for packaged air-handling units and plenums, located indoors or outdoors. For outdoor installations, a NEMA 4X power supply housing is mounted on outside of the air-handling unit or plenum, and lamp extends to inside of the equipment, within the airstream. Systems are generally less than 240,000 Btu/h (70 kW), and include unitary and applied HVAC equipment (rooftop units, fan-coil units, air conditioners, heat pumps, and terminal units). These systems would typically have a power supply with one or more lamps, preassembled, with the power supply installed on outside of an air-handling unit, plenum, or duct.

* + - * 1. Description: Factory-assembled UV-C lamp system with [**NEMA 4X**] power supply housing, four each, 1/2- or 3/4-inch electrical knock-outs, power supply with integrated lamp plug, lamp compression nut, and UV lamp.
				2. Power Supply: UL listed, single phase, 120 or 240 V ac, 50 or 60 Hz, with a programmed rapid start.

Power Factor: High power factor, Class P, Sound Rated A, Type 1 Outdoor, and with inherent thermal protection and without polychlorinated biphenyl.

Output: Automatically sense and maximize lamp output, energy efficiency, and reliability for lamp lengths from 17 to 61 inches.

Operating Temperature: From 34 to 194 deg F.

Safety: Integral interlock switch on power supply.

Power Consumption: Maximum 15 W/sq. ft.

Electrical Connection: Single electrical connection[**with service disconnect**].

Lamps should be encapsulated and coated to protect the system, space, and installer from residues of a broken UV lamp such as inert gas, mercury, and glass. Lamps should have their characteristics and ratings visibly printed on all lamps.

* + - * 1. UV-C Lamps: Encapsulated lamps with lamp wattage and model number visibly printed on all lamps, less than 8 Mg of mercury in each lamp. Lamps do not produce ozone.

Quantity and Type: [**One**] [**T5, hot cathode, single-ended, four pin**] <**Insert number and type of lamps**>.

Output: UV-C energy, primarily at 253.7-nm wavelength with a 360-degree energy distribution.

Base: Long-mount base lamp. Lamp filament extends into the airstream beyond plenum walls and insulation.

Operating Temperature: From 34 to 158 deg F, 100-percent relative humidity, at any velocity.

Lamp Protection: Hermetically sealed with a thin layer of UV-C-transmissible fluorinated ethylene propylene to provide protection against lamp breakage and to ensure lamp contents from a broken lamp are contained.

Lamp Life: Minimum of [**9000 hours**] <**Insert time**> with greater than 85 percent of initial output at end of lamp life.

* + - * 1. Power Supply Housing: High-performance, white polycarbonate for external thermal rejection, equipped with lamp support for lamp lengths up to 61 inches and a weathertight cover with an integrated seal. Housing contains all components in one integral assembly for safety and serviceability without tools.

Interlock: Disrupt lever on the cover actuates the interlock switch to disconnect or restore power when removed or installed. Padlock eyelets lock the housing cover to guard against unwanted entry.

Surface Installation Mounting: Four mounting holes and gasket to seal housing to the mounting surface.

* + - * 1. Lamp Holder and Lamp Clamp: Four-pin type accommodates a single-ended lamp.

Lamp Holder Construction: UV-resistant materials and designed to connect the lamp to the plug.

Lamp Clamp Construction: UV-resistant materials to ensure a watertight connection. A seal between the single-ended UV lamp and the lamp plug prevents electrical shock, connection shorts, and lamp or power supply failure, from lamp pin oxidation or arcing.

* + - 1. CONTROLS

Retain first paragraph below to specify temperature controls in Section 230923 "Direct-Digital Control System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC." Delete below and retain second paragraph to require controls integral to the UV-C lamp system to be provided by manufacturer of unit.

* + - * 1. Comply with requirements in Section 230923 "Direct-Digital Control System for HVAC" for control equipment and in Section 230993.11 "Sequence of Operations for HVAC DDC."
				2. Interface with DDC System for HVAC: Factory-installed hardware and software (where applicable) to enable the DDC system for HVAC to monitor, control, and display status and alarms.
				3. Lamp and Power Supply Monitoring: Factory-assembled and tested, consisting of a housing, PC board, and wire block. Construction is designed to withstand installation inside air-handling unit airstream.

Housing: Industrial-grade plastic equipped with a direct-reading high-output green LED, two mounting holes, and an external wiring block for wiring to a remote sensing or input device. PC board converts inductive field to a regulated electromotive force of 1 to 5 V dc, maximum.

Wiring Block: One positive and one negative terminal for No. 18 AWG and smaller wire.

Retain subparagraph below for optional remote monitor(s).

Remote Monitor(s): Installed outside the plenum in a suitable NEMA enclosure to directly or remotely monitor the lamp and power supply combination, with option for a single signal to the DDC system.

* + - * 1. Operating Control: Monitor lamp and power supply combination and provide a single on/off signal to the DDC system. UV-C lamp system operates continuously. Interlock UV-C lamp system operation with air-handling unit and component access doors. When an access door is opened, UV-C lamp system is de-energized.
1. EXECUTION
	* + 1. EXAMINATION
				1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
				2. Examine roughing-in for UV-C lamp system to verify actual locations of UV lamps and electrical connections before UV-C lamp system installation.
				3. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. INSTALLATION, GENERAL
				1. Install UV-C lamp systems according to manufacturer's installation manual and drawings unless otherwise indicated.
				2. Install UV lamps in each UV-C lamp system.
				3. Install UV-C lamp systems in locations that are accessible and that will permit servicing and maintenance.
				4. Provide sufficient length of wiring loom to facilitate lamp connection to a remotely located power supply and/or power supply housing, such that lamp and loom can be mounted anywhere in the system.
				5. Interface with DDC System for HVAC: Factory-installed hardware and software (where applicable) to enable the DDC system for HVAC to monitor, control, and display status and alarms.
				6. Lamp and Power Supply Monitoring: Factory-assembled and tested, consisting of a housing, PC board, and wire block. Construction is designed to withstand installation inside air-handling unit airstream.

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				4. Provide sufficient length of wiring loom to facilitate lamp connection to a remotely located power supply and/or power supply housing, such that lamp and loom can be mounted anywhere in the system.
				5. Seal air-handling unit penetrations to maintain integrity of air-handling unit casings.
				6. Irradiation: Quantity of UV lamps are to be installed to provide an equal distribution of available UV-C energy. When installed, UV-C energy produced shall be of the lowest possible reflected and shadowed losses, distributed in a 360-degree pattern within the cavity or plenum space.
				7. Intensity: UV-C lamp system modeling shall be included in the submittal and must contain necessary calculations to demonstrate a minimum of [**6 W/sq. ft.**] [**4 W/sq. ft.**] of coil surface area to achieve a minimum of 100 microwatts/sq. cm equally distributed on the target surface as recommended by ASHRAE.
				8. Housing Installation: Power supply housing can be installed inside or outside air-handling units or plenums.
				9. UV Lamp Installation: Mount UV lamp to irradiate surfaces, as well as the available line of sight airstream, through proper lamp placement, and incident angle reflection.
				10. Safety: Comply with requirements in UL 1995, "Standard of Safety for Heating and Cooling Equipment." Provide mechanical interlock switch on access panels and doors to UV lamp systems, or within view of UV lamp systems, to ensure that UV-C lamp systems will be de-energized when these accesses are opened. Warning signs and labels are specified in Section 230553 "Identification for HVAC Piping and Equipment."
				11. Signage: Comply with requirements in UL 1995 "Heating and Cooling Equipment." Mark access panels and doors to UV-C lamp systems with warning signs stating, "WARNING: UV LIGHT SOURCE" and "DISCONNECT POWER BEFORE SERVICING." Warning signs and labels are specified in Section 230553 "Identification for HVAC Piping and Equipment."
			3. INSTALLATION OF ANTIMICROBIAL UV-C LAMP SYSTEMS FOR LARGE AIR-HANDLING UNITS
				1. Size and rate supports for UV-C lamp system weight.
				2. Maintain UV lamp position after cleaning and relamping.
				3. Provide support for UV-C lamp system without causing deflection of air-handling unit casing.
				4. Provide vertical supports on interior air-handling unit surfaces for UV-C lamp system.
				5. UV-C lamp system mounting devices shall be capable of supporting a horizontal force of 100 percent of system weight, and a vertical force of 400 percent of system weight.
				6. Equipment supports are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
			4. ELECTRIC CONNECTIONS
				1. Provide electrical power and service disconnects to products requiring electrical connections.
				2. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
				3. Comply with requirements for service disconnects in Section 262816 "Enclosed Switches and Circuit Breakers."
				4. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				5. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
			5. CONTROL CONNECTIONS
				1. Install control and electrical power wiring to field-mounted control devices.
				2. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
			6. IDENTIFICATION
				1. Identify UV-C lamp systems with equipment labels. Comply with requirements for equipment labels specified in Section 230553 "Identification for HVAC Piping and Equipment."
			7. FIELD QUALITY CONTROL

Retain one of first three paragraphs below. Retain first "Testing Agency" Paragraph below if Owner will hire an independent testing agency.

Retain "Testing Agency" Paragraph below to require Contractor to hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Perform the following tests and inspections" Paragraph below to require Contractor to perform tests and inspections and retain option to require Contractor to arrange for the assistance of a factory-authorized service agent.

* + - * 1. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:

Operational Test: After installing UV-C lamp systems, and after electrical circuitry has been energized, test units to confirm proper operation.

Safety Interlock: Confirm proper operation of safety interlock power switches on access panels and doors.

* + - * 1. UV-C lamp systems and components will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. STARTUP SERVICE
				1. [**Engage a company field advisor to perform**] [**Perform**] startup service.
			2. ADJUSTING
				1. After installation, adjust UV-C lamp systems and supports to maximize exposure to surfaces, before energizing system.
			3. CLEANING
				1. Wipe lamps clean using manufacturers' recommended cleaning methods and materials.
			4. DEMONSTRATION
				1. [**Engage a Company Field Advisor to train**] [**Train**] Owner's Director's Representative maintenance personnel to adjust, operate, and maintain UV-C lamp systems.

END OF SECTION 230566