SECTION 466616 - CLOSED-VESSEL LOW-PRESSURE/HIGH-INTENSITY ULTRAVIOLET TREATMENT EQUIPMENT

Note that this section has only been edited for NYSOGS standardization and has not been technically edited. The designer shall make all technical edits specific to the project for this section.

This Section includes closed-vessel, low-pressure, high-intensity ultraviolet (UV) treatment equipment. Open-channel UV treatment equipment is specified in Sections 466653, 466656, and 466663. Closed-vessel, low-pressure, low-intensity UV treatment equipment is specified in Section 466613 and closed-vessel, medium-pressure UV treatment equipment is specified in Section 466623.

UV radiation is produced at wavelengths in the UV-A, UV-B, and UV-C spectrum ranges. UV-C radiation is also called "germicidal" radiation, because it inactivates microorganisms by damaging their DNA. The required dose of UV light (also called "fluence") may be determined by characteristics of water being treated as well as bulb strength and other UV treatment equipment criteria.

Two types of lamps are typically used for water disinfection: medium-pressure and low-pressure mercury vapor arc lamps ("pressure" refers to the mercury vapor pressure inside the lamp), either low- or high-intensity. Typical medium-pressure lamps produce most of their UV radiation (approximately 80 to 90 percent) in UV-A and UV-B wavelengths, but typical low-pressure UV lamps produce approximately 30 to 35 percent of their UV radiation in UV-C wavelengths. The broader radiation of medium-pressure lamps may result in disinfection efficiencies total organic carbon (TOC) reduction with fewer lamps than typical low-pressure UV treatment systems. Some references indicate that the broader spectrum output performs more efficiently than low-pressure lamps on water flow rates greater than about 80,000 gpd (13 cmh). Consult manufacturers and consider characteristics of specific water to be treated.

According to the EPA, medium-pressure lamps are generally used for large facilities and have approximately 15 to 20 times the germicidal UV intensity of low-pressure lamps. Medium-pressure lamps disinfect faster and have greater penetration capability because of their higher intensity. However, medium-pressure lamps operate at higher temperatures than low-pressure lamps, and therefore consume more energy. There are other differences: consult manufacturers and other references for application to this Project.

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes: Closed-vessel, low-pressure, high-intensity UV treatment equipment and accessories.
				2. Related Requirements:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

Section 460553 - Identification for Water and Wastewater Equipment: Nameplates for equipment specified in this Section.

* + - 1. REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

* + - * 1. American National Standards Institute:

ANSI C82.4 - American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).

* + - * 1. Federal Communications Commission (FCC):

47 CFR 15 - Radio Frequency Devices.

* + - * 1. National Electrical Manufacturers Association:

NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

* + - 1. COORDINATION
				1. Coordinate Work of this Section with Work of other Sections.

Consider including following Paragraph if Project is being constructed in an existing plant.

* + - * 1. Maintain flow of water and its disinfection until proposed system is tested, approved, and fully operational.
			1. PREINSTALLATION MEETINGS
				1. Convene minimum [**one week**] [**<\_\_\_\_\_\_\_\_> weeks**] prior to commencing Work of this Section.
			2. SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

* + - * 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: Submit manufacturer's information, including average UV intensity within each reactor, UV density, head loss caused by each bank of lamp modules, lamp module cross-sectional area, aspect ratio of lamp bank, [**and**] <**\_\_\_\_\_\_\_\_**>.
				5. Shop Drawings:

Indicate size and configuration of assembly, mountings, weights, and accessory connections.

Indicate system materials and component equipment.

* + - * 1. Manufacturer's Certificate: Certify that [**products**] <**\_\_\_\_\_\_\_\_**> meet or exceed [**specified requirements**] <**\_\_\_\_\_\_\_\_**>.

Include separate Paragraphs for additional certifications.

* + - * 1. Test and Evaluation Reports: Submit installation certificate from equipment manufacturer's representative, as described in PART 3.
				2. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
				3. Source Quality-Control Submittals: Indicate results of [**shop**] [**factory**] tests and inspections.
				4. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
				5. Manufacturer Reports:

Certify that [**equipment has been installed according to manufacturer instructions**] <**\_\_\_\_\_\_\_\_**>.

Indicate activities on Site, adverse findings, and recommendations.

* + - * 1. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

Submit qualifications for manufacturer and installer.

Submit manufacturer's approval of installer.

* + - 1. CLOSEOUT SUBMITTALS
				1. Project Record Documents: Record actual locations of installed UV treatment equipment and accessories.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Spare Parts:

Insert desired quantity in following Subparagraphs.

Completely Assembled Lamp Module: <**\_\_\_\_\_\_\_\_**>.

Low-Pressure, High-Intensity UV Lamps: <**\_\_\_\_\_\_\_\_**>.

Quartz Lamp Sleeves and Seals: <**\_\_\_\_\_\_\_\_**>.

Lamp/Sleeve Assemblies: <**\_\_\_\_\_\_\_\_**>.

Electronic Ballasts: <**\_\_\_\_\_\_\_\_**>.

Lamp Socket Connectors: <**\_\_\_\_\_\_\_\_**>.

UV-Blocking Face Shields: <**\_\_\_\_\_\_\_\_**>.

Lamp Cleaning Solution: <**\_\_\_\_\_\_\_\_**> gal.

* + - * 1. Tools: Furnish special [**wrenches**] <**\_\_\_\_\_\_\_\_**> and other devices required for Director’s Representative to maintain equipment.
			1. QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

In following Paragraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

* + - * 1. Perform Work according to <**\_\_\_\_\_\_\_\_**> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain <**\_\_\_\_\_\_\_\_**> [**copy**] [**copies**] of each standard affecting Work of this Section on Site.
			1. QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

* + - * 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience.
				2. Installer: Company specializing in performing Work of this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience [**and approved by manufacturer**].
			1. DELIVERY, STORAGE, AND HANDLING
				1. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
				2. Store materials according to manufacturer instructions.
				3. Protection:

Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

Provide additional protection according to manufacturer instructions.

* + - 1. EXISTING CONDITIONS
				1. Field Measurements:

Verify field measurements prior to fabrication.

Indicate field measurements on Shop Drawings.

* + - 1. WARRANTY

This Article extends warranty period beyond one year. Extended warranties may increase construction costs and Owner enforcement responsibilities. Specify warranties with caution.

* + - * 1. Furnish [**five**] <**\_\_\_\_\_\_\_\_**>-year manufacturer's warranty for UV treatment equipment.
1. PRODUCTS
	* + 1. CLOSED-VESSEL, LOW-PRESSURE, HIGH-INTENSITY ULTRAVIOLET TREATMENT EQUIPMENT
				1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=12092&mf=04&src=wd):

DESIGNER TO PROVIDE TWO MANUFACTURERS AND APPROVED EQUIVALENT FOR ALL LISTED PRODUCTS.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Description:

Closed-vessel, horizontally orientated UV disinfection system, consisting of following:

UV lamp module with support rack and bracket.

Instrumentation, controls, and power distribution.

UV monitoring system.

Elapsed time meter.

Lamp cleaning system.

<**\_\_\_\_\_\_\_\_**>.

* + - * 1. Lamps:

Type:

Mercury vapor.

Design: Hot cathode, instant start.

Filament: Clamped design to withstand shock and vibration.

Module:

Description: Lamps placed in individual fused-quartz sleeves, and sealed and supported in NEMA 6P stainless-steel frame.

Wiring: Completely enclosed and protected from water.

Base: Metal and ceramic.

Replacement: Capability of replacing lamp without disassembling or removing sleeve.

Furnish mechanical lifting device for individual lamp modules weighing over 55 lb

Sleeves:

Description: Close one end of each sleeve and seal opposite other end with lamp end seal and O-ring.

Material: [**Fused quartz**] <**\_\_\_\_\_\_\_\_**>.

Seal: Stainless-steel nut and O-ring seal.

Configuration: Prevent lamp sleeve from touching steel components.

Ballasts:

Comply with ANSI C82.4.

Minimum Power Factor: [**90**] <**\_\_\_\_\_\_\_\_**> percent.

Design: Modular, for quick disconnect and replacement.

Conducted and Radiated Emission: Comply with 47 CFR 15.

Power Output: Incremental steps from 30 to 100 percent of rated lamp power.

UV treatment equipment is based on such criteria as plant flow rates, total suspended solids (TSS), UV transmittance, and influent microorganism count. Consider obtaining UV transmittance from an independent laboratory.

* + - * 1. Performance and Design Criteria:

Flow Rate:

Peak: <**\_\_\_\_\_\_\_\_**> MGD

Average: <**\_\_\_\_\_\_\_\_**> MGD

Minimum: <**\_\_\_\_\_\_\_\_**> MGD

Head Loss at Peak Flow Rate: <**\_\_\_\_\_\_\_\_**> inches

TSS Concentration: <**\_\_\_\_\_\_\_\_**> mg/L.

Turbidity: <**\_\_\_\_\_\_\_\_**> NTU

Water Temperature Range: <**\_\_\_\_\_\_\_\_**> to <**\_\_\_\_\_\_\_\_**> degrees F

Five-Day BOD: <**\_\_\_\_\_\_\_\_**> mg/L.

System Pressure: <**\_\_\_\_\_\_\_\_**> psig

Minimum UV Density [**of Channel**]: <**\_\_\_\_\_\_\_\_**> W/gal.

Lamps:

Number: [**One**] [**Three**] <**\_\_\_\_\_\_\_\_**>.

Type: Low pressure, high intensity.

Useful Arc Tube Life: [**4,000**] [**8,000**] <**\_\_\_\_\_\_\_\_**> hours.

Output at One Year (8,760 Hours) of Operation: [**70**] <**\_\_\_\_\_\_\_\_**> percent of initial level.

Minimum UV Dose: <**\_\_\_\_\_\_\_\_**> microwatt-sec/sq. in.

Minimum UV Intensity: <**\_\_\_\_\_\_\_\_**> microwatts/sq. in. at 1 foot

UV Transmittance at 254 nm: [**70**] <**\_\_\_\_\_\_\_\_**> percent.

Maximum Power Input per Lamp: [**120**] [**320**] <**\_\_\_\_\_\_\_\_**> W.

Minimum UV Output per Lamp: <**\_\_\_\_\_\_\_\_**> W at 100 hours.

Minimum Arc Length: <**\_\_\_\_\_\_\_\_**> inches

Maximum Ozone Production: Zero.

States have differing disinfection standards; therefore, determine Site-specific disinfection requirements from authorities having jurisdiction.

Inactivation:

Total Effluent Coliform:

Thirty-Day Daily Sample Mean: [**200**] <**\_\_\_\_\_\_\_\_**> MPN per 100 mL.

Maximum Seven-Day Average: [**400**] <**\_\_\_\_\_\_\_\_**> per 100 mL.

* + - * 1. Materials:

Metal Components in Contact with Water: Type [**304**] [**316**] stainless steel.

Components Exposed to UV Light: [**Type 316 stainless steel**] [**, quartz**] [**, polytetrafluoroethylene (PTFE)**] [**, or**] <**\_\_\_\_\_\_\_\_**>.

* + - * 1. Operation:

Electrical Characteristics:

[**<\_\_\_\_\_\_\_\_> hp**] [<\_\_\_\_\_\_\_\_> RLA].

Voltage: [**480**] [**600**] <**\_\_\_\_\_\_\_\_**> V, [**single**] [**three**] phase, 60 Hz.

Maximum [**Fuse Size**] [**Circuit Breaker Size**] [**Overcurrent Protection**]: <**\_\_\_\_\_\_\_\_**> A.

Minimum Circuit Ampacity: <**\_\_\_\_\_\_\_\_**>.

Minimum Power Factor: [**1.15**] <**\_\_\_\_\_\_\_\_**> at rated load.

Control Panel:

Description: PLC-based controls and Operator Interface Station (OIS).

Factory mounted.

NEMA 250 Type [**4**] [**4X**] [**12**] <**\_\_\_\_\_\_\_\_**>.

Single-point power connection and grounding lug.

Controls:

Description: Automatic flow- and water-quality-paced PLC control system energizes and de-energizes lamps to maintain required UV dosage, and adjusts UV intensity in proportion to water flow rate.

OIS: Menu driven with automatic fault messages when alarm conditions are annunciated.

Signals: 4 to 20 mA dc.

Furnish programming to perform operations.

Lamp Status Indicators: ON-OFF.

Lamp Monitoring System:

Indicate location and operating status of each lamp.

Annunciate remote alarm upon lamp failure.

UV Intensity Detection System:

Description: Sense and display intensity in each bank of lamp modules between 254.5 and 255.0 nm.

Furnish one UV intensity meter for each bank of lamp modules.

Indicates safe intensity, low intensity, and unsafe intensity by means of color codes on meter face [**or zero to 100 percent scale**].

Elapsed Time Meter:

Description: One nonresettable elapsed time meter for each bank of lamp modules.

Operation: Zero to 99,999 hours.

Switches: Furnish one HAND-OFF-AUTO switch for each UV bank.

Alarms:

LOW UV INTENSITY WARNING.

LOW UV INTENSITY.

Individual LAMP FAILURE.

Two or more adjacent LAMPS FAILURE.

Multiple LAMPS FAILURE.

MODULE FAILURE.

Disconnect Switch: Factory mounted in control panel.

Determine operation sequences based on plant design requirements and selected manufacturer.

Operation Sequences: <**\_\_\_\_\_\_\_\_**>.

* + - 1. ACCESSORIES
				1. UV Transmittance Analyzer:

Description:

Analyzer, sensor, and sampler, each with a separate NEMA 250 Type [**4**] [**4X**] [**12**] <**\_\_\_\_\_\_\_\_**> enclosure.

Continuously monitor percent UV transmittance of water.

Range: Zero to 100 percent transmittance.

Accuracy: Plus and minus 1 percent of full scale.

Operating Temperature Range: 20 to 120 degrees F

Alarms: HIGH. LOW, and OFF.

Display: LCD, with [**60-minute**] [**24-hour**] graph.

States have differing disinfection standards; therefore, determine Site-specific disinfection requirements from state authorities having jurisdiction.

* + - * 1. Cleaning System:

Description:

Automatic mechanical/chemical cleaning system, capable of cleaning lamps during disinfection and without removing lamps from unit.

Automatically wipe lamp sleeve surface while dowsing lamp sleeve surface with acidic solution.

Cleaning Cycle: Field adjustable, from once each hour to once each month.

Manual Operation: Furnish operator interface.

* + - * 1. Cleaning Tank:

Description:

Tank of sufficient size to hold minimum [**three**] <**\_\_\_\_\_\_\_\_**> lamp modules.

Furnish rubber casters for portability, and sealed cover.

Material: Stainless steel.

Components:

Air compressor.

Lamp module rack.

Hose connections.

Drains.

Disconnect switch, grounded plug, and 10 feet of outdoor power cable.

* + - * 1. Cleaning Rack:

Description: Rack mounted above cleaning tank to hold one horizontal module above cleaning liquid for hand wiping of sleeves.

* + - * 1. Germicidal Sensors: One per lamp.
				2. Anchor Bolts, Nuts, and Washers: Stainless steel.
			1. SOURCE QUALITY CONTROL
				1. Provide shop inspection and testing of completed assembly.

Include one or both of following Paragraphs to require Director's inspection or witnessing of test at factory.

* + - * 1. Director’s Inspection:

Make completed clarifier equipment available for inspection at manufacturer's factory prior to packaging for shipment.

Notify Director’s Representative at least [**seven**] <**\_\_\_\_\_\_\_\_**> days before inspection is allowed.

* + - * 1. Director’s Witnessing:

Allow witnessing of factory inspections and test at manufacturer's test facility.

Notify Director’s Representative at least [**seven**] <**\_\_\_\_\_\_\_\_**> days before inspections and tests are scheduled.

Include following Paragraph if reliance on fabricator's approved quality-control program is sufficient for Project requirements.

* + - * 1. Certificate of Compliance: If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

Specified shop tests are not required for Work performed by approved fabricator.

1. EXECUTION
	* + 1. EXAMINATION
				1. Verify that facilities are ready to receive floating mechanical mixers.
			2. INSTALLATION
				1. According to manufacturer instructions.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Paragraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

* + - * 1. Installation Standards: Install Work according to <**\_\_\_\_\_\_\_\_**> standards.
			1. FIELD QUALITY CONTROL
				1. Inspection and Functional Testing:

Operate UV system for minimum seven consecutive days with plant water.

Test and Inspect:

Proper installation and alignment of UV support racks and frames.

Watertightness.

Electrical wiring and connections.

Instrumentation, alarms, and indicators.

ON-OFF and HAND-OFF-AUTO switches and ground fault circuit interrupters.

Lamp removal system.

Lamp cleaning system.

Performance testing may be performed by Owner or an independent laboratory contracted by Owner or Contractor.

* + - * 1. Performance Testing:

After installed UV equipment has been inspected and functional test has been completed, begin performance testing.

Collect samples at or near peak flow rate.

Analyze samples for following parameters:

Fecal coliform, MPN per 100 mL, immediately upstream of UV treatment equipment.

Fecal coliform, MPN per 100 mL, immediately downstream of UV treatment equipment.

TSS, immediately upstream of UV treatment equipment.

Percent UV transmittance (UVT) at 254 nm, immediately upstream of UV treatment equipment.

Test for 14 continuous days, and collect and analyze samples three times in each 24-hour period.

If sample results do not meet specified performance, retest for minimum two additional consecutive days or until acceptable bacteriological results have been obtained.

* + - * 1. Manufacturer Services:

Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than <**\_\_\_\_\_\_\_\_**> days on Site for installation, inspection, startup, field testing, and instructing Director’s Representative in maintenance of equipment.

* + - * 1. Equipment Acceptance:

Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

Make final adjustments to equipment under direction of manufacturer's representative.

* + - * 1. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.
			1. DEMONSTRATION
				1. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Director’s Representative

END OF SECTION 466616