

TECHNICAL SPECIFICATIONS

SECTION 46 66 56 - OPEN-CHANNEL LOW-PRESSURE/HIGH-INTENSITY ULTRAVIOLET TREATMENT EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Open-channel, low-pressure, high-intensity UV treatment equipment and accessories.
- B. Related Requirements:
 - 1. Section 26 05 03 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this Section.
 - 2. Section 46 05 53 - Identification for Water and Wastewater Equipment: Nameplates for equipment specified in this Section.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute:
 - 1. ANSI C82.4 - American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).
- B. Federal Communications Commission (FCC):
 - 1. 47 CFR 15 - Radio Frequency Devices.
- C. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Work of other Sections.
- C. Maintain flow of wastewater and its disinfection until proposed system is tested, approved, and fully operational.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. 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, and aspect ratio of lamp bank.
- C. Shop Drawings:
 - 1. Indicate size and configuration of assembly, mountings, weights, and accessory connections.
 - 2. Indicate system materials and component equipment.
 - 3. Hydraulic calculations demonstrating compliance with requirements.
 - 4. Disinfection performance guarantee.
 - 5. Electrical schematics and layouts.
- D. Manufacturer's Certificate: Certify that system meets or exceed specified requirements.
- E. Test and Evaluation Reports: Submit installation certificate from equipment manufacturer's representative, as described in PART 3.
- F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports:
 - 1. Certify that equipment has been installed according to manufacturer instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of installed UV treatment equipment and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Low-Pressure, High-Intensity UV Lamps: 16 each.
 - 2. Quartz Lamp Sleeves and Seals: 16 each.
 - 3. Lamp Holder Seals: 16 each.
 - 4. Operator kit including face shield, gloves and cleaning solution: 4 each.
- C. Tools: Furnish special tools and other devices required for Owner to maintain equipment.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish two-year manufacturer's warranty for UV treatment equipment. Lamps shall be warranted for 12,000 hours (prorated after 9,000 hours). Ballasts shall be warranted for 5 years (prorated after 1 year).

PART 2 - PRODUCTS

2.1 OPEN-CHANNEL, LOW-PRESSURE, HIGH-INTENSITY ULTRAVIOLET TREATMENT EQUIPMENT

- A. Description:
 - 1. Outdoor, open-channel, gravity-flow, horizontally orientated UV disinfection system, consisting of following:
 - a. UV lamp module with support rack and bracket.
 - b. Instrumentation, controls, and power distribution.
 - c. UV monitoring system.
 - d. Elapsed time meter.
 - e. Lamp cleaning system.
- B. Lamps:
 - 1. Type:

- a. High intensity, low pressure amalgam
 - b. Design: Hot cathode, instant start.
2. Filament: Clamped design to withstand shock and vibration.
 3. Module:
 - a. Description: Lamps placed in individual fused-quartz sleeves, and sealed and supported in NEMA 6P stainless-steel frames.
 - b. Wiring: Completely enclosed and protected from wastewater.
 - c. Base: Metal and ceramic.
 - d. Replacement: Capability of replacing lamp without disassembling or removing sleeve.
 - e. Furnish mechanical lifting device for individual lamp modules weighing over 55 lb.
 4. Sleeves:
 - a. Description: Close one end of each sleeve and seal opposite other end with lamp end seal and O-ring.
 - b. Material: Fused quartz, General Electric or equal
 - c. Seal: Stainless-steel nut and O-ring seal.
 - d. Configuration: Prevent lamp sleeve from touching steel components.
 5. Ballasts:
 - a. Comply with ANSI C82.4.
 - b. Minimum Power Factor: 90.
 - c. Design: Modular, for quick disconnect and replacement.
 - d. Conducted and Radiated Emission: Comply with 47 CFR 15.
 - e. Power Output: Incremental steps from 30 to 100 percent of rated lamp power.
- C. Performance and Design Criteria:
1. Flow Rate:
 - a. Peak: 27 MGD (Maximum daily flow with one channel out of service)
 - b. Average: 13.5 MGD (Maximum Daily Average with one channel out of service)
 - c. Minimum: 3 MGD. (Minimum Daily flow with one channel out of service)
 2. Head Loss at Peak Flow Rate: 3.6 inches.
 3. TSS Concentration: 20 mg/L
 4. Wastewater Temperature Range: 95 to 50 degrees F.
 5. Minimum UV Transmittance: 65 %.
 6. Lamps:
 - a. Arrangement per manufacturers recommendations
 7. Maximum Ozone Production: Zero.
 8. Inactivation:
 - a. Enterococci Bacteria:

- 1) Thirty-Day Daily Sample Mean: 35 MPN per 100 mL.
- 2) Maximum Seven-Day Average: 70 per 100 mL.

D. Materials:

1. Metal Components in Contact with Wastewater: Type 316 stainless steel.
2. Components Exposed to UV Light: Type 316 stainless steel, quartz or PTFE.

E. Operation:

1. Electrical Characteristics:

- a. Voltage: 460 V, three phase, 60 Hz.

2. Control Panel:

- a. Description: PLC-based controls and Operator Interface Station (OIS).
- b. Factory mounted.
- c. NEMA 250 Type 4.
- d. Single-point power connection and grounding lug.
- e. The panel shall include 4-20ma inputs for:
 - 1) Effluent Flow
 - 2) Effluent TSS
- f. The panel shall include a Hirschmann Model Gecko 4TX Managed Ethernet Switch and Hirschmann Model OZD 485 G12 BAS 943893321 Fiber Interface to provide connectivity to the plant-wide SCADA System furnished under other sections.

3. Controls:

- a. 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 wastewater flow rate.
- b. OIS: Menu driven with automatic fault messages when alarm conditions are annunciated.
- c. Signals: 4 to 20 mA dc.
- d. Furnish programming to perform operations.
- e. Lamp Status Indicators: ON-OFF.

4. Lamp Monitoring System:

- a. Indicate location and operating status of each lamp.
- b. Annunciate remote alarm upon lamp failure.

5. UV Intensity Detection System:

- a. Description: Sense and display intensity in each bank of lamp modules between 254.5 and 255.0 nm.
- b. Furnish one UV intensity meter for each bank of lamp modules.

- c. Indicate safe intensity, low intensity, and unsafe intensity by means of color codes on meter face or zero to 100 percent scale.
6. Elapsed Time Meter:
 - a. Description: One non-resettable elapsed time meter for each bank of lamp modules.
 - b. Operation: Zero to 99,999 hours.
7. Switches: Furnish one HAND-OFF-AUTO switch for each UV bank.
8. Alarms:
 - a. LOW UV INTENSITY WARNING.
 - b. LOW UV INTENSITY.
 - c. Individual LAMP FAILURE.
 - d. Two or more adjacent LAMPS FAILURE.
 - e. Multiple LAMPS FAILURE.
 - f. MODULE FAILURE.
9. Disconnect Switch: Factory mounted in control panel.

2.2 ACCESSORIES

A. UV Transmittance Analyzer:

1. Description:
 - a. Analyzer, sensor, and sampler, each with a separate NEMA 250 Type 4 enclosure.
 - b. Continuously monitor percent UV transmittance of wastewater.
2. Range: Zero to 100 percent transmittance.
3. Accuracy: Plus and minus 1 percent of full scale.
4. Operating Temperature Range: 20 to 120 degrees F.
5. Alarms: HIGH, LOW, and OFF.
6. Display: LCD with 24-hour graph.

B. Cleaning System:

1. Description:
 - a. Automatic mechanical/chemical cleaning system, capable of cleaning lamps during disinfection and without removing lamps from unit.
 - b. Automatically wipe lamp sleeve surface while dowsing lamp sleeve surface with acidic solution.
2. Cleaning Cycle: Field adjustable, from once each hour to once each month.
3. Manual Operation: Furnish operator interface.

C. Lamp Wipers:

1. Arms: Stainless steel.

- D. Germicidal Sensors: One per lamp.
- E. Anchor Bolts, Nuts, and Washers: Stainless steel.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facilities are ready to receive floating mechanical mixers.

3.2 INSTALLATION

- A. According to manufacturer instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection and Functional Testing:
 - 1. Operate UV system for minimum seven consecutive days with plant wastewater.
 - 2. Test and Inspect:
 - a. Proper installation and alignment of UV support racks and frames.
 - b. Watertightness.
 - c. Electrical wiring and connections.
 - d. Instrumentation, alarms, and indicators.
 - e. ON-OFF and HAND-OFF-AUTO switches and ground fault circuit interrupters.
 - f. Lamp removal system.
 - g. Lamp cleaning system.
- C. Performance Testing:
 - 1. After installed UV equipment has been inspected and functional test has been completed, begin performance testing.
 - 2. Collect samples at or near peak flow rate.
 - 3. Analyze samples for following parameters:

- a. Fecal coliform, MPN per 100 mL, immediately upstream of UV treatment equipment.
 - b. Fecal coliform, MPN per 100 mL, immediately downstream of UV treatment equipment.
 - c. TSS, immediately upstream of UV treatment equipment.
 - d. Percent UV transmittance (UVT) at 254 nm, immediately upstream of UV treatment equipment.
4. Test for 14 continuous days, and collect and analyze samples three times in each 24-hour period.
 5. If sample results do not meet specified performance, retest for minimum two additional consecutive days or until acceptable bacteriological results have been obtained.
- D. Manufacturer Services:
1. Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one trip of four days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.
- E. Equipment Acceptance:
1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 2. Make final adjustments to equipment under direction of manufacturer's representative.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 66 56