

SECTION 44 45 13.11
PACKAGE BIOFILTER SYSTEM

EQUIPMENT AND COMPONENT NUMBER(S)

022-BIOF-2213: Biofilter Vessel.
022-LCP-2201: Local Control Panel.
022-LCP-2202: Water Panel.
022-FAN-2215: Odor Control Fan 1.
022-FAN-2216: Odor Control Fan 2.

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Work of this section includes providing a package biofilter odor control system including biofilter vessel, media, irrigation system, exhaust fans (duty/standby), ductwork connections between vessel and fan, and accessories as specified herein.

- B. Unit Responsibility:
 - 1. The Work requires that the package biofilter odor control system including biofilter vessel, biofilter media, irrigation system, exhaust fans, and control systems complete with all accessories and appurtenances be the end product of one responsible system supplier.
 - 2. The biofilter system supplier shall provide media and components suitable for the service conditions listed herein.
 - 3. The biofilter system supplier shall provide the required hydrogen sulfide removal rate performance guarantee listed herein.
 - 4. The Supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions.
 - 5. The Contractor shall supply AFDs for Odor Control Fans in accordance with Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.

1.02 REFERENCES

- A. The Work of this section shall comply with the following standards:
 - 1. American National Standards Institute (ANSI).
 - 2. American Society of Mechanical Engineers (ASME).
 - 3. American Society for Testing and Materials (ASTM).

4. Air Movement and Control Association (AMCA).
5. American Bearing Manufacturer's Association (ABMA).
6. International Building Code (IBC).
7. International Mechanical Code.
8. National Electrical Manufacturers Association (NEMA): 250-2014, Enclosures for Electrical Equipment (1,000 volts, maximum).
9. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 820, Fire Protection in Wastewater Treatment and Collection Systems.
10. National Institute of Standards and Technology (NIST).
11. Occupational Safety and Health Act (OSHA).
12. Sheet Metal and Air Conditioning Contractors National Association.
13. UL: 508a, Industrial Control Panels.

1.03 DEFINITIONS

A. The following is a list of abbreviations which may be used in this section:

1. AFD: Adjustable Frequency Drive.
2. FRP: Fiberglass Reinforced Plastic.
3. EBRT: Empty Bed Residence Time equals volume that media occupies/air flow.
4. EPDM: Ethylene Propylene Diene Monomer rubber.
5. H₂S: Hydrogen Sulfide.
6. HDPE: High density polyethylene.
7. PTFE: Polytetrafluoroethylene.
8. PVC: Polyvinyl Chloride.
9. UV: Ultraviolet.

1.04 SUBMITTALS

A. Submittals shall be made as required in Section 01 33 23, Submittal Procedures. The following information shall be provided:

1. Action Submittals:
 - a. Shop Drawings:
 - 1) Manufacturer, product name, make, and model of the complete system and all individual equipment within the system.
 - 2) Catalog information for the complete system and all individual equipment within the system, including manufacturer's standard specifications, general descriptions, performance data, weights, drawings, dimensional data, crane requirements, proposed materials of construction,

- clearances required for disassembly or service, piping requirements, etc.
- 3) Detailed Structural and Mechanical Layout Drawings showing system fabrication, dimensions, size and locations of connections to other work.
 - 4) Vessel data indicating equipment number, pressure rating, resin type, diameter, and height.
 - 5) Confirmation that the complete package control system will be suitable for operation under the service conditions and will meet or exceed the performance requirements specified herein.
 - 6) Functional description of instrumentation and controls including list of parameters monitored, controlled, or alarmed. Provide drawings of field panels to be provided with package biofilter system showing indicators, alarms, switches, etc.
 - 7) Estimated annual water usage calculations.
 - 8) Performance guarantee statement for the biofilter system.
 - 9) Manufacturer's information/data on the biofilter media, including.
 - a) Media description.
 - b) Particle size.
 - c) Surface area.
 - d) Density.
 - e) Pressure loss.
 - f) Projected life cycle of media.
 - g) Media volume and depth to meet specified performance requirements.
 - h) Media residence time.
 - i) Operating data from previous installations to substantiate media performance claims.
 - j) Pressure drop calculations through supplier's entire biofilter system (itemize pressure drop for major items and show total pressure drop).
 - 10) Manufacturer's Information on the Exhaust Fan:
 - a) Performance data for the fan including curves showing pressure, capacity, horsepower demand, and fan efficiency over the entire operating range of the unit, from shutoff to maximum capacity.
 - b) Catalog cut showing all pertinent dimensions.
 - c) Coating information and color chart.
 - 11) Motor manufacturer's technical information shall be submitted in accordance with Section 26 20 00, Low-Voltage AC Induction Motors, including the following:
 - a) Standard specifications and catalog cut.
 - b) Nameplate data in accordance with NEMA MG 1.

- c) Additional Rating Information:
 - (1) Service factor.
 - (2) Locked rotor current.
 - (3) No load current.
 - d) Bearing type/lubrication/life.
 - e) Description and rating of motor thermal protection.
 - f) Motor sound power level in accordance with NEMA MG 1.
 - 12) Control panel elevation drawings showing construction and placement of operator interface devices.
 - 13) Water panel elevation drawings showing construction and placement of operator interface devices.
 - 14) Power and control wiring diagrams, including terminals and numbers.
 - 15) External utility requirements.
 - 16) Coating Systems: Include manufacturer's descriptive technical catalog literature and specifications for each coating to be applied. Provide a list of applications for coatings, showing the number and order of coats that are to be applied and the thickness of each coat in millimeters.
2. Informational Submittals:
- a. Field Performance Test Plan and Report.
 - b. All applicable warranty statements for media and biofilter system.
 - c. Special shipping, storage and protection, and handling instructions.
 - d. Manufacturer's installation instructions.
 - e. Factory Quality Control Report.
 - f. Statement that vessel has been designed to meet load requirements set forth herein stamped and signed by a structural engineer registered in the State of Arizona.
 - g. General information regarding the manufacturer and system supplier, including name, address, size, business history, list of product lines, and specific information related to the equipment addressed herein (i.e., years of manufacture, etc.). Also include the following:
 - 1) List of at least five installations of similar biofilter systems located within the United States. Listing should include basic descriptions of the installations referenced, such as the location, treatment capacity in cubic feet per minute, date of installation, contact names and phone numbers, etc.
 - 2) Address and phone number of the nearest service center(s) and manufacturer representatives, including a list of the manufacturer services available at the indicated location(s).
 - 3) Address and phone number of the nearest parts warehouse capable of providing full parts replacement and/or repair services.

- h. Suggested spare parts list to maintain the equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
- i. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
- j. Operation and Maintenance Data Manual in accordance with Section 01 78 23, Operation and Maintenance Data, for complete system and all individual equipment within the system.
- k. Training schedule and program for training to be conducted by manufacturer during manufacturer's field service.
- l. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
- m. Manufacturer's Certificate of Proper Installation completed by manufacturer during performance testing witnessed by manufacturer during equipment testing and field startup.

1.05 WARRANTY

- A. The Manufacturer shall warrant the media for a period of 10 years from the date of Substantial Completion. This warranty shall be issued to the Contracting Officer. In addition:
 - 1. The media shall not shrink or compact by more than 10 percent of the original bed depth, as indicated in differential pressure drops exceeding maximum limits stated herein at design airflow rates.
 - 2. The media shall not degrade or decompose during the 10-year warranty period.
 - 3. If the media does shrink or compact by more than 10 percent of the original bed depth or if the media is found, upon examination by the media supplier, to have degraded or decomposed or to be defective in material or workmanship or both the media supplier shall either (a) add new media or (b) repair or replace any part of the defective media or (c) replace the entire media bed at no cost to the Contracting Officer.
 - 4. The Manufacturer shall warrant all other biofilter components for a period of 1 year from the date of Substantial Completion.
- B. Warranty shall be contingent on the following conditions:
 - 1. The Contracting Officer must ensure that the biofilter package system is operated and maintained in accordance with the instructions provided in the manufacturer's Operation and Maintenance Manual.

2. The Contracting Officer must seek written authorization from equipment manufacturer prior to undertaking any service, modifications or the addition of any substance(s) to the media.

1.06 QUALIFICATIONS

- A. The biofilter system supplier shall have at least 5 years' experience in design and fabrication of similar systems as demonstrated by a list of at least five successful installations of comparable size (1000 cfm or higher), with references. References must include valid names and phone contact numbers that can be verified.
- B. The biofilter system supplier must be able to show two or more installations in which the media has lasted for 3 years or more with commensurate performance data with at least one installation in which the media has lasted for 5 years or more.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. For multiple units of the same type of equipment, furnish identical equipment and accessories of a single manufacturer.

2.02 SERVICE CONDITIONS

- A. Location: Outdoors, Grand Canyon National Park, Arizona.
- B. Area Classification: Class 1, Division 2, within 3 feet of leakage sources.
- C. Ambient Air Temperature Range: 0 degree F to 90 degrees F.
- D. Relative Humidity: Up to 15 percent.
- E. Elevation Above Sea Level: Approximately 7,000 feet.
- F. Gases: Foul air containing hydrogen sulfide and smaller amounts of reduced sulfur organic compounds (totaling less than 1 ppm) such as mercaptans, dimethyl disulfide, and dimethyl sulfide.
 1. Average hydrogen sulfide concentrations are defined as 5 ppm.
 2. Peak hydrogen sulfide concentrations are defined as 25 ppm.

2.03 EQUIPMENT AND MATERIALS

A. Biofilter Vessel:

1. Manufacturers:
 - a. Daniel Company.
 - b. Or equal.
2. Physical Characteristics:
 - a. Constructed of fiberglass reinforced plastic (FRP) with UV inhibitors, in accordance with ASTM standards. Resin shall be premium vinyl ester suitable for continuous exposure to saturated water vapor, hydrogen sulfide gas, and their associated acidic products.
 - b. Insulate vessel walls and top head with 2 inches thick polyisocyanurate rigid foam board shaped and wrapped to match the exterior of the vessel. Apply FRP overwrap "skin" to seal and protect the insulation material from the elements.
 - c. Media support system constructed of FRP or composite HDPE.
 - d. Vessel shall be complete with the following:
 - 1) Outlet flanged nozzle and stack.
 - 2) 4-inch drain nozzle.
 - 3) Hold-down lugs.
 - 4) Flanged inlet foul air nozzle.
 - 5) Access hatches for media replacement (one 24-inch diameter at top, one 24-inch diameter at side) and for spray nozzle observation (12-inch diameter minimum, with clear cover).
 - 6) Irrigation/makeup water inlet nozzles.
 - 7) 1-inch sample ports (two).
 - 8) 1-inch pressure differential indicator ports for monitoring pressure across media.
 - e. Provide sufficient access to all components and accessories for ease of removal and maintenance at ground level.
 - f. Design Loads:
 - 1) Top of Vessel: Live load of 100 pounds per square foot minimum.
 - 2) Snow Load: In accordance with structural notes on the Drawings
 - 3) Seismic and Wind Load: In accordance with structural notes on the Drawings.
 - g. Accessories:
 - 1) Flanges and Pipe Threads: Flanges on equipment shall comply with ANSI B16.1, Class 125; or Class B16.5, Class 150, unless otherwise indicated. Threaded flanges and

fittings shall have standard taper pipe threads complying with ANSI/ASME B1.20.1.

- 2) Identification Label and ID tag.
- h. Biofilter Media:
 - 1) Media shall be engineered inorganic substrate type.
 - 2) Media must be resistant to degradation and compaction. Media is not to settle by more than 15 percent of its original depth within 6 months after installation.
 - 3) The media shall not shrink or swell with varying moisture contents.
 - 4) The media shall be formulated with the proper nutrients and buffering agents for intended operation.
 - 5) Provide sufficient depth for a minimum empty bed retention time as stated herein.
3. Functional Characteristics:
 - a. The package biofilter system will treat foul air from the plant septage receiving station and vault, headworks screen channels and influent structure. Seasonally, there will also be intermittent flow from compost facility.
 - b. Total System Airflow Rate: 1,000 acfm (1,300 acfm with compost facility).
4. Performance Characteristics:
 - a. Hydrogen Sulfide: 99 percent removal for inlet concentrations above 10 ppmv or 0.1 ppmv maximum discharge concentration at inlet concentrations less than 10 ppmv.
 - b. Provide for even air distribution through the media such that channeling and short-circuiting are prevented.
 - c. Maximum pressure drop across the packaged biofilter shall not exceed 3 inches water column.
 - d. The biofilter system shall conform to the following parameters:

Design Parameter	Value
Empty Bed Residence Time:	Minimum 45 sec (based on normal flow)
Air Flow Rate:	1,000 cfm normal 1,300 cfm (for short term)
Instantaneous Water Consumption:	20 – 25 gpm
Maximum water consumption:	300 gallons per day

B. Biofilter System Components:

1. Physical Characteristics:
 - a. Piping and Accessories: Refer to piping and valve specifications.
 - b. Water Panel (LCP-2202):
 - 1) Type 316 stainless steel, NEMA 4X construction.
 - 2) Containing valves, strainer, flowmeter, and plumbing required for irrigation of media, as shown on the Drawings.
 - 3) Panel heater.
 - 4) Field connection to external water supply.
 - c. Miscellaneous Components:
 - 1) Differential Pressure Gauge (PDI-2264):
 - a) Range: Manufacturer recommended.
 - 2) Isolation Shutoff Valves: Schedule 80 PVC.
 - 3) Temperature Indicator (TI-2201):
 - a) Range: Manufacturer recommended.
 - 4) Pressure Regulator: Sized by system supplier to provide required irrigation flow rate and pressure.
 - 5) Strainer: Y-pattern PVC body, 150 psi nonshock rated, with screwed PVC cap and EPDM seals. Screwed or solvent weld and connections. Screen shall be heavy-gauge PVC, 1/32-inch mesh, minimum 2 to 1 screen area to pipe size ratio.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

C. Electrical and Instrument Components and Accessories:

1. Physical Characteristics:
 - a. Provide field panels and all necessary electrical and instrumentation components and wiring for a complete, functional system.
 - b. If a Programmable Logic Controller (PLC) or an Operator Interface Terminal (OIT) is necessary, provide in accordance with Section 40 99 90, Package Control Systems.
 - c. Electrical components shall be provided in accordance with the requirements of Division 26, Electrical.
 - d. Adjustable frequency drive (AFD) for fan motors shall be provided in a separate motor control center specified in Division 26, Electrical. Provide all necessary control functions to properly interface with the AFD.
 - e. Wiring: The Contractor is responsible for making any necessary modifications from what is shown on the Drawings to ensure a complete and operating system. All wiring shall meet the requirements set forth in Division 26, Electrical. All low-voltage

- (24V) signals shall be run in twisted, shielded pair cable and conduit.
- f. Electrical Raceways: All electrical wiring shall be installed in conduit meeting the requirements of Division 26, Electrical.
 - g. Motorized Valve (FV-2203):
 - 1) Control valve for water flow to the biofilter vessel.
 - 2) Schedule 80 PVC ball valve.
 - 3) Equipped with integral 120-volt power operator.
 - 4) OPEN and CLOSE position limit switches.
 - 5) Valve operator shall be explosion proof, housed in NEMA 4X enclosure.
 - h. Flowmeter (FIT-2271):
 - 1) Measure flow and transmit signal proportional to velocity of water in pipe.
 - a) Line Size: 1-1/2 inches.
 - b) Range: 0 gpm to 50 gpm.
 - 2) Type: Electromagnetic Flow Meter per Section 40 91 00, Instrumentation and Control Components.
 - i. Pressure Indicating Transmitter (PIT-2261, PIT-2262):
 - 1) Measure pressure and transmit signal proportional to measured pressure.
 - 2) Type: Pressure Transmitter per Section 40 91 00, Instrumentation and Control Components.
 - 3) Range: 0 inch to plus or minus 12 inches WC.
 - j. Local Control Panel (LCP-2201):
 - 1) Provide Type 316 stainless steel NEMA 4X field panel.
 - 2) Provide field panel and instruments with external interfaces as described herein.
 - 3) Panel shall contain the local control and monitoring for the biofilter components. This includes, but is not limited to valves, irrigation control, and flowmeter.
2. Functional Characteristics:
- a. Operator Controls and Indicators:
 - 1) As a minimum, the following operator interface functions and displays shall be provided on the panel exterior:
 - a) Control power ON indicating light.
 - b) OPEN/CLOSE/AUTO for irrigation valve.
 - c) OPEN indicating light for irrigation valve.
 - d) CLOSED indicating light for irrigation valve.

- b. External Interfaces:
 - 1) As a minimum, the following functions shall be provided:
 - a) Discrete Outputs:
 - (1) System ON.
 - (2) General failure.
 - (3) Irrigation valve OPEN.
 - b) Analog Outputs: Irrigation Flow.
 - c. Motorized Valve (FV-2203):
 - 1) OPEN motorized valve when the irrigation controller calls for water.
 - 2) CLOSE motorized valve when irrigation cycle is complete.
 - d. Power Supply:
 - 1) 120 volts, single-phase.
 - 2) Control power transformer (120V ac to 24V dc).
 - 3) Surge suppression on incoming power supply.
 - 4) Coordinate with Division 26, Electrical.
3. Performance Characteristics: None.
- D. Odor Control Fan(s) (022-FAN-2215, 022-FAN-2216):
- 1. Physical Characteristics:
 - a. Factory-assembled utility blower, including housing, fan wheel, drive assembly, motor, and accessories.
 - b. Fiberglass Construction: In accordance with ASTM D4167.
 - c. Suitable to convey air at temperatures up to 250 degrees F.
 - d. Spark Resistant Construction: Carbon fiber veil impregnated in housing and wheel fiberglass resin corrosion barrier with static grounding. Classification AMCA 99-0401 Type A.
 - e. Airstream Hardware: Type 316 stainless steel.
 - f. Fan resin shall be vinyl ester type suitable for exposure to the specified service conditions.
 - g. Resin shall have a flame spread index less than 25 per ASTM E84. Fire retardant additives used only in structural layer. Structural wall resin shall contain a minimum of 3 percent antimony trioxide if required to achieve required flame spread index.
 - h. Add ultraviolet absorbers to surfacing resin to improve weather resistance.
 - i. Exterior gel coat to be gray.
 - j. Reinforcement: Chemical surfacing mat (Type C glass veil), chopped strand mat (Type E glass, minimum 1-1/2 ounces per square foot, with silane finish and styrene soluble binder), continuous roving for chopper gun spray-up (Type E glass), or woven roving (Type E glass, nominal 24 ounce per square yard, 4 by 5 weave, with silane type finish).

- k. Laminate: Interior corrosion layer shall be resin rich, nominal 100 mil thickness. Structural layer exterior surface shall be relatively smooth, with no exposed fibers or sharp projections.
- l. Housing Material: Fiberglass with minimum of 10-mil Type C (chemical) glass surface veil with rigid bracing to increase structural rigidity.
- m. Curved scroll housing configuration.
- n. Flanged inlet and outlet for duct connections, factory drilled.
- o. Drain connection located at lowest point of fan housing. Minimum 1/2-inch drain line – NPT connection. Drain not used for bottom horizontal discharge.
- p. Inlet to be die-formed bell mouth of fiberglass construction, bolted to housing to permit wheel removal.
- q. Shaft Seal: PTFE, located at shaft penetration of housing.
- r. Base/Pedestal: All-welded heavy gauge epoxy-coated steel.
- s. Wheel Material: Fiberglass with minimum of 10-mil Type C (chemical) glass surface veil.
- t. Centrifugal wheel, one-piece, nonoverloading, radial blade type.
- u. Wheel hub permanently bonded to shaft and completely encapsulated in fiberglass.
- v. Shaft: Turned, ground and polished solid Type 316 stainless steel.
- w. Bearings: Grease lubricated, prevision antifriction ball, self-aligning type. Mounted in cast iron pillow block housing. Selected for average life (ABMA 9 L₅₀) of not less than 200,000 hours operation at maximum cataloged operating speed.
- x. Shaft Guard: Easily removable, enclosing entire drive assembly, meeting federal, OSHA, and State of Arizona requirements. Constructed of expanded metal with grilles for ventilation. Bright yellow finish. Epoxy coated.
- y. Arrangement: 8.
- z. Housing Access Door: Bolted and gasketed.
- aa. Noise Enclosure: If the maximum weighted average housing radiated sound power level of the untreated fan, in accordance with AMCA 300 (at Q=1, 5 feet), is greater than 85 dBA, then provide acoustical wrap around housing.
- bb. Extended lube lines.
- cc. Identification Label and ID tag.
- dd. Drive Motor, in accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

2. Functional Characteristics:
 - a. Fan Capacity: 1,000 acfm at 8 inches WC total static pressure, 3 hp, 480V, 60-Hz, three-phase.
3. Performance Characteristics: None.

2.04 SOURCE QUALITY CONTROL

- A. Balancing: Rotating elements of equipment shall be statically and dynamically balanced at the factory prior to final assembly. Provide certified copies of all test results.
- B. Biofilter Vessel: Provide vessel manufacturer's standard quality control report.
- C. Witnesses: The Contracting Officer reserves the right to witness factory tests.

PART 3 EXECUTION

3.01 GENERAL

- A. Package Equipment: Coordination shall include space and structural requirements, clearances, utility connections, signals, outputs, and features required by the manufacturer including safety interlocks.

3.02 INSTALLATION

- A. Install all systems in accordance with manufacturer's written instructions and recommendations.
- B. Lubricants: The installation includes oil and grease for initial operation.
- C. Ductwork condensate piping as shown on the Drawings.
- D. Anchor Bolts: Accurately place using templates furnished by fabricator.

3.03 FIELD FINISHING

- A. Damage to pigment gel coat or exterior laminate of any FRP component shall be repaired in accordance with equipment fabricator's recommendations. Exposed surfaces will be restored to a uniform texture and color-matched appearance.

3.04 FIELD TESTING AND FACILITY STARTUP

- A. Field Testing and Facility Startup shall be in accordance with the requirements of Section 01 91 14, Equipment Testing and Facility Startup.
- B. Facility startup specifies the order and prerequisites for the following tests of the equipment:
 - 1. Field functional testing.
 - 2. Software operational testing.
 - 3. Performance testing.
 - 4. Demonstration testing.
- C. All Field Testing and Facility Startup shall be performed using a qualified representative provided by the Manufacturer as specified in Section 01 91 14, Equipment Testing and Facility Startup, Section 01 43 33, Manufacturers' Field Services.

3.05 FIELD QUALITY CONTROL

- A. Provide minimum Field Quality Control Tests as follows:
 - 1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Functional Tests: Conduct on Biofilter Packaged system following supplier's written instructions.
 - 3. Complete system testing and balancing.
- B. Performance Tests:
 - 1. Coordinate tests with associated instrumentation and control system testing. Conduct performance test on package biofilter system under actual operating conditions as follows:
 - a. Submit Performance Testing Plan. Performance test shall not commence until Testing Plan has been approved.
 - b. Supplier shall inform Contracting Officer at least 14 days prior to the start of any performance testing. The Contracting Officer shall have the right to observe, sample, and make any parallel determinations during the performance test.
 - c. Test only after supplier approved acclimation period for the package biofilter. Acclimation is not to exceed 3 weeks.
 - d. Use portable hydrogen sulfide analyzer approved by Contracting Officer. Record inlet and outlet concentrations at 10-minute intervals for a period of 8 hours.
 - e. Record airflow, inlet and outlet concentrations, pressure drop, and other data as may be appropriate. All data to be submitted in report form.

- f. Within 30 days after the conclusion of the test period, the Supplier shall submit a Performance Test Report, including all field test data, stating the conclusions of the test with regard to the performance criteria.
- g. Retesting: In the event the biofilter fails to meet the performance requirements, the Supplier shall immediately make the necessary modifications or adjustments to meet these requirements. Additional testing shall be conducted until the performance requirements are met, at no additional cost to the Contracting Officer.

3.06 MANUFACTURER'S SERVICES

- A. Provide manufacturer's services and Manufacturer's Certificate of Proper Installation as follows during a minimum of two trips:
 - 1. Minimum of 1/2 person-day for Manufacturer's assistance to the Contractor.
 - 2. Minimum of 1/2 person-day for Manufacturer's Certificates of Proper Installation for the biofilter and exhaust fans/motors.
 - 3. Minimum of 1 person-day for Performance Testing.
 - 4. Minimum of 1/2 person-day for Manufacturer's Training Program. Training shall not commence until an accepted detailed lesson plan has been reviewed by Contracting Officer.
- B. See Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

