

## SECTION 1137X

### FINE BUBBLE DIFFUSER SYSTEM – PTFE MEMBRANE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. The Contractor shall furnish and install, complete and ready to operate, a flexible membrane fine bubble aeration system in aeration tanks in accordance with the system specification and drawings.

##### 1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to their equipment suppliers.

- 1. *Section 01xxx* Submittals
- 2. *Section 01xxx* Material & Equipment
- 3. *Section 01xxx* Equipment – General

##### 1.03 REFERENCE SPECIFICATIONS

- A. AISI 304L
- B. AISI 316L
- C. ASTM D412
- D. ASTMA778/774
- E. ASTM D1784
- F. ASTM D573
- G. ASTM D2240
- H. ASTM D624
- I. ASTM A380
- J. ANSI/ASCE 2-91
- K. ASCE 18-96

##### 1.04 PERFORMANCE REQUIREMENTS

- A. The fine bubble aeration system shall be located in the 1 aerobic zone of Aeration Tank No. 1.
  - 1. Average water depth in aerobic zone 1 is 16 feet.
  - 2. Summer wastewater temperature is 20 degrees C. Winter wastewater temp is 15 degrees C.
- B. Required airflow rates shall be determined from the following Standard Oxygen Requirements (SOR)

## 1. Oxygen Requirements

	Low	Design	Peak
Aerobic Zone 1, SOR In lbs/day	1000	1500	3000

### 1.05 DESIGN CRITERIA

#### A. Air Supply System

1. Aerobic Zone 1 will receive air supply from up to 2 blowers operating in parallel feeding two air headers. Two droplegs will feed each aerobic zone from its air header (refer to drawings).
2. The aeration system shall be capable of complete and uniform mixing and suspension of mixed liquor suspended solids (at MLSS concentrations of 1500 to 4500 mg/l) throughout the aerobic zone.
3. Air and mixing rates shall be variable over the range necessary for oxygen transfer and mixing.
4. Maximum diffuser membrane flux rates shall be 4 SCFM/sq ft, and maximum spacing between diffuser rows, center to center, shall be 4 ft.

#### B. Materials

1. 304L Stainless steel drop pipes
2. PVC manifold and lateral pipes
3. Diffuser assembly consisting of EPDM membrane diffuser, PVC or polypropylene diffuser holder, air flow control orifice, and mounting saddle
4. PVC drain line, sump and airlift purge system
5. Expansion joints and fixed joints
6. Type 304L stainless steel supports and anchor bolts
7. Diffuser pressure monitoring system

### 1.06 SUBMITTALS

- A. Submit shop drawings. Shop drawings shall include plan, elevation and appropriate cross sections and details of aeration equipment, support and anchor location.
- B. Submit headloss curves and complete headloss calculations for the aeration system to the manufacturer's point of responsibility.
- C. The contractor will supply data from an independent testing laboratory showing the performance characteristics of the diffusers in clean water.
  - 1. Minimum lab oxygen transfer efficiency will be as offered at the specified side water depth and design airflow conditions.
  - 2. This test data must include data from a depth similar to the design operating depth with similar diffuser density, or an appropriate interpolation may be made between test points. The test data should be developed in conformance with the general procedures set forth in the ASCE Clean Water Standards.
- D. The contractor will supply data from an independent testing laboratory confirming that destructive chemical testing has shown that the plasticizer content of a new membrane and a membrane which has been in active service in municipal sewage for a period of at least 2 years has not changed.

#### 1.07 SPARE PARTS

- A. Provide the following spare parts for the Owner's inventory:
  - 1. Ten percent of the number of installed complete diffusers
  - 2. One percent of the total number of installed pipe supports with anchors

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. The manufacturer of the fine bubble flexible membrane system shall be the following or equal:
  - 1. Stamford Scientific International, Inc. SSI-AFD Disc Diffuser, model AFD270 9" disc or AFD350 12" disc with low plasticizer PTFE layered EPDM membrane.

## 2.02 EQUIPMENT DESIGN

### A. Scope of Supply

1. Furnish all materials and equipment for a fine bubble membrane disc aeration system, beginning with a Van Stone flange and a 90 degree stainless steel elbow, and including all pre-engineered and pre-fabricated stainless steel and PVC piping within the tank, all fine bubble diffusers and accessories required to connect diffusers to pipe, as well 304L SS support stands, 304L SS shell expansion joints with PVC liners, and a moisture purge system for each piping grid.

### B. Stainless Steel Materials and Fabrication:

1. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel. Fabricate non-welded parts and pieces from sheets and plates of 304L stainless steel.
2. Pickle all stainless steel assemblies and parts after welding, fabrication and wire brushing by complete immersion in an acid solution as specified in ASTM A380-88. The acid shall be a nitric-hydrofluoric solution as defined in Table A2.1, Annex A2 of ASTM A380. Providing a final rinse using ordinary industrial or potable water and dry in conformance with Section 8.3 of ASTM A380. Corrosion protection techniques not employing full immersion methods are not acceptable.
3. Do all welding in the factory using MIG, TIG or plasma-arc welding inert gas processes. Field welding is not permitted.

### C. PVC Materials and Fabrication

1. Produce all PVC pipe and fittings from PVC compound with a minimum tensile strength of 7000 PSI.
2. Provide lower drop pipes, manifold pipes and header pipes with a minimum of SDR26 wall thickness. Header pipes to have a minimum outside diameter of 4.5".
3. Factory solvent-weld all PVC joints. Field solvent welding is not permitted.
4. Headers to terminate in removable end caps, to facilitate water

flushing of the piping before installation of diffusers.

5. One PVC drain line sump with airlift purge ejector line and eductor carrier column to be provided to drain the submerged aeration piping system. System to include one ball valve.

D. Membrane Aeration System Equipment Components – Support Stands

1. Provide expansion joints with 304L SS shell and PVC liners. Minimum of 4 slotted bands with stainless steel screws to be used. Positive locking type expansion joints are also acceptable.
2. Provide 304L support stands, including hold-down, guide straps, anchor bolts, and supporting structure. Each 20ft length of pipe shall have a minimum of 4 support stands. Guide straps shall be a minimum of 1.5" wide. Supports to have a mechanism to provide for +/- 2" vertical adjustment for alignment of the manifold in the field. Supports shall be designed to allow for complete removal from the tank (less anchor bolt) to enable cleaning and maintenance of tank bottom. Minimum anchor bolt and threaded rod diameter shall be 3/8". Anchor bolts shall be sized with a pull out strength design safety factor of 4 or greater.
3. Guide supports to consist of a self-limiting hold down and sliding mechanism. Hold down and sliding mechanism shall provide a full circumferential 2" wide contoured bearing surface with chamfered leading edges to minimize binding of the air distribution header. Sliding mechanism shall provide minimum resistance to movement of the air distribution header under full buoyant up-lit load. Mechanism to provide 1/8" clearance around header and be self-limiting if the mechanism is over-tightened. Worm gear clamps are not to be utilized for attaching header pipe to supports, and U-bolts are not acceptable.
4. Fixed supports to consist of a self-limiting hold down and sliding mechanism. Hold down and sliding mechanism shall provide a full circumferential 2" wide contoured bearing surface. Clamping device shall positively grip the air distribution header when tight and be self limiting to prevent overstressing the header if the clamp is overtightened. Worm gear clamps are not to be utilized for attaching header pipe to supports, and U-bolts are not acceptable.

5. Aligning and adjusting shall be infinitely adjustable within its limits to allow precise leveling of the air distribution headers and diffuser assemblies to within 1/4"/6mm of a common horizontal plane without removing the header from the support.
6. Attach supports to tank floor with a minimum of two stainless steel expansion type anchor bolts or Hilte type chemical anchors designed for embedment in 3000 PSI concrete. Supports which utilize only one anchor bolt or one chemical anchor, or which are made of plastic are not acceptable.

E. Diffuser assemblies

1. Furnish disc type 9" or 12" membrane diffusers only.
2. Diffuser to consist of a membrane with integral gasket, base, retaining ring, air flow control orifice of 1/4" in the case of 9" disc diffusers and 2/5" in the case of a 12" discs, and saddle. Diffusers with ceramic or plastic type diffusion media elements are not acceptable as alternatives to the membrane. Diffusers without a high performance fluoroelastomer sacrificial barrier layer such as PTFE or VITON® are not acceptable. Diffusers that require a center bolt or webbing to limit membrane deflection are not acceptable.
3. Membrane material to be premium quality compression molded EPDM with an oil content of less than 13%. Membranes which are injection molded are not acceptable.
4. Membrane shall collapse and seal when aeration system air is turned off. Membrane shall collapse onto base when air is not being diffused. Design should permit air to exit through the entire periphery of the membrane. Membrane shall be designed to resist clogging.

5. Characteristics follow:

Surface Layer	PTFE
Substrate Layer	EPDM
Tensile strength	1800 PSI
Tear strength	min 80 Lb/linear inch
Ozone resistance	Pass
UV resistance	Pass

Durometer	60
Ultimate elongation	700%
FOG resistant	Yes
Solvent resistant	Yes
Biofouling resistant	Yes
Friction Coefficient	0.09

6. Diffuser base and retaining ring to be constructed of polypropylene with organic UV stabilizers and anti-bacterial agents to prevent bacterial buildup & ease future membrane replacement. Plastics that do not utilize UV protection shall not be acceptable. Characteristics follow:

Specific Gravity	0.905
Water absorption	0.02%
Tensile Strength	5000 PSI
Coefficient of thermal expansion	05
Maximum Temperature	100C

7. Furnish bayonet type saddle clamps to connect diffusers to pipe manufactured of talc reinforced, UV stabilized polypropylene. Saddle clamps to be attached in the factory. Saddle mount to allow connection of 9" or 12" disc diffusers to enable future system expansion. Saddles which do not allow removal of the diffuser's retaining ring while diffuser remains mounted to pipe are not acceptable.
8. Diffuser is designed to prevent air escape at the seal. Gasket is integral with diffuser membrane.
9. Sealing method of retaining device shall generate a minimum of 50 pounds per inch of circumference of the sealing gasket to provide a long term positive seal and to prevent air escape.

#### F. Pressure Monitoring System

1. Furnish monitoring equipment to measure dynamic wet pressure (DWP) and diffuser airflow of a typical diffuser in each aeration grid.
2. Furnish one portable routine maintenance pressure monitoring panel. This panel shall be housed in a fiberglass NEMA 4X enclosure, mounted on an aluminum hand truck and contain the following equipment components:
  - i. Orifice and diffuser differential pressure gauges
  - ii. Bubble pipe blow down valve
  - iii. Bubble pipe air flow rotameter

- iv. Differential pressure switch
  - v. Quick coupling connectors
  - vi. Polypropylene fittings
  - vii. Polyethylene tubing
  - viii. Pressure monitoring instructions with calibration curves
3. Furnish one pressure monitoring connecting box assembly. The connecting box assembly shall be used to connect the pressure monitoring panel to the in-tank aeration grid. This assembly shall contain the following equipment components:
- i. One fiberglass connecting box housing, three sets of isolation valves and male quick disconnects
  - ii. Polyethylene tubes and fittings running from one connecting box isolation valves to the in tank aeration grid
  - iii. One of 3 sizes tapped holder, header and bubble pipe connections on one air distributor on the in tank aeration grid
  - iv. All pressure monitoring tubes shall be housed in a Sch 80 PVC carrier column extending from the top of the tank near the connecting box to the bottom of the tank
  - v. The carrier column shall be anchored to the tank floor and wall using 304L SS supports and fastening hardware
  - vi. The connecting box shall be mounted to the handrail using stainless steel supports and fastening hardware
  - vii. Furnish one set of 10 ft long pressure monitoring leads to connect the connecting boxes to the pressure monitoring panels. Each set to include 3 sizes of polyethylene tube with female end quick disconnects. The tube bundle shall be encased in 1.5" dia polyethylene tube.

#### G. Warranty

- 1. Warrant all parts to be free from defects in material and workmanship for a period of two years after installation. Furnish replacement parts to the Owner for any items to be found to be defective within the two year warranty period.

### PART 3 – EXECUTION

#### 3.01 Installation

- A. Follow equipment manufacturer's recommendations for sequencing of equipment installation.
  - i. Layout and install supports in accordance with instructions and anchor setting plan
  - ii. Level aeration system such that all diffusers are plus or minus  $\frac{1}{4}$ " of a common horizontal plane

iii. The top surface of each diffuser shall be horizontal and level

B. Clean air header pipe, laterals, blowers, filters and dropleg prior to installing diffuser elements

i. Install diffuser elements on saddles

ii. Protect diffuser elements from unnecessary direct sunlight and excessive heat and cold

C. Carry out system tests for support stand integrity, pipe joint and diffuser mount leaks, and proper air distribution and mixing in accordance with manufacturers' recommendations.