SECTION 11375

FINE BUBBLE AERATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install, ready for operation, fine bubble membrane disc aeration system for the two aeration basins, as shown on the Drawings and specified herein.

1.2 SECTION INCLUDES

A. Air distribution manifolds.

B. Air distribution laterals.

C. Supports.

D. Fine bubble air diffusers.

E. Accessories.

F. Welding and corrosion protection.

G. Spare equipment.

1.3 REFERENCES

A. All applicable ANSI, ASME, AWWA, and ASTM Standards.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Letters of Certification of Compliance on materials, equipment, etc.
   2. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
   3. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
   4. Provide the following Diffuser Data: Model number, weight, and size.
   5. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.

6. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
7. The formal test protocol for use during performance testing, if required.
8. Diffuser manufacturer on-site representative's complete signed report of results of the inspection, operation, adjustments, and tests. Include the manufacturer's certificate that equipment is ready for permanent operation, the OWNER'S personnel have been trained in accordance with Part 3 of this Specification, and that nothing in installation will render manufacturer's warranty null and void.
9. Recommended list of spare parts and safety equipment along with price and ordering information. Spare parts and safety equipment at a minimum shall include the equipment listed in Paragraph 2.5 of this Specification.
10. Total head losses through the diffuser at maximum and average flow conditions. Support calculations, with all assumptions clearly defined, shall also be supplied. Head loss calculations shall be derived using air at standard conditions.
11. Quality assurance information in accordance with Paragraph 1.5 of this Specification.
12. Warranties in accordance with Paragraph 1.6 of this Specification.

B. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals.

1.5 QUALITY ASSURANCE

A. The manufacturer shall have experience in the design, manufacturing, supplying, and commissioning of fine bubble membrane disc aeration system specified for this Project. The equipment quoted shall be of a proven design and shall be referenced by at least four installations of similar size or larger.

B. Fine Bubble Membrane Diffusers shall have a minimum oxygen transfer rate (SOTE) of 28% at an airflow rate of 2 scfm per diffuser at a diffuser submergence of 17.16 feet.

1.6 WARRANTY

A. As a condition precedent to final acceptance of the Work, the CONTRACTOR shall certify that the equipment included under this Section has been properly installed, aligned, tested, and placed into operation. The certification shall warrant that the equipment and its installation are free from defects, and suitable for trouble-free operation for a period of one year after the start-up. Furnish replacement parts to the OWNER for any items found to be defective within the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sanitaire Division of ITT Industries.

B. Or approved equal.

2.2 DESIGN CRITERIA

A. Aeration Basin:
   1. The design criteria for the aeration basins is as follows: The current design is for an average flow of 3.5 MGD and a peak flow of 7 MGD.
      a. 3.5 MGD Condition:
         1) Total Number of Basins: 2.
         2) Air Requirement/Basin.
         3) Zone 1, Anoxic Zone with Submersible Mixers.
         4) Zone 2 (peak day): 2,901 scfm.
         5) Zone 3 (peak day): 1,305.5 scfm.
         6) Maximum Anticipated Water Depth: 18.5 feet.
         7) Depth of Water From Top of Diffuser Plate: 17.16 feet.
         8) SOTE at 2 scfm: 28%.
   2. Flows through the basin at 7 MGD are shown below.
      a. Worst Case Scenario at 7 MGD Design Basin:
         1) Peak Influent Flow: 7 MGD.
         2) Return Activated Sludge: 21 MGD.
         3) Total Flow to Aeration Basins: 28 MGD.
         4) Total Flow per Aeration Basin: 14 MGD.
      b. Location of Submersible Mixers (in anoxic zone) and other equipment are also shown on the Drawings. The diffuser manufacturer shall take the location of all equipment, and its effects on the aeration system into account. If necessary, the diffuser manufacturer shall contact other equipment manufacturers for further information.
         1) Average of Water Temperature Expected: 73° F to 95° F.
         2) Range of Ambient Air Temperature Expected: 20° F to 120° F.
         3) Elevation, Above Mean Sea Level: 900 feet.
      c. Zones 2 and 3 are shown on the Drawings. The layout of the diffusers and diffusers per dropleg are also shown on the Drawings. All the droplegs and manifolds are sized for 3.5 MGD average condition.
   3. The lateral spacing shown on the Drawings is final. Minimum diffuser spacing for each zone is shown on the Drawings. Any new layout, if different from the one showed on the Plan, shall be submitted to the ENGINEER for approval. The decision on the new layout is entirely up to the ENGINEER. The design maximum airflow rate for fine bubble diffusers is 2 scfm at 3.5 MGD condition.

a. Available head loss through the dropleg, distribution manifold, distribution laterals, diffuser, and orifice shall not exceed 26-inches of water column at an airflow rate of 2 scfm per diffuser, and 40-inches of water column at an airflow rate of 3 scfm per diffuser for any droplegs shown on the Drawings.

2.3 MATERIALS

A. All materials used in the manufacturing of this equipment shall be new and of the best quality used for the purpose of commercial practice.

2.4 COMPONENTS

A. Air Distribution Manifolds:
   1. The air distribution manifolds shall be Schedule 80 PVC with a minimum of 2% TiO_2 and shall conform to ASTM D-1784. The manifold shall be connected to the stainless steel air distributor dropleg. The manifolds shall be shop fabricated with fixed joints and expansion joints per the manufacturer's recommendations.
   2. The outlet stubs from the air distribution manifold piping shall be constructed as follows:
      a. The longitudinal center of the outlet stubs shall not vary more than an angle of one degree from being perpendicular to the centerline of the manifold.
      b. Connections between outlet stubs in the manifold and the tees in the air distribution lateral piping shall be mechanical joints with gaskets.

B. Air Distribution Laterals:
   1. The air distribution laterals shall be PVC pipe with a minimum of 2% $Ti0_2$, shall be either SDR 30.5 conforming to ASTM D3915 and ASTM D3034, or SDR 32.5 conforming to ASTM D2241. The air distribution laterals shall connect to the air distribution manifold at the connections provided for that purpose with a fixed joint. The air distribution laterals shall be fabricated in sections not to exceed 24 feet in length. Joints between sections shall be of the expansion or fixed type and shall permit rotation of each section independently. All pipe and fittings shall be designed to be field installed with no solvent welding.
   2. Provisions shall be made for expansion/contraction of the distribution laterals resulting from temperature change. Expansion joints shall be provided for longitudinal expansion and contraction over temperatures ranging from 40° F to 120° F. Pipe couplings if required by the manufacturer shall incorporate a mechanical expansion joint. It is the responsibility of the diffuser manufacturer to determine whether expansion joints are required for laterals. If required, the location shall be determined by the diffuser manufacturer.

C. Supports:
   1. Each air distribution lateral shall be anchored in place by supports as required. The supports shall be 316 stainless steel designed and furnished by the diffuser manufacturer. Spacing and location shall be as required by the diffuser manufacturer. Supports along the manifold shall be made of concrete. Supports along the dropleg into the basin shall be 316 stainless steel. These supports shall withstand all environmental, hydraulic, and pneumatic conditions in the aeration basin. Anchors shall be epoxy type anchor bolts and shall have a minimum factor of safety of four.
   2. The diffuser manufacturer shall review all Drawings related to the aeration basins and shall be aware of all other equipment in the aeration basin, and design supports to withstand the effects of those equipment, including, but not limited to, anoxic submersible mixers. The diffuser manufacturer shall review all pertinent construction documents on the Project to determine potential loadings on the supports.
   3. All pipe supports shall be designed to withstand all loads described above and worst-case scenario flows at ultimate capacity (7 MGD condition) as tabulated in Paragraph 2.2 of this Section.

D. Air Diffusers:
   1. The CONTRACTOR shall supply fine bubble diffusers in the aeration basins as shown on the Drawings. Diffuser assemblies shall consist of a nominal 9-inch diameter, EPDM membrane diffuser with integral O-ring, a PVC retainer ring, and a diffuser support piece. Diffusers shall be composed of EPDM elastomer and shall be resistant to attack by common municipal wastewater. EPDM material shall meet the requirements of ASTM D-573. No other size diffusers are allowed.
   2. Diffusers shall be free of voids, tears, bubbles, creases, or other structural defects.
   3. Diffusers shall have a uniform distribution of air release across the entire surface area of the diffuser except for the center 1-inch diameter, which shall not be perforated. The non-perforated center of the diffuser shall provide the necessary sealing capabilities and backflow prevention when air supply to the diffuser is interrupted. The center shall be thickened to prevent ballooning and air abrasion where the air is released under the diffuser.
   4. Diffusers shall be disc-shaped with a 9-inch nominal diameter and an integral O-ring seal molded into the diffuser assembly. The diffuser cross-section shall be thickened at the center as noted above and at the periphery near the O-ring to resist stretching.
   5. Diffuser material shall have a durometer of 58 ±5, Shore A, with a minimum tensile strength of 1,200 psi, and a minimum elongation of 350% at break.
   6. After 70 hours at 100° C of oven age, the diffuser shall retain 75% of elongation with a minimum elongation a break of 350% according to ASTM D-573 and ASTM D-412. Longevity of the proposed membrane diffusers

shall have been demonstrated in at lease three full scale-municipal installations operating continuously for a minimum of three years. Test reports, prepared by an independent testing agency, shall confirm membrane longevity through compliance with the following maximum allowed percent (±) change in each membrane property. Tests conducted in-house by the supplier shall not be acceptable. Data from a minimum of three diffusers from each installation shall be provided.

a.

Property	Maximum Change
Durometer	5%
Weight	5%
Permanent Set	0.05%

7. The diffuser shall be perforated with uniform slits of a shape and size to prevent tearing or lengthening of the slits during operation.
8. The diffuser shall exhibit uniform distribution of air across the entire surface area when submerged and operating at 1.0 cfm per diffuser.
9. Dynamic wet pressure of the diffuser element shall be between 15.0-inches and 16.0-inches of water column at an airflow rate of 2 scfm per diffuser, and 17.0-inches and 18.0-inches of water column at an air flow rate of 3 scfm per diffuser. Dynamic wet pressure is the pressure required to operate the diffuser in tap water at the specified flow rates minus any loss for submergence and flow control devices.
10. The following provides information regarding the number of diffuser elements that need to be supplied in each aeration basin.
    a. Number of New Diffusers in Each Basin:
        1) Anoxic Zone: Submersible Mixers:

Zone 2 - Dropleg 1:	374 Diffusers
Zone 2 - Dropleg 2:	638 Diffusers
Total Zone 2:	1,012 Diffusers
Zone 3:	560 Diffusers
Total per Basin:	1,572 Diffusers
Grand Total: 2 x 1,572 =	3,144 Diffusers

E. Accessories:
1. Retainer Rings:
    a. The retainer ring shall be made of PVC with a minimum of 2% of $Ti0_2$ added for ultra-violet protection. The retainer ring shall have a minimum of 2-1/2 complete threads for effective sealing. The threads shall be buttress-type or square-type for maximum holding strength and to minimize stress concentration.
2. Diffuser Baseplates:
    a. Each diffuser baseplate shall be factory solvent welded to the PVC diffuser lateral and shall be manufactured of PVC with 2% $Ti0_2$ added for ultraviolet protection. The welding contact area between the baseplate and the distribution lateral shall be a minimum of 17 square inches to provide a structurally sound connection.

b. Angular variation of all the baseplates on a distribution lateral shall not exceed ±1.0 degree.
c. The baseplate shall be centered on the crown of the pipe.
d. Each base plate shall be the manufacturer's standard product.
e. Each baseplate shall incorporate a factory-drilled orifice sized to give minimum headloss while assuring uniform air distribution. Headloss through orifice should not exceed 4.0-inches to 5.0-inches of water column at an airflow rate of 2 scfm per diffuser and 11.0-inches to 12.0-inches of water column at an airflow rate of 3 scfm per diffuser. The control orifice shall be factory drilled. Designs requiring field drilling of the orifice shall not be acceptable. The air release of the orifice shall be designed to provide even air distribution under the horizontal surface of the diffuser element. The orifice shall be 1/4-inch diameter (unless otherwise noted).

3. Elastomeric Gaskets:
   a. The following gaskets shall be provided for the aeration system.
      1) Expansion Joint Gaskets: 4.50-inch I.D.
   b. Expansion joint gaskets shall be composed of solid neoprene rubber and shall conform to ASTM D-2000. Gaskets shall be suitable for withstanding the effects of wastewater and for temperatures up to 250° F.
   c. Expansion joint gaskets shall have a durometer of 40 ±5.

F. Welding and Corrosion Protection:
   1. All welding shall be done in the factory using MIG, TIG, or plasma-arc welding inert gas processes.
   2. All stainless steel surfaces shall be pickled in the factory by using the following procedure:
      a. Completely immerse all stainless steel assemblies and parts after welding and brushing in a pickling solution of 10% nitric acid and 3% hydrofluoric acid in a water bath per ASTM A380. Parts shall be free of iron particles or other foreign material after this procedure.
      b. Scrub as required. Immediately after, thoroughly rinse the components in clean hot water and let dry.
      c. Corrosion protection techniques not utilizing full immersion will not be acceptable.
   3. The manufacturer shall verify that pickling has been performed per the above Specification. Equipment without proper pickling may be rejected at the discretion of the ENGINEER.

2.5 SPARE EQUIPMENT

A. Provide the following Spare Parts:

1. 10% of the number of installed diffusers, including retainer rings and diffuser support plates.
2. 1% of the total number of pipe supports (non-concrete), including anchor bolts.
3. 1% of each type of diffuser lateral.

B. The above spare parts shall be provided strictly for the OWNER'S inventory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The aeration systems shall be installed in accordance with the manufacturer's recommendations.

3.2 MANUFACTURERS' FIELD SERVICE

A. Equipment Start-up: A factory employed representative of the manufacturer shall visit the site and provide installation and startup services as specified in Section 01650, Starting of Systems, per each basin. A total of three trips are required to provide this assistance. At least one day (eight hours) of field service is required per trip.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems. Training shall be for a period for four hours.

3.3 FACTORY CERTIFIED TESTS

A. The manufacturer shall perform tests to the diffuser elements to ensure proper permeability, uniformity, strength, and dimensions.

B. The aeration system manufacturer shall furnish to the OWNER, through the ENGINEER, a written report confirming that the diffusers have met all established quality assurance standards.

3.4 FIELD TESTS

A. After installation, the diffuser equipment shall be tested for mounting, levelness, air uniformity, and leakage as specified herein. Prior to initiating any field testing, all piping shall be inspected for proper joints, supports and tie downs, and plugs and drain relief valves.

B. Each tank shall be flooded with water to the top of the diffusers. The level of the diffusers shall then be checked to insure that they are at the same elevation within 1/4-inch, of a common horizontal plane for the aeration basin.

C. The basins will then be filled with water to 3-inches above the diffusers. Air shall then be released through the diffusers, and operation of the diffusers shall be checked. The surface of the water above the diffusers shall then be visually inspected to insure that airflow is uniformly distributed across the tank, as well as uniformly distributed across the surface of each diffuser. The air manifold, moisture blowoff, and drop piping above the water surface shall be checked for leaks with soapsuds. The piping shall be inspected for leaks. All leaks shall be fixed and subject to approval by the ENGINEER.

D. The CONTRACTOR shall notify the ENGINEER at least one week prior to the schedule testing date and shall confirm the testing schedule at least two days prior to the testing date, to allow the OWNER or his representatives to witness the field testing. The aeration equipment manufacturer shall provide a field service ENGINEER to monitor the installation, leveling, and testing of the aeration equipment.

END OF SECTION