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| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | September 22,2009 | Insertion of the pre-approved suppliers/manufacturers names and review/update of document cross-references |
| 3 | October 2, 2009 | Review of the pre-approved suppliers/manufacturers names |
| 4 | May 9, 2013 | Final Draft – Consolidated Comments Spec Update Project |
| 5 | May 27, 2013 | Final Draft – incorporation of additional comments from Jun Liu |
| 6 | June 17, 2013 | Finalized for Legal Review. Incorporation of new Commissioning and Computerized Maintenance Management System Data Requirements Specification cross references. |
| 7 | May 21, 2014 | Revised to incorporate Legal Services’ comments |
| 8 | July 15, 2014 | Amended to reflect changes related to commissioning specification and name change (AV) |
| 9 | September 24, 2014 | Updated, Finalized Specification – Reference eDOCS #1029449-v5 (AV) |
| 10 | February 18, 2015 | Updated standards (AV) |
| **11** | **March 2, 2015** | **Updated, Finalized Specification – Legal Reference eDOCS #5043367 v12 (AV)** |
| 12 | February 15, 2017 | Updated standards references. Updated the Acceptable Manufacturers list to include Xylem Inc. (CPD PMO, OMM) |

NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

**Notice:** This Document hardcopy must be used for reference purpose only.

**The on-line copy is the current version of the document.**

# General

## Scope of Work

### The work of this Section includes designing and providing the fine bubble air diffuser system, gas cleaning system (if applicable), air purging system with all accessories and appurtenances for bioreactor/aeration structure(s). The fine bubble diffuser system shall be made of an EPDM, tube, disc or panel diffuser type. Ceramic diffusers shall not be used. The nominal type of bubble diffuser system employed by the Region is the disc type.

### Unit Responsibility: The work requires that the fine bubble air diffuser system, gas cleaning system (if applicable), and air purging system with all accessories and appurtenances, be the end Product of one system manufacturer or system supplier. Unless otherwise indicated, the Contractor shall obtain each system from the supplier(s) of the equipment which shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment into operation in conformance with the specified performance requirements, features and functions without altering or modifying the Contractor's responsibilities under the Contract Documents. The Contractor shall provide on-line monitoring (such as air flow meters and oxygen sensors) that may not normally be provided by the system manufacturer or responsible system supplier. The Contractor is responsible to the Region for providing the equipment systems as specified herein.

## Related Sections

[Under "Related Sections", identify other Sections that are related to, and/or dependent on, the work results or information specified elsewhere. The list should be limited to Sections with specific information that the reader might expect to find in this Section, but is specified elsewhere. For example, if hardware for aluminum entrances is specified in the aluminum entrance Section, a cross-reference would be appropriate in the finish hardware Section. The purpose of this cross-referencing is for information only, to aid in finding those other requirements—not to define the scope of the Section.

Cross-referencing here may also be used to coordinate assemblies or systems whose components may span multiple Sections and which must meet certain performance requirements as an assembly or system.

This Section is to be completed/updated during the design development by the Consultant. If it is not applicable to the section for the specific project it may be deleted.]

[List Sections specifying installation of products supplied but not installed under this Section and indicate specific items.]

Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Execution requirements for ...[item]... specified under this Section.

[List Sections specifying products installed but not supplied under this Section and indicate specific items.]

Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Product requirements for ...[item]... for installation under this Section.

[List Sections specifying related requirements.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: [Optional short phrase indicating relationship].

### Section 01060 – Regulatory Requirements

### Section 01425 – Computerized Maintenance Management System Data Requirements

### Section 01430 – Operation and Maintenance Data

### Section 01810 – Equipment Testing and Facility Commissioning

### Section 01820 – Demonstration and Training

### Section 11010 – Equipment General Requirements

### Section 15200 – Process Piping and Fittings

### [Division 13 – SCADA and Instrumentation insert applicable sections]

## References

### Comply with the latest edition of the following codes and standards, and all amendments thereto:

#### American National Standards Institute (ANSI/ASME):

##### ASME B16.5-2013, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/inch Standard.

#### Ministry of the Environment and Climate Change,

##### Design Guidelines for Sewage Works (2008).

#### American Society of Civil Engineers (ASCE):

##### ASCE 2-06, Measurement of Oxygen Transfer in Clean Water.

#### Canadian Standards Association (CSA):

##### CSA B137 Series -17 – Thermoplastic Pressure Piping Compendium (CSA B137.3, Rigid polyvinylchloride (PVC) pipe and fittings for pressure applications).

#### American Society for Testing and Materials (ASTM):

##### ASTM A182 / A182M – 16a, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

##### ASTM A240 / A240M – 16a Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

##### ASTM A380/A380M-13 Standard practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems

## Definitions

### Adequate Mixing: Variation in mixed liquor suspended solids (total residue) of less than 15 percent between the mean value of samples taken at any two depths along any vertical line extending between the water surface and the elevation of the top of diffusers. The validation of “Adequate Mixing” to meet design performance requirements shall be in accordance with Computational Fluid Dynamics (CFD) or other approved methodology. Mixing can be inferred to be adequate provided that the actual air flow per square metre meets the requirements contained in Table 12-2 of the Design Guideline for Sewage Works (2008, MOE). *[Consultant and Region to decide whether an allowance for CFD shall be part of the Contract at the discretion of the Region]*

### Basin: Structure within which aeration occurs.

### Bay: Portion of grid on each side of drop-leg and manifold assembly.

### Cell: Portion of aeration basin physically separated from other portions of basin. A cell may contain an aeration zone or a portion of an aeration zone.

### Diffuser Assembly: Flexible membrane or non-ceramic diffuser with an element holder and retaining device.

### Distribution Header: Piping between manifold and diffuser assembly.

### Drop-leg: Connection from air source to manifold.

### Dynamic Wet Pressure (DWP): Pressure to operate at specified conditions minus submergence and flow control losses.

### Manifold: Single run of piping that connects drop-leg with distribution header(s).

### Specific Permeability Rating: Number of cubic metres of air per hour at 20 degrees Celsius (plus or minus 5 percent) and 10 to 50 percent relative humidity that will pass through 1 square metre of diffuser element materials, 25 mm thick with a differential pressure equivalent to 500 Pa or as defined by the Consultant.

### Standard Cubic Metres per hour (sm3/h): Air at 20 degrees Celsius, 101.3 kPa absolute, and 36 percent relative humidity.

### Standard Oxygen Transfer Rate (SOTR): Rate of oxygen transfer to tap water at standard conditions of 20 degrees Celsius, 0.0 mg/L residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).

### Standard Oxygen Transfer Efficiency (SOTE): Efficiency of oxygen transfer in % units.

### Actual Oxygen Transfer Rate (AOTR): Actual rate of oxygen transfer to wastewater (kilogram oxygen per hour or kilogram oxygen per day) under normal operating conditions. There is a fixed mathematical relationship between SOTE, SOTR and AOTR [Consultant to provide additional details regarding the fixed mathematical relationship].

### Zone: Area within a bioreactor/aeration structure used to provide a particular type or level of treatment. One or more cells may be included in a zone.

## Performance Requirements

### The Contractor shall provide a Performance Test Plan to the Consultant for review and approval a minimum of five Working Days prior to the date of the scheduled equipment installation. The Contractor shall not proceed with equipment installation until the Consultant has approved the Performance Test Plan. The test plan shall detail the methods to be utilized by the Contractor in order to confirm the fulfillment of the performance requirements cited in the commissioning schedule and in the subsections below.

### Airflow Rate Output: Shall not differ by more than 10 percent, at minimum and maximum airflows, for any two system diffusers (based on diffuser with lower flow rate).

### Air Distribution and Balancing: Control by use of orifices and proper header size selection only.

### All air flow testing in structures to conform to Confined Space Entry requirements including air monitoring testing for safety purposes.

### Do not use flow distribution control devices requiring automatic or manual operation.

### Mixing: Adequate throughout each zone of aeration basins at stated minimum airflow requirements.

### Achieve adequate mixing in aeration basins at mixed liquor suspended solids concentrations between [ ] and [ ] mg/L.

### Air Distribution and Balancing: Sufficient to maintain mixed liquor suspended solids in a state of suspension over the entire depth of the aeration basin at the stated minimum airflow requirements.

### The material being aerated is primary clarifier effluent (if applicable), mixed liquor, return activated sludge or as otherwise specified.

### System Aeration Requirements:

#### Allowable Diffuser Mounting Distance of Diffuser Element Above Basin Floor (mm):

##### Minimum: [     ].

##### Maximum: [     ].

##### Design Average Daily Biological Oxygen Demand “BOD” Loading: [     ].

##### Design Peak Daily Total Kjeldahl Nitrogen (TKN) Loading based on design peak daily flow: [     ].

##### Targeted Dissolved Oxygen “DO” level under average daily BOD organic loading and peak daily TKN loading in aeration tanks: [     ].

##### Targeted DO level in aerated selector: [     ].

#### Diffuser Airflow (sm3/h):

##### Minimum: [     ].

##### Maximum: [     ].

#### Available Pressure at Drop-leg Top (kPa gauge): [Minimum required air pressure at the drop-leg top to be provided by the aeration system manufacturer].

### System Zoned Aeration Requirements (per bioreactor/aeration structure):

#### Refer to the bioreactor drawing included in the Contract appendices for zone layout.

#### Available Airflow (sm3/h) [provided by the aeration system manufacturer]:

|  |  |  |
| --- | --- | --- |
| Zone | Peak | Average |
|  |  |  |
|  |  |  |
|  |  |  |

#### Average AOTR Required:

|  |  |
| --- | --- |
| Zone | O2 kg/Day per Zone |
|  |  |
|  |  |
|  |  |

#### Peak AOTR Required [to be provided by the Consultant and approved by the Region]:

|  |  |
| --- | --- |
| Zone | O2 kg/Day per Zone |
|  |  |
|  |  |
|  |  |

## Design Requirements

### Furnish fixed header, fine bubble, diffused air aeration equipment system as a complete package including, but not necessarily limited to, drop-leg; air manifold; on-line air monitoring, distribution headers; diffusers; supports; drain line, sump, and airlift purge; header joints; accessories; gas cleaning system; and miscellaneous appurtenances. Piping passivation (pickling) requirements are to be confirmed with the Consultant (refer to subsection 1.6.5 below).

### Furnish complete, engineered systems. Drawings indicate air manifold, header, and diffuser orientations only. Details such as air manifold sizes, air header sizes and spacing, air manifold and header supports and spacing, diffuser spacing, etc., shall be defined by and be the responsibility of the Contractor and shall be consistent with requirements in this Section.

### Design aeration equipment so that upon completion of installation, diffusers are level to within plus or minus 10 mm of a common horizontal plane.

### A condensation/moisture purge system shall be provided on each aeration pipe grid.

### Design the aeration equipment components so that it is suitable for use with cleaning systems utilizing appropriate chemicals designed for cleaning the fine bubbler diffusers and (as recommended by the manufacturer) or as otherwise dependent on the diffuser type and as directed by the Consultant.

## Submittals

### Shop Drawings:

#### Shop drawings shall be certified by a professional engineer licensed to practice in the Province of Ontario.

#### Detailed calculations certified by a professional engineer licensed to practice in the Province of Ontario showing air requirements for both mixing and biological processes.

#### Detailed calculations certified by a professional engineer licensed to practice in the Province of Ontario showing the air pressure requirement at the top of each drop leg.

#### Make, model, and weight of each equipment assembly. All information shall be provided in an electronic format suitable for upload to the Region’s CMMS (Maximo). All maintenance/equipment information shall conform to Section 01430 - Operation and Maintenance Data. Refer to Section 01425 - Computerized Maintenance Management System Data Requirements.

#### Manufacturer’s catalogue information, descriptive literature, specifications, and identification of materials of construction.

#### Manufacturer’s diffuser performance curves.

#### Detailed mechanical drawings showing equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.

#### A detailed drawing of proposed aeration equipment layout for each basin showing air-line sizes and lengths, distances between air distribution headers, and location of diffusers, supports, and expansion joints.

#### Diffuser, diffuser connector, balancing orifices, and system head loss curves covering the range of airflow rates specified in the Contract Documents.

#### Calculations showing distribution and balancing of air within each basin for the minimum and maximum airflow rates specified in the Contract Documents.

#### Calculations certified by a professional engineer licensed to practice in Ontario to demonstrate that support design complies with requirements of this section.

#### Information and details regarding the actual oxygen transfer rate (AOTR) at Site conditions, mixing conditions and air pressure requirements.

#### Shop and Field Painting Systems Proposed: Include the manufacturer’s descriptive technical catalogue literature and specifications.

#### Layout and details of gas cleaning system (if applicable).

### Information Submittals:

#### Factory test results, reports, and certifications. Include oxygen transfer performance test report.

#### Site Acceptance Test Report.

#### Manufacturer’s Certificate of Conformance: Manufactured/commercial products.

#### Special shipping, storage, protection and handling instructions.

#### Manufacturer’s Certificate of Proper Installation.

#### Operation and Maintenance Manual: Include the manufacturer’s written/printed installation instructions with erection drawings indicating, by piece marking, how the entire assembly (for each aeration structure) is to be shipped and field assembled. Installation and instructional records during construction, including commissioning, shall be provided in an electronic format suitable for uploading into the Region’s CMMS (Maximo). Refer to Section 01425 - Computerized Maintenance Management System Data Requirements*.*

#### Manufacturer’s special guarantee/warranty as defined by the Contract Documents.

#### Service records for maintenance performed during construction and up to the commissioning shall be provided in an electronic format suitable for uploading into the Region’s CMMS (Maximo).

## Extra Materials

### Furnish, tag, and box for shipment and storage the following spare parts and special tools or as modified by Consultant:

|  |  |
| --- | --- |
| Item | Quantity |
| Sealing gaskets | **[ ]** |
| Diffuser elements | **[ ]** |
| Diffuser element retainers | **[ ]** |
| Element tighteners | **[ ]** |
| Completely assembled diffusers | **[ ]** |
| Air distribution pipe support assemblies | **[ ]** |
| Air distribution pipe expansion joints | **[ ]** |
| Tool sets, if required, for removal and replacement of diffuser assemblies. | **[ ]** |

## Measurement and Payment

*[Choose one of the following payment language provisions that best suits the individual project.*

*If this Section is not specifically referenced by an item in the Bid Form, please use the following language:*

.1 The work of this Section will not be measured separately for payment. All costs associated with the work of this Section shall be included in the Contract Price.

*OR If this Section is specifically referenced in the Bid Form, use the following language and identify the relevant item in the Bid Form:*

.1 All costs associated with the work of this Section shall be included in the price(s) for Item No(s). \_\_\_ in the Bid Form.

*If the work of this Section is to be measured and paid for by several different methods, please amend the standard wording given above to reflect the different methods of measurement and payment.*]

# PRODUCTS

## Acceptable Manufacturers

### Materials, equipment, and accessories specified in this Section shall be the products of:

#### Produits Sanitaires Unique Inc.

#### US Filter Canada Inc.

#### Environmental Dynamics International (EDI).

#### Stamford Scientific International Inc. (SSI).

#### Aquarius Technologies Inc.

#### Xylem Inc.

#### Approved Equivalent.

## Service Conditions

### System

#### Number of Aeration Structures: **[ ].**

#### Type of bioreactor: **[ ].**

#### Bioreactor dimensions: [     ] m long, [     ] m wide or as otherwise defined by actual shape of the structure.

#### Temperature at Mixed Liquor:

##### Minimum: [     ] degrees Celsius.

##### Maximum: [     ] degrees Celsius.

#### pH of Mixed Liquor: [     ].

#### Mixed Liquor Suspended Solids Concentration:

##### Average: [     ] mg/L range.

#### Basin Side-water Depth (metres): [     ].

## General

### Shop fabricated welded metal parts and assemblies from Type 304L stainless steel with a 2D finish shall be in accordance with ASTM A240/A240M-16a.

### Shop fabricated non-welded parts and pieces from sheets and plates of Type 304 stainless steel shall be in accordance with ASTM A240/A240M-16a, unless specified otherwise in the Contract Documents.

### After fabrication, pickle and passivate stainless steel assemblies and parts by immersion in a pickling solution as described in ASTM A380-13. Use nitric-hydrofluoric acid solution as defined in ASTM A380-13. Provide final thorough rinsing using ordinary industrial or potable water and dry in accordance with ASTM A380-13.

### Unless otherwise indicated in the Contract Documents, each air manifold line shall extend to the full width of each zone.

### Header and Header Support System: Allow for expansion and contraction over a temperature range of zero to 70 degrees Celsius when installed.

## Drop-leg, Air Manifold, and Distribution Headers

### Drop-leg (in accordance with Section 15200 – Process Piping and Fittings):

#### Stainless steel drop-leg shall be, at a minimum, 1.0 m above the floor of aeration basin. At that point, drop-leg shall change to PVC. Provide plugged injection tap on the PVC portion of the drop-leg for the diffuser gas cleaning system connection.

### PVC Air Manifold:

#### Perpendicular to air distribution headers, same nominal pipe size as drop-leg, and located above distribution headers.

#### Connect the air manifold to distribution headers at the common pipe centreline. The manifold shall act as a drain line.

#### Fabricate with minimum 100 mm diameter fixed joint connections to each air distribution header. Fabricate manifolds in sections up to 6 metres in length.

#### Construct from Schedule 80 PVC. Use Schedule 40 PVC if the stub to the distribution header is reinforced with a solvent welded saddle tee, and Schedule 80 PVC if the stub is not reinforced. Manifolds shall be provided for long term exposure to a near wall temperature of 54 degrees Celsius.

### Distribution Headers:

#### Minimum 100mm, maximum Schedule 80 PVC (or as defined by the Consultant) conforming to CSA B137.3-17 with 2 parts by weight of titanium dioxide per 100 parts of resin.

#### Fabricate in sections up to a maximum of 8 metres in length, with fixed joints or expansion joints as required.

#### Fabricate with diffuser element holders factory solvent welded to crown of header. Attach diffuser elements to distribution headers to resist 200 N-m applied torque about the polar axis of holder and 136 N-m about the longitudinal axis. Equivalent alternate designs will be considered by the Consultant.

### Include expansion/contraction system consisting of fixed or flanged joints and guide supports. Guide supports shall allow for longitudinal movement.

### Each aeration structure consists of [ ] zones. The first zone of each basin shall contain a minimum of [ ] equally spaced diffuser assemblies with both bays on each zone containing half of required diffusers. Each of the second, third and fourth zones shall contain a minimum of [ ] diffusers. Each of various (as applicable) zones shall contain a minimum of [ ] diffusers for a tapered bioreactor aeration system. Spacing between diffuser assemblies on adjacent air distribution headers shall not exceed 1.2 m (or as designed by Consultant) from centreline to centreline of the air distribution header in order to provide for uniform mixing of the contents and to maximize oxygen transfer efficiency.

### PVC Diffuser Element Holders:

#### Air plenum chamber below the diffuser element.

#### Mechanism to attach the diffuser element to the element holder.

#### Provide complete peripheral edge support for the diffuser element.

### Retaining Device:

#### Securely hold and seal the diffuser element to the element holder.

#### Diffuser assembly and retaining device shall prevent air escape at the diffuser element-sealing gasket interface.

#### Gasket shall be on top of the diffuser.

#### Vertical edges of diffuser elements shall not be exposed to liquid.

#### The sealing method shall allow the applied sealing force between sealing gasket and diffuser element to be varied, with a minimum force of 9 daN per cm of circumference of the sealing gasket in order to provide a long-term positive seal and to prevent air escape except through the active area of the diffuser element.

#### Retainer ring with a minimum of 2 1/2 complete threads with a minimum cross-section of 3 mm for engagement. Each diffuser element holder shall have an airflow control orifice.

## Diffuser Assemblies

### Air Diffuser Elements:

#### Ceramic diffuser elements are not to be used unless approved by the Consultant and signed-off by the Region. Refer to the Process Narratives/Process Control Narratives which are included in the SCADA appendices as part of the Contract Documents for design details of the membrane diffusers and tube membrane diffusers to be considered. The Consultant will review and approve of the diffuser elements.

#### All maintenance requirements shall be provided in an electronic format suitable for uploading into the Region’s CMMS (Maximo). Refer to Section 01425 - Computerized Maintenance Management System Data Requirements.

## Supports

### Fabricate from 6.4 mm minimum Type 304 stainless steel plate or rod in accordance with ASTM A240/A240M-16a. Use Type 304L stainless steel for welded parts in accordance with ASTM A240/A240M-16a.

### Provide +/- 12 mm lateral and +/- 50 mm vertical adjustment of the header. Adjustment shall be continuous and possible without removing air piping from support. Each air piping section shall have a minimum of two supports and additional supports as necessary to maintain level. The support height shall be sufficient to provide the diffuser elevation shown on the Contract Drawings. Each support shall provide a bearing surface contoured to fit 360 degrees of air piping. The bearing surface shall be a minimum of 50 mm wide for manifolds and 38 mm wide for distribution headers.

### Air Manifold Piping Supports:

#### Maximum spacing between the supports of 2.4 m.

#### The supports must be capable of resisting thrust generated by the expansion or contraction of the air distribution headers.

#### Include manifold hold-down, guide straps, anchor bolts and supporting structure. Guide straps shall resist a minimum of 250 kg uplift force per support without exceeding 165 MPa design stress.

### Air Distribution Header (Guide) Supports:

#### Maximum spacing between supports of 2.3 metres.

#### Allow longitudinal movement of the header section in order to prevent stress buildup in header due to thermal expansion/contraction forces.

#### Shall consist of a self-limiting hold-down and sliding mechanism. The sliding mechanism shall provide minimum resistance to the movement of air distribution header under full buoyant uplift load. The mechanism shall provide 3 mm clearances around the header and shall be self-limiting if the mechanism is over-tightened. Maximum horizontal thrust of 9 daN or less shall initiate movement of the header relative to the mechanism under full buoyant uplift load.

### Support: Fixed, consisting of a hold-down mechanism and self-limiting clamp device. Clamping shall positively grip the air distribution header when tight and shall be self-limiting in order to prevent overstressing the header if the clamp is over-tightened.

## Drain Line, Sump, and Airlift Purge

### PVC System: To drain the entire submerged aeration piping system. Each grid shall have an integral 100 mm diameter drain line terminating at a sump.

### Sump:

#### Bottom elevation shall be lower than the invert of air distribution headers and drain line.

#### Connect to a 25 mm diameter airlift eductor line extending from the drain line invert elevation to a point approximately 0.8 m above the walkway level. Terminate with a PVC ball valve.

## Header Joints

### Special Flanged Joints or Slip Joints Between Sections of Air Distribution Header:

#### Individual header sections shall rotate independently of adjacent header sections for alignment.

#### Flanged Joints for Stainless Steel Piping: Face ring follower flange type with through bolts, shall capable of transmitting longitudinal forces caused by the expansion and contraction in the air distribution header.

#### Slip joints shall allow for the expansion and contraction of the air distribution header.

### Fixed Joints for PVC Piping: Spigot section solvent welded to one end of the distribution header, threaded socket section welded to the mating distribution header, and O ring gasket and threaded screw on the retainer ring.

## Appurtenances

### Couplings: Van Stone type flanges ASTM A182/A182M-16a stainless steel drilled 150 pound in accordance with ANSI/ASME B16.5-2013.

### Face Rings: Type 304L stainless steel in accordance with ASTM A240/A240M-16a, inside diameter (ID) drilled 1.6 mm larger than pipe outside diameter (OD).

### Gaskets: Neoprene, 45 to 55 durometer; locate at expansion joints and couplings to form an airtight connection at 140 kPa minimum.

### Miscellaneous: Nuts, bolts, washers, and other non-welded parts: Type 304 stainless steel in accordance with ASTM A240/A240M-16a. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

### Lifting Lugs: Suitably attached for equipment assemblies and components weighing over 45 kg.

### Anchor Bolts: Type 316 stainless steel, sized by the equipment manufacturer.

### All appurtenance details shall be submitted in an electronic format suitable for uploading to the Region’s CMMS (Maximo). Refer to Section 01425 - Computerized Maintenance Management System Data Requirements.

## Gas Cleaning System – If Applicable

### The diffuser in-place cleaning system (if any) shall depend on the type of diffuser employed.

### Design the cleaning system equipment for use with the Consultant to define the cleaning system and functions dependent on the type of diffuser employed in the design. All aspects of health and safety shall be taken into account for any cleaning system design.

### Design equipment to clean or reduce diffuser dynamic wet pressure without completely dewatering the aeration tank and without process interruption.

## Source Quality Control

### Materials Testing:

#### Test diffuser for DWP by submerging a diffuser at least [     ] mm in tap water and operating at an air rate of [     ] sm3/h per square metre plus or minus [     ] percent.

#### Test for strength by applying a vertical load of [     ] kN to centre [     ] mm diameter of diffuser element when the edges of the element are supported by a fixture identical to the diffuser element holder. The test shall be conducted on diffusers mounted in a holder that is identical to the installed system. Diffuser test reports shall be submitted to the Consultant for approval and sign-off by the Region.

### Factory Tests:

#### Perform one test on each typical aeration system furnished. Factory Test Reports shall be submitted to the Consultant for approval and sign-off by the Region.

#### Oxygen Transfer Performance Testing Procedure: As described in most recent ASCE 2-06 Standard for Measurement of Oxygen Transfer in Clean Water. Use a theta value of 1.024. The Consultant must approve of the specific details of the test procedure and any deviation from requirements stated below:

##### Non-steady state re-aeration test shall consist of three re-aeration test runs. SOTR shall be average of SOTRs obtained for each re-aeration test run. Sodium sulfite catalyzed with cobalt chloride shall be used to strip residual dissolved oxygen between re-aeration test runs.

##### Test Facilities: Provided by the manufacturer and subject to the approval of the Consultant. The test facility shall be capable of providing side-water depths and diffuser submergences specified under subsection 1.5 - Performance Requirements, above. The test aeration tank shall be a minimum of 20 square metres. Diffusers shall be located between 230 and 300 mm above bottom of tank.

##### Diffuser density for each test shall be equal to or less than the diffuser density proposed by the manufacturer for the aeration system being tested. Diffuser density is defined as the number of diffusers per square metre of tank area.

##### For each system being tested, the test airflow rate per diffuser (sm3/h per diffuser) shall not be greater than the airflow rate per diffuser proposed for the manufacturer’s system.

#### Obtain the approval of test reports from Consultant prior to the shipment of any equipment.

# EXECUTION

## Installation

### In accordance with the manufacturer’s written instructions.

### Accurately place anchor bolts using templates furnished by the manufacturer.

## Corrosion Protection

### Atmospheric exposed plastic surfaces shall be field prepared and painted for UV protection. Paint to be suitable for use on PVC without degrading the pipe integrity.

## Field Quality Control

### Leak test on gas cleaning system (if applicable):

#### After completing the installation of the HCl gas distribution system (if applicable), the Contractor shall perform a pressure and leak test on all components from the gas cylinders to the valves at the drop-legs. Test procedures shall be submitted to the Consultant for approval a minimum of three weeks prior to testing.

#### The components shall be tested with an inert gas (air or nitrogen) to locate leaks. All leaks shall be repaired and re-tested.

#### The Contractor shall provide the Consultant and the Region with certification that the system is leak free after testing has been performed.

### Functional Tests:

#### Conduct on each aeration system. Functional test reports shall be submitted to the Consultant for approval and sign-off by the Region.

### Performance Test:

#### Conduct on each aeration system. Performance Test Reports to be submitted to the Consultant for approval and sign-off by the Region.

#### Commissioning shall be performed in accordance with Section 01810 – Equipment Testing and Facility Commissioning.

#### Perform under actual or approved simulated operating conditions. Airflow shall be as measured by plant instrumentation. Calibrate airflow instrumentation as part of the testing procedure. Use the butterfly valve at each drop-leg to balance the air distribution at average flow. Measure the air flow at a 50mm port at the top of each drop-leg to verify the flow.

#### Test for a continuous three hour period without malfunction.

#### Adjust, realign, or modify units and retest if necessary.

#### Test as follows:

##### Pressure Test: Measure air pressure immediately upstream of elbow located at top of each drop-leg, and at the maximum airflows and submergences stated under subsection 1.5 - Performance Requirements, above.

##### Mixing Test:

###### Perform at average airflows stated in subsection 1.5 - Performance Requirements.

###### Select three vertical lines and two depths in each basin.

###### Take three samples at each of two depths along each vertical line using a Van Dorn sampler or equivalent type sampler.

###### An independent testing laboratory approved by Consultant will perform a residue test on each sample. The mean value of the total residue for the three samples at each depth will be used to determine conformance with the Contract requirements.

###### All testing and sampling shall conform to the procedures established in latest edition of Standard Methods for Examination of Water and Wastewater (22nd edition, AWWA).

###### Reports from testing and sampling shall be submitted to the Consultant for approval. The Consultant will provide the Contractor with applicable report templates for simplicity.

## Manufacturer’s Services

### Manufacturer’s Representative: The Contractor shall ensure that the manufacturer’s representative will be present at Site or the classroom designated by the Region for the minimum number of Person-days listed below, travel time excluded:

#### 1 Person-day, 2 separate Site visits for installation assistance and inspection.

#### 0.5 Person-day, 1 designated classroom or Site visit for pre-startup classroom or Site training.

#### 1 Person-day, 1 Site visit for facility startup.

### Training:

#### Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Consultant and approved by the Region.

#### Perform Demonstration Training in accordance with Section 01820 – Demonstration and Training.

### Refer to Section 01640 - Manufacturers’ Services, Section 01810 - Equipment Testing and Facility Commissioning, and Section 01820 - Demonstration and Training.

**END OF SECTION**