|  |  |  |
| --- | --- | --- |
| 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 | April 29, 2013 | Final Draft – Consolidated Comments Spec Update Project |
| 5 | June 17, 2013 | Finalized for Legal Review. Incorporation of new Commissioning and Computerized Maintenance Management System Data Requirements Specification cross references. |
| 6 | May 27, 2014 | Revised to incorporate Legal Services’ comments |
| 7 | July 15, 2014 | Amended to reflect changes related to commissioning specification and name change (AV) |
| 8 | September 24, 2014 | Updated, Finalized Specification – Reference eDOCS #1029448 v5 (AV) |
| 9 | February 18, 2015 | Updated standards (AV) |
| **10** | **March 2, 2015** | **Updated, Finalized Specification – Legal Reference eDOCS #5043353 v12 (AV)** |

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 covers the supply, delivery to the site, unloading unto storage, supervision of installation and testing coarse bubble air diffuser system for channel (or other structure as defined) aeration.

### Unit Responsibility: The Work requires that the Coarse Bubble Air Diffuser System, complete with all accessories be the end product of one system manufacturer or responsible system supplier. Unless otherwise indicated, the Contractor shall obtain each system from the supplier of the equipment, which 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 without altering or modifying the Contractor's responsibilities under the Contract Documents. The Contractor is responsible to the Region for providing the equipment systems as specified in this Specification Section.

## 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].

### [List Sections specifying related requirements.]

### Section 11010 – Equipment General 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 01600 – Material and Equipment

### Section 01640 – Manufacturers’ Services

### Section 01810 – Equipment Testing and Facility Commissioning

### Section 05500 – Metal Fabrications General

### Section 09900 – Painting and Protective Coatings

### Section 11010 – Equipment General Requirements

### Section 15200-08 – Stainless Steel Pipe and Fittings – General Service

### [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 Society of Mechanical Engineers

##### ANSI/ASME B16.5-2003, Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard.

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

##### ASTM A182/A182M-14b, Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service.

##### ASTM A240/A240M-15, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

##### ASTM A778-01(2009)e1, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

##### ASTM A774/A774M-14, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

##### ASTM A554-15, Standard Specification for Welded Stainless Steel Mechanical Tubing.

##### ASTM A743/A743M-13ae1, Standard Specification for Castings, Iron Chromium, Iron-Chromium-Nickel, Corrosion Resistant for General Application

#### Canadian Standards Association (CSA)

##### CSA 178.2-14, Certification of Welding Inspectors

## Definitions

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

### Drop-leg: Connection from the air source to the distribution header.

### Standard cubic metres per minute (Standard Cubic Feet per Minute (scfm)): Air at 20 degrees Celsius, 101 kPa, and 36 percent relative humidity.

## Submittals

### Action Submittals:

#### Shop Drawings:

##### Make, model, and weight of each equipment assembly.

##### Make, model, and weight of each air flow meter.

##### Manufacturer’s catalogue information, descriptive literature, specifications, and identification of materials of construction. All equipment information shall be submitted in an electronic format suitable for uploading into the Region’s CMMS (Maximo)

##### Manufacturers Diffuser Performance Curve.

##### 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 (including rings, gaskets, seals etc., if applicable).

##### A detailed drawing of the proposed aeration equipment layout for each channel or receiving structure, showing air-line sizes and lengths, 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 of oxygen transfer rate including, but not limited to, actual oxygen transfer efficiency with Site conditions.

##### Calculations of pressure drop in aeration system.

##### Calculations of required air for mixing.

##### Calculations showing distribution and balancing of air within each basin for the minimum and maximum airflow rates specified in the Contract Documents. The testing plan for the confirmation of balanced air distribution shall be submitted to the Consultant a minimum of three weeks prior to actual testing for approval prior to the commencement of test procedure activities.

### Informational Submittals:

#### Test plans, test results, test reports, and certifications.

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

##### Routine maintenance requirements prior to plant startup. All information shall be submitted in an electronic format suitable for uploading into the Region’s CMMS (Maximo).

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

#### Operation and Maintenance Data:

##### As specified in Section 01430 - Operation and Maintenance Data.

##### Include manufacturer’s written pre-printed installation instructions with erection drawings indicating, by piece marking, how entire assembly (for each basin service) is to be shipped and field assembled.

#### Service records for maintenance performed during construction. All information regarding maintenance work completed by the Contractor prior to hand-over to the Region shall be submitted in an electronic format suitable for uploading into the Region’s CMMS (Maximo)

#### Refer to Section 01425 - Computerized Maintenance Management System Data Requirements.

## Extra Materials

#### Furnish, tag, and box for shipment and storage following spare parts and special tools. All information shall be submitted in electronic format suitable for uploading into the Region’s CMMS (Maximo):

|  |  |
| --- | --- |
| Item | Quantity |
|  |  |
|  |  |

#### Delivery: In accordance with Section 01600 - Materials and Equipment.

## 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

## Approved Suppliers

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

#### Aquarius Technologies Inc.

#### Environmental Dynamics International (EDI).

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

#### Xylem Inc.

#### Approved Equivalent.

## Service Conditions

### System

#### Temperature at Mixed Liquor/sludge:

##### Minimum: [     ]°C

##### Maximum: [     ]°C

#### pH of Mixed Liquor/Sludge: [     ] to [     ].

#### Mixed Liquor/Sludge Total Suspended Solids Concentration:

##### Average: [     ] mg/L

##### Maximum: [     ] mg/L

#### Channel Side-water Depth (ft): [     ] - [     ] m.

## Design Requirements

### Furnish a fixed header, non-clog, coarse bubble, diffused air aeration equipment system as a complete package including, but not limited to, drop-leg, distribution headers, diffuser connectors, diffusers, supports, header joints, accessories, and any other miscellaneous appurtenances necessary to place the system into operation.

### Furnish complete, engineered systems in accordance with the Contract Documents. Drawings indicate header and diffuser orientations only. Details such as air header sizes and spacing, header supports and spacing, online air flow monitoring, diffuser spacing, etc., shall be defined by and be the responsibility of the manufacturer and shall be consistent with requirements in this Specification Section.

### Design aeration equipment so that upon completion of installation, all diffusers are level to within plus or minus 10 mm (3/8 inch) of a common horizontal plane.

### Design to incorporate on/off aeration impacts of the process as defined in Division 13 SCADA and Instrumentation and the Process Narratives/Process Control Narratives which are included as part of the Contract Documents in the SCADA appendices.

## Performance Requirements

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

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

### Mixing: Uniform mixing throughout channels.

### Standard oxygen transfer efficiency shall be between 9% and 13%.

### Standard aeration efficiency shall be between 1.3 and 1.9 kilograms Oxygen/kWh.

### Achieve adequate mixing in mixed liquor channels 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 mixed liquor channel. Proper air distribution shall be witnessed and approved by the Consultant.

### Material being aerated is mixed liquor.

### Diffusers shall be suitable for intermittent aeration without clogging.

### System Aeration Requirements:

#### Air flow rate: standard m3/m of channel length minimum (scfm per foot of channel length).

#### Dissolved oxygen concentration [ ] mg/L. The Consultant will define the performance range.

#### Mixing efficiency [ ], Consultant to define performance range.

## Equipment Description

### Air Piping:

#### Minimum Schedule 5S 316L stainless steel pipe for rolled grooved small pipe and Schedule 10S 316L stainless steel pipe for Tungsten Inert Gas (TIG) welding, unless specified otherwise in the Contract Documents.

### Headers:

#### Allow for expansion and contraction over a temperature range of 0 degrees Celsius (32 degrees Fahrenheit) to 52 degrees Celsius (125 degrees Fahrenheit) when installed, including the support system.

#### For the discharge piping of the aeration air blower, an allowance must be made for the expansion and contraction over a temperature range of 0 degrees Celsius (32 degrees Fahrenheit) to 52 degrees Celsius (125 degrees Fahrenheit) when installed, including support system.

#### Drop-leg:

##### Locate the elbow from the air supply main connection near the top of the channel. The top connection and drop-leg connection to the distribution header shall be loose follower flanges.

##### There shall be support from its upper connection, with additional support at lower elbow. The connection between the drop-leg and air diffuser shall be a slip joint for ease of installation.

##### Fixed header system.

#### Distribution:

##### Fabricate in sections up to [     ] m, ([     ] feet) in length. Bottom elevation of distribution headers shall be same throughout the channel. Use eccentric reducers to make changes in diameter in order to maintain diffusers at same elevation. The ends of each header shall have removable end caps.

##### Locate couplings between sections to permit individual header sections to be rotated independently of adjacent header sections. Each distribution header section shall have a positive locking device in order to prevent rotation. Do not use frictional clamps around the header.

##### Piping: Dimensional tolerances conforming to ASTM A778-01(2009)e1 and ASTM A774/A774M-14.

### Diffuser Connectors:

#### Factory welded to the bottom of distribution headers with a maximum diffuser spacing of 1.2 m. Diffuser connectors shall be on a common horizontal plane.

#### Provide welding inspection reports by inspectors certified under CSA W178.2-08 (R2013) to the Consultant.

#### Length: When the diffuser is connected, the innermost edge of diffuser, excluding 19mm (3/4 inch) National Pipe Thread (NPT) pipe connection, shall be flush with vertical projection of air header.

#### Single, continuous component; do not use multiple pieces connected by threads or other such means.

#### Connection Between Distribution Header and Diffuser Connector: Shall be capable of withstanding a minimum horizontal or vertical moment of 1,000 inch pounds without permanent deformation.

#### Pipe Connections for Attaching Diffusers:

##### Two 19 mm (3/4 inch) NPT

##### On one side of air distribution header.

##### Cap or plug for future use pipe connections not provided with diffusers.

#### Stiffening Gussets: Locate gussets on each side of connectors larger than 152 mm (6 inches) in order to connect the horizontal portion of the connectors to the sidewall of the header. The minimum cross sectional area of each gusset shall be 0.125 square inches.

### Diffusers:

#### Coarse bubble, non-clogging type, having no moving parts and providing full wide band aeration. Air shall be released uniformly along a 300mm (12 inch) diffuser. Air exit ports shall be at, or below, the diffuser connector invert.

#### End Cap:

##### 19 mm (3/4 inch) NPT pipe connection, as a minimum equivalent to Schedule 80 pipe, for connection to the diffuser connector.

##### Cast conforming to ASTM A743/A743M-13ae1, Grade CF3. Fabricated end caps shall not be accepted.

##### The end cap per pipe connection shall be capable of withstanding a minimum movement of 500 inch pounds without permanent deformation.

#### Deflector:

##### Locate below each diffuser for its full length and width.

##### Design to direct the liquid being aerated along the diffuser reservoir walls so that air exits through the port and is sheared into small bubbles and distributed into the liquid.

##### The deflector shall be integrated with the diffuser and supported by the diffuser end caps. Open bottom diffusers that allow liquid and debris to enter the bottom of the diffuser will not be permitted.

#### Provide the proper head loss to ensure uniform air distribution throughout the airflow ranges specified in the Contract Documents. Use air balancing orifices if necessary.

### Supports:

#### Fabricated of a minimum of 6 mm (0.250 inch) stainless steel plate, ASTM A240/A240M-15, Type 304.

#### Adjustment:

##### +/- 13mm (0.5 inches) lateral and +/- 50mm (2 inches) vertical adjustment of the header.

##### Adjustments possible without removing the header from the support.

#### Minimum of two supports for each header section. The height shall be sufficient to provide the diffuser elevation shown on the Contract Drawings.

#### Type 1 Header: End support on each header designed to anchor header against longitudinal movement; do not use frictional clamps around the headers.

#### Type 2 Header: Supports shall not be located at the end of the header in order to allow longitudinal movement of the supported header section.

#### Bearing Surface: Contoured to fit bottom 120 degrees of the header and shall be a minimum of 50mm (2 inches) wide.

### Header Joints:

#### Special Flanged or Slip Joints: Locate between sections of air distribution header.

#### Individual Header Sections: Capable of rotating independently of adjacent header sections for alignment purposes.

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

#### Slip Joints: Allow for the expansion and contraction of the air distribution header.

## Accessories

### Couplings: Van Stone type flanges, ASTM A182/A182M-14b stainless steel drilled 150 pound ANSI B16.5 standard.

### Face Rings: Stainless steel, ASTM A240/A240M-15, Type 304L, inside diameter (ID) drilled 1/16 inch larger than pipe outside diameter (OD).

### Gaskets: Neoprene, 45 to 55 durometer; locate at expansion joints and couplings to form an airtight connection at 20 psig minimum.

### Miscellaneous: Nuts, bolts, washers, and other non-welded parts shall be stainless steel, ASTM A240/A240M-15, Type 304. Threaded assemblies shall be chemically treated or lubricated prior to assembly in order to prevent galling.

### Lifting Lugs: Suitably attached for equipment assemblies and components weighing over 45kg (100 pounds).

### Equipment Anchor Bolts: Type 316 stainless steel sized by equipment manufacturer at least 12mm (½ inch) in diameter, or as shown, and as specified in Section 05500 - Metal Fabrications General. Coat the anchor bolts in accordance with Section 09900 – Painting and Protective Coating. Provide waterproofing capsules for anchor bolts.

## Shop Fabrication

### Shop fabricate welded metal parts and assemblies from stainless steel, ASTM A240/A240M-15, Type 316L with a 2D finish.

### Shop fabricate non-welded parts and pieces from sheets and plates of stainless steel, ASTM A240/A240M-15, Type 316L, unless specified otherwise in the Contract Documents.

### After fabrication, pickle and passivate the stainless steel assemblies and parts by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid at 60 degrees Celsius (140 degrees Fahrenheit) for 15 minutes. Neutralize by immersing in a trisodium phosphate solution. [The Consultant will determine whether passivation is required with the stainless steel grade specified in the Contract Documents.]

# EXECUTION

## Installation

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

### Anchor Bolts: Accurately place anchor bolts using the templates furnished by manufacturer and in accordance with Section 05500 - Metal Fabrications General.

## Field Quality Control

### Functional Tests: Conduct on each unit. Provide testing reports to the Consultant for approval and to the Region for sign-off.

### Performance Test:

#### Conduct performance testing on each unit. Provide testing reports to the Consultant for approval and to the Region for sign-off.

#### Perform the testing under actual or approved simulated operating conditions. Airflow shall be as measured by plant instrumentation.

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

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

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

## Manufacturer’s Services

### Manufacturer’s Representative: The Contractor shall ensure that the manufacturer’s representative is present at the Site or classroom designated by 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.

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

### See Section 01640 - Manufacturers’ Services and Section 01810 - Equipment Testing and Facility Commissioning.

**END OF SECTION**