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| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | September 22, 2009 | Review/update of the document “Related Sections” |
| 3 | March 16, 2011 | Minor revisions |
| 4 | April 9, 2013 | Final Draft – Consolidated Comments Spec Update Project |
| 5 | May 14, 2013 | Final Draft v4.1 |
| 6 | June 17, 2013 | Finalized for Legal Review. Incorporation of new Commissioning and Computerized Maintenance Management System Data Requirements Specification cross references. |
| 7 | June 3, 2014 | Incorporation of Legal Comments (AV) |
| 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 #1029441-v8 (AV) |
| 10 | February 11, 2015 | Updated standards and made corrections (AV) |
| 11 | March 2, 2015 | Updated, Finalized Specification – Legal Reference eDOCS #5043358 v13 (AV) |
| 12 | March 1, 2017 | Updated for references to NSF 372. (AV) |
| 13 | January 20, 2020 | Replaced Record Drawings with As-Built Drawings  Removed (BM) |
| 14 | January 11, 2022 | Updated for pump testing project (Q-18-300) (BM) |
| 15 | June 13, 2022 | 1.6 Added equipment tagging requirements (BM) |

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 general clauses for the supply and installation of all process equipment and other works as specified and/or described 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. [*Please ensure that the Process Narrative/Process Control Narratives are attached as appendix documents to the Contract]*

### Provide all labour and materials, obtain all necessary regulatory approvals, inspection reports, certificates, permits and any other documentation required to install and operate all equipment as designed and pay all related fees as may be required.

### Fully coordinate the work of all related Specification Sections. Use equipment specifications together with all Site Work specifications, concrete, building, electrical, controls and process control Specifications as necessary in order to produce a fully functional, performing (as designed) and coordinated Product and/or system that meets all the requirements of the Contract Documents.

### Fully coordinate all equipment and related components to function and perform as a complete working system as described in the Process Narrative, including all electrical sub-metering, process control programming, automation (as required), data management and network communication requirements.

### Provide all Computerized Maintenance Management System (CMMS) data requirements, reports, procedures, manuals, instructions and other information as defined by Section 01425 - Computerized Maintenance Management System Data Requirements in a format suitable for uploading to the Region’s CMMS (Maximo). The data shall be provided in compliance with the commissioning schedule defined, sequenced and timed in accordance with Section 01810 – Equipment Testing and Facility Commissioning.

### Fully coordinate and provide services, documentation and other requirements for commissioning individual elements and entire integrated systems as defined by Section 01810 – Equipment Testing and Facility Commissioning.

## 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.*

### *Typical cross-referenced Specifications provide detailed requirements in areas of (but not limited to):*

#### *Pre-start Health & Safety Checks & Procedures*

#### *Arc Flash Studies*

#### *Coordination Studies*

#### *Tagging Standards*

### *Equipment information requirements as defined*

### *Energy sub-metering, energy related metrics & indicators & data management*

### *Operations & Maintenance (O&M) Manuals*

### *Performance Metrics*

### *Performance Specifications (if cited)*

### *Maintenance Manuals & Maintenance Data Manuals*

### *Computerized Maintenance Management System (CMMS) Data Requirements (Maximo)*

### *Job Plans, Maintenance Plans, PM’s, PdM’s*

### *Spare parts lists, special tools lists*

### *As-Built Drawings*

### *Warranties*

### *Commissioning Plans as defined*

### *Performance Appraisals*

### *FAT’s and SAT’s (equipment and SCADA)*

### *iFIX platform and ODMS Management Plan & Implementation Standards*

### *Building Permits*

### *Division 13 – SCADA’s Metering and Switchboard Instruments – Power Monitoring-Digital Power Meter: Advanced Monitoring Specifications*

### *Division 13 – Process Narratives & Process Control Narratives and others*

### *Additional “Special Specifications” that may be defined]*

### The Contractor shall be responsible for the coordination of the Work. The Contractor shall be familiar with and incorporate all required elements of the cited Specification Sections into the Work.

### *[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 01080 – Process Equipment Location Tagging

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

### Section 01750 – Disinfection and Testing of Water Retaining Structures and Process Piping

### Section 01780 – Contract Closeout

### Section 01810 – Equipment Testing and Facility Commissioning

### Section 01820 – Demonstration and Training

### Section 03300 – Cast-In-Place Concrete

### [Division 13 SCADA and Instrumentation – Insert applicable specifications]

### [Product requirements for [item]... for installation under this Section.]

### *[List Sections specifying related requirements.]*

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

## Submittals

### Shop Drawings:

#### Submit shop drawings for all electric motors together with respective equipment indicating motor dimensions and characteristics, including efficiency, power factor, insulation class, details of winding protection, NEMA rating, torque design, service factor, voltage rating, current protection rating, bearing design and rating and all other required information as detailed in Section 01425 – Computerized Maintenance Management System Data Requirements.

#### Submit shop drawings for all equipment required in this Division, including relevant installation and fabrication details.

### Informational Submittals:

#### Factory Functional Test Report.

#### Factory Acceptance Test (FAT) Report

#### Report confirming compliance with performance requirements cited in the Specifications (if applicable).

#### Manufacturer’s Certification of Compliance that the factory finish system is identical to the requirements specified in the Contract Documents.

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

#### Manufacturer’s printed installation instructions.

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

#### Submittal of documentation required by the AWWA standards cited within the Specifications.

#### Operating and Maintenance Data for all equipment in this Section as detailed in the equipment information template in electronic format.

#### Suggested spare parts list to maintain the equipment in service for a period of five years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. The list shall be in an electronic format that can be uploaded to the Region’s CMMS (Maximo).

#### List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

#### For all energy consuming equipment over 50 kW, provide a list of power sub-metering equipment provided.

#### For all energy consuming equipment under 50 kW, provide a list of power sub-metering for the aggregate number of devices provided.

#### Asset Tag list

## Standards

### The materials and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the ASTM, AWWA, CEC and CSA. Canadian Standards shall take precedence over American Standards in the event of duplication or conflicting requirements.

### The Contractor shall be familiar with the appropriate sections of applicable standards pertaining to the Work and confirm compliance of such to the Consultant.

### All electrical motors and equipment shall be built incorporating the latest Canadian standards for energy efficient motors and/or US Department of Energy: Energy Efficiency and Renewable Energy - Hydraulic Institute. EEMAC (Electrical and Electronic Manufacturers' Association of Canada) standards are outdated but may be considered if there are no current equivalent applicable standards available. *[EEMAC standards are outdated but may be considered if there are no current equivalent applicable standards available. If EEMAC standards are to be applied, the Consultant will review the standards and approve any references to EEMAC standards in order to meet the Region’s energy efficiency objectives.]* All motorized and electrical equipment shall be CSA approved or supplied in accordance with ESA rules and regulations and subject to its approval.

### All Class 1 Division 1 equipment shall have its CSA classification visible to the eye with all supporting documentation contained within the O&M Manual.

### *[Standards Organizations Summary: Determine which codes/standards of the following organizations are relevant and be sure to include applicable codes/standards in the list below:*

#### *AWWA*

#### *ASTM*

#### *CEC*

#### *ASA*

#### *ASME*

#### *HI*

#### *ANSI*

#### *NEMA (EEMAC)*

#### *CSA*

#### *Other standards organizations]*

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

#### NSF International (NSF)

##### NSF 372-2011: Drinking Water System Components – Lead Content

##### NFS 60 Drinking Water Treatment Chemicals – Health Effects

##### NSF 61 Drinking Water System Components – Health Effects

#### Canadian Institute of Steel Construction (CISC)

##### CAN/CSA Standard S16-14, Design of Steel Structures

#### Canadian Standards Association (CSA)

##### CAN/CSA W59-13, Welded Steel Construction (Metal Arc Welding)

* + - 1. Occupational Health and Safety Act, RSO 1990
      2. All applicable codes and standards as specified in the individual specification sections.

## Factory Acceptance Testing

### Where the Contract specifies that Factory Acceptance Tests (FAT) must be witnessed by the Consultant or Consultant’s representative, the Contractor shall give notice to the Consultant and the Region a minimum of 10 Working Days prior to the proposed testing date. Confirmation of the test date and time shall be provided to the Consultant and the Region three Working Days prior to the testing date. Equipment shall not be delivered to the Site until Factory Acceptance Testing has been satisfactorily completed, witnessed, approved, and signed off by the Consultant and the Region. The Contractor shall provide a comprehensive summary of all FATs to the Consultant and the Region for final review prior to equipment acceptance.

### When certified FATs of the equipment or any component is specified, the Contractor shall ensure that the Supplier will provide the Consultant with two copies of required certified test reports showing that the equipment complies with the applicable Specification Section before the equipment is delivered to Site. The Contractor shall provide additional copies and electronic copies of the certified test reports as required for the Maintenance Data Manuals.

## Equipment Tagging

### All equipment to be tagged in accordance with Section 01080 – Process Equipment Location Tagging and the requirements of the individual specification sections.

## Spare Parts

### Furnish all spare parts in accordance with Section 01780 – Contract Closeout. Provide a list of spare parts for all equipment.

## As-Built Information

### Submit As-Built information in accordance with Section 01780 – Contract Closeout.

## Warranties and Bonds

### Guarantee all equipment in accordance with Section 01780 – Contract Closeout and the General Conditions and Supplementary Conditions of the Contract.

## 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:*

### 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:*

### 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

## Sleeves

### Install pipe sleeves at points where pipes pass through masonry, concrete or fire rated assemblies or as indicated otherwise on the Contract Drawings.

### Use schedule 40 steel pipe or an approved equivalent for all sleeves.

### Sleeves shall have puddle flanges when they are installed in foundation walls and/or floor slabs on grade.

### Provide a maximum 6 mm clearance all around between the sleeve and uninsulated pipe or between the sleeve and insulation.

### Terminate sleeves flush with the surface of concrete and masonry walls and concrete floors on grade. Terminate sleeves 25 mm above all other floors.

### Fill voids around pipes as follows:

#### Caulk between the sleeve and pipe in foundations walls and below grade with waterproof, fire retardant, non-hardening mastic or an approved equivalent.

#### Where sleeves pass through walls or floors provide space for fire proofing in a manner that is compliant in both design and material to the Ontario Fire Code and Ontario Building Code.

#### Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rated integrity as shown on the Contract Documents.

#### Ensure that installation does not allow galvanic reactions between dissimilar metals. Ensure that there is no contact between copper piping and ferrous sleeves.

### *[Consultant to indicate where fire stopping is required]*

## Escutcheons

### Install escutcheons on pipes passing through walls, partitions, floors and ceilings or as approved by the Consultant.

### Use chrome, plated brass or stainless steel or non-corroding approved equivalent two-piece type escutcheons mechanically secured to adjacent surface.

### Outside diameter of escutcheons shall cover the opening of the sleeve.

### The inside diameter of the escutcheon shall fit around the finished pipe.

## Noise Level

### When in operation, no single piece of equipment shall exceed the OH&S noise level requirement of 105 dBA for one hour exposure per day.

## High Noise Level Location

### The Contractor shall provide one personal hearing protection station at each high noise level location. Locations are defined as follows:

#### Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OH&SA noise level requirements for a 2 hour exposure. Where such equipment is separated by a distance of more than 6 meters, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.

#### Indoor Location: Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OH&SA noise level requirements for a 2 hour exposure. Any single equipment item or any group of equipment items located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8 hour exposure.

## Personal Hearing Protection

### The Contractor shall furnish 3 pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

## Drive Trains and Service Factors

### Service factors shall be applied in the selection or design of mechanical power transmission components. Components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and power. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

|  |  |  |
| --- | --- | --- |
| **Type of Equipment** | **Service Factor** | **Load Classification** |
| Reciprocating Air Compressors  Multi-cylinder  Single-cylinder | 2.0  2.0 | Heavy Shock  Heavy Shock |
| Pumps Centrifugal | 1.15 | Uniform |
| Cranes or Hoists | 1.25 | Moderate Shock |

## Mechanical Service Factors

|  |  |  |
| --- | --- | --- |
| **Mechanical Service Factors** | | |
|  | **Electric Motor** | **Internal Combustion**  **Engine** |
| Uniform | 1.25 | 1.50 |
| Moderate Shock | 1.50 | 1.75 |
| Heavy Shock | 2.00 | 2.25 |

### For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

### Where load classifications are not indicated, service factors shall be for standard load classifications and for flexible couplings.

## Vibration Isolators

### Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

# EXECUTION

## Delivery, Receiving and Storage Equipment

### The Contractor shall be responsible for all aspects of delivery, receiving and storage of equipment. In the event that the Region’s facilities are to be used to store equipment, such areas must be pre-approved by the Consultant and Region prior to receiving the equipment. The Contractor shall arrange for the delivery of all items of equipment to the Site as required to meet and maintain the project schedule. Delivery of very large and/or heavy equipment, chemicals and/or lubricants associated with such equipment must come with MSDS and be approved for storage by the Consultant and Region. The storage of equipment shall not impact any facility operations. Load limits of floors, reservoirs etc. must be considered by the Consultant prior to approving storage locations for such equipment.

### The Contractor is responsible for maintaining equipment over long storage periods in accordance with the manufacturer’s recommendations.

### Arrange for the delivery of all anchor bolts, templates, embedded metals, and other materials required during the concrete placement and assembly of equipment.

### Receive equipment at the Site. Unload and examine the equipment upon arrival for damage or defects and be responsible for its safekeeping, storage and installation. Immediately notify the Consultant and the supplier if any of the delivered equipment does not appear new or shows signs of damage or defects.

### Special measures shall be taken to ensure that electrical motors do not suffer from moisture, dust, dirt or mechanical damage if stored or installed and inactive.

### Equipment storage, safekeeping and relocation of equipment from one area of the Site to another, for whatever reason, shall be the sole responsibility of the Contractor from the time of initial off-loading at the Site until the date of Total Performance of the Work and acceptance by the Region.

### If the equipment will be subject to extended (more than 3 months) storage prior to installation and commissioning, the equipment manufacturer should be advised about the extent of the storage duration so that special long-term storage protection can be provided for the equipment prior to shipping to the Site. Periodic rotation of the pump and driver shaft will be required during long-term storage and inspection of the equipment by a factory representative prior to start up is required to ensure equipment integrity and compliance with the warranty requirements.

## Installation of Equipment

### Provide any appurtenant fittings and materials which are not specified in the Contract Documents but are necessary for the proper installation and operation of the equipment without additional payment.

### Provide all materials, labour and equipment required for the full installation and operation of the equipment at the performance levels required by the Contract Documents.

### Install the equipment in strict accordance with the manufacturer's instructions and to the satisfaction of the Consultant.

### Install all instruments in accordance with specific instrument specifications contained in Division 13. In the absence of detailed installation requirements, the Contractor shall install instruments with an in-line isolating valve and a tee and valve on their sample line to allow easy isolation from the process for maintenance and to allow air or moisture removal.

### Be fully acquainted with all work required for the complete installation of all equipment. Misunderstandings in regard to the nature or amount of work to be performed shall not constitute grounds for extra payment under this Contract.

### Ensure that no unnecessary strain is introduced into the equipment due to connections with piping or other appurtenances.

## Time of Completion

### Any delay in the delivery of the equipment or installation materials (including theft, damage, wrong equipment etc.) does not relieve the Contractor of its responsibility to complete the Contract in accordance with the Contract Documents and the Contract Time.

## Manufacturers Services and Certification of Installation

### Provide for all necessary services and expenses of any trained personnel representing the manufacturers of various pieces of specified equipment, in order to ensure the correctness of installation. The expenses to be provided shall also include any start-up costs required by suppliers which may be necessary to ensure the satisfactory installation, testing and commissioning of the equipment.

### Complete all equipment testing in accordance with Section 01810 – Equipment Testing and Facility Commissioning.

### Complete all commissioning in accordance with Section 01810 – Equipment Testing and Facility Commissioning and provide all documentation in a timely manner in order to commission process elements and entire systems as required by the construction schedule.

### Provide all materials, labour and equipment necessary to make any adjustments to the installation as required by the manufacturer or the Consultant until the equipment is fully tested and commissioned.

### Upon the completion of installation and testing, obtain from the suppliers or the manufacturers certification that the equipment is installed correctly, is in full operational condition, and is operating in accordance with its design rating. Submit the original certificate to the Consultant and all copies necessary to comply with other submittal requirements. Certification documentation shall include a statement to the effect that any adjoining pipe is properly and independently supported and does not cause undue stress that would be detrimental to the equipment performance.

### The Contractor shall coordinate the work of all equipment suppliers, fully commission all equipment and ensure that representatives from the various manufacturers are present during plant testing and commissioning as required by the Consultant. Refer to Section 01810 – Equipment Testing and Facility Commissioningfor additional requirements.

### The Contractor shall coordinate the work of all equipment suppliers with respect to performing warranty work on equipment during the warranty period from storage to installation to Total Performance of the Work and the defined warranty period following Total Performance of the Work. The Contractor shall provide a complete list of equipment under warranty, the date the warranty commences and details of all warranty work done on such equipment. The list shall be provided in an electronic format that can be uploaded to the Region’s CMMS (Maximo).

## Acquaintance with Work

### The Contractor shall be fully acquainted with all of the work required for the complete installation of all equipment. At no time shall the Contractor make any claim that any misunderstanding existed in regard to the nature or amount of work to be done in relation to the installation, testing and commissioning of all specified equipment.

### The Contractor shall be fully acquainted with all cross-referenced Specification Sections contained in the Contract Documents.

### Obtain all necessary details from equipment suppliers, including dimensions and other information pertinent to the Work.

## Material and Workmanship

### All materials and equipment are to conform to the latest edition of applicable standards in force at the time of tendering. In the event of a conflict between the Specifications and any standard, the more stringent of the two shall apply.

### Provide all materials and equipment in conformance with the following:

#### Materials and equipment are in new condition, not refurbished, used, damaged, sub-standard or outdated and shall be first class in every respect.

#### Constructed and finished in a workmanlike manner.

#### Fully suitable for the service intended.

#### Selected and fabricated in accordance with best engineering practices.

### Furnish safety devices, including shear pins, flexible coupling guards, belt guards and other pertinent items with the equipment.

### Design machinery such that working parts are readily accessible for inspection and repair, and each part is suitable for the service required.

### Ensure that materials and/or equipment coming in contact with water being treated and processed for drinking water purposes are certified NSF 60 and/or 61 and/or NSF 372 (as applicable). Provide original copies of the certificates to the Consultant.

### Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover any equipment having exposed bearings and glands in order to exclude foreign matter.

### Design equipment shall have adequate strength, power and capacity for both continuous and intermittent service and have motors and other parts capable of starting and operating under any conditions or loading likely to occur under normal plant operating conditions.

### Design the general mechanical and electrical equipment and particularly gearings, contacts and other wearing parts to satisfy the need for long periods of operation without frequent maintenance or attention.

### Provide adequate and, as far as practicable, authentic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routine greasing.

### Indicate on the working drawings submitted, the type of lubricants to be used (must be readily available in Ontario). Use grease nipples of a consistent type (Alemite button head type or equivalent). All SDS related to lubricants including NSF certification(s) (if applicable) shall be listed and provided to the Consultant for incorporation into the Region’s CMMS (Maximo).

### Make all lubrication points readily accessible using grease nipples and Type 316 stainless steel or copper tubing extensions where required. Secure the nipples and tubing to the equipment at the appropriate locations.

### Design all equipment to be installed outdoors for service under climatic conditions typical for the area. Give particular attention to winter operating conditions.

### Design the equipment or provide equipment that accounts for the historic facility power quality provided by the local distribution company so the equipment will not be susceptible to damage or operational outages due to sags and swells on the power supply to the facility. Provide appropriate protection for sensitive electronic equipment and components from historic power quality conditions.

### The equipment provided shall be suitable under the anticipated operating conditions and expected/normal duty cycles.

## Special Tools and Accessories

### Furnish a set of any special tools, wrenches, and accessories required for removing worn parts, for carrying out maintenance and for making adjustments. Special tools are tools which, because of their limited use or purpose-made design, are not normally readily available but are necessary for maintaining the equipment. Provide a list of special tools required to the Consultant with details for use or cross-referenced to O&M manuals. The list shall be in a format that can be uploaded to the Region’s CMMS (Maximo).

## Temporary Supports

### Provide all necessary temporary supports and bracing to prevent the overloading of all floors and walls, while equipment is being installed. Ascertain the weights of all pieces of equipment from the manufacturer, and move equipment into position in a manner and at a time approved by the Consultant.

### Provide eye bolts or hooks engineered for the safe handling of the equipment during installation. Eye bolts shall be left in place.

## Lubricants, Grease, Oil and Fuel

### Provide lubrication in accordance with ANSI/HI 14.4–2018 item A.5.1 and as specified herein.

### Provide the complete initial lubrication of all equipment in accordance with the manufacturer's recommendations. Provide a complete schedule to the Consultant of all manufacturers’ recommended lubricants. Fill grease, oil and fuel tanks, as required for the initial operation of the equipment. The Contractor shall maintain equipment in accordance with the manufacturer’s recommended maintenance program during the entire warranty period.

### Provide NSF documentation where required.

## Small Piping

### Supply and install all small connecting pipework, fittings and valves whether shown on the Contracts Drawings or not. Defining small piping for such purposes shall be by the Consultant. Perform all such work strictly in accordance with the instructions of the manufacturer whose equipment is being installed or connected. Coupling types shall be based on ease of maintenance requirements and shall be submitted to the Consultant for approval.

### Small piping connecting to potable water processes may require disinfection prior to installation. The Contractor shall develop a disinfection procedure (where required) for approval by the Consultant and for carrying out such approved disinfection procedures. The disinfection procedure shall comply with Section 01750 – Disinfection and Testing of Water Retaining Structures and Process Piping.

## Anchor Bolts

### Unless otherwise specified, supply all stainless steel anchor bolts, such anchor bolts being of a diameter and size as recommended by the manufacturers of the equipment and machinery being installed. Generally use expansive type anchorages in setting small equipment. Set large pumps by means of bolts with sleeves cast into the concrete to a minimum depth of 150 mm. Elsewhere, cast in place anchor bolts may be used subject to the approval of the Consultant; these anchor bolts shall be properly positioned by means of plates appropriately placed.

## Pump and Machinery Bases

### Provide minimum 300 mm high concrete bases for all equipment, including pumps, and mixers. Final setting of pump and machinery bases shall be on cement grout placed on concrete bases, or as otherwise recommended by the equipment supplier. Grouting shall be in accordance with Section 03300 – Cast-In-Place Concrete. Provide anchor bolts for all bases. Finish vertical sides of pump bases and bases to match the adjacent floor.

### The final shape and dimensions of bases and anchor bolt locations for the bases where not already finalized, will be determined by the Consultant after receipt of the equipment manufacturer's detailed drawings. In general, the concrete bases shall be a minimum of 50 mm larger than the supplied equipment base in each direction and shall be sufficient to provide the edge distances required by the anchor bolt calculations.

### Reinforced concrete bases shall be firmly fixed to the parent concrete slab by adequate dowels as shown on the Contract Drawings or as recommended by the equipment supplier and approved by the Consultant.

### The Contractor shall verify the size and weight of equipment foundation to insure compatibility with equipment. The dimensions of all concrete bases

## Equipment Cabinet Bases

### Install all floor-mounted cabinets on minimum 300 mm high concrete bases whether shown on the Drawings or not. Concrete shall be as specified in Section 03300 – Cast-in-Place Concrete.

### Anchor bases as recommended by the manufacturer or as specified elsewhere in the Contract Documents.

### Final shape and dimensions shall be determined by the Consultant after receipt of equipment manufacturer's detailed drawings.

## Field Welding and Fabrication

### Ascertain details of field welding and fabrication to be carried out for the erection and installation of the various items of equipment.

### Tungsten Inert Gas (TIG) welding shall be employed as a standard method of welding. Any other method of welding (such as metal inert gas (MIG) welding) must be approved by the Consultant and the Region prior to the commencement of any welding work.

### Fabricate the equipment in accordance with CAN/CSA Standard S16-14, Design of Steel Structures and the manufacturer's instructions.

### Shield the welding in accordance with CSA Standard CAN/CSA W59-18 Welded Steel Construction (metal arc welding).

### Provide all welding inspection reports to the Consultant.

## Equipment Guards

### Provide removable protective guards for all open rotating equipment including pulleys, belts, drives, shafts and couplings, etc.

### All equipment protective guards shall be provided prior to the pre-start inspection stage.

### Ascertain the extent of the work associated with the installation and/or the supply of equipment guards by directly contacting the equipment suppliers.

## Protection of Equipment

### After the equipment has been installed and prior to actual use by the Region, protect the equipment from damage. Ensure that the utilized protection measures are to the satisfaction of the manufacturer and the Consultant.

## Alignment

*[Note: Insert appropriate tolerances below suitable for the specific Contract Work]*

### All rotating equipment shall be set and aligned in accordance with the more stringent requirements of either the equipment manufacturer’s instructions or the following:

#### Level base, use machinists level on all machined surfaces.

#### Base shall be true and leveled.

#### Alignment of shafts, soft foot or motor and couplings shall be performed by reverse dial, rim to rim and face to face. Soft foot will be rim to rim vertical and horizontal mode.

##### Soft foot of motor shall be checked to be within a tolerance of [±0.038 mm].

##### Shaft to be aligned within a tolerance of [± 0.025 mm to 0.076 mm].

##### Piping strains to pump shall be within a tolerance of [± 0.025 mm to 0.076 mm]

##### Laser alignment devices are permissible.

##### Alignment tests to be done on equipment prior to operation and after a three hour “hot test”.

#### Provide the Consultant with an alignment report.

### The driver should not be aligned using shims, if the pumps are to be used with electric motors that have variable frequency drive systems (VFDs) due to potential changes on the resonant frequency of the driver/discharge head structure.

## Differential Settlement

### Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

## Vibration Monitoring

### Provide vibrational signature testing and documentation for each equipment having a power above 15 kW and operating speeds between 120 r/min and 15 000 r/min.

#### The vibration level shall be within the specified limit in accordance with the manufacturer's recommendations. Generally, unless specified otherwise in the Contract Documents, the current edition of the Hydraulic Institute Standard, “Acceptable Field Vibration Limits” shall be the standard for pump vibrational testing. Measurement shall be carried out with a real time analyzer. Provide a hard copy of the vibration signature spectrum showing vibration velocities over a frequency range of 0 to 2000 Hz, measured in a filter-in mode.

#### Defined equipment shall have dedicated vibration transducers for real-time vibration monitoring or for equipment protection. Provide appropriate devices and systems to link such vibration transducers to protective relays and the SCADA system as required.

#### Provide the Consultant with the original vibration monitoring reports and all copies necessary for the Maintenance Data to be uploaded to the Region’s CMMS (Maximo).

## Startup and Testing Requirements

### Prior to field testing of all equipment, the Contractor shall perform the following:

#### Inspect and clean equipment, devices, and connected piping so they are free of foreign material.

#### Lubricate equipment in accordance with manufacturer’s instructions.

#### Turn rotating equipment by hand.

#### Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

#### Test and commission related electrical system components in accordance with the requirements specified in the Electrical and the Electrical Equipment Installation sections.

#### Calibrate all instruments associated with the equipment.

#### Check for proper rotation, adjustment, alignment, balancing, mechanical and electrical connections, and any other conditions that may damage or impair equipment from functioning properly.

#### Inspect and verify proper anchorage.

#### Obtain manufacturer’s certification of proper installation where specified in the equipment sections.

## Testing and Commissioning

### Unless otherwise specified, provide commissioning and startup in accordance with Section 01810 – Equipment Testing and Facility Commissioning.

### Perform the disinfection of equipment being installed in drinking water treatment process systems that is in contact with water in accordance with Section 01750 – Disinfection and Testing of Water Retaining Structures and Process Piping.

### Unless otherwise specified, furnish a certificate of final inspection and approvals from the ESA to the Consultant.

### Provide defined commissioning activities in accordance with Section 01810 – Equipment Testing and Facility Commissioning.

### Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.

#### Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable standards.

#### Obtain concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures.

## Training

### Unless otherwise specified, provide demonstration and training in accordance with Section 01820 – Demonstration and Training.

**END OF SECTION**