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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 | September 7, 2011 | Changed wording under section 2.3 Acceptable Pump Suppliers | |
| 4 | May 9, 2013 | First 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 | March 10, 2014 | Improved reference to AWWA standards and general improvements (AV). | |
| 7 | June 2, 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 #1029451-v6 (AV) | |
| 10 | February 18, 2015 | | Updated standards (AV) |
| 11 | March 2, 2015 | | Updated, Finalized Specification – Legal Reference eDOCS #5043364 v12 (AV) |
| 12 | March 1, 2017 | | Updated for references to NSF 372. (AV) |
| 13 | January 12, 2022 | | Updated for pump testing project (Q-18-300) (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 includes the supply, delivery, supervision of installation and commissioning of pumps, motors, variable frequency drives where specified, and appurtenances, as specified in this Section.

### Unit Responsibility: The work requires that the horizontal split case pumps complete with all accessories be the end product on one responsible system manufacturer or responsible system supplier. Unless otherwise indicated, the Contractor shall obtain each system from the responsible supplier of the equipment, which supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and an 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 herein.

### For potable water applications, the horizontal split case pumps shall conform to AWWA E103-07, the applicable NSF 61 and NSF 372 requirements as cited in AWWA E103-07, and these Specifications.

### All equipment data, maintenance records, spare parts and tools lists, system curves, maintenance requirements and other essential asset information to conform to Section 01430 - Operation and Maintenance Data. All equipment information shall be in an electronic format suitable for upload to the Region’s CMMS (Maximo). Refer to Section 01425 - Computerized Maintenance Management System Data Requirements.

## 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 11010 – Equipment General Requirements.

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

### Section 01250 – Substitutions

### Section 01300 – Submittals

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

### Section 01430 – Operation and Maintenance Data

### Section 01600 – Material and Equipment

### Section 01810 – Equipment Testing and Facility Commissioning

### Section 01820 – Demonstration and Training

### Section 09900 – Painting and Protective Coatings

### Section 11010 – Equipment General Requirements

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

## References

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

#### ASTM - American Society for Testing and Materials

##### A48-03(2012), Standard Specification for Gray Iron Castings (Class 30)

##### ASTM A276/A276M-15, Standard Specification for Stainless Steel Bars and Shapes.

##### B584-14, Standard Specification for Copper Alloy Sand Castings for General Applications (Alloy 905; B143-905)

##### A743/A743M-13ae1, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant for General Applications (Grade CFR-3M, Grade CA-15 [Consultant to confirm appropriate standard])

#### American National Standards Institute (ANSI), Acoustical Society of America (ASA)

##### ANSI/ASA S1.13-2005 (R2010), Measurement of Sound Pressure Levels in Air

##### B16.1-2010 – Gray Iron Pipe Flanges and Flanged Fittings

#### AISI – American Iron and Steel Institute

##### Stainless Steel 440 A

#### American Bearing Manufacturer’s Association (ABMA)

##### [B-10 rating Consultant to confirm appropriate standard]

#### AWWA - E103-15, Horizontal and Vertical Line-Shaft Pumps.

#### ANSI/HI14.6-2016- American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

#### ANSI/HI 9.6.4-2016- Rotodynamic Pumps for Vibration Measurements and Allowable Values

#### NSF/ANSI Standard 61: Drinking Water System Components – Health Effects (for potable water applications).

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

#### NFPA – National Fire Protection Association, Codes and Standards

#### Canadian Standards Association (CSA)

##### CSA Z107.56-18, Measurement of Noise Exposure.

## Pump Requirements

### Provide pumping equipment with the following features: *[Consultant to provide schedule of pumping equipment]*

#### Quantity [ ]

#### Rated Condition Point [ ]

#### Capacity (ML/D) [ ]

#### Rated Condition Point [ ]

#### Total Dynamic Head (m) [ ]

#### Drive Requirements [ ]

#### RPM [ ]

#### Shut-Off Head [ ]

#### Liquid Pumped [ ]

#### Maximum Liquid Temperature ([ ]°) [ ]

### [Consultant to indicate if system head curves are available]

## Maximum Allowable NPSHR

### Suction lift requirements (NPSHR – Net Positive Suction Head Required) for the pumps are critical.

### NPSHR for the pumps cannot exceed the following values when the pump curve passes anywhere inside the system head curve envelope.

|  |  |
| --- | --- |
| **ITEM** | **PUMPS** |
| Pumps Size | [ ] |
| Maximum NPSH (m) | [ ] |

## Pump Operating Conditions

### Provide pumps which can operate under the following conditions, with no damage to the pump, vibration, cavitation, or recirculation problems:

#### Capable of starting up against a momentarily closed valve.

#### Capable of continuously operating at its rated condition point with no damage to the pump, vibration, recirculation, or cavitation problems.

## Submittals

### [Consultant to use this clause where appropriate.]

### Shop Drawings:

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

#### General dimensions of the pump layout (plan and elevation), complete with motor.

#### Pump anchor bolt base plan and drawings.

#### Head, flow, NPSH, efficiency, and kW (brake horsepower) curves for all pumps.

#### Pump cross-section details with materials list.

#### Motor data.

#### NSF 61 and/or NSF 372 certificates for applicable coatings, lubricants, temporary corrosion prevention compounds etc.

#### For variable speed drive applications: RPM, motor efficiency at 25%, 75% and 100% speed, power factor.

#### Torsional analysis calculations for pump drive shafts.

#### Complete a copy of Table 1 – Pump Motor Information, which is attached as a supplement to this Section.

#### All information shall be in an electronic format suitable for upload to the Region’s CMMS (Maximo). Refer to Section 01425 – Computerized Maintenance Management System Data Requirements.

### Information Submittals

#### Factory Functional Test Report approved by the Consultant and signed off by the Region.

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

#### Manufacturer’s printed installation instructions.

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

#### Operational and Maintenance Manuals.

##### The manuals shall include the following items: Reviewed shop drawings showing pump/motor layout, anchor bolt dimensions, certified pump curves, certified NPSHR curves, power draw curves, efficiency curves. Information on all other appurtenances to be supplied for the pumps.

##### Operation and Maintenance Manual and Maintenance Summary: Provide an Operation and Maintenance Manual and Maintenance Summary in accordance with the requirements of Section 01430 – Operation and Maintenance Data.

#### Special shipping, storage, protection and handling instructions. Product delivery, storage, and handling shall comply with Section 01600 – Material and Equipment. The Contractor is responsible for all aspects of delivery, security, maintenance during long-term storage and handling of Products.

#### List of suggested spare parts required to maintain the equipment in service for a period of five years. Include a list of any special tools required for checking, testing, parts replacement, and maintenance with current price information.

#### List any special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance. Refer to Section 01425 – Computerized Maintenance Management System Data Requirements.

#### Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide NPSHr curve for each speed.

#### Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.

## Quality Assurance

### Pumps shall be the product of one manufacturer.

### Pumps shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

### Provide all wetted parts of the pumps NSF 61 approved.

### The Contractor shall obtain the pumps, motors and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

### Variable frequency motor controllers can be supplied by the Contractor or the pump manufacturer at the Contractor’s option. The pumping system shall be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

#### The Contractor shall coordinate the variable frequency motor controllers with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

### If equipment proposed is heavier or taller, than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

### If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

### For variable speed pump systems the pump manufacturer shall perform a factory analysis of the combined motor and pump assembly for resonant frequency or their harmonics independent of a structure in the Factory.

#### Submit a copy of these calculations for the record.

#### Should calculations indicate the probability of encountering such frequencies within the speed range required, provide all additional supporting devices necessary to affect the unit mass, and raise or lower resonant point as necessary.

#### Provide and install such additional devices at no additional cost to the Region.

## Conditions of Service

### Provide pumping equipment suitable for the following conditions of service: *[Consultant to complete table below]*

|  |  |
| --- | --- |
| **ITEM** | **CRITERIA** |
| Water Temperature Range (ºC) | [ ] |
| Water pH | [ ] |
| Water Turbidity (NTU) | [ ] |
| Water Chlorine residual (mg/L) | [ ] |
| Process Treatment Chemicals Impacting Pumps | [ ] |
| Alum Dosage (mg/L) *or*  Poly-aluminum Chloride Dosage (mg/L) *or*  Ferric Chloride Dosage (mg/L) | [ ]  [ ]  [ ] |
| Interior Room Temperature (ºC) | [ ] |
| Interior Environmental Conditions | [ ] |

## Co-ordination

### The Contractor shall coordinate the compatibility of the motor and the VFD units. The Contractor shall also assess outside utility requirements for pumping equipment related to operating parameters for all required utilities. The Contractor shall be familiar with the facility power quality so that any electrical components (including VFD’s) can fully function under the typical levels of power quality as delivered by the Local Distribution Company (LDC). The Contractor shall provide electrical devices to protect electrical components (including VFDs) from sags and swells experienced from the LDC at no additional cost to the Region. The Consultant will verify and approve the compatibility of the motor and VFD unit(s). *[Consultant to delete above reference to VFD’s if they are not required]*

## 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

## Horizontal Case Split Style Pumps

### Casing:

#### Provide axially split casing along the shaft centreline with the following features:

##### Constructed from ASTM A48-03(2012), Class 30 cast iron.

##### Hydrostatically tested to [1720 kPa].

##### Bearing bracket integrally cast with the lower half of the casing.

##### Lifting lugs or eye bolts on the upper casing half.

##### Cast iron Class [125] suction and discharge flanges in accordance with ANSI B16.1-2010.

##### The casing shall be of the volute type and designed to produce a smooth flow with gradual changes in velocity. The casing shall be split on the horizontal centre line with the suction and discharge nozzles and casing feet cast integral with the lower casing half. The interior of the pump shall be easily inspected by removing the upper half of the casing. This shall be done without disturbing the pipe connections or pump alignment. The flanges between the halves will be sealed by a pre-cut gasket.

##### The upper and lower halves of the casing shall be accurately located by the use of straight dowel pins to eliminate any mismatch between the upper and lower halves which would impair both hydraulic and mechanical performance. The casing shall be hydro tested to one and one half times the working pressure: suction and discharge flanges shall contain drilled, tapped, gauge and plugged connections. The casing shall be single volute type.

##### The upper half of the casing shall have drilled, tapped and valved connection for pump priming and/or air release. The lower half of the casing shall be complete with a drainage connection and valve.

##### The casing shall be cast iron materials complete with renewable casing wear rings.

### Base Plate:

#### Mount the pump and driver on a common base plate having the following features:

##### Heavy cast iron a minimum of 13 mm thick welded structural steel base plate.

##### A minimum 20 mm thick pump and driver mounting.

##### Base designed to allow for grouting, complete with grout vent and anchor bolt holes.

##### Drip lips around the base plate, complete with drain connection.

##### Fine thread jack bolts to allow for the movement of the motor for realignment purposes.

### Impeller:

#### Provide the impeller with the following features:

##### Enclosed double suction type.

##### Constructed from bronze, conforming to ASTM B584 Alloy 905 or stainless steel conforming to ASTM A743/A743M-13ae1 Grade CRF -3M.

##### Statically and dynamically balanced.

##### The impeller shall be firmly secured to the shaft by a key positioned by shaft sleeves and both locked in place by shaft lock nuts external to the stuffing box.

### Wearing Rings:

#### Provide wearing rings with the following features:

##### Easily removable, angular wearing rings on the impeller and casing.

##### Constructed from bronze conforming to ASTM B584 Alloy 905 or stainless steel conforming to ASTM A743/A743M-13ae1 Grade CA-15.

##### Accurately machined on all faces.

### Bearings:

#### Provide bearings with the following features:

##### Anti-friction type ball or roller bearing type.

##### Oil or grease lubricated.

##### Heavy duty B-10 rating of 100,000 hours as set out by the American Bearing Manufacturers Association.

##### Designed to prevent lubricant from escaping and to prevent water from entering.

##### Interchangeable inboard and outboard bearings.

##### Integrally cast bearing brackets to the lower half of the casing.

#### Provide tapped openings for the addition and draining of lubricant. Lubricant reservoir (if applicable) to allow visual inspection of lubricant level at pump level.

#### Design the bearing frame to allow axial adjustment of wearing rungs by use of jacking screws and adjusting shims between the bearing frame and stuffing box head. *[This subsection is only applicable to end suction pumps]*

### Pump Shafts:

#### Provide pump shafts with the following features:

##### [AISI 440A alloy steel shaft.]

##### [ASTM A276/A276M-15 Grade 410 chrome (11.14%) steel shaft sleeve (325-400 BHN)]*[Consultant to confirm appropriate standard]*.

##### Sized to transmit full driver horsepower, prevent undue deflection or whip under all starting or running conditions from shut in to full running speed.

### Shaft/Pump Coupling:

#### Provide flexible mechanical shaft couplings to connect the pump shaft to the driver shaft.

#### Provide flexible cone ring type shaft couplings manufactured by David Brown or Elastomeric by Koppers or Equivalent.

### Mechanical Seals

#### Provide split single mechanical seals, with the following features on the pumps:

##### Silicon carbide rotary.

##### Carbon stationary.

##### EPR elastomers

##### 316 SS parts.

##### Hastelloy C springs.

#### *[Acceptable Suppliers: Consultant to provide list of a minimum of three acceptable suppliers meeting performance and efficiency requirements.]*

### Tappings:

#### Provide the pump with the following NPT tapped openings.

##### 12 mm vacuum priming tap – to be capped if no priming system is part of the design.

##### Water seal and drain pipe taps.

##### 6 mm taps on the suction and discharge flanges at the horizontal centre-line of the flanges. All taps shall be installed with plugs of a material that will not deteriorate due to corrosion between dissimilar metals.

##### Pipe ports on suction and discharge sides that are specifically designed and optimized for Yates Meter insertion probes. Ports shall be appropriately capped or plugged. The Consultant will review and confirm/approve of the test port position and orientation.

### Pump Bearing Temperature Switches:

#### Provide each set of pump bearings (on each pump 112 kW and up) with a 316SS RTD probe set at 80% of the bearings maximum operating temperature.

#### The signal generated by the RTD will be used to de-energize the pump through a magnetic contactor in the MCC.

#### All specified RTDs shall be hardwired to the motor protection relay.

### Coupling and Shaft Guards:

#### Provide guards around all revolving parts with the following features:

##### Constructed of stainless steel expanded metal mesh.

##### Designed in accordance with the Ontario Ministry of Labour regulations.

##### Designed to be firmly held in place and easily removable.

##### Openings to allow for grease nipple or oil cup lubrication without requiring the guard to be removed.

### Motors:

#### Provide motors sized to work over the entire range of the pump curve without infringing on the motor service factor.

### Anchor Bolts:

#### Provide ‘L’ shaped cadmium plated anchor bolts designed to suit to anchor the pump base in order to prevent pump movement or vibration.

#### For estimating purposes, assume the main concrete slab, including the maintenance pad, to be 400 mm thick. The Contractor shall consult with the Consultant prior to designing the anchor bolts to confirm concrete slab thicknesses.

### Nameplates:

#### Provide a stainless steel name plate inscribed with the following information:

##### Manufacturer’s name.

##### Year of manufacture.

##### Model number.

##### Serial number.

##### Capacity (ML/d).

##### Total dynamic head (m).

##### Impeller diameter (mm).

##### Speed (rpm).

### Pump Casing Temperature Switch

#### Provide each pump with 316 SS RTD probe set at a temperature setting recommended by the pump manufacturer.

#### The signal generated by the RTD will be used to de-energize the pump via a magnetic contactor in the MCC.

## Lubricants

### Furnish, prior to start-up all lubricating oils and greases necessary to continuously operate all equipment furnished under this Contract for a period of six months.

### The Contractor shall provide the Consultant with SDS for all lubricants prior to Site delivery.

## Acceptable Pump Suppliers

#### .1 *[Consultant to provide list of a minimum of three acceptable suppliers meeting performance and efficiency requirements.]*

# EXECUTION

## On-Site Installation and Inspection

### The Contractor shall ensure that the manufacturer’s representative(s) will attend the Site to inspect, operate, test, adjust, and trouble shoot the installation as required until the completion of testing and commissioning.

### Refer to Section 01820 – Demonstration and Training.

### Submit the manufacturer’s representative’s signed report describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to the requirements set out 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 appropriate for the service intended and ready for permanent operation. Obtain the Consultant’s approval of the report form prior to use.

### The inspection shall include:

#### Verification of the soundness of the system (that it is without any cracked or otherwise damaged parts).

#### Completeness of installation as specified in the Contract Documents and as recommended by the manufacturer.

#### Correctness of setting, alignment and relative arrangement of various parts of the system.

#### Vibration testing on the pump bearings and motor bearings for each pump. The tests shall be conducted by a company certified and experienced in this line of work. The results shall be submitted for review and approval by the Consultant. Vibration is not to exceed the guidelines stated in the Hydraulic Institute Standards. If it does, the pump will be rejected. All reports are to be approved by the Consultant and shall be in an electronic format suitable for upload to the Region’s CMMS (Maximo). Refer to Section 01300 – Submittals.

#### Equipment bearing check.

### Operating, testing and adjusting will serve to prove that the equipment is satisfactorily installed to operate under the intended conditions as specified in the Contract Documents.

### Equipment will not be accepted by the Consultant without the manufacturer representative’s report.

### Modify or replace any equipment or materials which fail the required tests.

### Perform any additional testing which may be required as a result of any changes to materials due to the failure of materials or construction to meet the requirements of the Specifications at no extra cost to the Region.

### Test and commission the equipment in accordance with Section 01810 – Equipment Testing and Facility Commissioning.

## On Site Noise Testing

### On-Site noise testing will be carried out by the Region’s representative on all pumping equipment using a testing firm specializing in this type of work. The overall sound pressure level at all possible operator locations within a radius of 1 metre from the pumping equipment shall not exceed 85 db on the “A” weighting network using survey and field methods conforming to ANSI/ASA S1.13-2005 (R2010) and CSA Z107.56. The Contractor will carry out any modifications necessary to achieve this noise rating at no additional cost to the Region.

## Performance Tests

### Certified witnessed shop tests, approved by the Consultant and signed off by the Region, shall be carried out for one representative pump and motor, to be supplied under this Contract. The tests shall be considered representative of the performance of similar machines. Notify the Consultant 15 Working Days in advance of conducting such tests in order that the Consultant may be present. No witnessed tests are required for motors less than 50 kW.

### Witnessed tests using calibrated instruments shall include:

#### Development of the entire head / capacity pump curve.

#### Development of the entire NPSHR curve.

#### Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.

#### Run pump at full speed rating point for 60 minutes prior to start of any testing.

#### Development of the pump efficiency curve and overall efficiency curve.

#### Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

#### Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available.

### Submit the test results to the Consultant for review prior to shipment of the equipment. All tests are to be stamped and signed by an authorized representative of the manufacturer, the Consultant and the Region.

### Variable speed tests:

#### Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

#### Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

#### Run a second test at a speed approximately midway between full and minimum speed.

#### Run addition tests for each reduced speed operating condition specified and indicated.

#### Development of the entire head / capacity pump curve.

### Non-witnessed tests for the remainder of the pumps are to be conducted for the same tests described in subsection 3.3.2, above, without the requirement of having the pump motor [or VFD] tested together with the pump.

### Correct any failure to meet the requirements of the Contract Documents before shipping the equipment to Site. If, after correction and retesting, the equipment still fails to meet the requirements of the Contract Documents, the Supplier’s equipment will still be rejected. The retesting shall be performed at no additional cost to the Region.

### Carry out the tests using calibrated instruments in accordance with ASME and the Hydraulic Institute (HI) of America Codes *[Consultant to confirm appropriate standard]*.

### The Consultant will provide a list of required tests based on the HI standards to the Contractor. The Region reserves the right to reject the equipment if the guaranteed pump performance does not fall within the performance and efficiency requirements set out 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, and the following tolerances: *[Consultant to confirm appropriate standard].*

#### ANSI/HI 14.6 Acceptance Grade: 1U.

### Negative tolerances for head, capacity and efficiency will not be allowed.

### The acceptance by the Region of the results of these tests does not constitute final acceptance of the work, but shall be sufficient only to permit the shipment of the equipment to the Site. Final acceptance will be given subject to the satisfactory installation and in place operation of this equipment in its final location.

### The Contractor shall ensure that the pump supplier will return to the Site after 200 running hours to confirm the pump’s alignment, efficiency and performance.

## Shop Testing

### Conduct motor efficiency and power factor tests at full load 100 and 50, 75 percent load.

### Test pump casings under a hydrostatic head of at least 75 psi (500 kPa) or 150 percent of rated shutoff head, whichever is greater. Test casing with pump assembled.

### Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.

### Take readings to determine flow, differential pressure, rpm, horsepower, and wire to water efficiency.

### Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available.

### Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

### Variable speed tests:

#### Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

#### Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

#### Run a second test at a speed approximately midway between full and minimum speed.

#### Run addition tests for each reduced speed operating condition specified and indicated.

### Testing Tolerances

#### ANSI/HI 14.6 Acceptance Grade: 1U.

#### Efficiency Tolerance: -0 percent.

#### If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.

## Field Testing

### Test piping connections to prove the discharge nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

### Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list.

### After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer’s field service technician, conduct running test for each pump in presence of the Consultant to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

### During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and vibration and motor inputs.

### Provide vibration signature test data for each pump and drive assembly.

#### Vibration Limits: 50% of the limits provided in ANSI/HI 9.6.4.

### Bearing Temperature: Bearing temperature not to exceed 180 degrees F.

### Test Duration: Determined by the Consultant, but not less than three hours of continuous operation at each condition specified and indicated.

### Run each pump for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.

### Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

### Repeat tests until specified results are obtained.

### Owner reserves the right to perform independent vibration testing to verify contractors test results prior to acceptance of the pumping unit.

### Contractor to provide all water labor, piping, equipment, flow meters and test gauges for conducting tests.

#### Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

#### All calibrations shall be within 30 days of the field testing.

#### The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

#### Contractor is responsible for delivery and disposal of water used for testing.

### Make all adjustments necessary to place equipment in specified working order at time of above tests.

### Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

### Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Consultant that equipment will perform the service specified, indicated and as submitted.

## Commissioning and Certification

### The Contractor shall arrange and pay for the services of qualified technical representatives of the pump supplier to commission the installation.

### The Contractor shall arrange for the Consultant and the Region’s representative to be present at the time of commissioning.

### The Contractor shall demonstrate that all the equipment is installed properly and is performing satisfactorily.

### The Contractor shall obtain and submit to the Consultant a certificate from the supplier stating that the installation was found to be to the satisfaction of its qualified representative. Submit the Certificate to the Consultant.

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

### The Contractor shall provide an Affidavit of Compliance in accordance with AWWA E103-07 (Section 6.3) to the Consultant (for potable water applications).

## Miscellaneous Piping

### The pumps shall have tapped openings for air relief, water seal and drainage pipe connections. Gauge connections tapped for suitable sized pipe shall be provided on the discharge nozzles close to the flanges. For Yates Meter test ports, refer to subsection 2.1.9.4, above.

## Painting

### All equipment to be supplied which is composed of cast iron or steel shall be shop primed and epoxy painted.

### Perform painting in accordance with Section 09900 – Painting and Protective Coating.

## Warranty

### The Contractor warrants that all equipment covered by or supplied under this Contract shall:

#### Comply with the Specification Sections for the said equipment.

#### Be free from defects in design, manufacture, workmanship or materials.

#### Perform efficiently and without unwanted interruption for a period of 24 months after the date of the Total Performance of the Work. The date of Total Performance of the Work shall be established by the Consultant and is as defined in the General Conditions of the Contract.

#### Repair, at the Contractor’s own expense, any breakage, damage, defects or deterioration that is reported to the Contractor during the warranty period.

## Supplements

### The supplement listed below, attached following “End of Section”, forms part of this Section:

#### Table 1 Pump Motor Information.

**END OF SECTION**

**TABLE 1**

**PUMP MOTOR INFORMATION**

Motor Data Sheet

Motor: kW / HP: \_\_\_\_\_\_\_\_\_/\_\_\_\_\_\_\_\_\_Volts: \_\_\_\_\_\_\_\_\_ Phase: \_\_\_\_\_\_\_\_\_ Hz: \_\_\_\_\_\_\_\_\_

Manufacturer:

F.L. Speed \_\_\_\_\_\_\_\_\_ RPM, FLA: \_\_\_\_\_\_\_\_\_ AMPS, LRA: \_\_\_\_\_\_\_\_\_ % FLA \_\_\_\_\_\_\_\_\_

Type of Enclosure: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Service Factor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Frame: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mounting: Horizontal \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Rotation as viewed from end \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Vertical \_\_\_\_\_ Opposite to shaft extension CW \_\_\_\_\_\_\_\_\_\_\_\_ CCW \_\_\_\_\_\_\_\_

Shaft: Solid \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Insulation: Class \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hollow \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ System \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(Housing) Max (Design) Temperature of Motor Housing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_°C

Weight: Complete with Motor \_\_\_\_\_\_\_\_\_\_\_\_ Torque: Locked Rotor \_\_\_\_\_\_\_\_\_\_\_\_

Rotor Only \_\_\_\_\_\_\_\_\_\_\_\_ Kg Inertia (WK5) of rotor \_\_\_\_\_\_\_\_\_\_\_\_ Kg/m5

Repeat Start Limitations: \_\_\_\_\_\_\_\_\_\_\_\_ Inertia of driven Equipment \_\_\_\_\_\_\_\_\_\_\_\_ Kg/m5

Provide Speed-torque curve \_\_\_\_\_\_\_\_\_\_\_\_

Provide Speed-current curve \_\_\_\_\_\_\_\_\_\_\_\_

**Full Load 3/4 Load 1/2 Load**

Max safe stall time \_\_\_\_\_\_\_\_\_\_\_\_ sec \_\_\_\_\_\_\_\_\_\_\_\_ sec \_\_\_\_\_\_\_\_\_\_\_\_ sec

Load Current \_\_\_\_\_\_\_\_\_\_\_\_ Amps Max safe accel time \_\_\_\_\_\_\_\_\_\_\_\_ sec

Total Losses \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

Efficiency \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

Power Factor \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

Acceleration time of motor and load from Standstill to full load speed \_\_\_\_\_\_\_\_\_\_\_\_ sec

**TABLE 1 continued**

**PUMP MOTOR INFORMATION**

At 80% Rated Voltage \_\_\_\_\_\_\_\_\_\_\_\_ sec

At 65% Rated Voltage \_\_\_\_\_\_\_\_\_\_\_\_ sec

At 100% Rated Voltage \_\_\_\_\_\_\_\_\_\_\_\_ sec

No Load Current \_\_\_\_\_\_\_\_\_\_\_\_ amps

Single Air Gap Size \_\_\_\_\_\_\_\_\_\_\_\_

No Load Power Factor \_\_\_\_\_\_\_\_\_\_\_\_

Guaranteed Sound Level \_\_\_\_\_\_\_\_\_\_\_\_ db

**All data shall be in an electronic format suitable for upload to the Region’s CMMS (Maximo).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pump Designation | Asset ID | Pump Model | Pump Weight  (kg) | Pump Speed (RPM) | Pump Efficiency at Midpoint of Pump Curve as it Passes Between LWL and HWL System HEAD Curves | Motor Efficiency at Midpoint of Pump Curve as it Passes Between LWL and HWL System, Head Curves | VFD Efficiency  (%) | Guaranteed Overall Efficiency at Midpoint of Pump Curve as it Passes Between LWL and HWL System, Head Curve | Guaranteed Maximum NPSHR  of Pump when the Pump Curve Intersects the HWL System, Head Curve | Guaranteed Maximum NPSHR  of Pump when the Pump Curve Intersects the HWL System, Head Curve | Pump Suction Size | Pump Discharge Size | Impeller Material |
| Pump XXX |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Pump XXX |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Pump XXX |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Pump XXX |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Pump XXX |  |  |  |  |  |  |  |  |  |  |  |  |  |

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