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| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | September 27, 2007 | Minor revisions by Legal Services |
| 3 | December 29, 2009 | Modified ‘Related Sections’ |
| 4 | September 28, 2010 | Minor Revisions |
| 5 | April 10, 2012 | Addition of References and Replacement Parts sections on this page |
| 6 | July 6, 2012 | Change tab settings for page 1-6. |
| 7 | July 15, 2014 | Spec name changed as part of Commissioning Update Project (JM/DK) |
| 8 | September 24, 2014 | Spec Rewritten as part of Commissioning Update Project (JM/DK) |
| 9 | November 17, 2014 | Stakeholder comments inserted and combined into 1 document (JM/DK) |
| 10 | December 8, 2014 | Removed related forms due to formatting issues (JM/DK) |
| 11 | November 18, 2015 | Section Name Change, integration with Section 01810A (JM/DK) |
| 12 | March 1, 2017 | Updated for reference to NSF 372. (AV) |
| 13 | March 27, 2017 | Removed the specified vibration measuring tool and updated names of forms. (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

## Intent

### This Section covers equipment and systems inspection, functional tests, five day water testing, performance testing, and facility commissioning that shall be completed prior to consideration for Substantial Performance of the Work.

## 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.

Contractor is responsible for coordination of 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 related requirements.]

### Section 01040 – Coordination

### Section 01200 – Project Meetings

### Section 01300 – Submittals

### Section 01310 – Project Schedules

### Section 01351 – Health and Safety

### Section 01430 – Operations and Maintenance Data

### Section 01505 – Mobilization and Demobilization

### Section 01520 – Field Office

### Section 01501 – Construction Sequencing

### Section 01640 – Manufacturer’s Services

### Section 01780 – Contract Close-out

### Section 01810A – Equipment Testing and Facility Commissioning Forms

### Section 01820 – Demonstration and Training

### [Specific requirements for testing of equipment and materials have been provided in individual Specification Sections in the Contract Documents and should be referenced.]

## Definitions

### Contingency Plan: Describes the Contractor’s back-up plan should equipment and/or systems malfunction as they are brought online, and during shutdowns in an operating facility to ensure continued safe operation.

### Facility Commissioning or Commissioning: Test or tests performed in the presence of the Consultant, the Region after any required successful performance test, to demonstrate and confirm that the facility meets the specified operational performance requirements, while simulating actual operating conditions to the greatest extent possible, with wastewater and/or sludge as required by the facility.

### Facility: Entire project, or an agreed-upon (by the Region) acceptable portion, including its entire unit processes.

### Factory Acceptance Test (FAT): The term, as used in the individual Specification Sections, which refers to specified testing performed on specified equipment at the manufacturer’s facility prior to shipment. No equipment can be shipped without FAT approval by the Consultant.

### Field Quality Control: Term, as used in the individual Specification Sections, which refers to specified on-Site functional and performance testing of equipment.

### Five Day Water Test: Test or tests performed in the presence of the Consultant, the Region after any required functional test, to demonstrate and confirm that the equipment and/or system meets the operational requirements specified in the Contract Documents, while simulating actual operating scenarios using effluent, air or potable water.

### Functional Test: Test or tests performed in the presence of the Consultant, the Region to demonstrate that installed equipment and/or systems meet the manufacturer’s installation, calibration, and adjustment requirements and other requirements specified in the Contract Documents including, but not limited to, noise, vibration, alignment, speed, proper electrical, instrumentation and control, mechanical connections, thrust restraint, proper rotation, initial servicing, and instrumentation calibration.

### Performance Test: Test or tests performed in the presence of the Consultant, the Region after any required successful five day water test, to demonstrate and confirm that the equipment and/or system meets the specified operational performance requirements, while simulating actual operating conditions to the greatest extent possible, with wastewater and/or sludge as required by the equipment and/or system, including but not limited to, noise, vibration, alignment, speed, proper electrical, instrumentation and control, mechanical connections, thrust restraint, proper rotation, initial servicing, and instrumentation calibration.

### Pre-purchased Equipment Vendor: The party under separate contract with the Owner to furnish products or special services.

### Site Acceptance Test (SAT): The term, as used in the individual Specification Sections, which refers to specified testing performed on specified equipment at the Region’s designated Site following shipment and installation to replicate the FAT tests performed at the manufacturer’s facility.

### Source Quality Control: Term, as used in the individual Specification Sections, which refers to specified testing performed on specified equipment at the manufacturer’s facility prior to shipment.

### System: The overall process, or a portion thereof, that performs a specified function. A system may consist of two or more subsystems as well as two or more types of equipment.

### Transition Plan: Description which details the progression of installation tasks, bringing new equipment online, and de-commissioning old equipment such that the impact on operations is minimized and the continued safe operation of the facility is assured

### Unit Process: As used in this Section, a unit process is a portion of the facility that performs a specific process function, such as HVAC, plumbing, filtration (component of the water treatment process) or pump station.

## Measurement and Payment

.1 All costs associated with the work of this Section shall be included in the price for Item No. *[insert Item No]* in the Bid Form.

.2 Payment for the work outlined in this Section shall be made according to the Region’s estimate of the percentage of the total amount of work completed for each item below:

*[Modify the payment list based on the payment requirements for your project]*

#### Pre-commissioning documentation submittal (Section 3.1 Pre-Commissioning Documentation Submittal)

#### Functional Testing (Section 3.2 Functional Testing)

#### Five Day Water Testing (Section 3.3 Five Day Water Testing)

#### 14-Day Performance Testing (Section 3.5 14-Day Performance Testing)

#### 45-Day Operation Testing (Section 3.6 14 Day Performance Testing)

## Systems

### *[The Consultant shall list here all systems to be commissioned.]*

### [Insert System 1 here]

### [Insert System 2 here]

### [Continue …]

## Quality Assurance

### The Contractor shall provide authorized and qualified manufacturer-approved representatives to inspect equipment installation prior to functional tests and to supervise the placing of equipment into operation as required through-out the phases of commissioning described within this Contract Document.

### The Contractor’s checkout, functional tests, Five Day water test, Performance Testing, and Facility Commissioning (Operational Testing) shall be witnessed by the Region’s Project Manager, the Consultant, and the Region’s Operation Maintenance and Monitoring Staff.

## Contractor’s Responsibilities

### The Contractor shall attend all testing and commissioning meetings.

### The Contractor shall coordinate and ensure that all applicable regulatory agency inspections to be conducted by the Technical Standards and Safety Authority, Electrical Safety Authority, Canadian Gas Association, *[Consultant to enter additional applicable agencies, i.e. applicable hydro agency]* are completed and that reports from these agencies are submitted to the Consultant a minimum of five Working Days prior to functional testing.

### The Contractor may not progress to an advanced phase of testing and commissioning prior to the satisfactory completion and close-out of the previous phase of testing and commissioning as deemed by the Consultant, including delivery and acceptance of all submittals listed below under each phase of testing and commissioning unless otherwise directed by the Consultant and the Region.

### The Contractor shall complete the installation of each unit and related processes before testing, including all related manufacturer’s representative services.

#### Provide the services of a senior mechanical engineer or technician for testing and commissioning of all mechanical equipment.

#### Provide the services of a senior electrical/instrumentation engineer, or technician, or programmer for testing and commissioning of all electrical equipment and manufacturer’s control panels with an integrated PLC program that controls the manufacturer’s equipment.

### The Contractor shall coordinate the testing and commissioning of equipment and systems with the Consultant, equipment supplier, Subcontractors, Other Contractor(s), the Region’s Project Manager and the Region’s Operations Maintenance and Monitoring Staff.

### The Contractor shall provide the services of qualified manufacturer’s representatives to assist in testing.

### The Contractor shall assist the equipment supplier to repair each system, equipment, and device as required throughout the testing and commissioning process.

### The Contractor shall cooperate with all parties involved and provide access to equipment and systems. The Contractor shall operate systems only at designated times and under the required conditions.

### Under no circumstance shall the Contractor operate a live system which is pushing water to a distribution system in a water application or collecting water in wastewater application.

### The Contractor shall provide written notification to the Consultant a minimum of 30 Working Days in advance of start-up, testing, and reliability demonstration activities.

### The Contractor shall designate and furnish one or more members of the Contractor’s personnel to coordinate and expedite testing and facility commissioning. Such person(s) shall be present during the equipment testing and facility commissioning meetings specified in Section 01200 – Project Meetings, and shall be available at all times during functional testing, five day water testing, performance testing, and the facility commissioning period. The Consultant will also designate a person to interface with the Contractor’s designated person. The Contractor shall coordinate all testing and commissioning activities with the Consultant’s designate. The Region’s Project Manager will also designate a person to interface with the Consultant’s and Contractor’s designates.

### The Contractor shall provide temporary valves, gauges, test equipment and other materials and equipment required to conduct testing. Unless otherwise indicated in the Contract Documents, the Contractor shall provide water, air, inert gases and chemicals as required for testing and facility commissioning.

### The Contractor shall provide related operating and equipment maintenance manuals, and spare parts and special tools as specified in the Contract Documents before testing any unit or system.

### The Contractor shall provide a minimum of two members of the Contractor’s staff who are trained and certified for confined space entry for activities in confined space locations. The Contractor shall provide all necessary confined space entry equipment and certification documentation prior to entry of confined space. The Contractor shall also conform to the Region’s confined space requirements.

### The Contractor shall furnish a listing of recommended lubricants with their designated application used in installation testing, a minimum of 21 Working Days prior to the scheduled startup and testing. All lubricants shall be compatible with the lubricants presently used in the Region’s maintenance operations.

### The Contractor shall complete the following pre-requisite tasks prior to any start-up of any piece of equipment or system: Functional Checkout, calibration, and training on instrumentation and control equipment; instruction of the Region’s operations staff on operation and maintenance, in accordance with Section 01820 – Demonstration and Training; and receive approval from the Consultant for start-up.

### Through-out the testing and commissioning periods, the Contractor shall provide local on-call staff during all shifts to supervise, troubleshoot, and/or repair the equipment. The Region will provide one operator per shift to work with the Contractor during operation of facilities. The Region’s Operations, Maintenance and Monitoring staff will meet all applicable licensing requirements for operating the facility. Prior to initiation of the start-up and commissioning period, the Contractor shall instruct the Region’s operations staff on operating procedures for equipment and systems supplied by the Contract as part of the training required by Section 01820 – Demonstration and Training. The Contractor shall provide a day-by-day schedule of all commissioning activities a minimum of 40 Days prior to any equipment start up to allow the Region to allocate staff for the commissioning process.

### The Contractor shall supply grease, oil, fuel and power, as required for the initial operation of the equipment.

### The Contractor shall rectify deficiencies discovered during pre-start health and safety reviews at no change to the Contract Price or Contract Time. The pre-start health and safety review will be done in accordance with the requirements of the Ontario Health and Safety Act and also in accordance with Section 01351– Health and Safety. The Contractor shall obtain a pre-start health and safety review certificate stating that the installation of the equipment has been inspected and that the equipment is safe for operation in accordance with the Ontario Health and Safety Act. If additional pre-start health and safety reviews of the system or equipment are required as a result of the Contractor’s Work being incomplete or deficient, the Contractor shall pay for the cost of additional reviews.

## Owner’s Responsibilities

### See Section 01040 – Coordination for operational services provided by the Region.

## Testing and Commissioning Group

### A Testing and Commissioning Group including the following members shall be formed:

#### Consultant Project Manager and Technical Staff;

#### Region’s Project Manager and Construction Staff;

#### Region’s Operations, Maintenance and Monitoring Representatives including SCADA/PCS representatives;

#### Contractor’s Representative(s), including Contractor’s Project Manager and/or Field Superintendent;

#### Sub-contractor’s Representatives as appropriate; and

#### Others as requested by the Consultant.

### The Testing and Commissioning Group shall be responsible for the planning and the implementation of the start-up process, including but not limited to, the following tasks:

#### Clarification of individual systems subject to start-up and the components that make-up each system;

#### Review the sequence of testing and commissioning of new/modified systems and decommissioning of any existing equipment and systems within the requirements of the Contract Documents;

#### Review the Contractor’s initial testing and commissioning schedule, plan, and subsequent revisions;

#### Clarification of the Consultant’s and the Contractor’s responsibilities as defined within the Contract Documents and as they pertain to system and equipment testing and commissioning;

#### Coordination of testing and commissioning with existing operations;

#### Responding to problems in the start-up of systems or equipment by investigating the cause and symptoms, determining responsibility, making recommendations for action, and overseeing the implementation of action;

#### Determining acceptance of systems and equipment; and

#### Other testing and commissioning issues as identified by the Consultant.

## Administrative Submittals:

### The Contractor shall prepare and submit to the Consultant for approval all administrative submittals listed below in subsection 3.1 - Pre-Commissioning Documentation Submittal prior to the commencement of any start-up or commissioning activity. All items shall be submitted in a format acceptable to the Consultant and the Region.

### *[Consultant to list additional submittals required for specific project outside of what is listed in Section 3.1 Pre-Commissioning Documentation Submittal]*

#### *[List items]*

## Quality Control Submittals:

### The Contractor shall prepare and submit to the Consultant for approval all Quality Control submittals listed below in subsection 3.1 - Pre-Commissioning Documentation Submittal prior to any start-up or commissioning activity. All items shall be submitted in a format acceptable to the Consultant and the Region.

### In addition to the submittals listed below, the Contractor shall submit to the Consultant all documentation, test reports, affidavits and other documentation cited in the AWWA Standards referenced in the relevant Specification Sections pertaining to the equipment.

## Testing and Commissioning Schedule and Plan

### The Contractor shall prepare and submit to the Consultant and the Region for approval all Testing and Commissioning Schedule and Plan submittals listed below in subsection 3.1 - Pre-Commissioning Documentation Submittal prior to initiation of any start-up or commissioning activity. All items shall be submitted in a format acceptable to the Consultant.

### The Contractor shall prepare and submit five copies to the Consultant the testing and commissioning plan a minimum of 40 Days prior to the start of related testing for approval by the Consultant. The Contractor shall revise the schedule based on the Consultant’s review and resubmit five copies of the approved schedule a minimum of 20 Working Days prior to the start of testing. The testing and commissioning plan shall describe, in detail, the proposed testing and commissioning procedures for each piece of equipment and each system during Functional Testing, the Five Day Water Test, Performance Testing, and Operational Testing (including expected performance, operation range of each tested equipment as specified in individual specification sections). The Contractor shall include all supporting documentation listed below in subsection 3.1 - Pre-Commissioning Documentation Submittal as appendices to the commissioning.

### The Contractor shall provide five copies of the proposed Factory Acceptance (FAT), and Site Acceptance (SAT) Test schedules and plans a minimum of 40 Working Days prior to the start of related testing for approval by the Consultant, including co-ordination with and acknowledgement of the Contractor’s schedule, showing Factory (FAT), Site (SAT) and Test schedules, test plans, procedures and log format. Revise schedule and plan based on Consultant’s review and re-submit five copies of the approved schedule and plan along with the commissioning plan.

### The Contractor shall include all supporting documentation listed in subsection 3.1 - Pre-Commissioning Documentation Submittal as appendices to the commissioning plan. The Contractor shall prepare and submit to the Consultant a testing and commissioning schedule showing the sequence of testing and commissioning. At a minimum, the Contractor shall include the following in the schedule:

#### Each system and major piece of equipment to be started up;

#### For each system, the Contractor shall include a detailed description, date and time of testing and commissioning activities for the following work items in daily stages: Functional Testing, Five-Day Water Testing, Performance Testing, Operational Testing, Constraints, equipment to be decommissioned, temporary systems, and any other factors that may impact upon testing and commissioning;

#### Schedule of operator training (training to be completed prior to commencement of Performance Testing); and

#### The Contractor shall provide the names of the Contractor’s personnel, Sub-contractor(s), manufacturer(s), or organization(s) proposed to perform the services, and documentation to confirm their qualifications.

## Commissioning Binder

### The Contractor shall maintain an organized and up-to-date commissioning binder on-Site inclusive of all documentation related to commissioning. At a minimum, the binder shall contain the commissioning plan, schedule, and all supporting documentation listed in subsection 3.1 - Pre-Commissioning Documentation Submittal.

## Commissioning Checklist and Sign-off form

### The Commissioning Sign-off Form (contained in Section 01810A Equipment Testing and Facility Commissioning Forms) will track the status of deliverables of each phase of commissioning, and approve progression through phases of the commissioning process. The Consultant shall keep the checklist up-to-date throughout the duration of the project. Sign-off is required from the Consultant, the Region Project Manager, and the Region Team Lead to close out any commissioning phase. Review of the Commissioning Sign-off Form shall be an agenda item on each project meeting. Prior to the commencement of any testing or commissioning activities, submit the Commissioning Sign-off Form to the Region for review and demonstrate that all required documentation have been submitted.

# PRODUCTS (NOT USED)

# EXECUTION

## Pre-Commissioning Documentation Submittal

*[Consultant to ensure that any below referenced attachments, forms, or appendix documents to be provided by the Consultant/Region are included in the Contract]*

### The Contractor shall prepare and submit to the Consultant for review and approval all items listed below before proceeding with any testing or commissioning activity. The Consultant will review and approve the submittals and provide recommendations to the Region.

### The items below shall form the Commissioning Plan:

*[Consultant to remove or add additional items]*

#### List of systems to be commissioned

#### Detailed list of installed equipment (including manufacturer and model number)

#### All applicable items on the 01810A-00 Pre-Commissioning Documentation Checklist

## Functional Testing

### Following the submittal of all documentation listed above in subsection 3.1 - Pre-Commissioning Documentation Submittal by the Contractor, and following review and approval of all documentation by the Consultant, the Consultant will direct the Contractor to advance to the Functional Testing phase.

### The Contractor shall complete the tasks below under the Consultant’s supervision. The Consultant will not allow the Contractor to start equipment prior to the completion of the tasks stipulated below.

### *[The Consultant shall review and revise the tasks listed below to suit the scope of this Contract.]*

#### Inspect and clean all equipment, instruments, devices, connected piping, structures, and the facility to ensure that they are free of dirt and debris.

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

#### Inspect valves, adjust as necessary. Clean bonnets and stems. Tighten packing glands to ensure no leakage while permitting valve stem to function without galling.

#### Test piping for leaks throughout the facility.

#### Ensure bases of all equipment are true and level.

#### Inspect all equipment for cracks or damaged parts. Inspect the correctness of the equipment settings and the relative arrangement of all components of the system.

#### Inspect bearings and verify alignment. Clean and remove all foreign matter.

#### Lubricate all equipment according to the manufacturer’s instructions.

#### Where possible, turn rotating equipment by hand to verify that the equipment is not seized.

#### Retain and calibrate testing equipment in accordance with the manufacturer’s instructions.

#### Adjust all equipment clearances and torque settings according to manufacturer’s instructions.

#### Adjust tension, alignment, and equipment speed on belt and variable pitch sheaves drives according to manufacturer’s instructions.

#### Ensure drive rotation, equipment speed, control sequence, and all other conditions comply with manufacturer’s specifications and will not cause damage.

#### Inspect, adjust, calibrate, and balance equipment and systems to ensure that they are fully operational. Retain and utilize all instruments required to do so.

#### Test electrical equipment to verify that meter readings and specific electrical characteristics, including motor amperage, comply with the manufacturer’s specifications.

#### Verify that monitoring, interlocks and manual control operate via the Operator Interface workstations throughout the facility.

#### Test and verify that controls are operational in both automatic and manual modes, and that all local and remote control points are fully functional.

#### Confirm that all programming and setup installation of Process Control Systems are complete. Provide the services of a senior electrical/instrumentation engineer or programmer from the equipment manufacturer for this testing and confirmation of programming.

#### Confirm that the wiring and support systems for equipment installed under separate contracts have been inspected and are completely operational.

### The Contractor shall complete the Installation and Start-Up Check-out/Verification/Test Report forms provided in Section 01810A – Equipment Testing and Facility Commissioning Forms for each piece of equipment. Project specific forms will be issued by the Consultant to the Contractor prior to start-up. All parties are to complete and sign the respective forms. The Contractor shall provide five copies of each completed form to the Consultant for review and approval. The forms are a minimum and additional forms are to be provided as required by the Consultant to cover all equipment included under the contract. The Contractor, with assistance from the equipment supplier, shall provide written documentation of all tests not covered by the forms listed below to the Consultant for review.

### The Consultant shall prepare and provide to the Contractor project specific forms to cover all equipment types. Forms are provided in Section 01810A-– Equipment Testing and Facility Commissioning Forms.

### Reporting Requirements

#### The Contractor shall submit all reporting requirements listed below to the Consultant for review and approval:

#### In addition to the test reports specified above, the Contractor shall submit the signed report prepared by the supplier’s representative describing, in detail, the findings of the pre-startup inspection, tests and adjustments made, quantitative results and suggestions for precautions to be taken for correct maintenance, if any.

#### Manufacturer’s certificate of proper installation, stating that the installation of the equipment has been inspected, is installed in accordance with the instructions, has been started and adjusted as necessary, is ready for operation, and is in warranty condition (See Section 01640 – Manufacturer’s Services).

#### Completed copies of manufacturer’s start-up log sheets

#### Completed copies of checkout/verification/test report forms for all equipment

#### Written documentation of all tests not covered by forms.

## Five Day Water Testing

### [The Consultant shall determine the need for the following testing procedures and revise the Section accordingly with the approval of the Region’s Project Manager. The Consultant shall review and revise the tasks listed below to suit the scope of this Contract]

### Ready-to-test determination will be reviewed and approved by the Consultant, and based on full compliance with the following:

#### Submission of all reporting requirements described above to close out the Functional Testing phase.

#### Notification by the Contractor of equipment readiness for testing.

#### Adequate completion of Work adjacent to, or interfacing with, the equipment to be tested.

#### Availability and acceptability of a manufacturer’s representative, when specified in the Contract Documents, to assist in testing of respective equipment.

#### Fulfillment of all other specified manufacturer’s responsibilities.

### General

#### The Contractor shall complete the tasks listed below under the Consultant’s supervision. The Consultant will not allow the Contractor to advance to the 14-Day Performance Testing phase prior to successful completion of the tasks stipulated below and submission of all reporting requirements.

#### The five Day water testing shall not be initiated until the equipment, system or facility meets the functional test requirements specified in the Contract Documents.

#### The Contractor shall provide testing that simulates the actual (or expected) operating conditions with the use of water, inert gas, air, etc., to simulate flows, operating pressure and other control parameters.

#### The Contractor shall provide all necessary equipment, devices, temporary systems, test medium and all other components (as required) to perform the five Day simulated testing.

#### The Contractor shall supply all special tools and accessories required for the repair and adjustment of each piece of equipment. All tools and accessories shall be turned over to the Region.

#### The Contractor shall have the Contract Documents, approved shop drawings, Product data, and operation and maintenance data on hand throughout the entire start-up and testing period.

#### The Contractor shall place equipment into operation in the appropriate sequence.

#### The Contractor shall check-out and start-up each piece of equipment (or system) only under the direct supervision of a responsible, qualified and approved manufacturer’s representative.

#### The Contractor shall correct or replace any equipment or materials failing the tests/simulation conducted.

#### In the event the materials supplied and/or Work fails to meet the requirements of the Specification Sections, the Contractor shall perform additional testing at no expense to the Region. The Contractor shall also provide additional services for inspection and start-up to meet the requirements of the Contract Documents at its own cost.

#### If, in the opinion of the Consultant and Region, the facility (or system) meets the five Day water testing requirements specified in the Contract Documents, the facility (or system) shall be accepted as compliant and the Contractor will be permitted to advance to the performance testing phase. If, in the sole opinion of the Consultant and/or Region, the five Day water testing results do not meet the requirements specified in the Contract Documents, the systems shall be considered as non-compliant.

#### In the instance of any significant interruption of operation during the five Day test (as defined below), the testing will be stopped immediately. The Contractor shall correct the deficiencies encountered and restart the simulated test for another five Days of continuous uninterrupted operation.

### Five Day Water Test

#### Following the demonstration of all systems and subsystems as specified above under the functional testing phase, the Contractor shall fill each system with the intended process fluids, except for wastewater, sludge and other wastewater systems.

#### All potable water, oil, air, and chemical systems shall be filled with the specified fluid.

#### Wastewater process systems shall be filled with potable water for testing purposes.

#### The Contractor shall install temporary connections, bulkheads and make other provisions to re-circulate process fluids or otherwise simulate anticipated operating conditions for a continuous five Day period.

#### All tests shall commence only on a Monday.

#### During the water testing period, the Contractor’s representatives shall monitor the characteristics of each machine according to manufacturer information and specifications and report any unusual conditions to the Consultant.

#### The Contractor shall provide temporary pumps to complete the tasks.

#### If the demonstration is not successful, reschedule a new five day test to start on a Monday.

#### The Contractor shall obtain all necessary permits from the applicable regulating bodies to allow for the temporary withdrawal and discharge of water if this demonstration procedure requires the withdrawal and discharge of water.

#### Submit operational test results to the Consultant within 15 Days from the end date of the successful test.

#### The Contractor shall place all items of equipment installed under the Contract into operation, along with related piping and metering systems.

#### Without exception, all rotating equipment shall be checked, witnessed by the Consultant and Region Operations, Maintenance and Monitoring staff, and tested for (submit all test results to the Region):

##### .1 Vibration level:

###### Vibration level shall be within the specified limit.

###### The peak vibration velocity shall not exceed 1mm/sec (0.04 inches/sec) measured in the filter-in mode.

###### The vibration level is to be measured and reported for both filter-in and filter-out modes.

###### The Contractor shall provide a hardcopy of the Vibration Signature Spectrum showing vibration velocities over a frequency range of 0 to 2000 Hz, measured in filter-in and filter-out modes.

###### Include this in each set of the Maintenance Manuals.

##### .2 Noise level: Noise level shall be within the specified limit indicated in the Specification Sections for each item of equipment.

##### .3 Initial winding analysis report *[To be within specified limit determined by the Consultant. Consultant to insert additional information]*

#### For Control Loop Checkout/Verification, arrange with the electrical, instrumentation and control Subcontractors for the testing of loop wiring between instrument and field devices. Coordinate with the Consultant for the Consultant’s attendance during control loop tests.

#### Perform the testing of instrumentation loops for each loop in sequence and in groups. Instrument and loop testing will be graded on a pass/fail basis. Should more than two instrument loops within a group fail the loop checkout, then the entire group of loops will be deemed to have failed the checkout. The failed loops shall be repaired and the entire group must be retested.

#### All operational features and controls shall be demonstrated to function in both manual and automatic modes, where applicable. All local and remote control points shall be demonstrated to be functional.

#### Five Day water testing of the system, the entire facility, or any portion thereof shall be considered complete when, in opinion of the Consultant, the system, facility or designated portion has operated in the manner intended for five continuous Days without significant interruption. Significant interruption shall include any of the following events:

##### Failure of the system, facility, or any portion thereof to meet the specified performance criteria for more than two consecutive hours.

##### Failure of any critical equipment or unit process that is not satisfactorily corrected within five hours from the initial time of failure.

##### Failure of any non-critical equipment or unit process that is not satisfactorily corrected within eight hours from the initial time of failure.

##### Any event deemed by the Consultant, at its sole discretion, to be a significant failure.

##### Failure of the Contractor to provide and maintain qualified on-site start-up personnel as scheduled.

#### Refer to Division 13 for additional information and requirements related to process instrumentation and control systems.

### Reporting Requirements

#### The Contractor shall submit all reporting requirements listed here to the Consultant for review and approval. Forms are included as a supplement at the end of this Section.

#### The Contractor shall complete the Consultant’s Standard Installation/Start-up Checkout Forms.

#### Vibration signature spectrums from rotating equipment.

#### Initial winding analysis report.

#### Water testing report (inclusive of any deficiencies noted during water testing).

#### Post-water test inspection results.

## Training

### The Contractor shall provide equipment specific training in the field for Region Operations, Maintenance and Monitoring Staff prior to the equipment being placed into service by the Region (that is, prior to 14-Day Performance Testing).

### Reporting Requirements

#### The Contractor shall submit all reporting requirements listed here to the Consultant for review and approval. Forms are included as a supplement at the end of this Section.

#### Completed Contractor/Supplier Training Sign-Off forms.

## 14-Day Performance Testing

*[The Consultant shall determine the need for the following testing procedures and revise the section accordingly with the approval of the Project Manager. The Consultant shall review and revise the tasks listed below to suit the scope of this Contract.]*

### General

#### The Contractor shall complete the tasks listed below under the Consultant’s supervision. The Consultant will not allow the Contractor to advance to the 45-Day Operational Testing phase (facility commissioning) prior to successful completion of the tasks stipulated below.

#### During performance testing, each system shall be operated continuously for 14 Days as a complete facility. In the instance that the operation is halted for any reason related to the facilities constructed or the equipment furnished, the performance testing program must be restarted and repeated until the fourteen day continuous period has been reached without interruption.

#### All defects encountered during the performance testing period must be corrected or the specific component or entire piece of equipment shall be replaced by the Contractor to the complete satisfaction of the Region at no added cost to the Region.

#### Performance testing shall not commence until the equipment, system or facility has been accepted by the Consultant and Region as having satisfied the five Day water test requirements as specified in the Contract Documents.

#### The Contractor shall arrange for and provide classroom and field training by the equipment Supplier(s) prior to commencing the performance testing period.

#### The Contractor shall follow the approved performance testing plan and detailed procedures specified in the Contract Documents.

#### The Contractor shall provide all labor, materials, and supplies for conducting the performance testing and taking all samples and performance measurements.

#### The Region (at their discretion) may conduct independent testing to verify test results. If through the independent testing, the testing fails, the Contractor shall correct all deficiencies and retest at their own cost.

#### Routine sampling and analytical laboratory work required during performance testing will be performed by the Region Operations, Maintenance and Monitoring Staff.

#### Performance testing of the system, the entire facility, or any portion thereof shall be considered complete when, in the sole opinion of the Consultant, the system, facility or designated portion has operated in the manner intended for fourteen continuous days without significant interruption. Significant interruption shall include any of the following events:

##### Failure of the system, facility, or any portion thereof to meet the specified performance criteria for more than two consecutive hours.

##### Failure of any critical equipment or unit process that is not satisfactorily corrected within five hours from the initial time of failure.

##### Failure of any non-critical equipment or unit process that is not satisfactorily corrected within eight hours from the initial time of failure.

##### Any event deemed by the Consultant, at its sole discretion, to be a significant failure.

##### Failure of the Contractor to provide and maintain qualified on-site start-up personnel as scheduled.

### Performance Testing

#### Following successful completion of the five Day water test and submission of all reporting requirements to close out the five Day water testing phase, the Contractor shall place the new, refurbished and/or reconstructed Work into operation starting on a designated Monday under supervision of the Consultant. For a 14 continuous Day period, the Region will operate the facility. The Contractor shall have supervisory personnel, mechanics, electricians, instrument technicians and other workmen on Site during the normal working day and as required at other times to ensure the safe continuous operation of the facility (as specified by the Consultant). During other times, the Contractor shall have the above personnel on call to perform any adjustments and/or corrections required. In the event the facility, system, or any portion thereof does not perform satisfactory for 14 continuous Days, continue with the program until the operation of the work is satisfactory or reschedule a new 14-Day performance testing program.

#### Equipment shall be operated using initially simulated interlock and alarm signals, where necessary, to check functionality.

#### Loop checks shall be completed from field instruments by simulated or quantifiable process inputs to terminals in the local control panel for interface with the remote PLC. The Contractor shall provide further calibration of field instruments, as required.

#### The performance testing shall demonstrate that all operational features and controls function in both manual and automatic modes, where applicable, and that all local and remote control points are functional.

#### The performance testing shall include verification of the following performance criteria:

##### Acceptable operation of the equipment/system including control devices and safety systems for the available control modes of operation.

##### Trending of monitored process variables and equipment parameters, as appropriate.

##### Adequate system responses to simulated abnormal/emergency conditions, including, but not limited to, localized power failure and specific hardware failure.

### Reporting Requirements

#### The Contractor shall submit all reporting requirements listed below to the Consultant for review and approval:

#### Upon satisfactory completion of performance testing for each piece of equipment, submit to the Consultant, the Manufacturer’s certificate of successful operation for each piece of equipment stating that the equipment is installed correctly, is in full operating condition, is operating in accordance with its design rating, and is in warranty condition. Submit the original certificates to the Consultant (See Section 01640 – Manufacturer’s Services);

#### Completed performance testing forms;

#### Performance testing report (inclusive of any deficiencies noted during performance testing); and

#### Post-performance test inspection results.

## 45-Day Operational Testing (Facility Commissioning)

*[The Consultant shall determine the need for the following testing procedures and revise this subsection accordingly with the approval of the Region’s Project Manager. The Consultant shall review and revise the tasks listed below to suit the scope of this Contract.]*

### General

#### The Consultant will not allow the Contractor to initiate the operational testing phase until successful completion of the performance testing phase, including submission of all reporting requirements listed above.

#### The Contractor shall complete the tasks below under the Consultant’s supervision. The Contract will not be considered for Substantial Performance of the Work until the tasks stipulated below are complete.

#### The operational testing (commissioning) of the facility is designated as the successful completion of a continuous 45 Day period of operation without significant interruption under the expected process conditions within the design boundaries.

#### Operational testing shall include verification of all performance criteria defined above under performance testing phase.

#### The Contractor shall remove, clean and replace all permanent and temporary filters and strainers in all pipeline systems; replace all HVAC filters; dewater and clean all sumps; and dewater all process units for final inspection as a condition precedent to commissioning. Areas to be commissioned shall be completely cleaned prior to turning over to the Region.

#### In the instance that a significant interruption occurs during the facility commissioning period, the operational testing shall be stopped immediately. The Contractor shall correct the required deficiencies and restart the facility commissioning test for another 45 Days of continuous operation. Significant interruption shall include any of the following events:

1. Failure of the system, facility, or any portion thereof to meet the specified performance criteria for more than two consecutive hours.
2. Failure of any critical equipment or unit process that is not satisfactorily corrected within five hours from the initial time of failure.
3. Failure of any non-critical equipment or unit process that is not satisfactorily corrected within eight hours from the initial time of failure.
4. Any event deemed by the Consultant to be a significant failure.
5. Failure of the Contractor to provide and maintain qualified on-site start-up personnel as scheduled.

#### The Contractor shall have supervisory personnel, mechanics, electricians, instrument technicians and other workmen on Site during the normal Working Day and as required at other times to ensure the safe continuous operation of the facility. During any other time throughout the operational testing period, the Contractor shall have the above listed personnel on call to attend to any adjustments and corrections as required.

#### The newly constructed works shall not be deemed to be Substantially Performed until successful completion of facility commissioning.

### Reporting Requirements

#### The Contractor shall submit all reporting requirements listed below to the Consultant for review and approval:

#### .1 Completed operational testing forms;

#### .2 Operational testing report (inclusive of any deficiencies noted during operational testing);

#### .3 Start-up and commissioning report; and

#### .4 Consultant’s report on operation of the facility.

## Post-Commissioning Documentation Submittal

### 45 Day Operational testing results

### Pressure testing results

### Copies of manufacturer’s certificates of proper installation (records)

### Copies of manufacturer’s certificates of successful operation (records)

### Copies of manufacturer’s start-up log sheets (records)

##### Copies of checkout / verification / test report forms for all equipment types (records)

##### Sample forms for documenting results of 5-day water test (records)

##### Shutdown request form

##### Shutdown permit to work

**END OF SECTION**

The forms referenced throughout this Section can be found in Section 01810A – Equipment Testing and Facility Commissioning Forms.