METROLINX

Mechanical Work Commissioning Specification

Specification 20 05 40

Revision 01

September 2025

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Metrolinx,

an Agency of the Government of Ontario

Amendment Record Sheet

Amendment in Clause No.	Date of Amendment	Description of Changes
1.4.3. a) 4)	September 2025	Revised paragraph to read: "complete test sheets and attach to the Certificate of Readiness" for clarity.

Contents:

1. GENERAL

1.1. SCOPE OF WORK

1.1.1. Commission work in accordance with requirements of this Section and as required by Consultant, Commissioning Agent (CxA) and outlined in Commissioning Plan.

1.1.2. Involvement of Commissioning Agent performing duties as described in this Section is not in any way to void or alter any Contractual warranty obligations.

1.1.3. This Section specifies commissioning requirements that are common to Mechanical Divisions Work Sections, and it is a supplement to each Section and shall be read accordingly.

1.1.4. Retain services of a qualified Commissioning Agent to provide following commissioning objectives:

a) Prepare Commissioning Plan aligned with Metrolinx Commissioning Plan and project closeout documents;

b) To support quality management by means of monitoring and checking installation;

c) To verify equipment/system performance by means of commissioning of completed installation; and

d) To move completed equipment/systems from "static completion" state to "dynamic" operating state to transfer a complete and properly operating installation from Contractor to Metrolinx.

1.1.5. Prerequisites to successful completion of commissioning:

a) Submittal of signed start-up and test reports;

b) Completion of system testing, adjusting, and balancing (TAB), and acceptance of TAB reports;

c) Permanent electrical and control connections of equipment;

d) Successful completion and documentation of pre-functional performance testing; and

e) Submittal of letters to Consultant certifying systems and subsystems have been started, tested, adjusted, successfully pre-functional performance tested, are ready for functional performance testing, and are in accordance with requirements of Contract Documents.

1.2. RELATED WORKS

1.2.1. Sections of Mechanical Divisions work.

1.2.2. Metrolinx documentation outlining station services commissioning and handover protocol.

1.2.3. Section 01 91 00 Commissioning Requirements

1.3. REFERENCE STANDARDS

1.3.1. Standards and codes shall be latest editions adopted by and enforced by local governing authorities.

1.3.2. ASHRAE Guideline 0, The Commissioning Process.

1.3.3. ASHRAE Guideline 1.1, The HVAC Commissioning Process.

1.3.4. ASHRAE Guideline 1.2, The Commissioning Process for Existing HVAC&R Systems.

1.3.5. ASHRAE Guideline 1.5, Commissioning Smoke Control Systems.

1.3.6. ASHRAE Handbook – HVAC Applications Chapter 44 HVAC Commissioning

1.3.7. ASHRAE 202 – Commissioning Process for Buildings and Systems

1.3.8. ASHRAE Guideline 4 – Preparation of O&M Documentation

1.3.9. CAN/CSA B139, Installation Code for Oil-Burning Equipment.

1.3.10. CAN/CSA B149.1, Natural Gas and Propane Installation Code.

1.3.11. CAN/CSA B149.2, Propane Storage and Handling Code.

1.3.12. CAN-ULC-S1001 - Standard for Integrated Systems Testing of Fire Protection & Life Safety Systems

1.3.13. CSA Z320, Building Commissioning Standard and Check Sheets.

1.3.14. CSA C282 – Emergency Power Supply for Buildings

1.3.15. NFPA 3 Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems

1.3.16. NIBS Guideline 3 – Building Enclosure Commissioning Process

1.3.17. ANSI/NETA ECS - Standard for Electrical Commissioning Specifications for Electrical Power Equipment and Systems

1.3.18. ANSI/NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.3.19. ASTM E783 - Standard Test for Field Measurement of Air Leakage through Installed Exterior Windows and Doors

1.3.20. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

1.3.21. CaGBC LEED-NC Reference Guide

a) LEED EAp1: Fundamental Commissioning and Verification

b) LEED EAc1: Enhanced Commissioning

1) Option 1. Path 2: Enhanced and Monitoring-Based Commissioning

2) Option 2. Envelope Commissioning

1.4. SUBMITTALS

1.4.1. Refer to submittal requirements in Section 20 05 05.

1.4.2. Submit copies of Commissioning Agent qualification credentials.

1.4.3. Commissioning Package

a) Submit the following:

1) Commissioning Plan;

2) Commissioning Procedures;

3) Certificate of Readiness;

4) complete test sheets and attach to the Certificate of Readiness; and

5) Source Quality Control inspection and test results attached to the Certificate of Readiness.

1.4.4. Commissioning Closeout Package

a) Submit the following:

1) Deficiency Report;

2) Commissioning Closeout Report; and

3) Submit the following for each Product for incorporation into the Operation and Maintenance Manuals:

i) Identification: manufacturer's name, type, year, serial number, number of units, capacity, and identification to related systems;

ii) Functional description detailing operation and control of components;

iii) Performance criteria and maintenance data;

iv) Safety precautions;

v) Operating instructions and precautions;

vi) Component parts availability, including names and addresses of spare part suppliers;

vii) Maintenance and troubleshooting guidelines/protocol;

viii) Product storage, preparation, handling, and installation requirements; and

ix) Commissioning Report.

1.4.5. Submit to Commissioning Agent, at same time as submittal to Consultant, copies of each shop drawing or product data sheet associated with equipment or systems shall be commissioned.

1.4.6. Submit for review, a Commissioning Plan with schedule, commissioning procedures for commissioning events, and a copy of Commissioning Agent's commissioning data sheets for equipment/systems shall be commissioned.

1.4.7. Submit a list of commissioning instruments and for each instrument, indicate purpose of instrument and include a recent calibration certificate.

1.4.8. Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of 1 month prior to equipment and system start-up procedures.

1.4.9. After start-up and successful prefunctional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter (Certificate of Readiness) confirming prefunctional performance testing has been successfully completed and system or subsystem is ready for functional performance testing and commissioning process to commence.

1.4.10. Submit complete, documented and signed test reports with recorded results test sheets.

1.4.11. Submit close-out documentation, including deficiency lists, with confirmation of deficiencies being corrected.

1.5. QUALITY ASSURANCE

1.5.1. Commissioning work shall be in accordance with requirements of referenced standards and Commissioning Agent.

1.5.2. Commissioning Agent shall meet following qualifications:

a) Be a third-party company to Contractor;

b) Be a member of Professional Engineers Association in Province of the work;

c) Be a member of Building Commissioning Association, and a Certified Commissioning Professional (CCP) as designated by Building Commissioning Association;

d) Have a minimum of five years of successful documented commissioning experience on projects of similar size and complexity as this Project; and

e) Supply a qualified P. Eng. and a Building Commissioning Association Certified Commissioning Professional (CCP) or an ASHRAE Commissioning Project Management Professional (CPMP) on site to supervise commissioning process.

1.6. COMMISSIONING TERMINOLOGY

1.6.1. Commissioning: process of demonstrating to Metrolinx and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, all as further described below.

1.6.2. Commissioning Agent: commissioning authority who shall supervise commissioning process, and who shall recommend final acceptance of commissioned mechanical work.

1.6.3. Start-Up and Adjusting: process of equipment manufacturer's/supplier's technical personnel, with Contractor, starting and operating equipment and systems, making any required adjustments, documenting process, and submitting manufacturer's/supplier's start-up reports to confirm equipment has been properly installed and is operational as intended.

1.6.4. Pre-Functional Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by Contractor, after start-up but before functional performance testing, to confirm components, equipment, systems and/or subsystems operate in accordance with requirements of Contract Documents, including modes and sequences of control and monitoring, interlocks, and responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.

1.6.5. Functional Performance Testing: a repeat of successful pre-functional performance testing by Contractor, in presence of Commissioning Agent and Consultant, with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.

1.6.6. Commissioning Documentation Sheets: prepared sheets for pre-functional performance testing and for functional performance testing supplied by Commissioning Agent for each piece of equipment/system that require commissioning, each sheet or set of sheets complete with Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag in accordance with drawings, and, for each commissioning procedure listed, a column giving expected data in accordance with Contract Documents, a column to fill in observed data during commissioning, and space for signatures of Contractor and Commissioning Agent.

1.6.7. Systems Operating Manual: a manual prepared by Commissioning Agent to present an overview of building mechanical systems and equipment shall be used by building maintenance personnel to assist them in daily operation of systems.

1.6.8. Validate: to confirm by examination and witnessing tests correctness of equipment and system operation.

1.7. TESTING EQUIPMENT

1.7.1. Supply instruments and test equipment required to conduct start-up, testing and commissioning procedures.

2. PRODUCTS

2.1. NOT USED

3. EXECUTION

3.1. COMMISSIONING

3.1.1. Perform commission work in accordance with requirements of this Section and as required by Commissioning Agent and in compliance with standards listed in Part 1including but not limited to CAN/CSA B139, B149.1, B149.2, and Z320, and ASHRAE Guidelines 0, 1.1, 1.2 and 1.5.

3.1.2. Project shall be constructed in phases as described in issued documents. Phase commissioning to align with progress and phases of Work.

3.2. DEFICIENCIES LISTED DURING COMMISSIONING

3.2.1. Commissioning Agent and Consultant to list deficiencies. Contractor to correct deficiencies listed by Consultant and Commissioning Agent during commissioning process within 15 calendar days of notification, unless agreed otherwise with Metrolinx and Consultant. When deficiencies have been corrected, notify Consultant and Commissioning Agent immediately.

3.2.2. Document that each deficiency has been corrected and verified.

3.3. SYSTEMS THAT REQUIRE COMMISSIONING

3.3.1. Mechanical systems that require commissioning include, but not limited to, systems described below. Specific commissioning procedures shall be as directed by Commissioning Agent. Include for applicable requirements from below and supplement to meet any specific project requirements.

3.3.2. Commissioning of drainage systems includes:

a) Commissioning of drainage pumps and controls by means of tests recommended by manufacturer to confirm proper operation and performance; and

b) Commissioning of equipment such as interceptors and backflow preventers.

3.3.3. Commissioning of fire protection systems shall be considered complete upon preparation and submittal by Contractor of completion certificates required by applicable NFPA Standards, demonstration of proper system operation to local Fire Chief and any other authorities, including Metrolinx's insurance underwriter as required, and coordination and cooperation with fire alarm system commissioning procedures, in particular smoke control systems and other such fan system control sequences.

3.3.4. Commissioning of water systems (all piping extended from Municipal main) includes:

a) Commissioning of pumps and controls;

b) Commissioning of water heaters;

c) Commissioning of piping specialties such as backflow preventers, mixing valves, and similar components;

d) Commissioning of trap seal primer units, including adjustment of water flows and confirmation of water flow at each connected trap;

e) Commissioning of plumbing fixtures;

f) Commissioning of well water systems; and

g) Commissioning of septic systems.

3.3.5. Commissioning of compressed air system includes "head end" compressor equipment, pressure reducing equipment, and outlets.

3.3.6. Commissioning of natural gas system includes pressure regulating equipment. Perform commissioning in accordance with requirements of CAN/CSA B149.1, and any supplemental requirements of governing authorities.

3.3.7. Commissioning of propane gas system includes pressure regulating equipment. Perform commissioning in accordance with requirements of CAN/CSA B149.2, and any supplemental requirements of governing authorities.

3.3.8. Perform commissioning of fuel oil system in accordance with requirements of CAN/CSA B139.

3.3.9. Commissioning of heating systems includes piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during heating season, a follow-up site visit during heating season shall be required to confirm proper flows and temperatures, and any required system "fine tuning".

3.3.10. Commissioning of cooling systems includes piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during cooling season, a follow-up site visit during cooling season shall be required to confirm proper flows and temperatures, and any required system "fine tuning".

3.3.11. Commissioning of HVAC chemical treatment systems includes feed and monitoring equipment, and testing of system fluids to confirm proper concentration of chemical. Note that use of such chemical treatment systems is subject to Metrolinx approval (Environmental).

3.3.12. Commissioning of air handling systems includes equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows in accordance with TAB reports.

3.3.13. Control work commissioning includes confirmation of proper operation of individual control components, and overall operation of controls in conjunction with operation of connected building systems, including heating season/cooling season testing requirements specified above, and integrated lighting and occupancy controls.

3.3.14. Control work commissioning includes confirmation of proper operation of equipment and systems connected off-site to remote systems and communications with remote systems.

3.3.15. Commissioning of BAS includes confirmation of proper operation of components, input/output points, hardware and software, and demonstration of system performing required procedures.

3.3.16. Commissioning of special usage room controls includes confirmation of proper operation of individual components, and proper operation of overall control system, all in accordance with governing Codes and Standards.

3.3.17. Commissioning of noise and vibration control equipment includes noise and vibration measurements to confirm proper operation of equipment.

3.3.18. Commissioning of snow-melting systems.

3.3.19. Commissioning of in-floor heating systems.

3.3.20. Perform commissioning of existing systems, revised as part of the Work, to standards as for new systems.

3.3.21. Where equipment is integrated to other equipment (BAS, boilers, etc.) to provide a system with sequence of operations, commission equipment as a complete system to ensure proper sequence of operations.

Perform integrated systems testing for Fire Protection and Life Safety systems in accordance with requirements of CAN/ULC S1001.

3.4. COMMISSIONING PROCESS

3.4.1. Perform commissioning process in stages and include, but not be limited to, following:

a) Stage 1: Commissioning of equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance of the Work and includes supervising and validating results of functional performance testing, and submittal of a reviewed Systems Operating Manual;

b) Stage 2: Commissioning work performed 12 months after issue of a Certificate of Substantial Performance, and which includes supervision of Contractor's "fine-tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions;

c) Stage 3: Successful completion of satisfactory equipment/system operation during 1st month after issue of a Certificate of Total Performance of the Work;

d) Stage 4: Successful completion of satisfactory equipment/system operation during 3rd month after issue of a Certificate of Total Performance of the Work;

e) Stage 5: Successful seasonal commissioning of all building equipment and systems; and

f) Stage 6: Successful 2nd year of warranty period commissioning of all building equipment and systems, similar to process for 1st year.

3.5. RESPONSIBILITIES OF COMMISSIONING AGENT

3.5.1. During construction phase, Commissioning Agent is to:

3.5.2. Plan, organize and implement the commissioning process as specified herein.

a) Review shop drawings for commissioning-related issues, and report any such issues to Consultant;

b) Prepare and issue a Commissioning Plan for review and comments. Revise the commissioning plan accordingly based on review comments;

c) Revise the commissioning plan as required during construction;

d) Prior to tests, supply pre-functional performance test commissioning data sheets for equipment and systems that require commissioning to the Contractor;

e) Monitor and inspect installation at intervals as dictated by the contract throughout construction stages, issue reports identifying any issues which have an impact on commissioning process, and work with project team to expeditiously resolve any problems that arise due to site conditions;

f) Arrange with Contractor for on-site commissioning meetings on an as-required basis, Prepare and distribute meeting minutes to all commissioning team members, including contractor, subcontractors, Metrolinx, and consultants, whether they attended the meeting or not. ;

g) Witness and validate tests, identify deficiencies, and issue progress reports;

h) Monitor system verification checks, and ensure the results are documented as the checks are completed;

i) Monitor controls point-to-point checks done by controls, and ensure the results are documented as checks are completed.

j) Coordinate commissioning, scheduling, and activities with Contractor;

k) Review final TAB report on site with Contractor, and check 100% of TAB results for fan equipment, 100% of TAB results for duct systems outward from fan equipment, and issue a report to Consultant;

l) For smaller multiple items of equipment such as air terminal boxes, fan coil units, backflow preventers, and similar equipment, review completed commissioning data sheets submitted by Contractor and review data sheet information on-site with Contractor for 100% of quantity of each item of equipment;

m) Review pre-functional performance test commissioning data sheets submitted by Contractor, then witness and supervise functional performance testing and supervise and direct commissioning process, validate commissioning procedures, witness completion of commissioning data sheets by Contractor, and sign completed data sheets;

n) Observe select start-ups and initial system operations tests and checks

o) Direct the contractor to operate equipment and systems as required to ensure that all required functional performance tests are carried out for verification purposes;

p) Witness functional performance tests and document the results;

q) Ensure all required O&M manuals, instructions and demonstrations are provided to the Owner’s designated operating staff;

r) Perform a preliminary review of Contractor's O & M Manuals, before they are issued to Consultant, and issue any comments to Consultant;

s) Coordinate, with Contractor and Metrolinx, training and instructions by Contractor and his equipment and system manufacturers/suppliers to Metrolinx's operating and maintenance personnel, and comment on quality of training and instructions to Consultant; and

t) Prepare and issue Systems Operation Manual to Metrolinx prior to equipment and system training by Contractor.

3.5.3. During post-construction phase, Commissioning Agent is to:

a) Prepare and issue final report on commissioning, identifying any deficiencies that remain outstanding. The report shall document all checks and tests done through the commissioning process and the results;

b) Recommend any training and/or instructions shall be given to Metrolinx's operating and maintenance personnel in addition to training and instructions already given;

c) After Substantial Performance of the Work, perform witness system checks and validate documentation by Contractor for each year of 2-year warranty period; for each year perform as follows:

1) Once during 1st month of building operation;

2) Once during 3rd month of building operation;

3) Once between 4th and 12th month of building operation but during a season opposite to 1st or 3rd month visits.

d) Ensure any deficient work resulting from system checks described above are corrected;

E) 1 year after Substantial Performance of the Work, attend a question-and-answer session(s) with Contractor to answer any questions and concerns related to commissioning work from Metrolinx's operating personnel.

3.6. ENGINEER OF RECORD RESPONSIBILITIES

3.6.1. Review the commissioning plan, proposed test procedures, and participate (as appropriate) in on-site commissioning meetings.

3.6.2. At their discretion during the acceptance phase of the commissioning process, be on site to review commissioning documentation, to witness functional performance tests, and to analyze the installation and its performance.

3.7. OWNER'S RESPONSIBILITIES

3.7.1. Ensure the availability of operating staff for all scheduled instructions and demonstration sessions. This staff will possess sufficient skills and knowledge to operate and maintain the installation following attendance at these sessions.

3.8. RESPONSIBILITIES OF CONTRACTOR

3.8.1. During construction phase, Contractor is to:

a) Prepare and submit an installation schedule which includes a time schedule for each activity with lead and lag time allowed and indicated, shop drawing and working detail drawing submissions, and major equipment factory testing and delivery dates;

b) Prepare and submit a commissioning schedule which shall include a time schedule coordinated with installation schedule referred to above, and Commissioning Agent, and allowances for additional time for re-tests as shall be required, and update schedule monthly as required;

c) When requested by Commissioning Agent, arrange site commissioning meetings with Metrolinx, Consultant, and applicable subcontractors present, shall be chaired by Commissioning Agent who shall also prepare and distribute meeting minutes;

d) Promptly correct reported deficient work, and report when corrective work is complete;

e) Where required by Codes and/or Specification, retain equipment manufacturers/suppliers or independent 3rd parties to certify correct installation of equipment/systems;

f) Under supervision of equipment manufacturers/suppliers, start-up and adjust equipment to design requirements, and submit start-up sheets which include equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by equipment manufacturer/supplier and Contractor;

g) Complete Commissioning Agent's commissioning data sheets for multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit sheets to Commissioning Agent, accompany Commissioning Agent for an on-site check of 100% of data sheet information for each type of equipment, and perform any corrective action required because of site checks;

h) Perform system testing, adjusting, and balancing, and when complete, issue a copy of final report to Commissioning Agent for review and a site check of results, and perform any corrective work required because of site checks by Commissioning Agent;

i) In accordance with updated commissioning schedule and actual progress at site, certify in writing to Consultant and Commissioning Agent that equipment and/or systems are complete, have been checked, started, and adjusted, successfully pre-functional performance tested and documented, and are ready for functional performance testing and commissioning procedures, giving Consultant and Commissioning Agent a minimum of 5 working days' notice; and

j) Perform system and subsystem functional performance testing under supervision of Commissioning Agent, and submit to Consultant and Commissioning Agent, completed, and signed functional performance testing and commissioning data sheets (issued by Commissioning Agent) and also signed by Commissioning Agent.

k) Coordinate and be responsible for all subcontractors (Division 20, 21, 22, 23 and 25) as required for commissioning of all Mechanical systems.

l) Provide documentation of all the procedures performed to commissioning team. Written documentation must contain recorded test values of all the tests performed per the individual product specification.

m) Attend all factory witness testing required within the respective specification sections. The subcontractor is responsible to cover all their costs and include them in their bid.

n) Perform tests using qualified personnel. Provide necessary instruments and equipment.

o) Include the cost of commissioning in the contract price, including any retesting due to testing and commissioning deficiencies.

p) Provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of pre-functional and functional testing procedures.

1) This may will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, complete factory testing reports, if any, and complete warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are shipped inside the equipment and the field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent

2) The Commissioning Agent may request further documentation necessary for the commissioning process. This data request may be made prior to normal submittals.

q) Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review

r) Assist (along with the Engineer of Record) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

s) Assist the CxA in preparation of the specific functional performance test procedures. Contractor shall review test procedures to ensure feasibility, safety, and equipment protection, and provide necessary written alarm limits to be used during the tests.

t) Develop a full start-up and checkout plan using manufacturer's start-up procedures and the pre-functional test sheets from the CxA. Submit manufacturer's detailed start-up procedures, the full start-up plan and procedures, and other requested equipment documentation to CxA for review.

u) During the start-up and checkout process, execute and document the mechanical-related portions of the pre-functional test sheets provided by the CxA for all commissioned equipment.

v) Perform and clearly document all completed start-up and system operational checkout procedures, providing a copy to the CxA.

w) Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed-upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

x) Perform functional performance testing under the direction of the CxA for specified equipment to be commissioned. Assist the CxA in interpreting the monitoring data, as necessary.

y) Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Team and retest the equipment.

z) Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

aa) During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts.

bb) Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

cc) Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

dd) Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

ee) Prepare a preliminary schedule for pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.

ff) Notify Commissioning team when pipe and duct system testing, flushing, cleaning, start-up of each piece of equipment and TAB will occur. Be responsible to notify the commissioning team, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

gg) Provide written notification to the commissioning team that the following work has been completed in accordance with the contract documents and the equipment, systems and sub-systems are operating as required:

1) Fire-stopping in the fire-rated construction, including caulking, gasketing and sealing of smoke barriers.

2) Seismic restraints installed to specification; a certification from the seismic restraint engineer meets this requirement.

hh) Start Up of Equipment

1) Follow the start-up and initial checkout procedures listed in the responsibilities list in this Section and in Section 01 91 00. The contractor has start-up responsibility and is required to complete systems and sub-systems, so they are fully functional, meeting the design objectives of the contract documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

2) Prior to the start-up equipment, arrange to have the Manufacturer of all major equipment inspect the installation to ensure their equipment has been installed in accordance with their recommendations

i) The Supplier shall submit a written report of their findings.

ii) Upon confirmation that the equipment has been installed in accordance with the Manufacturers Recommendations, the equipment may be started.

iii) All equipment shall be started by the Manufacturer’s representative.

ii) Pre-Functional Test Sheets

1) Pre-functional test sheet contains items for contractor to perform. On each checklist, a column is provided that is to be completed by the contractor. Those executing the test sheets are only responsible to perform items that apply to the specific application at hand. These test sheets do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant in relation to checkout procedures that will be documented on typical factory field checkout sheets. Double-documenting may be required in those cases.

2) Refer to Section 01 91 00 for additional requirements regarding pre-functional test sheets, start-up and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigour and clarity shall be used pending approval from the CxA.

jj) Provide training of the Owner's operating personnel.

1) Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01 91 00, Part 3.

2) Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, boilers, furnaces, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.

3) Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including start-up, shutdown, fire/smoke alarm, power failure, etc.

4) During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary, and the demonstration repeated.

5) The contractor or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the contractor or manufacturer's representative. Practical building operating expertise, as well as in-depth knowledge of all modes of operation of the specific piece of equipment, is required. More than one party may be required to execute the training.

6) The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate, whenever possible, the use of the O&M manuals for reference.

7) Training shall include:

i) Use of the printed installation, operation and maintenance instruction material included in the O&M manuals;

ii) Use of the System Manual prepared by the CxA;

iii) A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures;

iv) Discussion of relevant health and safety issues and concerns;

v) Discussion of warranties and guarantees;

vi) Common troubleshooting problems and solutions;

vii) Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility; and

viii) Discussion of any peculiarities of equipment installation or operation

8) The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1, latest edition, is recommended

9) Classroom sessions shall include the use of overhead projections, slides, video/audiotaped material as might be appropriate

10) Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment

11) Fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

12) Training shall occur after functional testing is complete, unless approved otherwise by Metrolinx.

13) Record all training sessions and submit the recordings in digital format, labelled and indexed. Maintain and submit training sign-in sheets to accompany the training records.

3.8.2. During post-construction phase, Contractor is to:

a) Optimize system operation in accordance with building occupants' needs and comments using System Operation Manual prepared by Commissioning Agent as reference;

b) Complete commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during construction phase;

c) Accompanied by Commissioning Agent, perform complete system checks and "fine tuning" with signed documentation for each year of 2 years of warranty period; for each year, perform as follows:

1) Once during 1st month of building operation;

2) Once during 3rd month of building operation; and

3) Once between 4th and 12th months in a season opposite to 1st and 3rd month visits.

d) Correct deficiencies revealed by system checks described above, and, where required, involve equipment manufacturers/suppliers during corrective actions, and report completion of corrective work; and

e) 1 year after Substantial Completion, conduct a question-and-answer session(s) at building with Metrolinx operating and maintenance personnel, with duration of session(s) dictated by number of questions and concerns that shall be addressed.

END OF SECTION