

Capital Projects Group

Mechanical Work General Instructions Specification

Specification 20 05 05

Revision 0

Date: August 2018

Superseded

Mechanical Work General Instructions Specification

Specification 20 05 05

Publication Date: August 2018

COPYRIGHT © 2018

Metrolinx,

an Agency of the Government of Ontario

The contents of this publication may be used solely as required for and during a project assignment from Metrolinx or for and during preparing a response to a Metrolinx procurement request. Otherwise, this publication or any part thereof shall not be reproduced, re-distributed, stored in an electronic database or transmitted in any form by any means, electronic, photocopying or otherwise, without written permission of the copyright holder. In no event shall this publication or any part thereof be sold or used for commercial purposes.

The information contained herein or otherwise provided or made available ancillary hereto is provided "as is" without warranty or guarantee of any kind as to accuracy, completeness, fitness for use, purpose, non-infringement of third party rights or any other warranty, express or implied. Metrolinx is not responsible and has no liability for any damages, losses, expenses or claims arising or purporting to arise from use of or reliance on the information contained herein.

Amendment Record Sheet

| Amendment in Clause No. | Date of Amendment | Description of Changes |
|-------------------------|-------------------|----------------------------|
| N/A | Sept. 20, 2018 | Removed 'DRAFT' watermark. |
| | | |
| | | |
| | | |
| | | |

Superseded

LIST OF CONTENT

| | |
|---|-----------|
| 1. GENERAL | 2 |
| 1.1. SCOPE OF WORK..... | 2 |
| 1.2. DESIGN REQUIREMENTS | 2 |
| 1.3. RELATED WORKS | 2 |
| 1.4. REFERENCE STANDARDS..... | 2 |
| 1.5. SPARE PARTS | 2 |
| 1.6. TRAINING | 3 |
| 1.7. WARRANTY | 5 |
| 1.8. DELIVERY, STORAGE AND HANDLING | 6 |
| 1.9. SUBMITTALS..... | 6 |
| 1.10. QUALITY ASSURANCE..... | 11 |
| 1.11. GENERAL DEFINITIONS | 11 |
| 1.12. DEFINITIONS RELATED TO TESTING, ADJUSTING AND BALANCING SECTION | 13 |
| 1.13. DOCUMENTS..... | 14 |
| 1.14. WORK STANDARDS..... | 14 |
| 1.15. EXAMINATION OF DOCUMENTS AND SITE..... | 18 |
| 1.16. PERMITS, CERTIFICATES, APPROVALS AND FEES | 18 |
| 1.17. REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS..... | 18 |
| 1.18. WORKPLACE SAFETY | 19 |
| 1.19. PLANNING AND LAYOUT OF WORK..... | 20 |
| 1.20. COORDINATION OF WORK..... | 20 |
| 1.21. PRODUCTS..... | 21 |
| 1.22. EQUIPMENT LOADS | 22 |
| 1.23. OPENINGS..... | 22 |
| 1.24. MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE..... | 23 |
| 1.25. CLEANING | 23 |
| 1.26. RECORD AS-BUILT DRAWINGS | 23 |
| 1.27. OPERATING AND MAINTENANCE MANUALS | 24 |
| 1.28. FINAL INSPECTION..... | 26 |
| 2. PRODUCTS | 27 |
| 2.1. NOT USED | 27 |
| 3. EXECUTION | 27 |
| 3.1. NOT USED | 27 |

1. GENERAL

1.1. SCOPE OF WORK

1.1.1. This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.1.2. Be responsible for advising product vendors of requirements of this Section.

1.2. DESIGN REQUIREMENTS

1.2.1. Design requirements are specific design requirements of products for each Section, and will include Metrolinx design standards and performance requirements. General specifications are included in part 2 of Sections.

1.3. RELATED WORKS

1.3.1. Related works include related specification sections and Metrolinx related standard documents.

1.4. REFERENCE STANDARDS

1.4.1. Reference standards are specific standards related to this section. Standards to be latest editions adopted by and enforced by local governing authorities.

1.4.2. ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings.

1.4.3. CSA B51, Boiler, Pressure Vessels and Pressure Piping Code.

1.4.4. Occupational Health and Safety Act - Ontario Regulation 632, Confined Spaces.

1.4.5. Refer to article 1.12 - Work Standards for additional code and standards requirements.

1.5. SPARE PARTS

1.5.1. Provide spare part list including component parts availability, names and addresses of spare part suppliers, and list of specialized tools necessary for maintenance.

1.5.2. Typically, include for spare parts under following conditions:

- a) parts that are easily replaceable and are as recommended by product manufacturers as standard spare parts;
- b) standard spare parts that cannot be delivered within 24 hours of ordering;
- c) standard spare parts for critical systems that cannot be shut down for any considerable time as directed by Metrolinx;
- D) as noted in individual sections.

- 1.5.3. Spare parts are to be new, undamaged, non-defective and of same quality and manufacturer as per products provided in the Work.
- 1.5.4. Spare parts determined to be defective regardless to previous inspections and rejected by Metrolinx, to be replaced at no cost to Metrolinx.

1.6. TRAINING

- 1.6.1. Manufacturers authorized trained representatives to provide Metrolinx personnel on methods of operating and maintenance of equipment and systems. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- 1.6.2. Training sessions to be on site or in vendor's facility at Metrolinx's choice.
- 1.6.3. Course schedules and training sessions to take into consideration limited availability of Metrolinx personnel due to their on-going operations and maintenance responsibilities.
- 1.6.4. To enable Metrolinx personnel working on shifts to participate in courses, training may take place at any time, including evenings and weekends. Time of each session to be at Metrolinx discretion.
- 1.6.5. Schedule separate training sessions on separate days.
- 1.6.6. It is unlikely that training sessions can be scheduled on consecutive days and may, in some cases, be scheduled weekly to account for constrained availability of Metrolinx personnel.
- 1.6.7. Refer to respective Sections for minimum requirements for number and duration of training sessions and number of personnel to be trained.
- 1.6.8. Training sessions to be on site or in vendor's facility at Metrolinx's choice.
- 1.6.9. For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:
 - a) operational requirements and criteria - permit conditions, equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;
 - b) troubleshooting - diagnostic instructions, test and inspection procedures;
 - c) documentation - equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;

- d) maintenance - inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;
 - e) repairs - diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- 1.6.10. Before instructing Metrolinx's designated personnel, submit to Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.
- 1.6.11. Obtain in writing from Consultant list of Metrolinx's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:
- a) date instructions were given to Metrolinx's staff;
 - b) duration of instruction;
 - c) names of persons instructed;
 - d) other parties present (manufacturer's representative, consultants, etc.).
- 1.6.12. Obtain signatures of Metrolinx's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.
- 1.6.13. Submit to Consultant, copy of electronic version of training materials loaded on USB flash drive. Include in operating and maintenance manuals submission.
- 1.6.14. Provide digital video disc (DVD) recording of operating and instructions training for following systems:
- a) building automation system;
 - b) other systems as specifically listed in Sections of Specification.
- 1.6.15. Provide a custom video in DVD format that details on site systems and equipment operations and includes following:
- a) professional videographer on site to capture training session; use wireless lavalier microphone to capture crystal clear audio of trainer in association with video footage; edit video to remove unnecessary footage;
 - b) DVD to include custom site specific system/equipment screens that outline key information about system/equipment and devices used on site only;

- c) DVD to also include custom site specific video that details programming procedures in conjunction with a voiceover from on-site technician;
- d) DVD created with a main menu screen and authored with chapters to allow operator to access specific areas of training instantly.

1.6.16. Supply minimum quantity of 3 copies of DVDs for each system/equipment.

1.6.17. Manufacturers are to instruct installers (who although are fully qualified and experienced installers on products in which they are installing), on any special methods of handling, installation and testing of products.

1.7. WARRANTY

1.7.1. Unless otherwise specified, warrant mechanical work and equipment to be in accordance with Contract Documents and free from defects for a period of 2 years from date of issue of a Certificate of Substantial Performance of the Work.

1.7.2. Where equipment includes extended warranty period, e.g., 5 years, initial 2 years of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Metrolinx. Extended warranties are to be provided by product manufacturer and not third-party company unless approved by Metrolinx. Submit signed and dated copies of extended warranties with shop drawing submissions to Consultant. Extended warranty documents to clearly identify term, ongoing service and parts included in warranty. Refer to requirements within Section to any extended warranties.

1.7.3. Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.

1.7.4. Repair and/or replace any defects that appear in Work within warranty period without additional expense to Metrolinx. Ensure that systems operate as integrated system and not just as individual components. Be responsible for costs incurred in making defective work good, properly integrating components, repair or replacement of building finishes and other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Metrolinx's staff or agents is exempted.

1.7.5. Do not include Metrolinx deductible amounts in warranties.

1.7.6. Warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.

1.7.7. Visit building during warranty period with Metrolinx representatives. Metrolinx to organize these visits. At these meetings, Metrolinx representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Metrolinx representatives, to satisfaction of Metrolinx's representatives. These site visits to occur starting with first year as follows and then repeated for 2nd year of warranty period:

- a) once during 1st month of building operation;
- b) once during 3rd month of building operation;
- c) once between 4th and 12th month in a season opposite to 1st and 3rd month visits.

1.8. DELIVERY, STORAGE AND HANDLING

1.8.1. Handle and store products in accordance with manufacturer's instructions, in locations approved by Metrolinx. Include one copy of these instructions with product at time of shipment.

1.8.2. Preparation for shipment to include protection of equipment and accessories against corrosion, breakage or vibration injury in transportation and handling. Package to prevent tampering or pilfering, and to approval of transportation companies.

1.9. SUBMITTALS

1.9.1. Direct submittals to Consultant for forwarding to Metrolinx.

1.9.2. Product Data

- a) Submit manufacturer's Product data indicating:
 - 1) technical data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items, and parts lists;
 - 2) performance criteria, compliance with appropriate reference standards; characteristics, limitations, and troubleshooting protocol;
 - 3) product transportation, storage, handling, and installation requirements;
 - 4) product identification in accordance with Metrolinx requirements;
 - 5) operating and maintenance manuals;
 - 6) Safety Data Sheets.

1.9.3. Shop Drawings

- a) Submit electronic copies of shop drawings unless otherwise directed by Metrolinx. Coordinate exact requirements with Consultant.
- b) Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:
 - 1) product literature cuts;
 - 2) equipment data sheets;
 - 3) equipment dimension drawings;
 - 4) system block diagrams;
 - 5) sequence of operation;
 - 6) connection wiring schematic diagrams;
 - 7) functionality with integrated systems.
- c) Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.
- d) Where any item of equipment is required by Code or Standard or Law or By-Law to meet a specific energy efficiency level, or discharge level or any other specific requirement, design calculations to ensure this requirement is clearly indicated on submission.
- e) Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.
- f) Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.
- g) Applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment are to indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.9.4. Engineered Submittals

- a) Submittals for items required to be sealed by a professional engineer (engineered submittals and reports) are to be duly prepared, sealed, and signed under direct control and supervision of a qualified professional engineer licensed in jurisdiction of the work. Professional engineer is to conform to requirements specified in this Section in article entitled Requirements for Contractor Retained Engineers.
- b) Reports that require sealing by professional engineer include but not be limited to following:
 - 1) fire protection (firestopping systems);
 - 2) structural and seismic restraints;
 - 3) special supports/anchors for piping;
 - 4) storm water flow reports;
 - 5) waste water treatment systems;
 - 6) air emission reports.
- c) Engineered submittals are to include, but not be limited to, following:
 - 1) complete CAD layout drawings indicating equipment, piping schematic, pipe routing and sizing, zones, devices, wiring schematics, and any other pertinent data;
 - 2) listing of design data used to determine system layout and sizing;
 - 3) complete copies of design calculations and listing of design data used in preparing calculations;
 - 4) list detailing standards, codes, regulations, etc. adhered to when designing system;
 - 5) items as noted in other Sections of the Specification.
- d) Professional engineer responsible for engineered submittals is to perform periodic field reviews, including review of associated mock-ups where applicable, at locations wherever work as described by engineered submittal is in progress, during fabrication and installation of such work, and submit a field review report after each visit. Submit field review reports to Consultant and authorities having jurisdiction as required.

- e) Field reviews are to be at intervals as necessary and appropriate to progress of work described by engineered submittal to allow engineer to be familiar with progress and quality of such work and to determine if work is proceeding in general conformity with Contract Documents including reviewed shop drawings and design calculations.
- f) Upon completion of work as described by engineered submittal, professional engineer responsible for preparation of engineered submittal and for performing periodic field reviews is to prepare and submit to Consultant and, if applicable, authorities having jurisdiction, a letter certifying that work has been supplied and installed in accordance with requirements of Contract Documents, authorities having jurisdiction and engineered submittal.

1.9.5. Commissioning Package

- a) Submit the following:
 - 1) Commissioning Plan;
 - 2) Commissioning Procedures;
 - 3) Certificate of Readiness;
 - 4) Permit maintenance and reporting requirements;
 - 5) complete test sheets specified in Section 20 05 40 and attach to the Certificate of Readiness;
 - 6) source quality control inspection and test results and attach to the Certificate of Readiness.

1.9.6. Commissioning Closeout Package:

- a) Submit the following:
 - 1) Deficiency Report;
 - 2) Commissioning Closeout Report;
 - 3) Operating Permits;
 - 4) Maintenance Records;
 - 5) 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;
- ix) extended warranties for equipment as specified and ongoing service agreements covered under warranty;
- x) Commissioning Report.

1.9.7. Project Closeout Submittals

- a) Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following:
 - 1) Operating and Maintenance Manuals;
 - 2) As-Built record drawings and associated data;
 - 3) extended warranties for equipment as specified;
 - 4) operating test certificates, i.e. Sprinkler Test Certificate;
 - 5) final commissioning report and TAB reports;
 - 6) identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;
 - 7) documents and certificates requested within sections;
 - 8) other data or products information as specified.

1.10. QUALITY ASSURANCE

1.10.1. Manufacturers Qualifications

- a) Manufacturer shall be ISO 9000, 9001 or 9002 certified. Manufacturer of product shall have produced similar product for a minimum period of five years. When requested by Consultant, an acceptable list of installations with similar product shall be provided demonstrating compliance with this requirement.
- b) Manufacturers are to be current members of industry organizations related to specific trades work.
- c) Where manufacturers provide after installation onsite inspection of product installations, include for manufacturer's authorized representative to perform onsite inspection and certificate of approvals.

1.10.2. Installers Qualifications

- a) Installers for work to be performed by or work under licensed Mechanical Contractor.
- b) Installers of equipment, systems and associated work are to be fully qualified and experienced installers of respective products and work in which they are installing.
- c) Where manufacturers provide training sessions to installers and certificates upon successful completion of training, installers to have obtained such certificates and submit copies with shop drawings.

1.10.3. Regulatory Requirements

- a) Products and work to comply with applicable local governing authority regulations, bylaws and directives.
- b) Include for required inspections and certificate of approvals of installation work from local governing authorities (ex. TSSA).

1.11. GENERAL DEFINITIONS

1.11.1. "barrier-free" - means when applied to a building and its facilities, that building and its facilities can be approached, entered and used by persons with physical or sensory disabilities in accordance with requirements of local governing building code.

1.11.2. "BAS" - means building automation system; "BMS" - means building management system; "FMS" - means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.

- 1.11.3. "concealed" - means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- 1.11.4. "Consultant" - means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Metrolinx to act for Metrolinx in a professional capacity in relation to the Work.
- 1.11.5. "delete" or "remove" (and tenses of "delete" or "remove") - means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Metrolinx and reviewed with Consultant.
- 1.11.6. "Electrical Divisions" - refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- 1.11.7. "exposed" - means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- 1.11.8. "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.
- 1.11.9. "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" - means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- 1.11.10. "install" (and tenses of "install") - means secure in position, connect complete, test, adjust, verify and certify.
- 1.11.11. "Mechanical Divisions" - refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.
- 1.11.12. "or approved equivalent" typically, with reference to product manufacturers or service companies means manufacturers or companies not listed in Specifications but may be proposed for review by Consultant and approval by Metrolinx. Refer to article entitled "Products" later in this Section.
- 1.11.13. "OSHA" and "OHSA" - stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.

- 1.11.14. "provision" or "provide" (and tenses of "provide") - means supply and install complete.
- 1.11.15. "supply" - means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.
- 1.11.16. Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.
- 1.11.17. Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.12. DEFINITIONS RELATED TO TESTING, ADJUSTING AND BALANCING SECTION

- 1.12.1. "Agency" - means agency to perform testing, adjusting and balancing work.
- 1.12.2. "TAB" - means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.
- 1.12.3. "hydronic systems" - includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
- 1.12.4. "air systems" - includes outside air, supply air, return air, exhaust air, and relief air systems.
- 1.12.5. "flow rate tolerance" - means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.
- 1.12.6. "report forms" - means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting and balancing.
- 1.12.7. "terminal" - means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- 1.12.8. "main" - means duct or pipe containing system's major or entire fluid flow.

- 1.12.9. "submain" - means duct or pipe containing part of the systems' capacity and serving two or more branch mains.
- 1.12.10. "branch main" - means duct or pipe servicing two or more terminals.
- 1.12.11. "branch" - means duct or pipe serving a single terminal.

1.13. DOCUMENTS

- 1.13.1. Specification including other issued Documents identify labour, products and services necessary for performance of work. They are intended to be cooperative. Provide work that is shown, specified, or reasonably implied on drawings but not mentioned in Specification or other Documents, or vice-versa, as though fully covered by both.
- 1.13.2. Unless otherwise noted, Sections are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and Sections are to be read in whole.
- 1.13.3. Specification does not generally indicate specific number of items or amounts of material required. Singular may be read as plural and vice versa.
- 1.13.4. Specification uses Canadian National Master Construction Specification (NMS) latest version, 50 Division format as a guideline, with broad scope use of section numbering where some common products have been grouped together in one section for brevity. Prepare detailed specifications based on general design and performance criteria of systems and materials described herein these output specifications. More detailed specifications to include expanded section numbering following NMS section format and with refined and coordinated requirements that reflect proposed innovations to enhance design but still maintain the basic criteria herein.
- 1.13.5. Starter/motor control centre (MCC)/variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Review starter, MCC, VFD, and motor specification requirements prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.

1.14. WORK STANDARDS

- 1.14.1. Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.

- 1.14.2. Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Metrolinx and reviewed with Consultant.
- 1.14.3. Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:
- a) Air-Conditioning, Heating and Refrigeration Institute (AHRI);
 - b) Air Movement and Control Association (AMCA);
 - c) American Iron and Steel Institute (AISI);
 - d) American National Standards Institute (ANSI);
 - e) American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);
 - f) American Society of Mechanical Engineers (ASME);
 - g) American Society of Testing and Materials (ASTM);
 - h) American Water Works Association (AWWA);
 - i) Associated Air Balance Council (AABC);
 - j) Building Industry Consulting Services, International (BICSI);
 - k) Canadian Gas Association (CGA);
 - l) Canadian General Standards Board (CGSB);
 - m) Canadian Standards Association (CSA);
 - n) Electrical and Electronic Manufacturers Association of Canada (EEMAC);
 - o) Electrical Safety Authority (ESA);
 - p) Electronic Industries Association (EIA);
 - q) Factory Mutual Systems (FM);
 - r) Illuminating Engineering Society (IES);
 - s) Institute of Electrical and Electronic Engineers (IEEE);
 - t) International Standards Organization (ISO);
 - u) Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);

- v) National Building Code of Canada (NBC);
 - w) National Electrical Manufacturers Association (NEMA);
 - x) National Environmental Balancing Bureau (NEBB);
 - y) National Fire Protection Association (NFPA);
 - z) National Standards of Canada;
 - aa) NSF International;
 - bb) Occupational Health and Safety Act (OHSA);
 - cc) Ontario Building Code (OBC);
 - dd) Ontario Electrical Safety Code (OESC);
 - ee) Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);
 - ff) Technical Standards and Safety Authority (TSSA);
 - gg) Thermal Insulation Association of Canada (TIAC);
 - hh) Underwriters' Laboratories of Canada (ULC);
 - ii) Workplace Hazardous Materials Information System (WHMIS);
 - jj) Safety Data Sheets (SDS) by product manufacturers;
 - kk) local utility inspection permits;
 - ll) Codes, standards, and regulations of local governing authorities having jurisdiction;
 - mm) additional codes and standards listed in Trade Sections;
 - nn) Metrolinx's standards and guidelines.
- 1.14.4. Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.
- 1.14.5. Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.

- 1.14.6. Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions. Notify Consultant in writing of conflicts between Contract Documents and manufacturer's instructions.
- 1.14.7. Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on-site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.
- 1.14.8. Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with Consultant at any time.
- 1.14.9. Experienced and qualified superintendent is to be on-site at times when work is being performed.
- 1.14.10. Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Metrolinx and reviewed with Consultant. Maintain in operation existing services to these areas to allow Metrolinx continued access and continued use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Metrolinx and Consultant.
- 1.14.11. Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Metrolinx on a 24 hours basis or over various hours, coordinate hours of work with Metrolinx on a regular basis to suit Metrolinx's schedule. Execute work at times confirmed with and agreed to by Metrolinx and reviewed with Consultant, so as not to inconvenience Metrolinx's occupation or in any way hinder Metrolinx's use of building.
- 1.14.12. Coordinate work inspection reviews and approvals with governing inspection department to ensure construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.
- 1.14.13. Properly protect equipment and materials on site from damage and defacement due to elements and work of trades, to satisfaction of Metrolinx and reviewed with Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.
- 1.14.14. Mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products are to bear a CRN number.

1.14.15. Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

1.15. EXAMINATION OF DOCUMENTS AND SITE

1.15.1. Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions.

1.15.2. Report to Consultant any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.

1.15.3. Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.16. PERMITS, CERTIFICATES, APPROVALS AND FEES

1.16.1. Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.

1.16.2. Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.

1.16.3. Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.

1.16.4. Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.17. REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

1.17.1. Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.

1.17.2. Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.

- 1.17.3. Unless otherwise specified, liability insurance requirements are as follows:
- a) coverage is to be a minimum of \$1,000,000.00 CDN inclusive of any one occurrence;
 - b) insurance policy is not to be cancelled or changed in any way without insurer giving Metrolinx minimum thirty days written notice;
 - c) liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;
 - d) retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;
 - e) evidence of the required liability insurance in such form as may be required is to be issued to Metrolinx, Metrolinx's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.18. WORKPLACE SAFETY

- 1.18.1. Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials. Submit WHMIS Safety Data Sheets for products where required, and maintain one copy at site in a visible and accessible location available to personnel.
- 1.18.2. Comply with requirements of Occupational Health and Safety Act, Workplace Safety Insurance Act, regulations governed by these Acts, and any other regulations pertaining to health & safety. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.
- 1.18.3. Comply with requirements of Environmental Protection Act and Ontario Water Resources Act and other regulations pertaining to environmental protection and spill prevention and reporting.
- 1.18.4. If at any time during course of existing building work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Metrolinx and reviewed with Consultant.
- 1.18.5. Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

1.19. PLANNING AND LAYOUT OF WORK

- 1.19.1. Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.
- 1.19.2. Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions.
- 1.19.3. Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.
- 1.19.4. Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or $\frac{1}{4}''=1' 0''$) of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab.
- 1.19.5. Shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- 1.19.6. Be responsible for making necessary changes to accommodate structural and building conditions that were missed due to lack of coordination.

1.20. COORDINATION OF WORK

- 1.20.1. Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:
 - a) requirements for openings, sleeves, inserts and other hardware necessary for installation of work;
 - b) concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;
 - c) depth and routing of excavation required for work, and requirements for bedding and backfill;
 - d) wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements;

- e) coordination with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling and water.
- 1.20.2. Phasing and scheduling of Work is required in order to maintain existing building operations. Include for scheduling, co-ordination, and construction phasing to suit project requirements. Review phasing requirements with Consultant prior to start of Work. Provide partial occupancy permits as required.
- 1.20.3. Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.
- 1.20.4. Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Metrolinx and reviewed with Metrolinx, and protected from elements.
- 1.20.5. Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.
- 1.20.6. Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.
- 1.21. PRODUCTS**
- 1.21.1. Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines.
- 1.21.2. Products are to be supplied from manufacturer's authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable.
- 1.21.3. Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.

- 1.21.4. Products scheduled and/or specified and/or named as standard of acceptance manufacturers have been selected to establish a performance and quality standard. Where applicable, in some instances is included as dimensional standard.
- 1.21.5. Where products are listed as "or approved equivalent", and are proposed by Contractor, certify that such product being proposed in lieu of one of specified standard of acceptance named manufacturers products, at least meets space, performance, power, design, energy consumption, and other requirements of standard of acceptance named manufacturer and is equivalent or better than standard of acceptance named product. When requested by Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equivalent" products is at sole discretion of Metrolinx. It is understood that there will be no increase in Contract Price because of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by Metrolinx acceptance of approved equivalent product. There must be no increase in Contract price due to Metrolinx rejection of proposed equivalent product.

1.22. EQUIPMENT LOADS

- 1.22.1. Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to Consultant, via shop drawing submissions, prior to construction.
- 1.22.2. Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.
- 1.22.3. Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Review locations of equipment with Consultant prior to construction.

1.23. OPENINGS

- 1.23.1. Supply opening sizes and locations to Consultant and General Trades Contractor to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.
- 1.23.2. No openings are permitted through completed structure without written approval from Metrolinx and reviewed with Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to Consultant for review, well in advance of doing work.

- 1.23.3. Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless otherwise directed by Metrolinx and reviewed with Consultant, do not leave any openings unprotected and unfinished overnight.

1.24. MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- 1.24.1. Maintain equipment in accordance with manufacturer's instructions prior to start-up, testing and commissioning.
- 1.24.2. Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.
- 1.24.3. Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminum tubing.
- 1.24.4. All filters are to be new upon Substantial Performance of the Work. This is in addition to any spare filters specified.

1.25. CLEANING

- 1.25.1. During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Metrolinx and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.
- 1.25.2. Clean equipment and devices installed as part of this project.

1.26. RECORD AS-BUILT DRAWINGS

- 1.26.1. As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:
- a) dimensioned location of inaccessible concealed work;
 - b) locations of control devices with identification for each;
 - c) for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;

- d) for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;
 - e) location of piping system air vents;
 - f) location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
- 1.26.2. Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Metrolinx and Consultant.
- 1.26.3. Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.
- 1.26.4. Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with CAD software release version confirmed with Consultant.
- 1.26.5. Retain services of a land surveyor registered in Place of the Work to measure, verify, and record size, location, invert elevation and pitch of buried piping services, and, when complete, to produce a signed and sealed CAD disc (of release version reviewed with Consultant) of survey work which is to be submitted to Consultant. Transfer survey work to as-built drawings.

1.27. OPERATING AND MAINTENANCE MANUALS

- 1.27.1. For each item of equipment for which a shop drawing is required (except for simple equipment), supply minimum 3, project specific, indexed hard copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Review exact quantity of manuals with Consultant. Consolidate each copy of data in an identified hard cover three "D" ring binder. Each binder to include:
- a) front cover: project name; wording - "Mechanical Systems Operating and Maintenance Manual"; and date;
 - b) introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
 - c) equipment manufacturer's authorized contact person name, telephone number and company website;

- d) Table of Contents sheet, and corresponding index tab sheets;
- e) copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;
- f) equipment name, type, year, serial number, number of units, capacity, and identification to related systems;
- g) operating data as follows:
 - 1) pressure test reports, and certificates issued by governing authorities;
 - 2) description of each system and its controls;
 - 3) control schematics for equipment/systems including building environmental controls;
 - 4) wiring and connection diagrams;
 - 5) if applicable, BAS architecture and all required operating data;
 - 6) description of operation of each system at various loads together with reset schedules and seasonal variances;
 - 7) operation instruction for each system and each component;
 - 8) description of actions to be taken in event of emergencies and/or equipment failure;
 - 9) valve tag schedule, and flow diagrams to indicate valve locations.
- h) maintenance data as follows:
 - 1) operation, maintenance and trouble-shooting instructions for each item of equipment and each system;
 - 2) schedules of tasks, frequency, tools required, and estimated task time;
 - 3) recommended maintenance practices and precautions including warnings of any maintenance practice that will damage or disfigure equipment/systems;
 - 4) complete parts lists with numbers;

- 5) component parts availability, including names and addresses of spare part suppliers;
 - 6) maintenance requirements outlined in corresponding permit or operating certificate.
 - i) performance data as follows:
 - 1) equipment and system start-up data sheets;
 - 2) equipment performance criteria, verification test results, and final commissioning report;
 - 3) final testing, adjusting and balancing reports.
 - j) product storage, preparation, handling, and installation requirements;
 - k) copies of warranties;
 - l) commissioning reports;
 - m) operating permits, certificates and expiry;
 - n) items requested specifically in Section Articles.
- 1.27.2. Generally, binders are not to exceed 75 mm (3") thick and not to be more than 2/3 full.
- 1.27.3. Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Metrolinx's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.
- 1.27.4. Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O & M Manual and submit to Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.
- 1.27.5. Provide 2 digital copies of contents of operating and maintenance manuals and load onto separate USB type flash drives and submit to Consultant. Prepare digital copies using version of Adobe Acrobat Portable Document Format or equal as reviewed with Consultant and enhanced with bookmarks and internal document links.
- 1.28. FINAL INSPECTION**
- 1.28.1. Submit to Consultant, written request for final inspection of systems. Include written certification that:
- a) deficiencies noted during job inspections have been rectified and completed;
 - b) field quality control procedures have been completed;

- c) systems have been tested and verified, balanced and adjusted, and are ready for operation;
- d) maintenance and operating data have been completed and submitted to, reviewed with Consultant and accepted by Metrolinx;
- e) tags and nameplates are in place and equipment identifications have been completed;
- f) clean-up is complete;
- g) spare parts and replacement parts specified have been provided and acknowledged by Consultant;
- h) as-built and record drawings have been completed and submitted to and reviewed with Consultant and accepted by Metrolinx;
- i) Metrolinx's staff has been instructed in operation and maintenance of systems;
- j) commissioning procedures have been completed.

2. PRODUCTS

2.1. NOT USED

3. EXECUTION

3.1. NOT USED

END OF SECTION