

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Specification shall revise, amend, and supplement the requirements of CW1110.

1.2 REFERENCE STANDARDS

- .1 City of Winnipeg General Conditions for Construction, Revision 2019-09-01.
- .2 City of Winnipeg Specification CW1110.

1.3 ADMINISTRATIVE

- .1 Submit to the Contract Administrator submittals required by individual Specification sections for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until reviewed by the Contract Administrator.
- .3 Present Shop Drawings, product data, samples, and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units, converted values are acceptable. If both Imperial and SI Metric units are shown, SI Metric equivalent shall be the primary unit with the Imperial shown in parentheses.
- .5 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract. Submittals not stamped, signed, dated, and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify the Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by the Contract Administrator's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by the Contract Administrator's review.
- .10 Keep one reviewed copy of each submission on site.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "Shop Drawing" as defined in the City's General Conditions for Construction (Revision 2020-01-31) means all drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data which are prepared by the Contractor, Subcontractor, manufacturer, supplier, or distributor and which illustrate some portion of the Work.
- .2 Submit Shop Drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba if requested.

- .3 Indicate materials, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of section under which adjacent items will be supplied and installed. Indicate cross references to design Drawings and Specifications.
- .4 Allow seven (7) Business Days for review of each submission by the Contract Administrator.
- .5 The review by the Contract Administrator of the Shop Drawings is for the sole purpose of ascertaining conformance with the design concept.
- .6 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Contract Administrator prior to proceeding with Work.
- .7 Make changes in Shop Drawings as the Contract Administrator may require, consistent with Contract. When resubmitting, notify the Contract Administrator in writing of revisions other than those requested.
- .8 Accompany submissions with transmittal, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each Shop Drawing, product data, and sample.
 - .5 Other pertinent data.
- .9 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Section name and clause number equipment is specified under.
 - .4 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .5 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract.
 - .6 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.

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- .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After the Contract Administrator's review, distribute copies as required.
 - .10 Submit electronic copy of Shop Drawings for each requirement requested in Specification sections and as the Contract Administrator may reasonably request.
 - .11 Submit electronic copies of product data sheets or brochures for requirements requested in Specification sections and as requested by the Contract Administrator where Shop Drawings will not be prepared due to standardized manufacture of product.
 - .12 Submit electronic copies of test reports for requirements requested in Specification sections and as requested by the Contract Administrator.
 - .1 Report signed by authorized official of testing laboratory that material, product, or system identical to material, product, or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within three (3) years of date of Contract award for project.
 - .13 Submit electronic copies of certificates for requirements requested in Specification sections and as requested by the Contract Administrator.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system, or material attesting that product, system, or material meets Specification requirements.
 - .2 Certificates must be dated after award of Contract and include the project name.
 - .14 Submit electronic copies of manufacturer's instructions for requirements requested in Specification sections and as requested by the Contract Administrator.
 - .1 Pre-printed material describing installation of product, system, or material, including special notices and Safety Data Sheets concerning impedances, hazards, and safety precautions.
 - .15 Submit electronic copies of manufacturer's field reports for requirements requested in Specification sections and as requested by the Contract Administrator.
 - .16 Submit documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
 - .17 Submit electronic copies of operation and maintenance data for requirements requested in Specification sections and as requested by the Contract Administrator
 - .18 Delete information not applicable to project.
 - .19 Supplement standard information to provide details applicable to project.
 - .20 If upon review by the Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, a copy will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and resubmission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.5 DESCRIPTION OF CONSTRUCTION METHODS

- .1 The Contractor shall, if required by the Contract Administrator, submit for the review of the Contract Administrator method statements which describe in detail, supplemented with drawings where necessary, the methods to be adopted for executing any portion of Work.
- .2 These method statements shall also include details of constructional plan and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

1.6 REQUESTS FOR INFORMATION

- .1 In the event that the Contractor, or any Subcontractor involved in the Work, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation by the Contract Administrator, the Contractor shall submit a Request for Information (RFI) in writing to the Contract Administrator.
- .2 Submission Procedure:
 - .1 Submit RFI's to the Contract Administrator on the "Request for Information" form appended to this section. The Contract Administrator shall not respond to a RFI except as submitted on this form.
 - .2 Number RFI's consecutively in one sequence in order submitted, in a numbering system established by the Contract Administrator.
 - .3 Submit one distinct subject per RFI request. Do not combine unrelated items on one form.
 - .4 Where RFI form does not have sufficient space, attach additional sheets as required.
 - .5 Submit with RFI form all necessary supporting documentation.
- .3 In the RFI, the Contractor shall clearly and concisely set forth:
 - .1 the issue for which clarification or interpretation is sought and why a response is needed from the Contract Administrator; and
 - .2 an interpretation or understanding of the requirement along with reasons why such an understanding was reached.
- .4 The Contract Administrator will review all RFIs to determine whether they are valid RFIs. If it is determined that the document is not a valid RFI, it will be returned to the Contractor not having been reviewed with an explanation why it was deemed not valid.
- .5 A RFI response shall be issued within 14 Calendar Days of receipt of the request from the Contractor unless the Contract Administrator determines that a longer time is necessary to provide an adequate response. When the RFI submission is received by the Contract Administrator before noon, the review period commences on that Calendar Day. When the RFI submission is received by the Contract Administrator after noon, the review period commences on the subsequent Calendar Day.
- .6 If, at any time, the Contractor submits a large number of RFIs or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFIs within 14 Calendar Days, the Contract Administrator shall confer with the Contractor within five (5) Calendar Days of receipt of such RFIs and the

Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority among the RFIs submitted. The Contractor shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.

- .7 If the Contractor submits a RFI on an activity with 14 Calendar Days or less of available time to the impacted activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Contractor Administrator to respond to the request provided that the Contract Administrator responds within the 14 Calendar Days set forth above.
- .8 A RFI response from the Contract Administrator will not change any requirement of the Contract. In the event the Contractor believes that the RFI response from the Contract Administrator will cause a change to the requirements of the Contract, the Contractor shall within 14 Calendar Days give written notice to the Contract Administrator stating that the Contractor believes the RFI response will result in a change in requirements to the Contract and the Contractor intends to submit a change request. Failure to give such written notice of 14 Calendar Days shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

1.7 CLOSEOUT SUBMITTALS

- .1 Refer to Section 01 78 00 – Closeout Submittals for closeout submittal requirements.

1.8 MISCELLANEOUS SUBMITTALS

- .1 Prepare and submit submittals required by individual Specification sections.
- .2 Copies: Submit one electronic copy to Contract Administrator. Method of electronic submission to be coordinated with Contract Administrator after execution of the Contract. Submit hard copies only where specifically required under individual Specification sections.
- .3 Contract Administrator will review submittals for general conformance with design concept and intent, and general compliance with Contract.
- .4 Contract Administrator's review does not relieve Contractor from compliance with requirements of Contract nor from errors in submittals or Contractor's design.
- .5 Contractor is responsible for confirmation of dimensions at jobsite; fabrication processes; means, methods, techniques, sequences, and procedures of construction; coordination of work of all trades; and performance of Work in safe and satisfactory manner.
- .6 At Contract Administrator's option, Contract Administrator's review comments and review stamp will be placed either directly on submitted copies of submittals or on separate submittal review comment form.
- .7 Where work is to be designed by Contractor, comply with applicable codes and furnish submittals signed and sealed by professional engineer licensed in Province of Manitoba, as required by Specifications. If requested, calculations shall be submitted for review. Calculations shall also be signed and sealed by a professional engineer registered in the Province of Manitoba.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION



Request for Information (RFI)

RFI No. 0

For details and instructions on how to complete this document, click the [?] icon under the Home tab to display the hidden text.

RFI Title: _____ **RFI No.:** 0

Date RFI initiated: _____ **Date Response Requested by:** _____

Date Response Issued: _____

Project Name: _____

Submitted To:

Contract Administrator (CA): _____ Consultant Ref. No. _____

Company/Dept.: _____ Tender No. _____

Requested By:	For CA Use	
Name: _____	City File No.:	_____
Title: _____	Project ID:	_____
Company: _____	Project Record Index No.:	_____
Email: _____	Purchase Order No.:	_____

Request/Question: (to be completed by Contractor)

Answer/Response: (to be completed by Contract Administrator)

Attachment(s):

Distribution (to be completed by Contract Administrator)

- Contract Administrator
- Contractor
- City Project Manager
- Other:

Part 1 General

1.1 INTENT

- .1 This specification is to supplement the health and safety requirements contained in the Section D of the Tender Documents, and the City of Winnipeg's "General Conditions for Construction".

1.2 REFERENCE STANDARDS

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Province of Manitoba
 - .1 The Workers Compensation Act RSM 1987 – Updated 2013.
- .3 General Conditions for Construction, City of Winnipeg, Revision 2020-01-31.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit copies of reports or directions issued by federal, provincial and territorial health and safety inspectors.
- .3 Submit copies of incident and accident reports.
- .4 Submit WHMIS SDS – Safety Data Sheets where indicated in individual sections.
- .5 The Contract Administrator will review Contractor's Site-specific Safe Work Plan and provide comments to the Contractor within three (3) Business Days.
- .6 The Contract Administrator's review of Contractor's final Safe Work Plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction health and safety.

1.4 SAFETY ASSESSMENT

- .1 Perform Site specific safety hazard assessment related to project.

1.5 MEETINGS

- .1 Schedule and administer a health and safety meeting with the Contract Administrator and City personnel prior to commencement of the Work.

1.6 REGULATORY REQUIREMENTS

- .1 Do Work in accordance with all applicable regulatory requirements.

1.7 GENERAL REQUIREMENTS

- .1 Develop written Site-specific Safe Work Plan based on hazard assessment prior to beginning Site Work and continue to implement, maintain, and enforce plan until final demobilization from Site. The Safe Work Plan must address project specifications.
- .2 The Contract Administrator and the City may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on Site, safety of property on Site and for protection of persons adjacent to Site and environment to extent that they may be affected by conduct of Work.
- .2 Contractor will be responsible and assume the role of prime contractor as described in the Manitoba Workplace Safety and Health Act.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with Site-specific Safe Work Plan.

1.9 COMPLIANCE REQUIREMENTS

- .1 Comply with the Workers Compensation Act, Workplace Safety Regulation, Manitoba.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 UNFORESEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occurs during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of the Province of Manitoba and advise Contract Administrator verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occurs during performance of Work, advise the Health and Safety co-ordinator and follow procedures in accordance with Acts and Regulations of the Province of Manitoba and advise the Contract Administrator verbally and in writing.

1.11 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, a competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's health and safety training sessions and ensuring that personnel not successfully completing required training are not permitted to enter Site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring Contractor's Safe Work Plan.

- .2 The Health and Safety Co-ordinator's contact information should be prominently displayed in the construction Site office.

1.12 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on Site in accordance with Acts and Regulations of the Province of Manitoba and in consultation with the Contract Administrator.

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by the Contract Administrator.
- .2 Provide the Contract Administrator with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 The Contract Administrator may issue a stop Work order if non-compliance of health and safety regulations is not corrected.

1.14 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from the Contract Administrator.

1.15 WORK STOPPAGE

- .1 Give precedence to safety and health of public and Site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 INSPECTION

- .1 Allow the Contract Administrator access to the Work. If part of the Work is in preparation at locations other than the Site, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if the Work is designated for special tests, inspections, or approvals by the Contract Administrator or inspection authorities.
- .3 If the Contractor covers or permits to be covered Work that has been designated for special tests, inspections, or approvals before such is made, uncover such Work at no additional cost and have inspections or tests satisfactorily completed and make good such Work.
- .4 The Contract Administrator will order part of the Work to be examined if the Work is suspected to be not in accordance with the Contract. If, upon examination, such work is found not in accordance with the Contract, correct such Work and pay cost of examination and correction. If such Work is found in accordance with the Contract, the City shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION AGENCIES

- .1 The Contract Administrator is to determine/approve the required inspection/testing. Independent inspection/testing agencies shall be engaged and coordinated by the Contractor for purpose of inspecting and/or testing portions of the Work. The Contract Administrator is to be copied on all inspection and/or testing results and correspondence from the inspection/testing agency. Additional tests required due to defective Work shall be paid by the Contractor at no additional cost to the Contract.
- .2 The maximum allowed markup by the Contractor is 10% of the inspection/testing subcontractor costs. If additional inspection and/or tests are required due to defective Work by the Contractor, the additional costs will be borne by the Contractor.
- .3 All equipment required for executing inspection and testing will be provided by the respective agencies.
- .4 Employment of inspection/testing agencies does not relieve or relax the Contractor's responsibility to perform the Work in accordance with the Contract.
- .5 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain the full degree of defect. Correct the defect and irregularities as advised by the Contract Administrator at no cost to the City. The Contractor shall be responsible for the costs of the subsequent testing and inspection of the corrected Work. The City shall deduct such costs from the Contract, amount of which will be determined by the Contract Administrator.

1.3 ACCESS TO WORK

- .1 The City, the Contract Administrator, and other inspection authorities shall have access to the Work.

1.4 REJECTED WORK

- .1 Remove defective Work, whether the result of poor workmanship, use of defective products, or damage and whether incorporated in Work or not, which has been rejected by the Contract Administrator as failing to conform to the Contract. Replace or re-execute in accordance with the Contract.

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- .2 Make good other contractor's work damaged by such removals or replacement of defective Work.
 - .3 If, in opinion of the Contract Administrator, it is not expedient to correct defective Work or Work not performed in accordance with the Contract, the City will deduct from the Contract Price the difference in the value between Work performed and that called for by the Contract, amount of which will be determined by the Contract Administrator.

1.5 REPORTS

- .1 Submit draft inspection and test reports to the Contract Administrator, prior to inclusion with the operation and maintenance manuals and in accordance with Section 01 33 00 – Submittal Procedures

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submittals to include but are not limited to:
 - .1 Site plan as described in Part 1.2.
 - .2 Shop Drawings, including scaffolding and/or platforms as described in Part 1.3.

1.2 INSTALLATION AND REMOVAL

- .1 Prepare and submit Site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area, and details of fence installation.
 - .1 Identify any areas which have to be gravelled to prevent tracking of mud.
 - .2 Indicate use of supplemental or other staging area.
- .2 Provide construction facilities in order to execute the Work expeditiously.
- .3 Remove from Site all construction facilities after use.
- .4 Restore grassed areas damaged from construction activities.

1.3 SCAFFOLDING AND TEMPORARY PLATFORMS

- .1 Scaffolding in accordance with:
 - .1 CAN/CSA-S269.2 – Access Scaffolding for Construction Purposes
 - .2 C.C.S.M.c W210 – Manitoba, The Workplace Safety and Health Act
- .2 Provide and maintain scaffolding, platforms, and ladders.
- .3 Submit Shop Drawings of scaffolding and/or platforms in accordance with Section 01 33 00 – Submittal Procedures where requested on the Drawings.

1.4 SITE STORAGE/LOADING

- .1 Confine Work and operations of employees to the scope of the Contract. Do not unreasonably encumber premises with products.

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- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.
 - .3 All construction materials shall be stored at designated storage areas. Stored combustible materials shall be separated by clear space to prevent fire spread and allow access for manual fire fighting equipment, including fire hoses, extinguishers, hydrants, etc.
 - .4 Pressurized dry chemical fire extinguishers of suitable capacity or equally effective extinguishers as per NFPA 10 shall be provided where:
 - .1 Flammable liquids are stored or handled.
 - .2 Welding or flame cutting is performed.

1.5 CONSTRUCTION PARKING

- .1 Parking will be permitted on the Site provided it does not disrupt performance of the Work or access by the City.
- .2 Provide and maintain adequate access to the project Site including fire route access.

1.6 OFFICES

- .1 Provide a construction office heated to 22 degrees C, lighted 750 lx, and ventilated, of sufficient size to accommodate Site meetings and furnished with drawing laydown table.
- .2 Provide a marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.
- .4 Supply temporary office facilities for the Contract Administrator on Site, meeting the following requirements:
 - .1 Minimum floor area of 20 square metres, with windows and a door entrance complete with suitable lock satisfactory to the Contract Administrator.
 - .2 Suitable for all-weather use and capable of maintaining a temperature range between 20 and 25 degrees C.
 - .3 Equipped with fluorescent lights and 120 volt ac electrical wall outlets.
 - .4 Furnished with one desk, one filing cabinet, and two chairs, all satisfactory to the Contract Administrator.
 - .5 All of the temporary structures provided by the Contractor for this project shall be stabilized in a sufficient manner to prevent the temporary structure from being overturned by wind forces as defined in the National Building Code (NBC). The stabilization provided shall be designed by a Professional Engineer registered in the Province of Manitoba. Detailed drawings and design notes for the stabilization works bearing the Engineer's seal shall be provided to the Contract Administrator for review.
 - .6 The Contractor shall be responsible for installation, maintenance, removal, operating costs, and service installation costs for the field office as described herein.

1.8 EQUIPMENT, TOOL, AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment, and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on Site in manner to cause least interference with work activities.

1.9 SANITARY FACILITIES

- .1 The Contractor shall provide sanitary facilities for work force in accordance with governing regulations and ordinances.
 - .1 The Contractor shall post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.10 PROTECTION AND MAINTENANCE OF TRAFFIC ON METCALFE AVENUE

- .1 Maintain and protect traffic on Metcalfe Avenue throughout Construction.
- .2 If required, provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.
- .3 Verify adequacy of existing roads and allowable load limit on these roads. Contractor shall be responsible for repair of damage to roads caused by construction operations.

1.11 DISPOSAL OF WASTE MATERIALS

- .1 Spoiled and waste materials shall not be dumped, under any circumstances, in any locations other than those approved by the local authorities. Any cost for permits and fees for disposing of waste materials shall be at the Contractor's expense.
- .2 Disposal of all excavated and waste materials shall be in accordance with the requirements of the appropriate provincial regulatory agencies.
- .3 When working anywhere within the Works, the Contractor shall at the end of each day remove the rubbish and leave the Site in a clean and tidy state, to the satisfaction of the Contract Administrator. If this is not done, the City may clean the Site and deduct such costs from the Contract, amount of which will be determined by the Contract Administrator.

1.12 FACILITY ELECTRICAL SUPPLY AND DISTRIBUTION

- .1 If service interruptions are necessary, such interruptions shall be made only at times approved by the Contract Administrator.

1.13 WARNINGS AND TRAFFIC SIGNS

- .1 All Work affecting Site access must be authorized by the Contract Administrator. Provide a minimum of one week notice to the Contract Administrator when Work will affect Site access.

- .2 When Work is performed within public areas, provide and erect adequate warning signs as necessary to give proper warning. Place signs sufficiently in advance to enable public to respond to directions.
- .3 Provide and maintain signs and other devices required to indicate construction activities or other temporary or unusual conditions resulting from the Work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-O121-M1978(R2003), Douglas Fir Plywood.

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary controls in order to execute the Work expeditiously.
- .2 Remove from Site all such work after use.

1.3 HOARDING

- .1 Erect temporary site enclosures using construction grade lumber framing and exterior grade fir plywood to CSA O121.
- .2 Provide hoarding and ventilation for the building as required to maintain operation of the pumping station.

1.4 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs, and any other fall hazards.
- .2 Provide as required by governing authorities.

1.5 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts, and other openings in floors and roofs. Provide protection for the interior of the pumping station and existing equipment during re-roofing works (during removal of existing roof and installation of the new roof).
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading, if applicable.

1.6 DUST TIGHT SCREENS

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, and finished areas of Work.
- .2 Maintain and relocate protection until such Work is complete.

1.7 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.9 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with the Contract Administrator locations and installation schedule three (3) Business Days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain the Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the City or other contractors.
- .2 Remove waste materials from the Site at daily regularly scheduled times or dispose of as directed by the Contract Administrator. Do not burn waste materials on the Site.
- .3 Clear snow and ice accumulations to maintain access to the pumping station building and drainage facility building. Bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Dispose of waste materials and debris off site.
- .7 Clean interior areas prior to start of finishing Work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers and remove from premises at end of each day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by the manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris, and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

- .1 When Work is substantially performed, remove surplus products, tools, construction machinery, and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review, remove surplus products, tools, construction machinery, and equipment.
- .4 Remove waste products and debris other than that caused by the City or other contractors.
- .5 Remove waste materials from the Site at regularly scheduled times or dispose of as directed by the Contract Administrator. Do not burn waste materials on the Site.
- .6 Vacuum clean and dust building interiors, behind grilles, louvres, and screens.
- .7 Inspect finishes, fitments, and equipment and ensure specified workmanship and operation.

- .8 Clean roofs, downspouts, and drainage systems.
- .9 Remove debris and surplus materials from crawlspace areas and other accessible concealed spaces.
- .10 Remove snow and ice from access to building.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 OPERATION AND MAINTENANCE MANUALS

- .1 General
 - .1 Provide operation and maintenance manuals in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 An electronic draft copy of the operation and maintenance manuals shall be submitted (word version, if available) two (2) weeks prior to Substantial Performance of the Work for review and comments. Submission of individual data will not be accepted unless directed by the City. Make changes and incorporate the Contract Administrator’s review comments as required and re-submit as directed by the Contract Administrator.
 - .3 After review and acceptance by the City, five (5) hard copies and one electronic (PDF) copy of the final operation and maintenance manuals shall be submitted. The final electronic copy shall be provided on a flash memory drive.
 - .4 Prepare operation and maintenance manuals using personnel experienced in maintenance and operation of described products.
 - .5 Operation and maintenance instructions and technical data to be sufficiently detailed with respect to design elements, construction features, component function, correct installation procedure, and maintenance requirements to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of installation. Technical data to be in the form of approved Shop Drawings, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists.
 - .6 For the guidance of the City’s operation and maintenance personnel, the Contractor shall prepare operation and maintenance manuals for the Work, describing in detail the construction of each part of the Work and the recommended procedure for operation, servicing, and maintenance.
 - .7 All instructions in these operation and maintenance manuals shall be in simple language to guide the City in the proper operation and maintenance of this installation.
- .2 Format
 - .1 Organize data as instructional manual.
 - .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf, 8.5” by 11” with spine and face pockets.
 - .3 When multiple binders are used, correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine and face.
 - .4 Cover: identify each binder with title sheet labelled "Operation and Maintenance Instructions", and containing project name and date, facilities covered in the manual, City’s Contract number, the name and address of the Contractor, and the issue date.
 - .5 Arrange content by Division and Section numbers and sequence of Table of Contents.
 - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

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- .7 Text: manufacturer's printed data or type written data.
 - .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
 - .3 Contents
 - .1 For each operation and maintenance manual volume, provide an overall title sheet that includes:
 - .1 The title "Operation and Maintenance Instructions";
 - .2 Project name and date;
 - .3 Facilities covered in the manual;
 - .4 City's Contract number;
 - .5 Addresses and telephone numbers of Consultant and Contractor with name of responsible parties; and
 - .6 Schedule of products and systems, indexed to content of volume;
 - .2 For each operation and maintenance manual volume, provide an overall list of contents which includes the contents for all the operation and maintenance manual volumes.
 - .3 In addition to operation and maintenance information required in the individual Specification sections, include:
 - .1 Brochures/catalogue excerpts of all components of the Work.
 - .2 Product data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .3 Documentation of all test results.
 - .4 Complete set of equipment and assembly drawings.
 - .5 Installation, start-up, individual equipment operation and maintenance manuals.
 - .6 Shop Drawings and cutsheets of all equipment and materials.
 - .1 Do not utilize the cutsheet and Shop Drawing submittals that were sent to the Contract Administrator for review as these may contain inaccurate information and markups. Only provide cutsheets and Shop Drawings representing the final materials and equipment supplied, without any markups from the Contract Administrator.
 - .2 For generic cutsheets and Shop Drawings that list multiple model numbers or configurations, place a rectangle around the specific model that was supplied and cross out other models.
 - .7 Sections for the record Drawings and as-built Drawings of all installations. Drafted record Drawings and as-built Drawings of size 432x279 mm (11 x 17") will be inserted by the Contract Administrator, based on the as-built Drawings marked up by the Contractor.
 - .8 Names, addresses, and telephone numbers of all major Subcontractors and suppliers.
 - .9 Certificate of Inspection from the inspection authority.
 - .10 Testing and commissioning documentation.
 - .11 Warranty certificate, signed and dated.
 - .12 Written process narratives outlining the programming of the PLC systems for individual processes or systems.

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- .13 Final instrumentation set points including but not limited to:
 - .1 Units
 - .2 Scale
 - .3 Alarm points (low-low, low, high, high-high)
 - .4 4-20 mA settings
 - .14 Logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 – Quality Control.
 - .4 General catalog data for the operations and maintenance manual is unacceptable. If manufacturer's specification sheets are generalized in any way, they shall be clearly marked to show exactly which item has been supplied, and the project designation for that item (e.g., SF-Y601) is to be noted on manufacturer's specification sheet which includes all details for this unit, including complete model number, serial number, and construction and performance data.
 - .4 Equipment and Systems
 - .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics, and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .3 Include installed colour coded wiring diagrams.
 - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
 - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .6 Provide servicing and lubrication schedule, and list of lubricants required.
 - .7 Include manufacturer's printed operation and maintenance instructions.
 - .8 Include sequence of operation by controls manufacturer.
 - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - .10 Provide installed control diagrams by controls manufacturer.
 - .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
 - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .14 Additional requirements: as specified in individual Specification sections.
 - .5 Materials and Finishes
 - .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

- .1 Provide information for re-ordering custom manufactured products if applicable.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual Specifications sections.

1.2 AS-BUILT / RECORD DRAWINGS

- .1 Accurately mark-up deviations from the Contract caused by the Site conditions and changes ordered by the Contract Administrator. Update daily.
 - .2 The Contractor shall keep one complete set of white prints at the Site during the Work, including all addenda, change orders, Site instructions, clarifications, and revisions for the purpose of the as-built and record Drawings. As the Work on-site proceeds, the Contractor shall clearly mark up the white prints in red pencil all the Work which deviated from the original Contract. Identify Drawings as "Project Record Copy". Maintain in good condition and make available for inspection on-site by the Contract Administrator at all times.

1.3 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty meeting, to the Contract Administrator for approval.
- .3 Warranty management plan to include required actions and documents to assure that the City receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit warranty information, made available during construction phase, to the Contract Administrator for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work, and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within ten Business Days after completion of applicable item of Work.
 - .4 Verify that documents are in proper form and contain full information.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with the City's permission, leave date of beginning of time of warranty until date of Total Performance is determined.
- .8 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process,

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- including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers or suppliers involved.
- .2 Listing and status of delivery of certificates of warranty for warranty items, to include roofs, HVAC balancing, pumps, and commissioned systems. Provide list for each warranted equipment, item, feature of construction, or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses, and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent operation and maintenance manuals.
 - .11 Organization, names, and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .3 Procedure and status of tagging of equipment covered by extended warranties.
 - .4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
 - .9 Respond in timely manner to oral or written notification of required construction warranty repair work.
 - .10 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Contract Administrator to proceed with action against the Contractor.

1.4 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by the Contract Administrator.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
 - .2 Related Requirements
 - .1 864-2022 Bid Opportunity.
 - .3 Acronyms:
 - .1 Cx - Commissioning.
 - .2 EMCS - Energy Monitoring and Control Systems.
 - .3 O&M - Operation and Maintenance.
 - .4 PI - Product Information.
 - .5 PV - Performance Verification.
 - .6 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the O&M Manual.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively operated with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 For Cx responsibilities refer to Section 01 91 13.13 - Commissioning Plan.
 - .2 Cx to be a line item of Contractor's cost breakdown.
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- .3 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .4 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built pumping station upgrades are constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .5 Contract Administrator will issue Commissioning Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Contract Administrator.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Contract Administrator, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents, confirm by writing to Contract Administrator.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
 - .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
 - .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation ready for use during commissioning.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to Contract Administrator.
 - .7 Have Cx schedules up-to-date
 - .8 Ensure systems have been cleaned thoroughly.
-

- .9 Complete TAB procedures on systems, submit TAB reports to Contract Administrator for review and approval.
- .10 Ensure "As-Built" system schematics are available.
- .4 Inform Contract Administrator in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Contract Administrator before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's third party Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to Contract Administrator for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Contract Administrator where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Contract Administrator.

1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Contract Administrator to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Contract Administrator.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with 864-2022 Bid Opportunity D12, Detailed Work Schedule.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: 864-2022 Bid Opportunity D12, Detailed Work Schedule and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage, Contractor to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Discussion items at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 21 days notice prior to commencement.
- .2 Contract Administrator and the City to witness of start-up and testing
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by Contract Administrator.
 - .3 Arrange for Contract Administrator to witness tests.
 - .4 Obtain written approval of test results and documentation Contract Administrator before delivery to site.
 - .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Contract Administrator.
-

- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Contract Administrator after distinct phases have been completed and before commencing next phase.
- .4 Document required tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Contract Administrator. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by Contract Administrator.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Contract Administrator.
 - .3 If evaluation report concludes that major damage has occurred, Contract Administrator shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Contract Administrator for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit Contract Administrator to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Contract Administrator for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of commissioning acceptance.

1.17 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

- .1 Notify Contract Administrator at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

- .1 Submit to Contract Administrator for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
 - .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
-

- .3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

- .1 Contract Administrator and the City to have the opportunity to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Contract Administrator within 5 days of test and with Cx report.

1.23 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.24 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Contract Administrator.
- .2 Report problems, faults or defects affecting Cx to Contract Administrator in writing. Stop Cx until problems are rectified. Proceed with written approval from Contract Administrator.

1.25 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
 - .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
 - .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Contract Administrator.
-

1.26 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.27 TRAINING

- .1 In accordance with Section 01 91 13.83 - Commissioning Training.

1.28 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.29 OCCUPANCY

- .1 Cooperate fully with Contract Administrator during stages of acceptance and occupancy of facility.

1.30 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with Contract Administrator.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.31 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

1.32 CITY'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by Contract Administrator will not relieve Contractor from compliance with specified start-up and testing procedures.
-

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Description of overall structure of Plan and roles and responsibilities of commissioning team.
 - .2 Related Requirements
 - .1 864-2022 Bid Opportunity.

1.2 REFERENCE STANDARDS

- .1 American Water Works Association (AWWA)
- .2 Hydraulic Institute (ANSI/HI)
 - .1 9.6.3 [17], Rotodynamic Pumps – Guideline for Operating Region
 - .2 9.6.4 [16], Rotodynamic Pumps for Vibration Measurements and Allowable Values
 - .3 14.6 [22], Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 820 [16], Fire Protection in Wastewater Treatment and Collection Facilities
- .4 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-[03].

1.3 GENERAL

- .1 Provide a fully functional pumping station:
 - .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
 - .2 O&M personnel have been fully trained in aspects of installed systems.
 - .3 Complete documentation relating to installed equipment and systems.
 - .2 Term "Cx" in this section means "Commissioning".
 - .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process and administration of Cx.
 - .4 Describes process of verification of how built works meet design requirements.
 - .5 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
-

- .1 Overview of Cx.
- .2 General description of elements that make up Cx Plan.
- .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 Cx - Commissioning.
 - .2 EMCS - Energy Monitoring and Control Systems.
 - .3 HMI – Human Machine Interface
 - .4 O&M - Operation and Maintenance.
 - .5 PI - Product Information.
 - .6 PLC – Programmable Logic Controller
 - .7 PV - Performance Verification.
 - .8 TAB - Testing, Adjusting and Balancing.
 - .9 WHMIS - Workplace Hazardous Materials Information System.
 - .10 WHMIS Safety Data Sheets (SDS).
- .5 Commissioning terms used in this Section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 100% completed minimum 8 weeks prior to commissioning to take into account:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Contractor's, sub-contractor's, suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to Contract Administrator and obtain written approval.

1.5 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
 - .2 Revise, refine and update during construction phase. At each revision, indicate revision number and date.
 - .3 Submit each revised Cx Plan to Contract Administrator for review and obtain written approval.
 - .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.
-

1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

- .1 Contract Administrator to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 The Cx Team shall consist of the following members:
 - .1 Contract Administrator is responsible for:
 - .1 During construction, will conduct periodic site reviews to observe general progress.
 - .2 Monitoring operations Cx activities.
 - .3 Ensures Cx activities are carried out to ensure delivery of a fully operational pump station including:
 - .1 Review of Cx documentation from operational perspective.
 - .4 Witnessing, certifying accuracy of reported results.
 - .5 Witnessing and certifying TAB and other tests.
 - .6 Ensuring implementation of final Cx Plan.
 - .7 Witnessing verification of performance of installed systems and equipment.
 - .8 Ensuring implementation of Training Plan.
 - .9 Training on the HMI, PLC panel selector switches, and standalone level controllers located within the PLC panel.
 - .10 Commissioning of the HMI, PLC, and standalone level controllers.
 - .2 Construction Team: contractor, subcontractors, suppliers and support disciplines, are responsible for construction/installation in accordance with Contract Documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Organizing Cx
 - .4 Performance of Cx activities to ensure delivery of a fully operational pump station including:
 - .1 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .2 Protection of health, safety and comfort of occupants and O&M personnel.
 - .5 Delivery of training and Cx documentation.
 - .6 Assigning one person as point of contact with Contract Administrator and Cx agent for administrative and coordination purposes.
 - .3 Contractor's Cx agent implements specified Cx activities including:
 - .1 Demonstrations.
 - .2 Training, except as noted below.
 - .1 HMI training, PLC panel selector switches training, and training on the standalone level controllers located within the PLC panel.
 - .3 Testing.
 - .4 Development of Cx documentation.
 - .5 Preparation, submission of test reports.

- .6 Developing O&M Manual.
- .4 The City: represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving the completed facility.
 - .2 Day-To-Day operation and maintenance of the completed facility.

1.7 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor:
 - .1 Equipment and systems except as noted below.
 - .1 HMI screens, PLC Control panel, PLC panel selector switches, and standalone level controllers commissioning shall be in the scope of the Contract Administrator.
 - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .1 Process pumps P-L01, P-L02, P-L03
 - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
 - .4 Ensure that Cx participant:
 - .1 Could complete work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
 - .1 Modify ventilation rates.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
 - .5 Provide names of participants to Contract Administrator and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

1.8 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment including but not limited to:
 - .1 Process pumping systems:
 - .1 Process Pumps (P-L01, P-L02, P-L03)
 - .2 Process valves
 - .3 Wet well level gauges (LG-L100-1, LG-L100-2)
 - .2 Plumbing systems:
 - .1 Domestic CWS.
 - .2 Sump pump (P-L04)
 - .3 HVAC systems:
 - .1 HVAC systems
-

- .1 Fans (SF-L64, EF-L65)
- .2 Air conditioning unit (AC-L68)
- .3 Unit Heaters (L-63)
- .4 Duct Heaters (HCE-L61)
- .5 Dampers
- .6 Filters (FIL-L66)
- .7 HVAC Controls
- .4 Fire and life safety systems:
 - .1 Fire extinguishers.
- .2 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3 Motor control centres.
 - .4 Motor control field devices.
 - .2 Emergency power generation systems:
 - .1 Transfer switchgear.
 - .2 Uninterruptible power systems.
 - .3 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.
- .3 Commission automation systems and equipment:
 - .1 Process instrumentation.
 - .2 Control panels.

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General requirements:
 - .1 Compile English documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
 - .2 Provide deliverables:
 - .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools and maintenance materials.
 - .4 Maintenance Management System (MMS) identification system used.
 - .5 WHMIS information.
 - .6 WHMIS Safety Data Sheets (SDS).
 - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.
-

1.10 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
 - .1 Cx as used in this section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
 - .1 Cx Specifications.
 - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
 - .3 Completed installation checklists (ICL).
 - .4 Completed product information (PI) report forms.
 - .5 Completed performance verification (PV) report forms.
 - .6 Results of Performance Verification Tests and Inspections.
 - .7 Description of Cx activities and documentation.
 - .8 Description of Cx of integrated systems and documentation.
 - .9 Training Plans.
 - .10 Cx Reports.
 - .11 Prescribed activities during warranty period.
- .4 Contract Administrator to witness and certify tests and reports of results provided to Departmental Representative.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by Contractor prior to permission to start up and rectification of deficiencies to Contract Administrators satisfaction.
 - .2 Contractor to use approved check lists.
 - .3 Contract Administrator may monitor all of these pre-start-up inspections.
 - .4 Include completed documentation with Cx report.
 - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Contract Administrator and does not form part of Cx specifications.
 - .6 Contract Administrator may monitor some of these inspections and tests.
 - .7 Include completed documentation in Cx report.
 - .2 Pre-Cx activities - MECHANICAL:
 - .1 Process pumping systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
-

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- .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .2 Plumbing systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .3 HVAC equipment and systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 At this time, complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .4 Perform TAB on systems. TAB reports to be approved by Contract Administrator.
 - .4 EMCS:
 - .1 EMCS trending to be available as supporting documentation for performance verification.
 - .2 Perform point-by-point testing in parallel with start-up.
 - .3 Carry out point-by-point verification.
 - .4 Demonstrate performance of systems, to be witnessed by Contract Administrator prior to start of 30 day Final Acceptance Test period.
 - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
 - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
 - .3 Pre-Cx activities – FIRE AND LIFE SAFETY SYSTEMS
 - .1 No pre-Cx activities.
 - .4 Pre-Cx activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
 - .2 Emergency power generation systems
 - .1 Transfer switch: test of manual operation of switch
 - .3 Lighting systems:
 - .1 Emergency lighting systems:
 - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.
 - .4 Automation systems: these include:
 - .1 Instrumentation calibration.
 - .2 Control panel loop checks and field wiring connections for process and HVAC.
 - .3 Communications between the pumping station and the City's SCADA system.
-

1.12 START-UP

- .1 Start up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, all equipment and systems except the following:
 - .1 PLC control panel, HMI screens, and standalone level controllers shall be started up under the supervision of the Contract Administrator. Contract Administrator shall perform commissioning of the PLC control panel and standalone level controllers.
- .3 Contract Administrator to monitor some of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Contract Administrator.
- .4 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Contract Administrator.
 - .2 Use modified generic procedures to suit project requirements.
 - .3 Contract Administrator to witness and certify reported results using approved PI and PV forms.
 - .4 Contract Administrator to approve completed PV.
 - .5 Contract Administrator reserves right to verify up to 30% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by Cx agency and approved by Contract Administrator.
- .2 Contract Administrator to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Cx agency to witness and certify reported results of Cx activities and forward to Contract Administrator.
- .5 Contract Administrator reserves right to verify a percentage of reported results at no cost to contract.

1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Cx agency and approved by Contract Administrator.
 - .2 Tests to be witnessed by the City and Contract Administrator and documented on approved report forms.
 - .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Cx agency and submitted to Contract Administrator for review.
-

.4 Contract Administrator reserves right to verify percentage of reported results.

.5 Integrated systems to include:

- .1 HVAC and associated systems forming part of integrated HVAC systems.
- .2 Transfer switch.
- .3 Lighting & Emergency lighting systems.
- .4 Automation systems.

1.15 INSTALLATION CHECK LISTS (ICL)

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.16 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 PERFORMANCE VERIFICATION (PV) REPORT

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.18 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Contract Administrator for review and approval same time as project Construction Schedule. Include:

- .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Cx agents' credentials: 60 days before start of Cx.
 - .2 Cx procedures: 3 months after award of contract.
 - .3 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
 - .4 Notification of intention to start TAB: 21 days before start of TAB.
 - .5 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .6 Notification of intention to start Cx: 14 days before start of Cx.
 - .7 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
 - .8 Identification of deferred Cx.
 - .9 Implementation of training plans.
 - .10 Cx reports: immediately upon successful completion of Cx.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to the City.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

- .3 Contract Administrator, Contractor, and Contractor's Cx agent will monitor progress of Cx against this schedule.

1.19 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by Cx agency to Contract Administrator who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Contract Administrator.

1.20 ACTIVITIES DURING WARRANTY PERIOD

- .1 Cx activities must be completed before issuance of Commissioning Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
 - .1 Fine tuning of HVAC systems.

1.21 TESTS TO BE PERFORMED BY THE CITY

- .1 None anticipated on this project.

1.22 TRAINING PLANS

- .1 Refer to Section 01 91 13.18 – Commissioning Training.

1.23 FINAL SETTINGS

- .1 Upon completion of Cx to satisfaction of Contract Administrator, lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Commissioning forms to be completed for equipment, system and integrated system.
- .2 Related Requirements
 - .1 864-2022 Bid Opportunity
 - .2 Section 40 80 11 – Automation - Commissioning

1.2 INSTALLATION/ START-UP CHECK LISTS

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Contract Administrator supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Contract Administrator. Check lists will be required during Commissioning and will be included in Operation & Maintenance Manual (O&M Manual) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the O&M Manual at completion of work.
 - .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Contract Administrator's approval.
-

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Contract Administrator's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 Contract Administrator will develop and provide to Contractor samples of required project-specific Commissioning forms in electronic format. The following equipment categories are representative of the forms that may be required but not limited to:
 - .1 Process Pumping System Commissioning Forms:
 - .1 Process Pumps
 - .2 Valves
 - .3 Level Gauge
 - .2 Plumbing System Commissioning Forms:
 - .1 Water Meter
 - .2 Valves
 - .3 Sump Pump
 - .3 HVAC System Commissioning Forms:
 - .1 Fans
 - .2 Air Conditioning Unit
 - .3 Unit Heater
 - .4 Duct Heater
 - .5 Dampers
 - .6 Filter
 - .7 HVAC controls
 - .4 Fire and Life Safety Systems Commissioning Forms:
 - .1 Fire extinguishers
 - .5 Low Voltage (below 750V) Commissioning Forms
 - .1 Low voltage equipment
 - .2 Low voltage distribution systems
 - .3 Motor control centres
 - .4 Motor control field devices
 - .6 Emergency Power Generation Systems
 - .1 Transfer switchgear
 - .2 Uninterruptible power systems
 - .7 Lighting Systems
 - .1 Lighting equipment.
-

- .2 Distribution systems.
- .3 Emergency lighting systems, including battery packs.
- .8 Automation systems and equipment:
 - .1 Process instrumentation calibration sheets.
 - .2 Process instrumentation loop checks
 - .3 PLC control panels
 - .1 PLC Control Panel and standalone level controllers shall be commissioned by the Contract Administrator. As part of the loop check procedure, Contractor shall assist/collaborate with Contract Administrator to verify functionality of each PLC input/output to the instrumentation device in the field.
- .2 Revise items on Commissioning forms to suit project requirements.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

- .1 When additional forms are required, but are not available from Contract Administrator, develop appropriate verification forms and submit to Contract Administrator for approval prior to use.

1.7 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Commissioning agent provides project-specific Commissioning forms.
 - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation as per design criteria and intent.
 - .4 Identify variances between design and operation and reasons for variances.
 - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .6 Record analytical and substantiating data.
 - .7 Verify reported results.
 - .8 Form to bear signatures of recording technician and reviewed and signed off by Contract Administrator.
 - .9 Submit immediately after tests are performed.
 - .10 Reported results in true measured SI unit values.
 - .11 Provide Contract Administrator with originals of completed forms.
 - .12 Maintain copy on site during start-up, testing and commissioning period.
 - .13 Forms to be both hard copy and electronic format with typed written results in Operation & Maintenance Manual in accordance with Section 01 78 00 – Closeout Submittals.

1.8 LANGUAGE

- .1 To suit the language profile of the awarded contract.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 This Section specifies roles and responsibilities of Commissioning Training.
- .2 Related Requirements
 - .1 864-2022 Bid Opportunity
 - .2 Section 40 80 11 – Automation - Commissioning

1.2 TRAINEES

- .1 Trainees: personnel selected for operating and maintaining the facility. Includes facility managers, operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 INSTRUCTORS

- .1 Contract Administrator will provide:
 - .1 Operator training on HMI screens; navigation and general use.
 - .2 Operator training on PLC panel selector switches
 - .3 Operator training on standalone level controllers
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

- .1 Training to be detailed and duration to ensure:
 - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
 - .2 Effective on-going inspection, measurements of system performance.
 - .3 Proper preventive maintenance, diagnosis and trouble-shooting.
 - .4 Ability to update documentation.
-

- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.
 - .3 Maintenance Manual.
 - .4 TAB and PV Reports.
- .3 Training materials to be in a format that permits future training procedures to same degree of detail.

1.6 SCHEDULING

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be 3 hours in length.
- .3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
- .2 City Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by City Representative.

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
 - .2 Content includes:
 - .1 Functional requirements.
 - .2 System philosophy, limitations of systems and emergency procedures.
 - .3 Review of system layout, equipment, components and controls.
 - .4 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .5 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
-

- .6 Maintenance and servicing.
- .7 Trouble-shooting diagnosis.
- .8 Inter-Action among systems during integrated operation.
- .9 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1. GENERAL

1.1 WORK INCLUDED

- .1 Design, supply, and installation of fibreglass reinforced plastic (FRP) grating, ladders and associated connections and accessories.

1.2 SUBMITTALS

- .1 Design of the (FRP) structural grating, ladders, connections and accessories shall be performed by a Professional Engineer registered in the Province of Manitoba (Contractor's Engineer).
 - .1 Use loads, load combinations, and stress levels for design in accordance with the structural drawings, National Building Code of Canada (NBCC) 2010, Manitoba Amendments and ANSI A14.3-2008 American National Standard for Ladders.
 - .2 Submit sealed shop drawings of the design to Contract Administrator in accordance with Section 01 33 00 Submittal Procedures.
 - .1 Include erection drawings, elevations, and details (including connection details).
 - .3 The Contractor's Engineer doing the design shall review the in-place installation and certify in writing that the work is in conformance with her/his design.
 - .4 Submit one (1) sample of each type of grating for selection.

1.3 QUALITY ASSURANCE

- .1 The installation Contractor shall be an erector approved by the Manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Manufactured materials shall be delivered stored and handled in accordance with Manufacturer's instructions.

2. PRODUCTS

2.1 MATERIALS

- .1 Grating:
 - .1 Acceptable product: molded FRP grating in Fibergrate Vi-Corr resin by Fibergrate Composite Structures Inc., colour dark gray, top surface: Applied Grit Top, $\frac{3}{4}$ " square mesh pattern.
 - .2 Hold-down clips: stainless steel.
- .2 Ladders (in manhole risers only):
 - .1 Acceptable product: Dynarail FRP Safety Ladders in VEFR resin by Fibergrate Composite Structures Inc., colour safety yellow.
 - .2 Anchorage to concrete riser walls shall be completed with stainless steel adhesive anchors. Design by Shop Drawings Engineer.

3. EXECUTION

3.1 EXAMINATION

- .1 Before starting erection, examine other Work that may affect this Work.
- .2 Notify the Contract Administrator of any conditions that would prevent proper installation of this Work.
- .3 Commencement of erection Work implies acceptance of existing conditions.

3.2 FRP INSTALLATION

- .1 FRP products shall be installed in accordance with Manufacturer's Shop Drawings and written instructions.
- .2 The Construction Contractor shall verify measurements in field for the Work prior to FRP fabrication. Determine correct size and locations of required holes or cutouts from field dimensions before fabrication.
- .3 Gratings shall be fabricated free from warps, twists, or other defects that affect appearance and serviceability.
- .4 Hold-down clips shall be provided and spaced with a minimum of four (4) per piece of grating, or as recommended by the Manufacturer. Hold-down clips and related appurtenances shall be stainless steel.
- .5 All cuts and abrasions are to be sealed in accordance with the FRP Manufacturer's written instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 03 30 00 - Cast-in-Place Concrete
- .2 04 05 13 - Masonry Mortaring and Grouting
- .3 04 05 19 - Masonry Anchorage and Reinforcing
- .4 04 05 23 - Masonry Accessories
- .5 04 21 14 – Brick Masonry

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-A165 Series-14, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A371-14, Masonry Construction for Buildings.
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:
 - .1 Verify project requirements, including mock-up requirements.
 - .2 Verify substrate conditions.
 - .3 Co-ordinate products, installation methods and techniques.
 - .4 Sequence work of related sections.
 - .5 Co-ordinate with other building subtrades.
 - .6 Review manufacturer's installation instructions.
 - .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
 - .8 Review warranty requirements.
- .2 Sequencing: comply with manufacturer's written recommendations for sequencing construction operations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Submit shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.
- .4 Samples:
 - .1 Upon request of Contract Administrator, provide samples as follows:
 - .1 1 of each type of brick and concrete masonry unit specified, including special shapes.
 - .2 2 cured samples of mortar and grout, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04 05 13 - Masonry Mortaring and Grout.
 - .3 2 of each type of masonry accessory and flashing specified, supplemented by specific requirements in Section 04 05 23 - Masonry Accessories.
 - .4 2 of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19 - Masonry Anchorage and Reinforcing.
 - .5 Samples: used for testing and when accepted become standard for material used.
- .5 Test and Evaluation Reports:
 - .1 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
 - .2 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.
- .6 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.
- .7 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:
 - .1 Verification of compliance of work with Contract.
 - .2 Site visit reports providing detailed review of installation of work, and installed work.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 EXTRA MATERIALS

- .1 Submit manufacturer's instructions in accordance with Section 01 78 00 - Closeout Submittals covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.7 QUALITY ASSURANCE

- .1 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Construct mock-up panel of exterior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, pointing, coursing, mortar and quality of work.
 - .3 Mock-up used:
 - .1 To judge quality of work, substrate preparation, operation of equipment and material application.
 - .4 Construct mock-up where directed by Contract Administrator.
 - .5 Allow 24 hours for inspection of mock-up by Contract Administrator before proceeding with work.
 - .6 When accepted by Contract Administrator, mock-up to demonstrate minimum standard for this work. Mock-up may remain as part of finished work.
 - .7 Start work only upon receipt of written approval of mock-up by Contract Administrator.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect material packages from nicks, scratches and blemishes.
 - .3 Keep materials dry until use.
 - .4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
 - .5 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding and other packaging materials as specified in accordance with Section 01 74 19 - Waste Management and Disposal.

1.9 SITE CONDITIONS

- .1 Ambient Conditions: assemble and erect components when temperatures are above 10 degrees C.
- .2 Weather Requirements: to CAN/CSA-A371 and to IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- .3 Cold weather requirements:
 - .1 To CAN/CSA-A371 with following requirements.
 - .1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.

- .2 Maintain ambient temperature of masonry work and its constituent materials between 5 degrees C and 50 degrees C and protect site from windchill.
- .3 Maintain temperature of masonry above 0 degrees C for minimum of 3 days, after mortar is installed.
- .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.
- .2 Hot weather requirements:
 - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
 - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
- .3 Spray mortar surface at intervals and keep moist for maximum of 3 days after installation.

1.10 WARRANTY

- .1 12 months warranty period shall be provided for Work under this Section.

Part 2 Products

2.1 MATERIALS

- .1 Masonry materials are specified elsewhere in related Sections:
 - .1 Section 042200 - Concrete Unit Masonry.
 - .2 Section 042113 - Brick Masonry.

Part 3 Execution

3.1 INSTALLERS

- .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 EXAMINATION

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
 - .1 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Contract Administrator.
- .3 Verification of Conditions:
 - .1 Verify that:

- .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of brick and concrete block.
- .2 Site conditions are acceptable and are ready to receive work.
- .3 Built-in items are in proper location, and ready for roughing into masonry work.
- .2 Commencing installation means acceptance of existing substrates.

3.3 PREPARATION

- .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.
- .2 Establish and protect lines, levels, and coursing.
- .3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

- .1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

- .1 Exposed masonry:
 - .1 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.
- .2 Jointing:
 - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
 - .2 Allow joints to set just enough to remove excess water, then rake joints uniformly to 6 mm depth and compress with square tool to provide smooth, compressed, raked joints of uniform depth where raked joints are indicated.
 - .3 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
- .3 Cutting:
 - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
 - .2 Make cuts straight, clean, and free from uneven edges.
- .4 Building-In:
 - .1 Build in items required built into masonry.
 - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

- .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- .5 Wetting of bricks:
 - .1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mm²: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.
 - .2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.
- .6 Support of loads:
 - .1 Use 30 MPa concrete to Section 03 30 00 - Cast-in-Place Concrete, where concrete fill is used instead of solid units.
 - .2 Use grout to CAN/CSA-A179 where grout is used instead of solid units.
 - .3 Install building paper below voids to be filled with grout; keep paper 25 mm back from faces of units.
- .7 Provision for movement:
 - .1 Built masonry to tie in with stabilizers, with provision for vertical movement.
- .8 Loose steel lintels:
 - .1 Install loose steel lintels. Center over opening width.
- .9 Control joints:
 - .1 Construct continuous control joints as indicated.
- .10 Movement joints:
 - .1 Build-in continuous movement joints as indicated.
- 3.6 SITE TOLERANCES**
 - .1 Tolerances in notes to CAN/CSA-A371 apply.
- 3.7 SITE QUALITY CONTROL**
 - .1 Site Tests, Inspection:
 - .1 Perform site inspection and testing in accordance with Section 01 45 00 - Quality Control.
 - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
 - .2 Manufacturer's Services:
 - .1 Upon request, have manufacturer of products supplied under this Section review work involved in handling, installation/application, and protection of its products, and submit written reports in acceptable format to verify compliance of work with Contract.
 - .2 Manufacturer's site services: provide manufacturer's site services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work as installation is about to begin.
 - .4 Schedule site visits to review work at stages listed:

- .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
- .2 Twice during progress of work at 25% and 60% complete.
- .3 Upon completion of work, after cleaning is carried out.
- .5 Obtain reports within 7 days of review and submit immediately to Contract Administrator.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

- .1 Temporary Bracing:
 - .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
 - .2 Bracing approved by Contract Administrator.
 - .3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.
- .2 Moisture Protection:
 - .1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
 - .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
 - .3 Air Temperature Protection: protect completed masonry as recommended in 1.9, SITE CONDITIONS.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 04 05 00 - Common Work Results for Masonry
- .2 04 22 00 – Concrete Unit Masonry

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A371-14, Masonry Construction for Buildings.
 - .4 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- .3 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry mortar and grout and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .3 Samples:
 - .1 Samples: upon request, submit unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:
 - .1 Submit two samples of mortar.
 - .2 Submit samples and confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Contract Administrator of:
 - .1 Aggregate: course aggregate and sand.
 - .2 Cement.
 - .3 Lime.
 - .4 Colour pigment samples.
- .4 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect masonry mortar and grout packages from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials.

1.6 SITE CONDITIONS

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 10 degrees C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Weather Requirements: CAN/CSA-A371 and International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

Part 2 Products

2.1 MATERIALS

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:
 - .1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (Type 10), HE - High-early-strength hydraulic cement (Type 30) gray colour.
 - .1 Use low VOC products.
 - .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA-A179.
 - .3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type N, S.

- .1 Use low VOC products.
- .4 Packaged Dry Combined Materials for mortar: to CAN/CSA-A179, Type N, S.
- .3 Aggregate: supplied by one supplier.
 - .1 Fine Aggregate: to CAN/CSA-A179.
 - .2 Course Aggregate: to CAN/CSA-A179.
- .4 Water: clean and potable.
- .5 Lime:
 - .1 Quick Lime: to CAN/CSA-A179.
 - .2 Hydrated Lime: to CAN/CSA-A179.
- .6 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture if required.

2.2 COLOUR ADDITIVES

- .1 Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, to produce coloured mortar to match approved sample. Admixtures approved prior to use. Use in accordance with specific manufacturer's recommendations.
- .2 Powder: inorganic mineral oxide pigment, colour as selected.

2.3 ADMIXTURES

- .1 Submit data sheets for every admixture product used.
 - .1 Use low VOC products.

2.4 MORTAR MIXES

- .1 Mortar for masonry above grade:
 - .1 Load Bearing: type S based on property specifications.
 - .2 Non-Load Bearing: N based on property specifications.

2.5 MORTAR MIXING

- .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to within 1% accuracy.
- .2 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use
- .3 Maintain sand uniformly damp immediately before mixing process.
- .4 Add mortar colour and admixtures as required and as approved in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.
- .5 Using anti-freeze compounds including calcium chloride or chloride based compounds is prohibited.
- .6 Adding air entraining admixture to mortar mix is prohibited.
- .7 Use a batch type mixer in accordance with CAN/CSA-A179

- .8 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.

2.6 GROUT MIXES

- .1 Bond Beams: grout mix 12.5 MPa strength at 28 days; 200-250 mm slump; fine grout.
- .2 Lintels: grout mix 12.5 MPa strength at 28 days; 200-250 mm slump; fine grout.
- .3 Grout: Minimum compressive strength of 12.5 MPa at 28 days; 200-250 mm slump; fine grout.

2.7 GROUT MIXING

- .1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 transit mixed
- .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA-A179 fine grout.
- .3 If applicable, add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .4 Using calcium chloride or chloride based admixtures is prohibited.

2.8 MIX TESTS

- .1 Testing Mortar Mix:
 - .1 Test mortar to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for mortar based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Consistency.
 - .3 Mortar aggregate ratio.
 - .4 Sand/cement ratio.
 - .5 Water content and water/cement ratio.
 - .6 Air content.
 - .7 Splitting tensile strength.
 - .2 Testing Grout Mix:
 - .1 Test grout to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for grout based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Sand/cement ratio.
 - .3 Water content and water/cement ratio.
 - .4 Slump.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for masonry installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Contract Administrator.
- .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 PREPARATION

- .1 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 CONSTRUCTION

- .1 Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise

3.4 MIXING

- .1 Clean mixing boards and mechanical mixing machine between batches.
- .2 Mortar: weaker than units it is binding.
- .3 Contractor to appoint one individual to mix mortar, for duration of project. In event that this individual is changed, mortar mixing must cease until new individual is trained, and mortar mix is tested.

3.5 MORTAR PLACEMENT

- .1 Install mortar to manufacturer's instructions.
- .2 Install mortar to requirements of CAN/CSA-A179.
- .3 Remove excess mortar from grout spaces.

3.6 GROUT PLACEMENT

- .1 Install grout in accordance with manufacturer's instructions.
- .2 Install grout in accordance with CAN/CSA-A179
- .3 Work grout into masonry cores and cavities to eliminate voids.
- .4 Installing grout in lifts greater than 400 mm, without consolidating grout by rodding is prohibited.
- .5 Displacing reinforcement while placing grout is prohibited.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
 - .1 Test and evaluate mortar prior to construction and during construction in accordance with CAN/CSA-A179.
 - .2 Test and evaluate grout prior to construction and during construction to CAN/CSA-A179; test in conjunction with masonry unit sections specified.
- .2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Remove droppings and splashings using clean sponge and water.
- .3 Clean masonry with low pressure clean water and soft natural bristle brush.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .5 Waste Management: separate waste materials for reuse and recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

- .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 04 05 00 - Common Work Results for Masonry

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 36/A 36M-14, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A 167-15, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .4 ASTM A 580/A 580M-16, Standard Specification for Stainless Steel Wire.
 - .5 ASTM A 641/A 641M-(R2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .6 ASTM A 666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - .7 ASTM A 1022 16B, Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement.
- .2 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-14 (R2015), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A370-14, Connectors for Masonry.
 - .4 CAN/CSA-A371-14, Masonry Construction for Buildings.
 - .5 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .6 CSA S304-14(R2015), Design of Masonry Structures.
 - .7 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 Reinforcing Steel Institute of Canada (RSIC)
 - .1 Reinforcing Steel Manual of Standard Practice, 2004.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for anchorage and reinforcing materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.

- .2 Submit drawings detailing bar bending details, anchorage details lists and placement drawings
- .3 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
- .4 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

1.5 SITE MEASUREMENTS

- .1 Make site measurements necessary for proper fit of members.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect anchorage and reinforcing materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return to manufacturer pallets, crates, padding and packaging materials.

Part 2 Products

2.1 MATERIALS

- .1 Bar reinforcement: Steel to CAN/CSA-A371 and CSA G30.18, Grade 400.
- .2 Connectors: to CAN/CSA-A370 and CSA S304.1. Connectors shall be of stainless steel.
- .3 Corrosion protection: to CSA S304.1, Stainless steel to ASTM A 1022.
- .4 Fasteners: installed post-construction:
 - .1 Screw Shields and Plugs: vibration-resistant, chemical-resistant, water-resistant; placed directly into solid masonry units.
 - .2 Bolts and Screws: size and type to suit application, locate where indicated.
 - .3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.

- .4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.
- .5 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.
- .5 Ties: stainless steel; to CAN/CSA-A370.
 - .1 Corrugated to: CAN/CSA-A370
 - .2 Unit ties, to CAN/CSA-A370: Z style, fabricated from wire stainless steel, size to suit application.
 - .3 Adjustable Unit Ties: to CAN/CSA-A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations
- .6 Joint Reinforcement Ties: CSA A371 with corrosion protection to CSA S304 and CSA A370 :
 - .1 Single Wythe Joint Reinforcement: ladder type:
 - .1 Steel wire, hot dip galvanized: to ASTM A 641, Class 3.
 - .2 Cold drawn steel wire.
- .7 Anchors: to CAN/CSA-A370:
 - .1 Conventional Anchors: type steel bolts with bent bar anchors, shape L, sized to suit application.
 - .2 Wedge Anchors: expansion anchors type wedge and bolt, sized to suit application.
 - .3 Sleeve Anchors: type sleeve and bolt, sized to suit application.
 - .4 Self-Contained Anchors: type double-glass/plastic vial system, with epoxy resin and hardener.
 - .5 Spiral Anchors: 6.4 mm stainless steel spiral anchors to Grade 304.
 - .6 Anchor Bolts: proprietary (patented) anchors, stainless steel or galvanized to CAN/CSA-A370 Table 5.2 as required by the application.
 - .7 Stainless steel anchors shall be utilized in all exterior applications. Galvanized anchors shall be utilized in interior applications.
- .8 Conventional Bolts:
 - .1 Bolts: to ASTM F1554 Grade 36.
 - .2 Plate anchors: steel to ASTM A 36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end
 - .3 Through bolt rods: to ASTM F1554 Grade 36 threaded rod or threaded ASTM A 36 bar stock.
- .9 Adhesive Anchors: proprietary systems, consisting of resin and hardener.

2.2 FABRICATION

- .1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CAN/CSA-A370.
- .3 Obtain Contract Administrator's approval for locations of reinforcement splices other than shown on placing drawings.
- .4 Upon approval of Contract Administrator, weld reinforcement in accordance with CSA W186.

- .5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Contract Administrator with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis prior to commencing reinforcement work.
- .2 Upon request, inform Contract Administrator of proposed source of supplied material.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for anchorage and reinforcing materials installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Contract Administrator.
- .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 PREPARATION

- .1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 INSTALLATION

- .1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370 , CAN/CSA-A371 , CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise
- .2 Prior to placing grout, obtain Contract Administrator's approval of placement of reinforcement and connectors.
- .3 Supply and install additional reinforcement to masonry as indicated.

3.4 BONDING AND TYING

- .1 Tie masonry veneer to backing in accordance with National Building Code of Canada (NBC), CSA S304.1, CAN/CSA-A371 and as indicated.
- .2 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370, CAN/CSA-A371 and manufacturer's instructions.
- .1 Install horizontal joint reinforcement 400 mm on centre.
- .2 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
- .3 Place joint reinforcement continuous in first joint below top of walls.
- .4 Lap joint reinforcement ends minimum 200 mm.
- .5 Connect joint corners and intersections with strap anchors 400 mm on centre.

3.5 REINFORCED LINTELS AND BOND BEAMS

- .1 Reinforce masonry beams, masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.

.3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

3.6 GROUTING

.1 Grout masonry in accordance with CSA S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated

3.7 ANCHORS

.1 Supply and install metal anchors in accordance with CAN/CSA-A370 and CAN/CSA-A371 or as indicated.

3.8 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.9 MOVEMENT JOINTS

.1 Reinforcement not continuous across movement joints unless otherwise indicated.

3.10 FIELD BENDING

.1 Do not field bend reinforcement and connectors except where indicated or authorized by Contract Administrator.

.2 When field bending authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars and connectors with cracks or splits.

3.11 FIELD QUALITY CONTROL

.1 Site inspections in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Obtain Contract Administrator approval of placement of reinforcement and connectors, prior to placing grout.

3.12 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.13 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling.

- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D 2240-15, Standard Test Method for Rubber Property - Durometer Hardness.
- .2 CSA Group (CSA)
 - .1 CAN/CSA-A371-14, Masonry Construction for Buildings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Indicate on drawings:
 - .1 Flashing, installation details, sizes, spacing, location and quantities of fasteners.
- .4 Samples:
 - .1 Submit 2 samples of masonry accessories as follows:
 - .1 Moisture control material samples, illustrating colour and colour range, size, and shape. Include:
 - .1 Weep hole vents.
 - .2 Mortar diverters.
 - .3 Grout screens.
 - .2 Flashing material samples, illustrating colour and colour range, size, shape, and profile. Include as specified:
 - .1 Sheet metal flashings.

1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports [including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Manufacturer's Instructions: submit manufacturer's instructions as follows:
 - .1 Submit installation instructions for weeps ventsscreens and flashings.

1.4 SITE MEASUREMENTS

- .1 Make site measurements necessary to ensure proper fit of members.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect masonry accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Lap adhesive: recommended by masonry flashing manufacturer.
- .2 Weep hole vents: purpose-made PVC, colour to match grout.
- .3 Mechanical fasteners: recommended by flashing manufacturer to suit project requirements.

2.2 MOISTURE CONTROL

- .1 Weep Hole Vents: PVC, colour to match grout.
- .2 Mortar diverters: shaped and sized to suit cavity spaces.
 - .1 Cavity space size: 25 mm.
 - .2 Manufactures from recycled material.
- .3 Grout Screens: 6 mm square monofilament screen fabricated from high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.
 - .1 Size: 150 mm wide x 30 m.

2.3 FLASHINGS

- .1 Sheet metal: galvanized steel.
 - .1 Thickness: 0.551 mm (26ga.).
 - .2 Finish: Pre-finished.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for masonry accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions remedied.

3.2 INSTALLATION: MATERIALS

- .1 Install continuous movement joint fillers in movement joints at locations indicated on drawings.
- .2 Lap adhesive: apply adhesive to flashing lap joints.
- .3 Mechanical fasteners: install fasteners to suit application and in accordance with manufacturer's written installation instructions.
- .4 Reglets: install reglets at locations indicated on drawings.
- .5 Brick vents: install brick vents at locations indicated on drawings.

3.3 INSTALLATION: MOISTURE CONTROL

- .1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm on centre.
- .2 Mortar diverters: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.
- .3 Grout screens: install purpose made screens in cavities where indicated and as directed, size and shape to suit purpose and function.

3.4 INSTALLATION: FLASHINGS

- .1 Build in flashings in masonry in accordance with CAN/CSA-A371
 - .1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.
 - .2 In cavity walls and veneered walls, carry flashings from front edge of exterior masonry, under outer wythe, then up backing minimum 150 mm, and as follows:
 - .1 For masonry backing embed or bond flashing 25 mm in joint.
 - .2 For concrete backing, insert or bond flashing into reglets.
 - .3 For wood frame backing, staple flashing to walls behind water resistive paper, and lap joints.
 - .4 For gypsum board and glass fibre faced sheathing backing, bond to wall using manufacturer's recommended adhesive.
 - .3 Lap joints 150 mm and seal with adhesive.
- .2 Form flashing (end dams) at lintels, sills and wall ends to prevent water from travelling horizontally past flashing ends.
- .3 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 04 05 00 - Common Work Results for Masonry
- .2 04 05 13 - Masonry Mortar and Grouting
- .3 04 05 19 - Masonry Anchorage and Reinforcing
- .4 04 05 23 - Masonry Accessories

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM E 336-11, Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings.
- .2 CSA Group (CSA)
 - .1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units. Consists: A165.1, A165.2, A165.3.
 - .2 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
 - .3 CSA S304.1-04(R2010), Design of Masonry Structures.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2010 (NBC) and Manitoba Amendments (MBC 2011).
- .4 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-07(R2010), Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

- .3 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
 - .1 Construct mock-up panel of exterior concrete unit masonry construction 1200 x 1800 mm.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.
 - .2 Do not use brick tongs to move or handle masonry.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Do not double stack cubes of concrete unit masonry.
 - .3 Cover masonry units with non-staining waterproof membrane covering.
 - .4 Allow air circulation around units.
 - .5 Installation of wet or stained masonry units is prohibited.
 - .6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.
 - .7 Store and protect concrete unit masonry from nicks, scratches, and blemishes.
 - .8 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return to manufacturer of pallets, crates, padding and other packaging materials.

Part 2 Products

2.1 MATERIALS

- .1 Standard concrete block units: to CAN/CSA-A165 CAN/CSA-A165 CAN/CSA-A165
 - .1 Classification: H / 15 / A / M.
 - .2 Dimensions Nominal: 150 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: provide bull-nosed units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

2.2 REINFORCEMENT

- .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.3 CONNECTORS

- .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.4 FLASHING

- .1 Flashing: in accordance with Section 04 05 23 - Masonry Accessories.

2.5 MORTAR MIXES

- .1 Mortar and mortar mixes in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

2.6 GROUT MIXES

- .1 Grout and grout mixes in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

2.7 CLEANING COMPOUNDS

- .1 Use low VOC products.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.8 TOLERANCES

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:
 - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete unit masonry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Contract Administrator.
 - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 PREPARATION

- .1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

- .1 Concrete block units:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or other finish coating is specified.

- .2 Special Shapes:
 - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
 - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
 - .3 End bearing: not less than 200 mm.
 - .4 Install special site cut shaped units.

3.4 REINFORCEMENT

- .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.5 CONNECTORS

- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.6 FLASHING

- .1 Install flashings: in accordance with Section 04 05 23 - Masonry Accessories.

3.7 MORTAR PLACEMENT

- .1 Place mortar in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

3.8 GROUT PLACEMENT

- .1 Place grout in accordance with Section 04 05 13 - Masonry Mortar and Grouting.

3.9 CONSTRUCTION

- .1 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves etc.
- .2 Construct masonry walls using running bond unless otherwise noted.
- .3 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .4 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .5 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .6 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .7 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .8 Tamp units firmly into place.
- .9 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.

- .10 Tool exposed joints concave; strike concealed joints flush.
- .11 After mortar has achieved initial set up, tool joints.
- .12 Do not interrupt bond below or above openings.

3.10 REPAIR/RESTORATION

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.11 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

3.12 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Standard Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.13 PROTECTION

- .1 Brace and protect concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 04 05 00 - Common Work Results for Masonry
- .2 04 05 13 - Masonry Mortar and Grouting
- .3 04 05 19 - Masonry Anchorage and Reinforcing
- .4 04 05 23 - Masonry Accessories

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C 73-10, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).
 - .2 ASTM C 216-13, Standard Specification for, Facing Brick (Solid Masonry Units Made of Clay or Shale).
- .2 Brick Industry Association (BIA)
 - .1 Technical Note No. 20-2006, Cleaning Brick Work.
- .3 CSA Group (CSA)
 - .1 CAN/CSA-A82-06(R2011), Fired Masonry Brick Made From Clay or Shale.
 - .2 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .3 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [brick masonry] and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section [04 05 00 - Common Work Results for Masonry.
 - .1 Construct mock-up panel of exterior brick construction 1200 x 1800 mm.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect brick masonry from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

- .1 Ambient Conditions: assemble and erect components only when temperature is above 4 degrees C.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Face brick:
 - .1 Fired clay brick: to CAN/CSA-A82
 - .1 Type: S.
 - .2 Grade: EG.
 - .3 Size: 90 wide x 57 high x 190 long.
 - .4 Colour and texture: to be selected by contract administrator from standard colour pallette.
 - .5 Solid/hollow.
- .2 Reinforcement:
 - .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .3 Connectors:
 - .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing .
- .4 Flashings:
 - .1 Flashing: in accordance with Section 04 05 23 - Masonry Accessories.
- .5 Mortar Mixes:
 - .1 Mortar and mortar mixes in accordance with Section 04 05 13 - Masonry Mortar and Grouting.
- .6 Grout Mixes:
 - .1 Grout and grout mixes in accordance with Section 04 05 13 - Masonry Mortar and Grouting.
- .7 Cleaning Compounds:
 - .1 Use low VOC products.
 - .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

- .3 Cleaning compounds compatible with brick masonry units and in accordance with manufacturer's written recommendations and instructions.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for brick masonry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

- .1 Construction to conform to CAN/CSA-A371
- .2 Bond: stretcher.
- .3 Coursing height: 200 mm for three/two bricks and three/two joints.
- .4 Jointing: concave where exposed or where paint or similar thin finish coating is specified.
 - .1 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.
 - .2 Clean unglazed clay masonry as work progresses.
 - .3 Reinforcement:
 - .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.
 - .4 Connectors:
 - .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.
 - .5 Flashings:
 - .1 Install flashings in accordance with Section 04 05 23 - Masonry Accessories.
 - .6 Mortar Placement:
 - .1 Place mortar in accordance with Section 04 05 13 - Masonry Mortar and Grouting.
 - .7 Grout Placement:
 - .1 Place grout in accordance with Section 04 05 13 - Masonry Mortar and Grouting.
 - .8 Repair/Restoration:
 - .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.
 - .9 Field Quality Control:
 - .1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
 - .2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

- .10 Tolerances:
 - .1 To CAN/CSA-A371.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .3 Clean unglazed clay masonry as directed below and leave for one week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work, and clean brick masonry as follows.
 - .1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
 - .2 Scrub with solution of 25 ml trisodium phosphate and 25 ml household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions.
 - .3 Repeat cleaning process as often as necessary to remove mortar and other stains.
 - .4 Use acid solution treatment for difficult to clean masonry as described in Technical Note No.20 by the Brick Industry Association.
- .4 Clean concrete brick masonry as work progresses.
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of brick and finally by brushing.
- .5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Brace and protect brick masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 04 22 00 – Concrete Unit Masonry
- .2 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 71-GP-24M-AMEND-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S604-2012, Standard for Factory-Built Type A Chimneys.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
- .3 ASTM
 - .1 ASTM E 96/E 96M-13, Standard Test Methods for Water Vapour Transmission of Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for board insulation and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.
 - .2 Submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
-

- .3 Replace defective or damaged materials with new.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 -Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.6 AMBIENT CONDITIONS

- .1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.
- .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
- .3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.7 SEQUENCING

- .1 Sequence work to permit installation of materials in conjunction with related materials and seals.

Part 2 Products

2.1 INSULATION

- .1 Extruded polystyrene (XPS): to CAN/ULC-S701
 - .1 Type: 4.
 - .2 Compressive strength: 25 psi
 - .3 Thickness: as indicated.
 - .4 Size: Largest practical size available for application.
 - .5 Edges: square.

2.2 ACCESSORIES

- .1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self-locking type.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
-

3.2 GENERAL

3.3 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for board insulation application in accordance with manufacturer's written instructions.
- .2 Visually inspect substrate.
- .3 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
- .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

3.4 INSTALLATION

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 type A chimneys and CSA B149.1 and CSA B149.2 type B and L vents.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by the Contract Administrator

3.5 RIGID INSULATION INSTALLATION

- .1 Imbed insulation boards into vapour barrier type adhesive, applied as specified, prior to skinning of adhesive.

3.6 PERIMETER INSULATION

- .1 Exterior application: extend boards below finish grade as indicated. Install on exterior face of perimeter foundation wall with adhesive.
- .2 Exterior application: extend boards 1200 mm from perimeter foundation walls. Slope boards away from foundation on compacted fill.

3.7 CAVITY WALL INSTALLATION

- .1 Install extruded polystyrene insulation boards on outer surface of inner wythe of wall cavity over impaling clips.
-

- .2 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150mm wide modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.9 PROTECTION OF WORK

- .1 Protect finished work in accordance with manufacturer's recommendations].
- .2 Do not permit adjacent work to damage work of this section.
- .3 Ensure finished work is protected from climatic conditions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 07 62 00 – Sheet Metal Flashing and Trim
- .2 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.13M-[M87], Sealing Compound, One Component, Elastomeric Chemical Curing.
 - .2 CAN/CGSB-19.24M-[M90], Multi-Component, Chemical Curing Sealing Compound.
 - .3 CGSB 19-GP-14M-[84], Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S741, Standard for Air Barrier Materials - Specification
- .3 ASTM
 - .1 ASTM E2178-21a, Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeability of Building Materials

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.
 - .3 Quality Assurance Submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Contract Administrator.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
 - .4 Manufacturer's Field Reports: submit manufacturer's written reports within [3] days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
-

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Applicator: company specializing in performing work of this section with minimum 5 years documented experience with installation of air/vapour barrier systems.
 - .1 Completed installation must be approved by the material manufacturer.
 - .2 Applicator: company:
 - .1 Currently licensed by National Air Barrier Association.
 - .2 Must maintain their licence throughout the duration of the project.
- .2 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Avoid spillage: immediately notify Contract Administrator if spillage occurs and start clean up procedures.
- .4 Clean spills and leave area as it was prior to spill.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 -Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.7 AMBIENT CONDITIONS

- .1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.
- .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
- .3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.8 SEQUENCING

- .1 Sequence work to permit installation of materials in conjunction with related materials and seals.
-

Part 2 Products

- .1 Air/Vapour Barrier
 - .1 Description: Thermofusible air/vapour barrier for use in wall composed of SBS modified bitumen and a non-woven polyester reinforcement.
 - .2 Acceptable Product: Sopraseal 180 HD by Soprema or approved equal in accordance with B8.

2.2 SHEET MATERIALS

- .1 Sheet Seal: thermofusible elastomeric bitumen membrane reinforced with a non-woven polyester reinforcement.

2.3 SEALANTS

- .1 Sealants in accordance with Section 07 92 00 - Joint Sealants.
- .2 Butyl Sealant: CGSB 19-GP-14M, butyl rubber base, single component, solvent release, non-skinning, Shore "A" Hardness Range of 10 to 30; black colour.
- .3 Primer: recommended by sealant manufacturer.
- .4 Substrate Cleaner: non-corrosive type recommended by sealant manufacturer and compatible with adjacent materials].

2.4 ACCESSORIES

- .1 Thinner and cleaner for Butyl Sheet: as recommended by sheet material manufacturer.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

- .1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.
- .2 Perform Work in accordance with requirements for materials and installation.

3.3 EXAMINATION

- .1 Verify that surfaces and conditions are ready to accept work of this section.
 - .2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
 - .3 Report unsatisfactory conditions to Contract Administrator in writing.
 - .4 Do not start work until deficiencies have been corrected.
-

- .1 Beginning of Work implies acceptance of conditions.

3.4 PREPARATION

- .1 Remove loose or foreign matter, which might impair adhesion of materials.
- .2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.
- .3 Ensure substrates are free of surface moisture prior to application of [self-adhesive] membrane and primer.
- .4 Ensure metal closures are free of sharp edges and burrs.
- .5 Prime substrate surfaces in accordance with manufacturer's instructions.
 - .1 Acceptable Product: Elastocol 500 by Soprema or approved equal in accordance with B8.

3.5 INSTALLATION

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Secure sheet seal to masonry materials with heat bonding.
 - .1 Caulk with butyl sealant to ensure complete seal.
 - .2 Position lap seal over firm bearing.
- .3 Lap sheet seal onto roof vapour retarder and seal with heat bonding.
 - .1 Caulk to ensure complete air seal.
 - .2 Position lap seal over firm bearing.
- .4 Apply sealant within recommended application temperature ranges.
 - .1 Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.6 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
 - .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
-

3.8 PROTECTION OF WORK

- .1 Protect finished work in accordance with manufacturer's recommendations].
- .2 Do not permit adjacent work to damage work of this section.
- .3 Ensure finished work is protected from climatic conditions.

3.9 SCHEDULES

- .1 Wall Air/Vapour Barrier Over Outer Surface of Masonry:
 - .1 Seal masonry anchor penetrations air tight.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 07 13 52 – Modified Bituminous Sheet Waterproofing

1.2 WORK INCLUDED

- .1 Base/drip flashings
- .2 Pre-finished Brake Metal

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/SPRI/FM 4435/ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems 2011.
- .2 ASTM International (ASTM)
 - .1 ASTM A 792/A 792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .2 ASTM D 4587-11 Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
 - .3 ASTM F 1667-15 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .3 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual 2012.
- .4 Canadian Sheet Steel Building Institute (CSSBI)
 - .1 CSSBI S8-2008 Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
 - .2 CSSBI B17-2002 Barrier Series Prefinished Steel Sheet: Product Performance & Applications.
 - .3 CSSBI Sheet Steel Facts #12 2003 Fastener Guide for Sheet Steel Building Products.
- .5 CSA Group (CSA)
 - .1 CSA A123.3-05(2015), Asphalt Saturated Organic Roofing Felt.
 - .2 CSA A123.22-08(2013) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).

1.4 EXISTING CONDITIONS/PROTECTION

- .1 Exercise care when working on or about roof surfaces to avoid damaging or puncturing membrane or flexible flashings.
-

- .2 Place plywood panels on roof surfaces to Work of this Section and on access routes. Keep in place until completion of Work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's instructions.
- .2 Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.

Part 2 Products

2.1 SHEET METALS

- .1 Galvanized steel: minimum 24-gauge core steel; conforming to requirements of ASTM A525 G90 Galvanized Coating.
- .2 Prefinished galvanized flashing: ASTM A446; G90 zinc coating; 24-gauge core steel; shop precoated; Colour as per schedule.

2.2 ACCESSORY MATERIALS AND COMPONENTS

- .1 Fasteners: concealed clip type, of same materials as flashings; sized to suit application.
- .2 Rubber-asphalt sealing compound: conforming to requirements of CGSB 37-GP-5M.
- .3 Bituminous paint: acid and alkali resistant type; black colour.

2.3 FABRICATION

- .1 Fabricate metal flashings in accordance with recommendations of CRCA and as indicated on Drawings.
- .2 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .3 Form sections in 2438 mm (8 ft) lengths. Make allowances for expansion at joints.
- .4 All seams are to be flat lock type except corners. Fabricate corners minimum 460 mm, mitred, soldered or welded, and sealed as one (1) piece.
- .5 Hem exposed edges of flashings on underside 13 mm.
- .6 Backpaint flashing with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals. Fabricate scuppers as detailed.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verify membrane termination and base flashings are in place, sealed, and secure.
 - .2 Beginning of installation means acceptance of existing conditions.
-

3.2 PREPARATION

- .1 Field measure Site conditions prior to fabricating Work.
- .2 Install starter and edge strips, and cleats before starting installation.

3.3 INSTALLATION

- .1 Install flashings in accordance with CRCA recommendations and as indicated on Drawings.
- .2 Secure flashing in place using concealed type fasteners. Use exposed fasteners in locations approved by the Contract Administrator only. When using exposed fasteners, they are to be of the same finish as flashings.
- .3 Apply sealing compound at junction of metal flashings and asphalt felt flashings.
- .4 Lock seams and end joints. Fit flashing tight in place. Make corners square, surfaces true and straight in all planes and all lines accurate to profiles.
- .5 Counter-flash all mechanical and electrical items projecting through.
- .6 Install galvanized flashing to all locations indicated on Drawings.
- .7 Install pre-finished flashing to all locations indicated on Drawings.
- .8 Seal metal joints watertight.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 05 31 00 – Steel Decking

1.2 WORK INCLUDED

- .1 Supply and installation of all sealant and backing materials as required.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C 919-18, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .3 General Services Administration (GSA) - Federal Specifications (FS)
 - .1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Manufacturer's product to describe:
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .3 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
-

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect joint sealants from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 ENVIRONMENTAL CONDITIONS

- .1 Sealant and substrate materials to be minimum 5°C.
- .2 Should it become necessary to apply sealants below 5°C, consult sealant Manufacturer and follow their recommendations.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to Health Canada.

Part 2 Products

2.1 MATERIALS

- .1 Primers: type recommended by sealant Manufacturer.
 - .2 Joint fillers
 - .1 General: compatible with primers and sealants, oversized 30 to 50%.
 - .2 Polyethylene, urethane, neoprene or vinyl: extruded closed cell foam, Shore A hardness 20, tensile strength 140 to 200 kPa.
 - .3 Neoprene or butyl rubber: round solid rod, Shore A hardness 70.
 - .4 Polyvinyl chloride or neoprene: extruded tubing with 6mm minimum thick walls.
 - .5 Impregnated precompressed polyurethane foam sealant tape.
 - .6 Acceptable Product: Emseal "Grayflex" or approved equal in accordance with B8.
 - .3 Bond breaker: pressure sensitive plastic tape, which will not bond to sealants.
-

- .4 Sealants
 - .1 Sealant shall be UV-resistant and ozone resistant, capable of supporting their own weight, conforming to CAN2-19.13.
 - .2 Sealants for vertical and horizontal non-traffic bearing joints, to Table 1, CGSB19-GP-23.
 - .3 Colour of sealants shall match adjacent surface. Colours to be selected by the Contract Administrator, from standard colour range.
 - .4 Joint cleaner: xylol, methylethylketone or non-corrosive type recommended by sealant Manufacturer and compatible with joint forming materials.

2.2 ACCEPTABLE PRODUCTS

- .1 For all non-traffic bearing joints unless indicated otherwise Dow Corning No. 790 or approved equal in accordance with B8.
- .2 For joints between exterior doors, windows, ductwork, etc., and adjacent materials: Dow Corning No. 795 or approved equal in accordance with B8.

Part 3 Execution

3.1 PREPARATION

- .1 Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.
- .2 Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
- .3 Remove oil, grease, and other coatings from nonferrous metals with joint cleaner.
- .4 Prepare concrete, glazed, and vitreous surfaces to sealant Manufacturer's instructions.
- .5 Examine joint sizes and correct to achieve depth ratio one-half of joint width with minimum width and depth of 6 mm, maximum width 25 mm.
- .6 Install joint filler to achieve correct joint depth.
- .7 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .8 Apply bond breaker tape where required to Manufacturer's instructions.
- .9 Prime sides of joints in accordance with sealant Manufacturer's instructions immediately prior to caulking.

3.2 APPLICATION

- .1 Apply sealants, primers, joint fillers, bond breakers, to Manufacturer's instructions. Apply sealant using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
 - .2 Apply sealant to joints between door frames to adjacent building components, around perimeter of every external opening, to control joints in concrete slabs and where indicated.
-

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean adjacent surfaces immediately.
 - .3 Remove excess and droppings, using recommended cleaners as work progresses.
 - .4 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 08 71 00 - Door Hardware
- .2 09 91 23 - Interior Painting

1.2 WORK INCLUDED

- .1 Non-rated rolled steel frames
- .2 Non-rated hollow steel doors

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A 653/A 653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM B 29-03, Standard Specification for Refined Lead.
 - .3 ASTM B 749-03, Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 CSA Group (CSA)
 - .1 CSA-G40.20-04 /G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
 - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
 - .3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 for ratings specified or indicated.
 - .4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104 and listed by nationally recognized agency having factory inspection services.
-

1.5 QUALITY ASSURANCE

- .1 Conform to requirements of Canadian Steel Door and Frame Manufacturers Association Standards.
- .2 Fire rated construction to conform to ULC standards.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Indicate on Shop Drawings, frame configuration, anchor types and spacings, location of cutouts for hardware, reinforcement and finish.
 - .3 Indicate on Shop Drawings, door elevations, internal reinforcement, and closure method, and location of cutouts for glazing.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door and frames from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Macotta
- .2 Allmar
- .3 Shanahans
- .4 Or approved equal in accordance with B8.

2.2 FRAMES

- .1 Type/Size: as shown on Drawings and Schedules.
 - .2 Frames: 1.52 mm (16 gauge) cold rolled sheet steel with ZF75 Colourbond coating.
 - .3 Bumpers: Resilient rubber.
 - .4 Anchors: purpose made to rigidly secure frames, 3 per jamb.
 - .5 Mortar Guard Boxes: 0.76 mm (22 gauge) welded in place.
 - .6 Primer: zinc chromate type.
 - .7 Insulation: Sprayed-in Polyurethane Foam.
-

2.3 DOORS

- .1 Insulated Core Doors: minimum 1.52 mm (16 gauge.) surface sheets, and top and bottom end channels; steel stiffened, cores filled with polyurethane insulation.
- .2 Reinforcement for hardware:
 - .1 Locks: minimum 1.52 mm (16 gauge) steel.
 - .2 Butts: minimum 3.42 mm (10 gauge) steel.
 - .3 Flush Bolts: minimum 3.42 mm (10 gauge) steel
 - .4 Door Closures: minimum 1.9 (14 gauge) mm steel.
 - .5 Door Holders: minimum 1.9 mm (14 gauge) steel.

2.4 FABRICATION - FRAMES

- .1 Fabricate frames as welded unit.
- .2 Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.
- .3 Prepare frame for silencers. Provide three (3) single silencers for single doors and mullions of double doors on strike side, and two single silencers on frame head at double doors without mullions.
- .4 Attach channel spreaders at bottom of frames for shipping.
- .5 Reinforce exterior frames at lock side, to prevent frame distortion.

2.5 FABRICATION - DOORS

- .1 Fabricate hollow metal doors and panels in accordance with requirements of "Canadian Manufacturing Standards for Steel Doors and Frames" produced by the Canadian Steel Door and Frame Manufacturer's Association and as indicated on Drawings.
 - .2 Fabricate fire rated hollow metal doors in accordance with requirements of ULC. Place ULC labels where visible when in installed position.
 - .3 All doors in fire rated walls shall be listed and labelled with a maximum temperature rise limitation of 250°C after 30 minutes in accordance with the National Building Code.
 - .4 Mechanically interlock longitudinal seams of honeycomb core type doors weld seams and sand flush. Top and bottom of doors closed with end channels recessed and spot welded in place.
 - .5 Reinforce and prepare doors to receive hardware. Refer to Section 08700 for hardware requirements.
 - .6 Each exterior hollow metal door to be supplied complete with a full length 3.42 mm (10 gauge) anti-intrusion plate welded to latch side of door.
-

Part 3 Execution

3.1 INSTALLATION

- .1 Install doors and frames in accordance with Canadian Steel Door and Frame Manufacturers Association standards.
- .2 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.
- .3 After installation, touch up all scratched or damaged surface and prime.
- .4 Insulate all frames exposed to the exterior.

3.2 TOLERANCES

- .1 Maximum diagonal distortion: 2 mm measured with straight edge, corner to corner.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 08 11 00 – Metal Doors and Frames

1.2 WORK INCLUDED

- .1 Hardware for hollow metal doors
- .2 Thresholds and weatherstripping

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.3-2001, Exit Devices.
 - .4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
 - .5 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
 - .7 ANSI/BHMA A156.10-1999, Power Operated Pedestrian Doors.
 - .8 ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
 - .9 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
 - .10 ANSI/BHMA A156.15-2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .11 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
 - .12 ANSI/BHMA A156.18-2006, Materials and Finishes.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 ULC – List of Equipment and Materials, Volume 2.

1.4 COORDINATION

- .1 Coordinate Work of this Section with other directly affected Sections involving Manufacturer of and internal reinforcement for door hardware.
- .2 Supply templates to Manufacturers of components affected by hardware.

1.5 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for requirements applicable to fire rated doors, frames and hardware.
 - .2 Conform to ULC requirements for fire rated doors, frames and hardware.
-

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Indicate on Shop Drawings, locations and mounting heights of each type of hardware.
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
 - .3 Hardware list shall list each door individually and shall list hardware for each door as a described item, not by a code as is done in the Specification. Hardware list shall be in terminology understandable by a layman.
 - .4 Submit one (1) copy of Manufacturers' catalogue cuts of each item, with hardware list.
- .5 Put parts lists, Manufacturer's instructions, and catalogue cuts into maintenance manual as per Section 01 33 00 – Submittal Procedures
- .6 Supply templates to door and frame Manufacturer to enable accurate sizes, locations of cut outs, and reinforcement for hardware.
- .7 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .8 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.9 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
-

- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store hardware in locked, dry area in individual packages or like groups.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 As per schedule on drawings.
- .2 Use Products from a single Manufacturer for all similar items.

2.2 DOOR HARDWARE

- .1 Butts: Provide 1-1/2 pair for all doors, except doors over 900 mm wide or over 2,200 mm high are to have two (2) pairs.
- .2 Protective plates: supply to both sides of door unless otherwise specified.

2.3 FASTENERS

- .1 Supply all fastening devices for installation and operation of hardware.
- .2 All exposed fasteners to be finished to match hardware.
- .3 Use fasteners compatible with material through which they pass.

2.4 KEYING

- .1 Door locks: Use construction cylinders to allow for a grand master key system to match existing system by Medeco to be installed at a later date.
 - .2 Supply three (3) keys for each lock. Supply three (3) master keys for each group, and three (3) grand master keys.
-

Part 3 Execution

3.1 INSPECTION

- .1 Verify that door and frame components are ready to receive Work and dimensions are as required.
- .2 Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- .1 Install hardware in accordance with Manufacturer's instructions.
- .2 Install locksets as specified with construction cylinder for later installation of Medeco cylinder keying system by Contract Administrator.
- .3 Use the templates provided by hardware item Manufacturer.
- .4 Maintain the following mounting heights for doors, from finished floor to centre line of hardware item:
 - .1 Locksets: 1020 mm
 - .2 Dead locks: 1525 mm
 - .3 Exit devices: 1020 mm

3.3 SCHEDULE

- .1 Refer to Building Drawings.

END OF SECTION

Part 1 General

1.1 RELATED DOCUMENTS

- .1 Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- .1 This Section includes one resinous flooring system, one with epoxy body.
 - .1 Application Method: Metal, power or hand troweled.

1.3 SUBMITTALS

- .1 Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendation for each resinous flooring component required.
- .2 Samples of Verification: For each resinous flooring system required, 150 mm square, applied to a rigid backing by Installer for this Project.
- .3 Room Finish Schedule: Use resinous flooring indicated on Drawings in room finish schedule.
- .4 Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- .5 Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- .1 No request for substitution shall be considered that would change the generic type of floor system specified (i.e. epoxy mortar based system). Equivalent materials of other manufactures may be substituted only on approval of the contract administrator. Request for substitution will only be considered only if submitted 10 days prior to bid date. Request will be subject to specification requirements described in this section.
 - .2 Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
 - .1 Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring system indicated.
 - .2 Contractor shall have completed at least 10 projects of similar size and complexity.
 - .3 Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
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- .4 Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
 - .1 Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
- .5 Pre-installation Conference:
 - .1 General contractor shall arrange a meeting not less than thirty days prior to starting work.
 - .2 Attendance:
 - .1 General Contractor
 - .2 Manufacturer/Installer's Representative

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in original packages and containers, with seals unbroken, bearing manufacture's labels indicating brand name and directions for storage and mixing with other components.
- .2 Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
- .3 All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing of volumetric measurements allowed.

1.6 PROJECT CONDITIONS

- .1 Environmental Limitation: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
 - .1 Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.
- .2 Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- .3 Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.
- .4 Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.

1.7 WARRANTY

- .1 Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full year from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year
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from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

Part 2 Products

2.1 RESINOUS FLOORING

- .1 Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include:
 - .1 Build of Broadcast or liquid rich type system will not be accepted and will result in a disqualification from bid.
- .2 Acceptable Manufactures
 - .1 Stonhard Basis of design
- .3 Products: Subject to compliance with requirements:
 - .1 Stonhard; Stonclad GS®. With top coat Stonkote GS4.
- .4 System Characteristics:
 - .1 Color and Pattern: Pewter
 - .2 Wearing Surface: Standard smooth with broadcast slip resistant texture.
 - .3 Integral Cove Base: not required
 - .4 Overall System Thickness: nominal 6 mm
- .5 System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - .1 Primer:
 - .1 Material Basis: Stonhard Standard Primer
 - .2 Resin: Epoxy
 - .3 Formulation Description: (2) two component, 100 percent solids.
 - .4 Application Method: Squeegee and roller.
 - .5 Number of Coats: (1) one.
 - .2 Mortar Base:
 - .1 Material design basis: Stonclad GS
 - .2 Resin: Epoxy.
 - .3 Formulation Description: (3) three component, 100 percent solids.
 - .1 Application Method: Metal Trowel.
 - .2 Thickness of Coats: nominal 6mm.
 - .4 Number of Coats: One.
 - .5 Aggregates: Pigmented Blended aggregate.
 - .3 Top Coat:
 - .1 Material design basis: Stonkote GS4
 - .2 Resin: Epoxy.
 - .3 Formulation Description: (2) two component, 100 percent solids.
 - .4 Type: pigmented.
 - .5 Finish: standard.
 - .6 Number of Coats: one.

.6 System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

- .1 Compressive Strength: 10,000 psi after 7 days per ASTM C 579.
- .2 Tensile Strength: 1,750 psi per ASTM C 307.
- .3 Flexural Strength: 4,000 psi per ASTM C 580.
- .4 Water Absorption: < 1% per ASTM C 413.
- .5 Impact Resistance: > 160 in. lbs. per ASTM D 2794.
- .6 Flammability: Class 1 per ASTM E-648.
- .7 Hardness: 85 to 90, Shore D per ASTM D 2240.

2.2 ACCESSORY MATERIALS

- .1 Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- .2 Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment. Unit prices should be included if the extent of control joints and non-moving cracks are not quantifiable at time of bid.

Part 3 Execution

3.1 PREPARATION

- .1 General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.
 - .2 Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - .1 Mechanically prepare substrates as follows:
 - .1 Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - .2 Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - .2 Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 - .3 Verify that concrete substrates are dry.
 - .1 Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 75 percent.
 - .2 Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. of slab in 24 hours.
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- .3 Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- .4 Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- .3 Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- .4 Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- .5 Treat control joints and other non-moving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment.

3.2 APPLICATION

- .1 General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - .1 Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - .2 Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - .3 At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - .1 Apply joint sealant to comply with manufacturer's written recommendations.
- .2 Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.
- .3 Apply metal trowel single mortar coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- .4 Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 TERMINATION

- .1 Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.
 - .2 Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
 - .3 Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
 - .4 Treat floor drains by chasing the flooring system to lock in place at point of termination.
-

3.4 JOINTS AND CRACKS

- .1 Treat control joints to bridge potential cracks and to maintain monolithic protection.
- .2 Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- .3 Discontinue floor coating system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.5 FIELD QUALITY CONTROL

- .1 Material Sampling: Contract Administrator may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
 - .1 Contract Administrator will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - .2 Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - .3 If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.6 CLEANING, PROTECTING, AND CURING

- .1 Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours.
- .2 Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- .3 Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 03 30 00 - Cast-In-Place Concrete
- .2 04 22 00 - Concrete Unit Masonry
- .3 05 21 00 - Steel Joist Framing
- .4 05 31 00 - Steel Decking
- .5 05 50 00 - Metal Fabrications

1.2 WORK INCLUDED

- .1 Prepare surfaces which are to receive finish. Surfaces include underside steel deck, steel joists and concrete unit masonry.
- .2 Finish surfaces as indicated in the schedule at the end of this Section.

1.3 REFERENCE STANDARDS

- .1 Environmental Protection Agency (EPA)
 - .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.
 - .2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .3 Master Painters Institute (MPI)
 - .1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM) - [current edition].
 - .2 Standard GPS-1-12, MPI Green Performance Standard.
 - .3 Standard GPS-2-12, MPI Green Performance Standard.
- .4 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada 2015 (NFC).
- .5 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.4 QUALITY ASSURANCE

- .1 Acceptable Manufacturers, materials, workmanship and all items affecting the Work of this Section are to be in accordance with CPCA Architectural Painting Specification Manual.
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- .2 Prior to ordering paints, submit to the Contract Administrator for review a complete schedule of paint materials proposed for use. This schedule shall include Manufacturer's name, brand name or code number, type and recommended application.

1.5 COLOUR SCHEDULE

- .1 Paint colours shall be as per room finish schedule and as selected by the Contract Administrator.
- .2 Prior to commencement of Work, the Contract Administrator will furnish three (3) copies of colour schedule.

1.6 DELIVERY

- .1 Deliver paint materials in sealed original labelled containers, bearing Manufacturer's name, type of paint, brand name, colour designation and instructions for mixing or reducing.

1.7 STORAGE

- .1 Provide adequate storage facilities. Store paint materials at a minimum ambient temperature of 8°C and in a well-ventilated area.
- .2 Take all precautionary measures to prevent fire hazards and spontaneous combustion.

1.8 ENVIRONMENTAL CONDITIONS

- .1 Ensure surface temperatures or the surrounding air temperature is above 5°C before applying finishes. Minimum application temperatures for latex paints for interior Work is 7°C and for exterior Work 10°C.
- .2 Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 7°C for twenty-four (24) hours before, during and forty-eight (48) hours after application of finishes.
- .3 Provide minimum 300 Lux of lighting on surfaces to be finished.

1.9 PROTECTION

- .1 Adequately protect other surfaces from paint and damage. Make good any damage as a result of inadequate or unsuitable protection.
 - .2 Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
 - .3 Place cotton waste, cloths and material which may constitute a fire hazard in closed metal containers and remove daily from Site.
 - .4 Remove all electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items are to be carefully stored, cleaned and replaced on completion of Work in each area. Do not use solvents that may remove the permanent lacquer finish to clean hardware.
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1.10 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's instructions, printed product literature and data sheets for paint and paint products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedure.
 - .3 Confirm products to be used are in MPI's approved product list.
- .3 Upon completion, provide records of products used. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour number[s].
 - .4 MPI Environmentally Friendly classification system rating.
 - .5 Manufacturer's Safety Data Sheets (SDS).
 - .6 MPI #
- .4 Samples:
 - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
 - .2 Prepare 300 mm x 200 mm samples of paint type finishes when requested by Contract Administrator. Apply finishes on identical type materials to which they will be applied on job.
 - .3 Identify each sample as to finish, colour name and number and sheen name and gloss units.
- .5 Test reports: Provide certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Lead, cadmium and chromium: presence of and amounts.
 - .2 Mercury: presence of and amounts.
 - .3 Organochlorines and PCBs: presence of and amounts.
- .6 Certificates: Provide certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties. MPI Gateway #.
- .7 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation and application instructions.

1.11 CLOSEOUT SUBMITTALS

- .1 Provide in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual.
 - .3 Include:
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- .1 Product name, type and use.
- .2 Manufacturer's product number.
- .3 Colour number[s].
- .4 MPI Environmentally Friendly classification system rating.

1.12 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

- .1 Paint materials to be Products of a single Manufacturer.
- .2 All painting materials shall be the best quality and shall be accepted by the Contract Administrator.
- .3 Paint shall not be settled, caked or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency, and shall have excellent application properties.
- .4 Paint shall arrive on the job colour-mixed except for tinting of undercoats and possible thinning.
- .5 All thinning and tinting materials shall be as recommended by the Manufacturer for the particular material thinned or tinted.
- .6 Mixed colours shall match colour selection made by the Contract Administrator prior to application of the coating.
- .7 Paint shall be ready mixed except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- .8 Paint shall have good flow and brushing properties, and be capable of drying or curing free of streaks or sags.
- .9 Paint accessory materials: Linseed oil, shellac, turpentine, and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- .10 Paint Acceptable Manufacturers: Dulux, Benjamin Moore, C.I.L., or approved equal in accordance with B8.

Part 3 Execution

3.1 CONDITIONS OF SURFACES

- .1 Thoroughly examine all surfaces schedule to be painted prior to commencement of Work. Report in writing to the Contract Administrator any condition that may potentially affect proper application. Do not commence until all such defects have been corrected.
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- .2 Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below maximums established by the paint Manufacturer.
- .3 Beginning of installation means acceptance of existing surfaces.

3.2 PREPARATION OF SURFACES

- .1 Impervious Surfaces: remove mildew by scrubbing with a solution of TSP and bleach. Rinse with clean water and allow surface to dry completely.
- .2 Insulated Surfaces: remove dirt, grease and oil from canvas and cotton insulated coverings.
- .3 Galvanized surfaces: remove surface contamination and oils from surfaces and wash with solvent. Apply a coat of etching type primer.
- .4 Zinc coated surfaces: remove surface contamination and oils from surfaces and prepare for priming in accordance with metal Manufacturer's recommendations.
- .5 Remove stains caused by weathering of corroding metals from concrete with a solution of sodium metasilicate after being thoroughly wetted with water. Allow to thoroughly dry.
- .6 Steel and iron surfaces: remove grease, rust, scale, dirt and dust from surfaces. Where heavy coatings of scale are evident, remove by wire brushing, sandblasting or any other necessary method. Ensure all steel surfaces are satisfactory before paint finishing.
- .7 Unprimed steel surfaces: clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned. Prime surfaces to identify defects. Prime paint after defects have been remedied.
- .8 Concrete and unit masonry surfaces scheduled to receive paint finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate, rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- .9 Specialty Coating for UV shall be prepared for according to any additional instructions by Manufacturer.

3.3 APPLICATIONS

- .1 Apply paint and other finishes in accordance with good trade practice.
 - .2 Finishes specified are intended to cover surfaces satisfactorily when applied in accordance with Manufacturer's recommendations.
 - .3 Apply each coat at the proper consistency.
 - .4 Each coat of paint is to be slightly darker than the preceding coat unless otherwise acceptable to the Contract Administrator.
 - .5 Sand lightly between coats to achieve required finish.
 - .6 Do not apply finishes on surfaces that are not sufficiently dry.
-

- .7 Allow each coat of finish to dry before a following coat is applied, unless directed otherwise by Manufacturer.

3.4 PROCESS, MECHANICAL, AND ELECTRICAL EQUIPMENT

- .1 Refer to Process, Mechanical, and Electrical Sections with respect to painting and finishing requirements.
- .2 Remove grilles, covers and access panels for mechanical and electrical systems from location and paint separately.
- .3 Finish paint primed equipment.
- .4 Prime and paint insulated and exposed pipes, conduits, boxes, hangers, brackets, collars and supports to match adjacent Work, except where items are plated or pre-finished unless otherwise noted as being painted as separate colour than surrounding Work - refer to Section 15010.
- .5 Replace identification markings on mechanical or electrical equipment when painted over or spattered.
- .6 Paint interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvres with one (1) coat of flat black paint to limit of sight line. Paint dampers exposed behind louvres, grilles, convector and baseboard cabinets to match face panels.
- .7 Paint exposed conduit and electrical equipment occurring in finished areas including baseboard heaters and force flow heaters. Colour and texture are to be selected by Contract Administrator.
- .8 Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and before mounting equipment on them.
- .9 Colour coding equipment, piping, conduit and exposed ductwork and all colour banding and identification (flow arrows, naming, numbering, etc.) shall be performed to the requirements of Divisions 11 and 15. Piping and ductwork not required to be coded shall be painted in accordance with Mechanical and Process colour schedules.
- .10 Paint all exposed exterior mechanical and electrical equipment that has not been factory finished.
- .11 Ductwork and piping in truck bay to be finished with epoxy paint.

3.5 PROTECTION

- .1 Protect other surfaces from paint or damage. Repair damage.
 - .2 Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
 - .3 Collect cotton waste, cloths and material which may constitute a fire hazard, place in closed metal containers and remove daily from Site.
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3.6 CLEANING

- .1 As Work proceeds and upon completion, promptly remove all paint where spilled, splashed or spattered.
- .2 During the progress of Work keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.
- .3 Upon completion of Work leave premises neat and clean, to the satisfaction of the Contract Administrator.

3.7 PAINTING AND FINISHING SCHEDULE

- .1 Interior Painting:
 - .1 Primed Metal Surfaces:
 - .1 One (1) coat enamel undercoat
 - .2 Two (2) coats alkyd semi-gloss enamel
 - .2 Galvanized Metal Surfaces:
 - .1 One (1) coat galvanized iron primer
 - .2 Two (2) coats alkyd semi-gloss
 - .3 Concrete Block and Concrete
 - .1 One (1) coat latex block filler
 - .2 Two (2) coats alkyd enamel semi-gloss finish

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 10-2006, Standard for Portable Fire Extinguishers.
 - .2 NFPA 820 – 2016 Standard for Fire Protection in Wastewater Treatment and Collection Facilities

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with the Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Extinguishers and Mounting Brackets: Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- .3 Provide shop drawings.
- .4 Certificates: Provide written certificate that components are compatible, and where applicable, certified for intended use by nationally recognized testing agency.
- .5 Quality control submittals: submit following.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
 - .2 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work.
- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store and handle materials in accordance with equipment vendor recommendations.
 - .2 Deliver products in original wrappings or containers with manufacturers' labels intact.
 - .3 Do not deliver fire extinguishers to site until spaces to receive them are clean, dry, and ready for installation.

1.4 ACCEPTED MANUFACTURERS

- .1 Where a Manufacturer's name is specified, it is for the purpose of setting a standard of quality, performance, capacity, appearance, and serviceability. Accepted Manufacturers listed below are expected to be capable of providing the specified material or equipment. Although a particular Manufacturer may be listed below, it is mandatory that every product provided meets all parameters and standards of the specification.
- .2 Approval as an Equal or Alternate product does not absolve the supplier of the obligation to meet all clauses of these specifications.
- .3 Equipment Acceptable Manufacturers:
 - .1 Strike First, Sylprotec, Larsen, Badger

Part 2 Products

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

- .1 Stored pressure rechargeable type with hose and shut-off nozzle or integral shut-off nozzle, ULC labelled for A, B and C class protection.
 - .1 Capacity and Rating: 4-A:60-B:C, 4.5-kg.
 - .2 Refer to mechanical schedule on drawing for details.

2.2 EXTINGUISHER BRACKETS

- .1 Type recommended by extinguisher manufacturer.
- .2 Provide extinguisher brackets as indicated on drawings.

2.3 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10.
- .2 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXAMINATION

- .1 Examine walls and partitions for suitable blocking.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- .1 Install or mount extinguishers on brackets in accordance with NFPA 10.
- .2 The top of the fire extinguisher should be mounted at 900 mm AFFL.
- .3 The extinguishers operating instructions shall be clearly visible and located on the front of the extinguisher.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A 126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
 - .1 ANSI/AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
 - .2 ANSI/AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.
 - .3 ANSI/AWWA C702, Standard for Cold Water Meters-Compound Type.
- .3 CSA Group (CSA)
 - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79, Commercial and Residential Drains and Cleanouts.
 - .3 CAN/CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada (NPC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals, include:
 - .1 Description of plumbing specialties and accessories, giving manufactures name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

Part 2 Products

2.1 BACK FLOW PREVENTERS

- .1 Preventers: to CSA-B64 Series, reduced pressure principle type.
- .2 Valve body: bronze.
- .3 End connections: threaded, NPT.
- .4 Maximum working pressure: 1207 kPa (2413 kPa test).
- .5 Temperature range: -40 to 40°C.
- .6 Shutoff Valve: full port, resilient seated, bronze ball valve with bronze ball valve test cock.
- .7 Accessories: drain line air gap fitting.
- .8 Acceptable material: Watts or approved equal in accordance with B7.

2.2 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.3 WATER METER

- .1 Displacement type to ANSI/AWWA C700.
- .2 Coordinate with City of Winnipeg to obtain water meter for the building.

2.4 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.

- .1 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation only after unacceptable conditions have been remedied after receipt of written approval to proceed from the Contract Administrator.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.3 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada NPC and the local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.4 BACK FLOW PREVENTERS

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code
- .2 Pipe discharge to terminate over nearest drain.
- .3 Test backflow preventers and provide certification.

3.5 HOSE BIBBS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.6 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.7 WATER METERS

- .1 Install water metre provided by local water authority.
- .2 Install water metre as indicated.

3.8 START-UP

- .1 Complete start-up and commissioning in accordance with section 01 91 13 – General Commissioning Requirements.
- .2 Timing: start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
- .3 Provide continuous supervision during start-up.

3.9 TESTING AND ADJUSTING

- .1 Timing:

- .1 After start-up deficiencies rectified.
- .2 After certificate of completion has been issued by authority having jurisdiction.
- .2 Back Flow Preventer:
 - .1 Test operation of equipment and provide certification to meet local AHJ requirements.
- .3 Hose bibbs:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.
- .4 Water meters:
 - .1 Verify location and accessibility.
 - .2 Test metre reading accuracy.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop Drawings.
 - .1 Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Manufacturers' Field Reports: manufacturers' field reports specified.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
 - .1 Manufacturers name, type, model year, capacity and serial number.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 SUMP PUMP SUBMERSIBLE – P-L04

- .1 Capacity: Refer to mechanical schedule.
 - .2 General Construction:
 - .1 Class 25 cast iron housing with powder coat finish.
 - .2 Discharge Size: 38 mm (1-1/2") NPT.
 - .3 Maximum solid handling capability: 19 mm (3/4").
 - .4 Stainless steel shaft and hardware.
 - .5 Seals: Unitized carbon/ceramic seal with stainless steel housing and spring.
 - .6 Impeller: vortex style, polymer material.
 - .3 Motor: Oil filled permanent split capacitor, rated for continuous duty.
 - .1 0.56 kW (3/4 hp), 3450 rpm.
 - .2 120V/1ph/60hz.
-

- .3 Class B insulated NEMA B design.
- .4 Internal thermal overloaded protection.
- .4 Control:
 - .1 The pump shall be controlled with a piggy-back style on/off switch.
- .5 Acceptable product: Liberty Pumps, series-290 or approved equal in accordance with B7.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

- .1 Ensure pump and motor assembly do not support piping.
- .2 Follow all written manufacturer installation instructions.

3.3 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS: General Requirements, supplemented as specified herein.
 - .2 Procedures:
 - .1 Check power supply.
 - .2 Start pumps, check impeller rotation.
 - .3 Check for safe and proper operation.
 - .4 Eliminate causes of cavitation, flashing, air entrainment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 22 05 15 – Plumbing Specialities and Accessories.
- .2 Section 23 05 00 – Common Work Results – Mechanical
- .3 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .5 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .6 ASME B31.9-14, Building Services Piping.
 - .2 ASTM International (ASTM)
 - .1 ASTM A 307-, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A 351/A 351M, Castings, Austenitic, for Pressure Containing Parts.
 - .3 ASTM B 32, Standard Specification for Solder Metal.
 - .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 ANSI/AWWA C151/A21.51, Ductile Iron Pipe, Centrifugally Cast, for Water.
 - .3 AWWA C904-[06], Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.
 - .4 CSA Group (CSA)
 - .1 CSA B137.5, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
 - .2 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
 - .6 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
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- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .7 National Research Council (NRC)
 - .1 National Plumbing Code of Canada (NPC)
- .8 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section [01 78 00 - Closeout Submittals].

Part 2 Products

2.1 PIPING

- .1 Domestic cold water systems, within building.
 - .1 Above ground:
 - .1 PEX Piping to CSA B137.5
 - .2 Type L Copper Tubing to ASTM B88

2.2 FITTINGS

- .1 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15
- .2 NPS 2 and larger:
 - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242
 - .2 PEX fittings to CSA B137.5 and F1960
- .3 NPS 1 ½ and smaller:
 - .1 PEX fittings to CSA B137.5
 - .2 Type L Copper Tubing to ASTM B88

2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111
 - .2 Bolts, nuts, hex head and washers: to ASTM A 307, heavy series
 - .3 Solder: 95/5 tin copper alloy.
-

- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.
- .7 NPS 1 ½ and smaller: PEX fittings to CSA B137.5
- .8 NPS 2 and larger: PEX fittings to CSA B137.5 and ASTM F 1960. Elbows, adapters, couplings, plugs, tees, multi-port tees and valves

2.4 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
- .2 NPS 2 and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.

2.5 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, stainless ball, PTFE adjustable packing, brass gland and Buna-N seat, stainless steel lever handle.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with Manitoba Plumbing Code and local authority having jurisdiction.
 - .1 Provide pipe supports at a maximum horizontal spacing to meet Manitoba Plumbing Code requirements.
 - .1 Copper Pipe: 3m
 - .2 PVC Pipe: 1.2m
 - .3 PEX: 0.8m
 - .2 Pipe supports shall be located at high elevation or close to the mounting service to avoid interference with other building systems.
 - .3 Routing shown on drawing is schematic in nature. Contractor shall field route small bore piping systems to avoid interferences, as required.
-

- .4 Provide pipe support standoff from mounting surface, so pipe is not in direct contact. Fasteners shall be suitable for the substrate (ie: concrete, wood, metal, etc).
- .5 Provide riser clamp pipe supports for all vertical piping risers.
- .6 Completely seal pipe penetrations and provide an escutcheon cover at the main floor level between the dry well and the electrical room.
- .7 Paint all metallic pipe supports to protect from corrosion.
- .2 Install pipe work as shown on drawing and as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .7 Valves
 - .1 Isolate equipment, fixtures and branches with ball valves as indicated on the drawings or as directed by the Contract Administrator.

3.3 PRESSURE TESTS

- .1 Conform to requirements of Section 23 05 00 – Common Work Results – Mechanical.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.4 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.5 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to Provincial potable water guidelines.
-

- .2 Upon completion, provide laboratory test reports on water quality for Contract Administrator approval.

3.7 START-UP

- .1 Complete start-up and commissioning in accordance with section 01 91 13 – General Commissioning Requirements.
- .2 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.
- .4 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Verify that all new piping accessories, valves and equipment are in good working condition.
 - .4 Check control, limit, safety devices for normal and safe operation.
 - .5 Confirm compliance with safety and health requirements.
 - .6 Check that water quality is consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.
- .5 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

- .1 Timing:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
 - .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Verify compliance with safety and health requirements.
 - .4 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
 - .3 Reports:
 - .1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.
-

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 22 05 15 – Plumbing Specialities and Accessories.
- .2 Section 23 05 00 – Common Work Results – Mechanical
- .3 23 05 15 - Common installation requirements for HVAC pipework

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM D 2564, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 CSA Group (CSA)
 - .1 CAN/CSA-Series B1800, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada (NPC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.

Part 2 Products

2.1 MATERIAL

2.2 PIPING AND FITTINGS

- .1 For above ground DWV to:

- .1 CAN/CSA B1800
- .2 For above ground wastewater piping associated to level gauge piping system within sub-level 3.
 - .1 PVC SCH 80
 - .2 Refer to mechanical drawing for details.

2.3 JOINTS

- .1 Solvent weld for PVC: to ASTM D 2564

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with Manitoba Plumbing Code and local authority having jurisdiction.
 - .1 Provide pipe supports at a maximum horizontal spacing to meet Manitoba Plumbing Code requirements.
 - .1 Copper Pipe: 3m
 - .2 PVC Pipe: 1.2m
 - .3 PEX: 0.8m
 - .2 Pipe supports shall be located at high elevation or close to the mounting service to avoid interference with other building systems.
 - .3 Routing shown on drawing is schematic in nature. Contractor shall field route small bore piping systems to avoid interferences, as required.
 - .4 Provide pipe support standoff from mounting surface, so pipe is not in direct contact. Fasteners shall be suitable for the substrate (ie: concrete, wood, metal, etc).
 - .5 Provide riser clamp pipe supports for all vertical piping risers.
 - .6 Completely seal pipe penetrations and provide an escutcheon cover at the main floor level between the dry well and the electrical room.
 - .7 Paint all metallic pipe supports to protect from corrosion.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.

- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Critical dimensions.
 - .4 Performance characteristics, where applicable.
- .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.

1.2 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of speciality tools required to service equipment as recommended by manufacturer and in accordance with Section 01 78 00 – Closeout Submittals.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and any additional written instruction from the manufacturer.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials in dry location in clean, dry, well-ventilated area and in accordance with manufacturer's recommendations.
-

Part 2 Products

2.1 MATERIALS

Not applicable.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 DEMONSTRATION

- .1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
-

3.6

PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
 - .2 Lettering and numbers raised or recessed.
 - .3 Information to include, as appropriate:
-

- .1 Equipment: manufacturer's name, model, size, serial number, capacity.
- .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Contract Administrator.

2.4 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.5 CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.

2.6 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.7 LANGUAGE

- .1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

- .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On both sides of visual obstruction or where run is difficult to follow.
 - .2 At least once in each small room through which piping or ductwork passes.
 - .3 On both sides of separations such as walls, floors, partitions.
 - .4 At beginning and end points of each run and at each piece of equipment in run.
-

- .5 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .6 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 CONTROLLERS

- .1 Controllers: Secure tags with non-ferrous chains or closed “S” hooks.
- .2 Install one copy of flow diagrams and equipment schedule mounted in a frame behind non-glare glass where directed by the Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to the Contract Administrator within 90 days of award of contract.
 - .2 Provide documentation confirming qualifications, successful experience.
 - .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems .
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing .
 - .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
 - .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
 - .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
 - .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
 - .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.
-

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review Contract Documents before project construction is started and confirm in writing to the Contract Administrator of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to the Contract Administrator in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Complete start-up and commissioning in accordance with section 01 91 13 – General Commissioning Requirements.
- .2 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by the Contract Administrator for verification of TAB reports.
-

1.9 START OF TAB

- .1 Notify the Contract Administrator 3 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, and caulking.
 - .3 Pressure, leakage, other tests specified elsewhere Division 23.
 - .4 Provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
 - .2 Calibrate within 3 months of TAB. Provide certificate of calibration to the Contract Administrator.
-

1.13 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval from the Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .2 Submit 6 copies of TAB Report to the Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by the Contract Administrator.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by the Contract Administrator.
- .4 Pay costs to repeat TAB as required to satisfaction of the Contract Administrator.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of the Contract Administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when the final TAB Report received and approved by the Contract Administrator.

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of AABC and SMACNA.
-

- .2 Do TAB of the following systems, equipment, components and controls:
 - .1 Fans.
 - .2 Dampers.
 - .3 Grilles.
- .3 Qualifications: personnel performing TAB shall be a current member in good standing with AABC.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Zone pressure differences:
 - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials as indicated on the drawings.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International (ASTM)
 - .1 ASTM B 209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards
 - .5 Underwriters Laboratories of Canada (ULC)
-

- .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: compatible with insulation.

2.4 ACCESSORIES

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
 - .2 Contact adhesive: quick-setting.
 - .3 Canvas adhesive: washable.
 - .4 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.
-

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards
- .2 Apply materials in accordance with manufacturers instructions and as indicated.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular and round ducts – outdoor air between louvers and fans.	C-1	yes	50

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

- .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

- .1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, exposed	CRF/1	CRD/2

- .3

3.5 SEALING

- .1 Seal all exterior foil type vapour jacket duct insulation with 100 mm wide RFFRK self adhesive tape applied over all retaining pins, longitudinal and butt joints, and along other breaks in the vapour barrier to provide a continuous vapour seal.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A635/A635M-15, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .2 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM A368-15, Standard Specification for Stainless Steel Wire Strand
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual.
 - .3 IAQ Guideline for Occupied Buildings Under Construction.
- .4 CSA International
 - .1 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Protect on site stored or installed absorptive material from moisture damage.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with tape.
-

- .3 Class C: transverse joints and connections made airtight with tape. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

2.2 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Mitred elbows, rectangular:
 - .1 600 mm or less:
 - .1 Double thickness turning vanes.
 - .2 55 mm wide rails spaced on 50 mm centres
 - .2 Greater than 600 mm:
 - .1 Double thickness turning vanes.
 - .2 115 wide rails spaced on 115 mm centres.
- .3 Branches:
 - .1 Provide volume control damper in branch duct near connection to main duct.
- .4 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .5 Offsets:
 - .1 Radiused elbows as indicated on the drawings.

2.5 DUCT SEALANTS

- .1 Water-based, vinyl acetate duct sealant designed for sealing joints in low and high pressure systems.
- .2 Formulated for indoor and outdoor use, remains flexible, non-flammable.
- .3 Acceptable materials: Duro Dyne DDS181 or approved equal in accordance with B7.

2.6 DUCT AND PLENUM ACCESS DOORS

- .1 Insulated access doors with latches and hinges.
 - .2 Frames secured to ductwork using sheet metal screws at 150 mm (6") on center.
-

2.7 FLEXIBLE DUCT CONNECTIONS

- .1 Neoprene coated fibreglass 150 mm (6") wide with 75 mm (3") galvanized metal for the connections.

2.8 ALUMINUM

- .1 To SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.9 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .2 Support all horizontal ductwork with non-perforated, galvanized steel, or rods and steel angle passing under ducts to the following schedule:
-

Longest Dimension of Duct	Round Hangers	Trapeze Strap Hangers	Shelf Angles	Maximum Spacing
Up to 450 mm (18")	6 mm (1/4" rod)	25 mm (1") x 18 Ga.	25x25x3 mm (1"x1"x1/8")	3000 mm (10'-0")
475 thru 750 mm (19"-30")	6 mm (1/4" rod)	25 mm (1") x 16 Ga.	25x25x3 mm (1"x1"x1/8")	3000 mm (10'-0")
775 thru 1050 mm (31"-42")	6 mm (1/4" rod)	25 mm (1") x 16 Ga.	38x38x3 mm (1-1/2"x1-1/2"x1/8")	3000 mm (10'-0")
1175 thru 1500 mm (43"-60")	10 mm (3/8") Rod	38 mm (1-1/2") x 16 Ga.	38x38x3 mm (1-1/2"x1-1/2"x1/8")	3000 mm (10'-0")
1152 thru 2100 mm (61" to 84")	10 mm (3/8") Rod	38 mm (1-1/2") x 16 Ga.	50x50x3 mm (2"x2"x1/8")	2400 mm (8'-0")
2125 thru 2400 mm (85"-96")	12 mm (1/4") Rod	38 mm (1-1/2") x 16 Ga.	50x50x3 mm (2"x2"x1/8")	2400 mm (8'-0")
Over 2425 mm (97")	12 mm (1/4") Rod	38 mm (1-1/2") x 16 Ga.	50x50x6 mm (2"x2"x1/4")	2400 mm (8'-0")

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
 - .1 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

3.2 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA

3.4 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 °C to plus 90 °C, density of 1.3 kg/m² with 75 mm (3") galvanized metal for connections.

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
 - .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
 - .3 Gaskets: neoprene.
-

- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks.
 - .2 301 to 450 mm: four sash locks.
 - .3 Where hinged access doors are inconvenient, removable doors with 4 cam locks are acceptable.

2.4 TURNING VANES

- .1 Factory or shop fabricated, to recommendations of SMACNA and as indicated

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
 - .1 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
-

- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 200 x 200 mm for viewing, where space is available.
 - .2 Locations:
 - .1 Control dampers.
 - .2 Devices requiring maintenance.
 - .3 Required by code.
 - .4 Reheat coils.
 - .5 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by the Contract Administrator.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning Vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 **CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
-

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Balancing dampers for dry well supply and exhaust system.

1.2 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00:
 - .1 Certificates: submit certificates signed by manufacture certifying that the materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into the manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards

2.2 BALANCING DAMPERS

- .1 Material: 304 stainless steel, factory manufactured.
-

- .2 Round butterfly style damper..
- .3 Size: 8 inches.
- .4 Acceptable Materials: Price, Ruskin, Greenheck or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
- .3 Dampers: vibration free.
- .4 Ensure damper operators are observable and accessible.
- .5 Install access door adjacent to each damper. See Section 23 33 00 – Air Duct Accessories.
- .6 Corrections and adjustments conducted by the Contract Administrator.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Operating dampers for mechanical forced air ventilation systems.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish, and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 OUTDOOR AIR EXHAUST DAMPER AND DAMPER OPERATORS – FV-L641, FV-L651

- .1 Multi-blade type, opposed or parallel as indicated on schedule.
 - .2 Frame:
 - .1 Extruded aluminum (6063-T5) not be less than 0.080” (2.03 mm) in thickness.
 - .2 101.6 mm deep x 25.4 mm, with duct mounting flanges on both sides of frame.
 - .3 50.8 mm mounting flange on the rear of the damper.
 - .4 Assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.
-

- .3 Blades:
 - .1 Maximum 162.6 mm deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 1.52mm.
 - .2 Internally insulated with expanded polyurethane foam; thermally broken.
 - .3 Insulating factor of R-2.29 and a temperature index of 55 (tested to AAMA 1502.7 Test Method).
 - .4 Blade seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum blade extrusions.
 - .2 Mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals are not acceptable.
 - .5 Frame seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
 - .6 Bearings:
 - .1 Dual bearing system composed of a Celcon inner bearing (fixed around a 11.1 mm aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame.
 - .2 Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.
 - .7 Hexagonal control shaft:
 - .1 Size: 11.1 mm.
 - .2 Adjustable length; integral part of the blade axle. A field-applied control shaft shall not be acceptable.
 - .3 All parts zinc-plated steel.
 - .8 Linkage hardware:
 - .1 Aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation.
 - .2 Complete with cup-point trunnion screws to prevent linkage slippage. Linkage that consists of metal rubbing metal will not be approved.
 - .9 Performance:
 - .1 Designed for operation in temperatures ranging from -40°C to 100°C.
 - .2 AMCA rated for Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
 - .10 Operators:
 - .1 Refer to Section 40 92 00
 - .11 Dampers shall be custom made to the required size, with blade stops not exceed 31.7 mm in height. Refer to schedule for sizing.
 - .12 Mounting: As per schedule.
 - .13 Acceptable materials: Refer to schedule.
-

2.2 MIXED AIR DAMPER AND DAMPER OPERATORS – FV-L642

- .1 Multi-blade type, opposed or parallel as indicated on schedule.
 - .2 Frame:
 - .1 Extruded aluminum (6063-T5) not be less than 0.080” (2.03 mm) in thickness.
 - .2 101.6 mm deep x 25.4 mm, with duct mounting flanges on both sides of frame.
 - .3 50.8 mm mounting flange on the rear of the damper.
 - .4 Assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.
 - .3 Blades:
 - .1 Maximum 162.6 mm deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 1.52 mm.
 - .4 Blade seals:
 - .1 Extruded EPDM, secured in an integral slot within the aluminum blade extrusions; mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals are not acceptable.
 - .5 Frame seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum frame extrusions; mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
 - .6 Bearings:
 - .1 Dual bearing system composed of a Celcon inner bearing (fixed around a 11.1 mm aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame.
 - .2 Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.
 - .7 Hexagonal control shaft:
 - .1 Size: 11.1 mm.
 - .2 Adjustable length; integral part of the blade axle. A field-applied control shaft shall not be acceptable.
 - .3 All parts zinc-plated steel.
 - .8 Linkage hardware:
 - .1 Aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation.
 - .2 Complete with cup-point trunnion screws to prevent linkage slippage. Linkage that consists of metal rubbing metal will not be approved.
 - .9 Performance:
 - .1 Designed for operation in temperatures ranging from -40°C to 100°C.
 - .2 AMCA rated for Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
 - .10 Operators:
-

- .1 Refer to Section 40 92 00
- .11 Dampers shall be custom made to the required size, with blade stops not exceed 31.7 mm in height. Refer to schedule for sizing.
- .12 Mounting: As per schedule.
- .13 Acceptable materials: As per schedule.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from the Contract Administrator.

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Fans, motors, accessories, and hardware for commercial use.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99, Standards Handbook.
 - .2 ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual .
 - .1 MPI #18, Primer, Zinc Rich, Organic.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total static pressure, kW, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
 - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Provide:
 - .1 Fan performance curves showing point of operation, kW and efficiency.
-

- .2 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controllers.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 FANS GENERAL

- .1 Refer to schedule.
- .2 Motors:
 - .1 Sizes as indicated
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: hanging spring isolators.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 CENTRIFUGAL FANS – SF-L64, EF-L65

- .1 General
 - .1 Base fan performance at standard conditions.
 - .2 Performance capabilities per schedule.
-

- .3 Permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number on the cabinet.
- .4 Fan wheels:
 - .1 Non-overloading, backward inclined centrifugal wheel.
 - .2 Aluminum construction.
 - .3 Statically and dynamically balanced in accordance to AMCA Standard 204-05.
 - .4 Wheel cone and fan inlet matched and with precise running tolerances for maximum performance and operating efficiency.
 - .5 Single thickness blades securely riveted or welded to a heavy gauge back plate and wheel cone.
- .5 Motor:
 - .1 Induction:
 - .1 Motor enclosure: TEFC.
 - .2 Permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the scheduled voltage and phase.
- .6 Local on/Off Switch
- .2 Inline Centrifugal:
 - .1 Housing/Cabinet Construction:
 - .1 Square design constructed of heavy gauge galvanized steel, includes square duct mounting collars.
 - .2 Housing and bearing supports constructed of heavy gauge bolted and welded steel to prevent vibration and rigidly support shaft and bearing assembly.
 - .3 Housing supports constructed of structural steel with formed flanges.
 - .4 Drive frame supporting the motor constructed of welded steel.
 - .5 Access panels: Two sided, located perpendicular to motor mounting panel, permit easy access to all internal components.
 - .6 Insulation: 25 mm fibreglass liner.
 - .2 Acceptable materials: Greenheck BSQ-90 or approved equal in accordance with B7.
- .3 Filter Section:
 - .1 Provide filter section on all supply fans with removable MERV 8 filters. Filter housing shall have integral connections for differential pressure switch.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.
 - .1 Inform the Contract Administrator. of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.
-

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings and flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Bearings and extension tubes to be easily accessible.
- .3 Access doors and access panels to be easily accessible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 START-UP

- .1 Complete start-up and commissioning in accordance with section 01 91 13 – General Commissioning Requirements.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Pressure drop.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 LOUVERS – GR-L642, GR-L651

- .1 General
 - .1 Drainable Louver
 - .2 Size: Refer to mechanical schedule.
 - .3 Construction:
 - .1 Louvers shall be constructed of 6063-T5 alloy extruded aluminum.
 - .2 Louver blades and frames shall be minimum 0.081 inch wall thickness. Louver assemblies shall be 4 inches deep with 39-degree stationary drainable blades. Louvers shall be welded construction.
 - .3 Louvers shall be designed to withstand a 25 pound per square foot wind load.
 - .4 Louvers shall be fitted with 1/2 inch x 0.051 inch flattened expanded aluminum bird screen. Bird screen shall be mounted on interior louver face.
 - .5 Louvers shall be supplied with a standard mill finish.
 - .4 Finish:
 - .1 Cured fluoropolymer-based resin coating for weather protection in architectural applications:
-

- .1 Louvers shall be factory primed and finished-after-assembly with a fluoropolymer based resin coating. Primer and resin coating shall be oven cured in accordance with the coating manufacturer's instructions.
- .2 The coating system shall have a minimum dry film thickness of 0.25 mil primer and 1.0 mil colour coat in accordance with ASTM D7091.
- .3 The coating system product shall meet salt spray and hardness specifications of AAMA 2605.
- .5 Acceptable materials: Refer to mechanical schedule.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.
 - .1 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers instructions.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise Criteria.
 - .4 Pressure drop.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.3 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with 01 78 00 – Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

Part 2 Products

2.1 SUPPLY GRILLES – GR-L643, GR-L644, GR-L645, GR-L646

- .1 Furnish and install supply registers of the sizes and mounting types indicated on the plans and outlet schedule. Registers shall be single deflection type with one set of fully adjustable deflection blades spaced 19 mm (3/4”) on center. The blades shall run parallel to the long/short dimension of the registers, as indicated in the outlet schedule. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. The grille shall be finished in B15 Aluminum Powder Coat.
- .2 Acceptable materials: Price 610 or approved equal in accordance with B7.
- .3 Refer to mechanical schedule for grille sizes and performance.

2.2 RETURN GRILLES – GR-L652, GR-L653, GR-L654, GR-L655

- .1 Furnish and install exhaust registers of the sizes and mounting types indicated on the plans and outlet schedule. Grilles shall be 0 degree deflection fixed louver type with blades spaced 19 mm (3/4”) on center. The blades shall run parallel to the (long) dimension of the register. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the diffuser face
- .2 Acceptable materials: Price 610Z, or approved equal in accordance with B7.
- .3 Refer to mechanical schedule for grille sizes and performance.
- .4

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.
 - .1 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers instructions.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Heating and Refrigeration Institute (AHRI)
 - .1 AHRI 410, Forced-Circulation Air-Cooling and Air-Heating Coils.
- .2 Canadian Standards Association International (CSA)
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
- .4 Underwriters Laboratories (UL)
 - .1 UL 1995, Heating and Cooling Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for duct heaters and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit product data and include:
 - .1 Element support details.
 - .2 Heater: total kW rating, voltage, phase.
 - .3 Number of stages.
 - .4 Rating of stage: rating, voltage, phase.
 - .5 Heater element watt/density and maximum sheath temperature.
 - .6 Maximum discharge temperature.
 - .7 Unit support.
 - .8 Clearance from combustible materials.
 - .9 Internal components wiring diagrams.
 - .10 Minimum operating airflow.
 - .11 Pressure drop at operating airflow.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 DUCT HEATERS – HCE-L61

- .1 Type: Insert type.
 - .2 Elements: Open coil.
-

- .3 Staging:
 - .1 Staged Heaters: Balanced line current at each stage.
 - .2 Each stage: uniform face distribution.
- .4 Maximum temperature at discharge: 66°C.
- .5 Controls:
 - .1 Remote control via remote 0-10V signal, which proportionally controls the heat output, 0-100%.
 - .2 Controls mounted in a CSA Type enclosure to include:
 - .1 Integral disconnect switch.
 - .2 Magnetic contactors.
 - .3 Control transformers.
 - .4 SCR controller.
 - .3 Where controls are mounted in the heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
 - .4 High temperature cut-out and air proving switch.
- .6 Electrical
 - .1 Size as indicated.
 - .2 575 V, 3ph.
- .7 Main isolation disconnect switch.
- .8 Performance: Refer to equipment schedule on mechanical drawings.
- .9 Acceptable materials: Caloritech, E.H. Price, Thermolec or approved equal in accordance with B7.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 GENERAL

- .1 Mount on structural supports to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3 Manufacturers field service representative to approve installation.

3.3 INSTALLATION

- .1 Make power and control connections to CSA C22.2 No.46.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 – Common Work Results – for Electrical.
-

- .2 Provide test report to the Contract Administrator and include copy with Operations and Maintenance Manuals.

3.5 START-UP

- .1 Complete start-up and commissioning in accordance with section 01 91 13 – General Commissioning Requirements.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
 - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.
 - .2 ANSI/ASHRAE 127, Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners.
- .2 ASTM International (ASTM)
 - .1 ASTM C 547, Specification for Mineral Fiber Pipe Insulation.
- .3 CSA Group (CSA)
 - .1 CSA B52, Mechanical Refrigeration Code.
 - .2 CAN/CSA-C656, Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Major components and accessories including sound power levels of units.
 - .2 Type of refrigerant used.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect air conditioning components from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESCRIPTION

- .1 General:
 - .1 Furnish and install a self-contained, vertical, exterior wall mount, through-the-wall air conditioner.
 - .2 Unit shall be factory assembled, pre-charged, pre-wired, tested, and ready to operate. Unit performance shall be certified in accordance with the Air Conditioning Heating and Refrigeration Institute (AHRI) Standard 390-2003 for Single Package Vertical Units. Unit efficiency shall be specified by EER.
 - .3 Capacities shall be as indicated on mechanical schedule.
- .2 Construction Features:
 - .1 Cabinet:
 - .1 Construction shall be a single, enclosed, weatherproof casing constructed of 20-gauge galvanized steel, stainless steel, or aluminum. Unit base is constructed of 16-gauge galvanized steel for painted and aluminum cabinets, stainless steel for stainless cabinets.
 - .2 Each exterior casing panel to be baked on enamel to withstand 1000 hrs of salt spray tests per ASTM B117-03.
 - .3 Openings shall be provided for power connections. Access openings appropriate for outside structure to all fan motors and compressor for making repairs and for removing internal components without removing unit from its permanent installation.
 - .4 Fresh air intake and outdoor coil shall be protected from intrusions by a sturdy metal grating with less than 6 mm (1/4") openings.
 - .5 Cooling section shall be fully insulated with 1-inch non-fiberglass to prevent sweating and to muffle sounds. Insulation shall be foil faced for ease of cleaning.
 - .6 Full-length side mounting brackets shall be an integral part of the cabinet. Bottom mounting bracket shall be provided.
 - .7 The unit shall use a high efficiency scroll compressor.
 - .8 The compressor shall be covered by a 5-year parts warranty.
 - .9 The refrigeration circuit shall be equipped with factory installed high and low pressure controls and liquid line filter dryer. The refrigeration control shall be a factory installed capillary tube. Compressor shall be mounted on rubber grommets. Unit shall be provided with R-410A (HFC) non-ozone depleting refrigerant.
 - .10 The condenser fan, motor and shroud shall be of slide out configuration for easy access.
 - .11 The indoor blower motor shall be ECM type.
 - .12 Electrical components are easily accessible for routine inspection and maintenance through front service panels. Circuit breaker is standard on all 208/230-volt models. Circuit breaker-access is through lockable access panel.

- .3 Heating:
 - .1 The air conditioner shall have a factory installed electric resistance heater. Heater shall include automatic limit safety controls.
 - .2 Refer to mechanical schedule.
- .4 Economizer:
 - .1 The Economizer is internally mounted and allows outside air to be used for free-cooling when temperature and humidity conditions are favorable. The amount of exhaust air varies in response to the system controls and settings defined by the user. It includes a built-in exhaust air damper.
 - .2 The economizer is designed to provide free-cooling when outside conditions are cool and dry enough to satisfy cooling requirements without operating the compressor, providing lower operating costs while extending the life of the compressor.
 - .3 Standard Features:
 - .1 Fully modulating
 - .2 High torque actuator.
 - .3 Positive shut-off with non-stick gaskets.
 - .4 Filter:
 - .1 50 mm (2") Pleated – Merv 8.
- .5 Environmental Controls
 - .1 Electronic control system.
 - .2 Provide remote thermostat control. Refer to mechanical equipment schedule.
- .6 Acceptable Materials: Bard - or approved equal in accordance with B7.
- .7 Refer to equipment schedule for additional details.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air conditioning components installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Contract Administrator.
 - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Contract Administrator.

3.2 GENERAL

- .1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

3.3 EQUIPMENT PREPARATION

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by air conditioning unit installation.

3.6 START-UP

- .1 Complete start-up and commissioning in accordance with section 01 91 13 – General Commissioning Requirements.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for duct heaters and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit product data and include:
 - .1 Element support details.
 - .2 Heater: total kW rating, voltage, phase.
 - .3 Number of stages.
 - .4 Rating of stage: rating, voltage, phase.
 - .5 Heater element watt/density and maximum sheath temperature.
 - .6 Maximum discharge temperature.
 - .7 Unit support.
 - .8 Clearance from combustible materials.
 - .9 Internal components wiring diagrams.
 - .10 Minimum operating airflow.
 - .11 Pressure drop at operating airflow.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 UNIT HEATER -UH-L63

- .1 Capacity: as per schedule.
 - .2 General:
 - .1 Cabinet: 18 and 20 gauge steel, epoxy/polyester powder coated.
 - .2 Horizontal mount with factory supplied mounting brackets.
 - .3 Fan Motor:
 - .1 Mounted in cold compartment.
 - .2 Thermally protected.
 - .3 Totally enclosed and factory-lubricated ball bearings.
 - .4 Elements: Tubular stainless steel.
 - .5 Controls:
-

- .1 Heater supplied with relay to allow 24 VAC control.
- .2 Factory supplied, wall mounted thermostat.
- .3 24 VAC, mechanical.
- .6 Electrical
 - .1 Size as indicated.
 - .2 575 V, 3ph.
- .7 Performance: Refer to schedule on mechanical drawings.
- .8 Acceptable materials: Modine or approved equal in accordance with B7.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 GENERAL

- .1 Mount on structural supports to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3 Manufacturers field service representative to approve installation.

3.3 INSTALLATION

- .1 Make power and control connections to CSA C22.2 No.46.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 – Common Work Results – for Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Provide test report to the Contract Administrator and include copy with Operations and Maintenance Manuals.

3.5 START-UP

- .1 Complete start-up and commissioning in accordance with section 01 91 13 – General Commissioning Requirements.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 This Section covers items common to Sections Division 26, Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-2018, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 DRAWINGS AND SPECIFICATIONS

- .1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested, and ready for operation.
 - .2 These Specifications and the Drawings and Specifications of all other divisions shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.
 - .3 Provide all minor items and work not shown or specified but which are reasonably
-

necessary to complete the work.

- .4 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting Bid, in accordance with B4.

1.6 CARE, OPERATION AND START-UP

- .1 Instruct City maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Where services of a manufacturer's factory service engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.7 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Contract Administrator of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.8 SUBMITTALS

- .1 Prior to delivery of any Products to job Site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division.
 - .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit copies of 600 x 600 mm minimum size drawings and product data to inspection authorities.
-

- .6 If changes are required, notify Contract Administrator of these changes before they are made.
- .3 Quality Control:
 - .1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Permits and fees: in accordance with General Conditions of contract.
 - .4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .5 Submit certificate of acceptance from inspection authority upon completion of Work to Contract Administrator.
- .4 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.9 AS-BUILT DRAWINGS

- .1 The Contractor shall keep one (1) complete set of white prints at the Site during work, including all addenda, change orders, Site instructions, clarifications, and revisions for the purpose of As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents. As-Built Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

1.10 QUALITY ASSURANCE

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in a provincial apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Contract Administrator with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.12 SYSTEM STARTUP

- .1 Instruct Contract Administrator and operating personnel in operation, care and maintenance of systems, system equipment and components.
 - .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
-

- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with aspects of its care and operation.

1.13 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.14 MEASUREMENT AND PAYMENT:

- .1 Payment will be based on Form B, Item 34, as accepted and measured by the Contract Administrator.
 - .1 A maximum of 95% may be submitted for progress payments prior to the total completion of the associated services, including the provision of as-built drawing mark-ups and O&M manuals.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
 - .3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.
 - .4 Factory assemble control panels and component assemblies.
-

2.2 ELECTRICAL EQUIPMENT MODIFICATION

- .1 Where electrical equipment is field modified, arrange for special inspection and pay all associated fees.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical and controls equipment and instrumentation with nameplates and labels as follows:

- .1 Nameplates: lamacoid 3 mm melamine, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
Size 8	50 x 100 mm	2 lines	12 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
 - .3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.
 - .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
 - .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
-

- .6 Identify equipment with Size 3 labels engraved as directed by Contract Administrator. Eg. "P600"
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Identify each wire at termination points with unique wire tag, generally as shown on the drawings. Markers shall consist of machine printed sleeves.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor MCC and distribution enclosures light gray to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
 - .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
-

- .4 In mechanical rooms: 1400 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Telephone and interphone outlets: 300 mm.
- .5 Wall mounted telephone and interphone outlets: 1500 mm.
- .6 Fire alarm stations: 1500 mm.
- .7 Fire alarm bells: 2100 mm.
- .8 Television outlets: 300 mm.
- .9 Wall mounted speakers: 2100 mm.
- .10 Clocks: 2100 mm.
- .11 Doorbell pushbuttons: 1500 mm.

3.6 CUTTING AND PATCHING

- .1 Provide all cutting a patching required.
- .2 Return exposed surfaces to an as-found condition.
- .3 Exercise care where cutting holes existing concrete elements so as not to damage existing reinforcing.
 - .1 Locate existing reinforcing utilizing a reinforcing bar locator and mark out on the surface of the concrete.
 - .2 For all holes larger than 50mm passing through reinforced concrete, mark the location of the desired hole and all adjacent rebar. Obtain approval from the Contract Administrator prior to cutting.
 - .3 Firestop and seal all penetrations, regardless of whether the penetration requires a fire rating.

3.7 ANCHOR INSTALLATION

- .1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling, the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.8 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.9 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
-

- .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system and communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Contract Administrator.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.10 TESTING

- .1 All test instruments utilized are to have been calibrated within one year of the date utilized.

3.11 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.18.1-13 (R2018), Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX-J-023/1)
 - .2 CSA C22.2 No.65-18, Wire Connectors.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical
- .2 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3-09 (R2014), Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-17, Type TECK 90 Cable.
- .3 City of Winnipeg
 - .1 Identification Standard – 510276-0000-40ER-0002.
 - .2 Tag Naming Standard – 612620-0014-40ER-0001.

1.3 SHOP DRAWING

- .1 Include detail construction, dimension, capacities, weights of equipment or material.

Part 2 Products

2.1 BUILDING WIRES

- .1 Wire: to CAN/CSA-C22.2 No. 38
- .2 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .3 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .4 Voltage rating:
 - .1 Circuits 480 V and less: 600 V
 - .2 Circuits > 480 V: 1000 V
 - .3 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90.
- .4 Colour coding to Section 26 05 01, wires sized 2 AWG and smaller to be factory-coded, taping will not be accepted.

2.2 1 KV TECK90 POWER CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
 - .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated. (12 AWG minimum where not indicated)
-

- .3 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 300 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Cable Fittings:
 - .1 Minimum requirement: Watertight, approved for TECK cable.
 - .2 Hazardous Locations:
 - .1 CSA approved.
 - .2 Watertight type with:
 - .1 an elastomeric bevelled bushing.
 - .2 a funnel entry, splined gland nut.
 - .3 a non-magnetic, stainless steel grounding device with dual grounding action.
 - .4 a taper threaded hub.
 - .5 a hexagonal body and gland nut
 - .3 Integral seal type with metal-to-metal contact construction.
 - .4 Sealing of multi-conductor cable shall be accomplished with a liquid type polyurethane compound.
 - .5 The fitting must:
 - .1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.
 - .2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding or the explosionproof seal.
 - .6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop
 - .7 (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.
 - .8 Approved products:
 - .1 T&B Startech XP series or approved equal in accordance with B7.

2.3 600 V TECK90 CONTROL CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
 - .2 Conductors:
-

- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated. (14 AWG minimum where not indicated)
- .3 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 300 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
 - .1 Watertight, explosion-proof approved for TECK cable.

2.4 300 V INSTRUMENT ACIC/CIC CONTROL CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.
- .2 Conductors: 16 AWG where not indicated on drawings, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.
- .3 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 Volt.
- .4 Twisted pairs/triads cabled with staggered lays.
- .5 Shielding: Individual twisted pair(s)/triads Aluminum/mylar shield with ST drain wire, 100 % shield. Overall aluminum/mylar shield with ST drain wire. Individual drain wires one size smaller than conductor AWG. Overall drain wire the same AWG as conductors.
- .6 Armour: interlocking aluminum.
- .7 Overall covering: thermoplastic polyvinyl chloride material (90 °C, -40 °C).
- .8 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 300 mm centers.
- .9 Connectors:
 - .1 Watertight, explosion proof approved for armoured cable.

2.5 TYPE RW90 CONDCUTOR

- .1 In accordance with CSA C22.2 No.38
-

- .2 Circuit conductors shall be concentric stranded soft copper, size as indicated (12 AWG minimum where not indicated).
- .3 Insulation to be chemically cross-linked thermosetting polyethylene rated type RW90 XLPE, 600V
- .4 Suitable for installation in temperatures down to -40 °C.
- .5 90 °C conductor operating temperature.

2.6 WIRING IDENTIFICATION

- .1 Provide wiring identification in accordance with Section 26 05 01 – Common Work Results – For Electrical

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
- .2 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit and Conduit Fittings.

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
 - .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 -1000 V.

3.3 INSTALLATION OF ARMoured CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 -1000 V.

3.4 INSTALLATION OF CONTROL CABLES

- .1 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.
 - .2 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Fully insulate the shield. Do not cut the shield drain wire off.
 - .3 ACIC cable may be installed in cable tray, provided that:
 - .1 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing.
 - .2 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.
-

3.5 TERMINATIONS AND SPLICES

- .1 Wire nuts are permitted only in the following circuits:
 - .1 Lighting circuits.
 - .2 Receptacle circuits.
- .2 Exercise care in stripping insulation from wire. Do not nick conductors.
- .3 Strictly follow manufacturer's instructions with regards to tool size and application methods of terminations and compounds.
- .4 Where screw-type terminals are provided on equipment and instrumentation, terminate field wiring with insulated fork tongue terminals.
 - .1 Manufacturer: Thomas and Betts, Sta-Kon, or approved equal in accordance with B7.

3.6 INSTALLATION IN CONDUIT

- .1 Utilize cable grips, appropriately selected to accommodate the type and geometry of the cable.
- .2 Utilize cable pulling lubricant, compatible with the cable and conduit.

3.7 CABLE IDENTIFICATION

- .1 Install cable tags.

3.8 TESTING

- .1 Test all power conductors 10 AWG and larger in accordance with 26 08 05.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required.
 - .2 Grounding conductors: stranded copper, tinned, soft annealed, size as indicated.
 - .3 Insulated grounding conductors: green, type RW90.
 - .4 Ground bus: copper, size 2/0 AWG, complete with insulated supports, fastenings, connectors.
 - .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
-

- .3 Bolted type conductor connectors.
- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .8 Connect building structural steel and metal siding to ground by welding copper to steel.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.
- .11 Ground secondary service pedestals.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of primary 600 V system and secondary 120 V system.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.4 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
-

- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, intercommunication systems as indicated.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 FRAMING AND SUPPORT SYSTEM

- .1 Materials:
 - .1 Conduit support structures shall employ an aluminum strut framing system together with the manufacturer's connecting components and fasteners for a complete system.
 - .2 Finishes:
 - .1 Wet locations: Aluminum.
 - .2 Indoors, dry locations: Aluminum.
 - .3 Nuts, bolts, machine screws: Stainless steel.

2.2 CONCRETE AND MASONRY ANCHORS

- .1 Materials: hardened steel inserts, zinc plated for corrosion resistance.
- .2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.
- .3 Manufacturer: Hilti (Canada) Limited or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
-

- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Touch up abraded surfaces and cut ends of galvanized members with an approved galvanizing repair compound.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Include detail construction, dimension, capacities, weights of equipment or material.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Type and size as indicated on the drawings, or sized as per code requirements
- .4 Utilize stainless steel or PVC construction for NEMA 4X junction and pull boxes.

2.2 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface mounting.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
 - .2 Mount cabinets with top not higher than 2 m above finished floor.
 - .3 Install terminal blocks as indicated in Type T cabinets.
-

- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.2 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

- .1 CSA C22.1-2006, Canadian Electrical Code, Part 1.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.
- .6 Material Requirements:
 - .1 Main Floor & Drywell: PVC
 - .2 Wetwell: Metal

2.2 SURFACE MOUNTED OUTLET BOXES, METAL

- .1 General Requirements:
 - .1 Acceptable materials:
 - .1 Cast Aluminum
 - .2 Cast ferrous alloy with corrosion resistant epoxy coating.
 - .2 Finish
 - .1 Epoxy Enamel
-

- .3 Mounting lugs as required.
- .4 Wet location covers for all locations unless otherwise approved by the Contract Administrator.
- .5 To CSA 22.2
- .2 Round Boxes:
 - .1 100mm (4") round.
 - .2 Tapped conduit openings and plugs.
 - .3 Manufacturer / Model:
 - .1 Crouse Hinds VXF series
 - .2 Or approved equal in accordance with B7.
- .3 Device Boxes
 - .1 FS or FD cast aluminum boxes with factory threaded hubs and mounting feet for surface wiring of receptacles.
 - .2 Single gang unless specified otherwise.
 - .3 Manufacturer / Model:
 - .1 Crouse Hinds FS/FD series
 - .2 Or approved equal in accordance with B7.

2.3 SURFACE MOUNTED OUTLET BOXES, PVC

- .1 General Requirements:
 - .1 To CSA C22.2 No. 18.
 - .2 Acceptable materials:
 - .1 PVC
 - .3 Grounding stud.
 - .4 Mounting lugs as required.
 - .5 NEMA 4X, unless otherwise indicated.
- .2 Specific Requirements:
 - .1 Ceiling Outlets:
 - .1 IPEX OB series
 - .2 Or approved equal in accordance with B7.
 - .2 Device Boxes:
 - .1 IPEX FS/FD series
 - .2 Or approved equal in accordance with B7.

2.4 CONDUIT BOXES FOR PVC CONDUIT

- .1 Non-metallic PVC boxes with mounting feet for surface wiring of devices.
 - .2 Acceptable products:
 - .1 Ipex
 - .2 Or approved equal in accordance with B7.
-

2.5 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.6 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.7 CONDUIT BOXES

- .1 Cast FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.8 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.9 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.
- .2 Pedestal type 'low tension' fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish to accommodate two amphenol jack connectors.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18.1-13 (R2018), Metallic outlet boxes (Tri-national standar, with UL 514A and ANCE NMX-J-023/1).
 - .2 CSA C22.2 No. 45-M1981(R2008), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 211.2, Rigid PVC (Un-plasticized) Conduit.
 - .5 CAN/CSA C22.2 No. 227.3, Flexible Non-metallic Tubing.
- .2 Submittals
 - .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures for the following:
 - .1 Metal conduit fittings.
 - .2 Fittings for hazardous locations.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
 - .4 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.
-

Part 2 Products

2.1 GENERAL

.1 Material Requirements:

- .1 Main Floor and lower level non-hazardous circuits: PVC
- .2 Main floor to wetwell hazardous circuits: Metal (threaded)
- .3 Wet Well: Metal (threaded)

2.2 RIGID PVC CONDUIT

- .1 Meets CSA C22.2 No. 211.2.
- .2 Minimum conduit size: 19 mm, unless specifically indicated on the drawings or approved by the Contract Administrator.

2.3 FLEXIBLE METAL CONDUIT

- .1 To CSA C22.2 No. 56, liquid-tight flexible metal.
- .2 Minimum conduit size: 19 mm, unless specifically indicated on the drawings or approved by the Contract Administrator.

2.4 RIGID METAL CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, aluminum, threaded.

2.5 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.6 CONDUIT SPACERS

- .1 PVC coated malleable iron spacers, CSA approved for the purpose.
- .2 Aluminum channel may be utilized where conduits are grouped, however a non-metallic spacer must be provided between the aluminum channel and concrete.

2.7 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
 - .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.
-

- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.8 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.9 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 ROUTING

- .1 Locate conduits containing communication and low voltage conductors away from conduits containing power wiring.
- .2 Route conduits on existing or new pipe rack or suspended channels where possible.
- .3 Avoid routes that would interfere with any potential maintenance activities such as but not limited to:
 - .1 Roof hatches.
 - .2 Mechanical Dampers.
 - .3 Building/Equipment door openings.
- .4 Where not specifically shown in detail on the drawings, review proposed conduit routing with Contract Administrator prior to installation. Comply with all routing changes requested by the Contract Administrator.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .2 Conceal conduits in finished areas.
 - .3 Surface mount conduits except in mechanical and electrical service rooms and in unfinished areas.
 - .4 Use rigid aluminum threaded conduit except where specified otherwise.
 - .5 Use explosion proof flexible connection for connection to explosion proof motors.
-

-
- .6 Install conduit sealing fittings in hazardous areas. Fill with compound.
 - .7 Minimum conduit size for lighting and power circuits: 19 mm.
 - .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .9 Mechanically bend steel conduit over 19 mm dia.
 - .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .11 Install fish cord in empty conduits.
 - .12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
 - .13 Dry conduits out before installing wire.
 - .14 Install ground bonding wire in all conduits. Size ground wire as per CEC Table 17.
 - .15 Underground Conduits
 - .1 Slope conduits to provide drainage.
 - .16 Surface Conduits
 - .1 Run parallel or perpendicular to building lines.
 - .2 Group conduits wherever possible on suspended or surface channels.
 - .3 Provide a minimum space of 12 mm between conduits.
 - .4 Do not pass conduits through structural members except as indicated.
 - .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
 - .6 Install spacers as required to provide a space between the conduits and the supporting surface, with a minimum space as follows:
 - .1 Above grade spaces not classified as CEC Category 1 or 2:
 - .1 Drywall / Wood surfaces: no space required
 - .2 Masonry / concrete surfaces: 6 mm
 - .2 Below grade spaces: 12 mm
 - .17 Colour Coding
 - .1 Apply plastic tape or paint colour coded bands to conduits at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.
 - .2 Bands: 38 mm wide prime colour and 19 mm wide auxiliary colours
-

.3 Band colours as per the following table.

System	Prime Band	Aux. Band
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	
Control Wiring (120 V)	Black	Green
Fire Alarm	Red	Orange
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange
Intrinsically Safe	Blue	White

3.3 PVC CONDUIT

.1 Concrete Penetrations:

.1 Seal and fire stop penetration around conduit with CSA approved assembly for the installation conditions.

.2 Maximum spacing between supports for rigid PVC conduit:

.1	27mm conduit	0.75 m
.2	35mm conduit	0.75 m
.3	41mm conduit	1.2 m
.4	53mm conduit	1.5 m
.5	63mm conduit	1.5 m
.6	78mm conduit	1.5 m
.7	91mm conduit and larger	2.0 m

3.4 METAL CONDUIT

.1 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.2 Mechanically bend conduits over 19 mm in diameter.

.3 Concrete Penetrations:

.1 Sleeves for Aluminum Conduit

- .1 Install schedule 40 galvanized steel pipe, sized for free passage of conduit.
- .2 Seal and fire stop penetration around conduit with CSA approved assembly for the installation conditions.
- .4 Maximum spacing between supports for rigid metallic conduit:
 - .1 16mm conduit: 1.0 m
 - .2 21mm conduit: 1.5 m
 - .3 27mm conduit 1.5 m
 - .4 35mm conduit 2.0 m
 - .5 41mm conduit and larger 2.5 m

3.5 LIQUID-TIGHT FLEXIBLE CONDUIT

- .1 Use as raceways at all motors, pipe-mounted control devices, and other devices subject to movement or water.
- .2 At all motors provide a short length before connecting to the motor terminal box. Minimum length shall be 450 mm plus four times the conduit diameter.
- .3 Provide a separate ground wire within flexible conduit, bonded to motor frames and system ground.

3.6 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
- .7 Provide stand-of conduit clamp / clip.

3.7 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.8 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
-

- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.9 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.10 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.11 INSTALLATIONS IN CATEGORY 1 LOCATIONS

- .1 Arrange to provide drainage at frequent intervals to suitable locations.
- .2 Equip with approved fittings to permit the moisture to drain out of the system.
- .3 Install the conduit with a minimum of 12 mm space from the supporting surface.
- .4 Install every joint to be water-tight.
- .5 Where conduit leaves a warm room and enters a cooler atmosphere, seal the conduit and arrange the conduit in a manner to avoid condensation accumulation at the seal.

3.12 INSTALLATIONS IN CATEGORY 2 LOCATIONS

- .1 Comply with all requirements of Category 1 locations.

3.13 INSTALLATIONS IN CATEGORY 2 WET LOCATIONS

- .1 Comply with all requirements of Category 1 locations.

3.14 INSTALLATIONS IN HAZARDOUS ZONE 1 LOCATIONS

- .1 Explosion proof conduit sealing fittings:
 - .1 Install sealing fittings as indicated and on all new conduit installations to meet CEC requirements.
 - .2 Add sealing compound following manufacturer's instructions.

3.15 INSTALLATIONS IN HAZARDOUS ZONE 2 LOCATIONS

- .1 Explosion proof conduit sealing fittings:
 - .1 Install sealing fittings as indicated and on all new conduit installations to meet CEC requirements.
 - .2 Add sealing compound following manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C37.30.1-2011, IEEE Standard Requirements for AC High-Voltage Air Switches Rated Above 1000 V.
 - .2 ANSI/IEEE C37.30.1a-2017, IEEE Standard Requirements for AC High-Voltage Air Switches Rated Above 1000 V – Amendment 1: Criteria for acceptance.
 - .3 ANSI/IEEE 141-1993, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants.
- .2 CSA International
 - .1 CSA C22.2 No.31-10, Switchgear Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for interlock systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 INTERLOCK SYSTEMS

- .1 Kirk key interlocks Type F for normal power breaker and standby power breaker to prevent:
 - .1 Standby power breaker closing unless normal power breaker is open.
 - .2 Normal power breaker closing unless standby breaker is open.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for interlock systems installation in accordance with manufacturer's written instructions.
-

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections Division 26, Electrical.

1.2 REFERENCE STANDARDS

- .1 Electrical Equipment Manufacturers Association of Canada (EEMAC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for motor control centres and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Indicate on drawings:
 - .1 Outline dimensions.
 - .2 Configuration of identified compartments.
 - .3 Floor anchoring method and dimensioned foundation template.
 - .4 Cable entry and exit locations.
 - .5 Dimensioned position and size of busbars and details of provision for future extension.
 - .6 Schematic and wiring diagrams.
 - .4 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for motor control centre for incorporation into manual.
 - .1 Include data for each type and style of starter.

1.5 EXTRA STOCK MATERIALS

- .1 Submit maintenance materials in accordance with Section 01 78 00- Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect motor control centres from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SUPPLY CHARACTERISTICS

- .1 600 VAC, 60 Hz, Wye connected, 3 Phase, 4 Wire.

2.2 GENERAL DESCRIPTION

- .1 Compartmentalized vertical sections with common power busbars.
 - .2 Floor mounting, free standing, enclosed dead front.
 - .3 Indoor CSA gasketed enclosure.
 - .4 Suitability for Service Entrance: Yes.
 - .5 Wiring class: Class 1, Type B-D or B-T as shown on the drawings.
 - .6 Compartment Nameplates:
 - .1 White background with black letters.
 - .2 Identification as indicated on the Drawings.
 - .7 Nameplates for Control Equipment Flush Mounted on Compartments:
 - .1 White background with black letters. Black background with white text will not be accepted.
 - .2 Identification as indicated on the Drawings.
 - .3 Locations as shown on the Drawings
 - .8 SCCR: 14 kA minimum.
 - .9 Acceptable manufacturer:
 - .1 Schneider Electric Model 6.
 - .2 This product was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.
 - .10 Purchase or Quotation:
 - .1 All requests for purchase or quotation shall reference RFP 756-2013 to receive standardized pricing that the City has negotiated with the vendor.
 - .2 Contact: Schneider Electric, 21 Omands Creek Blvd, Winnipeg, MB.
 - .3 The Bidder's bid price shall reflect the discounted equipment price. The City will review the purchase price for standardized equipment to ensure the applicable discount factor has been applied.
-

2.3 VERTICAL SECTION CONSTRUCTION

- .1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.
- .2 Each vertical section divided into compartment units, height as indicated.
- .3 Each unit to have complete top and bottom steel plate for isolation between units.
- .4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.
- .5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.
- .6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.
- .7 Incoming cables to enter at top.
- .8 Provision for outgoing cables to exit via top or bottom with terminals.
- .9 Removable lifting means.
- .10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.
- .11 Divide assembly for shipment to site, as indicated complete with hardware and instructions for re-assembly.
- .12 Provide all spaces complete with bussing hardware and other accessories required so that additional combination starter units can be readily installed. Provide barriers to isolate the space from all buswork.
- .13 Provide barriers to isolate all buswork to prevent accidental contact when starter units are removed or spaces are provided. Barriers shall also provide phase-to-phase isolation of the vertical bus.
- .14 Master nameplate lamacoid: text as follows:
 - .1 Line 1 is to be MCC identifier as indicated on the Drawings, for example
 - .2 "MCC-L71".
 - .3 Line 2 is to be the voltage, for example "600V, 3-Phase".
 - .4 Line 3 is to be the rating, for example "225A, 4-Wire".

2.4 SILLS

- .1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.5 BUSBARS

- .1 Main horizontal and branch vertical, three phase and neutral high conductivity plated aluminum busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:
 - .1 Main horizontal busbars: as indicated.
 - .2 Branch vertical busbars: as indicated.
-

- .2 Branch vertical busbars for distribution of power to units in vertical sections.
- .3 No other cables, wires, equipment in main and branch busbar compartments.
- .4 Brace buswork to withstand effects of short-circuit current of 42kA rms symmetrical.
- .5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.6 GROUND BUS

- .1 Copper ground bus extending entire width of motor control centre.
 - .1 Size: 6 x 25 mm (1/4" x 1")
 - .2 Plating: Tin
 - .3 Location: Top
- .2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.
 - .1 Material: tin plated copper.

2.7 TRANSIENT VOLTAGE SURGE SUPPRESSOR

- .1 Supply and install a Transient Voltage Surge Suppressor (TVSS) where shown on the drawings.
- .2 Requirements:
 - .1 TVSS units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).
 - .2 Voltage: Refer to drawings.
 - .3 Maximum Continuous Operating Voltage (MCOV): The MCOV shall not be less than 115% of the nominal system operating voltage.
 - .4 The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
 - .5 Protection Modes – The TVSS must protect all modes of the electrical system being utilized. The required protection modes are:
 - .1 3Ø, 3W System: L-L, and L-G
 - .2 3Ø, 4W Wye System: L-L, L-N, L-G, and N-G
 - .3 1Ø, 3W Wye System: L-L, L-N, L-G, and N-G
 - .6 Nominal Discharge Current (In) – All TVSSs applied to the distribution system shall have a 20kA In rating regardless of their TVSS Type (includes Types 1 and 2) or operating voltage. TVSSs having an In less than 20kA shall be rejected.
 - .7 ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:
 - .1 L-N, L-G, N-G:
 - .1 120/208 V: 700V
 - .2 347/600 V: 1500V

- .2 L-L:
 - .1 120/208 V: 1200V
 - .2 347/600 V: 3000V
 - .8 TVSS Design
 - .1 Maintenance Free Design – The TVSS shall be maintenance free and shall not require any user intervention throughout its life. TVSSs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. TVSSs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. TVSSs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
 - .2 Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable TVSS modules shall not be accepted.
 - .3 Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.
 - .4 Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall utilize low impedance conductors.
 - .5 Monitoring Diagnostics – Each TVSS shall provide the following integral monitoring options:
 - .1 Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of each protection mode on each phase.
 - .6 The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - .7 Overcurrent Protection
 - .1 The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
 - .8 Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:
-

- .1 600V Equipment – Service Entrance: 240 kA
- .9 600V Equipment – Not Service Entrance: 120 kA
- .9 Installation Requirements:
 - .1 The TVSS shall be installed immediately following the load side of the main breaker or main switch.
 - .2 The MCC shall be capable of re-energizing upon removal of the TVSS.
 - .3 Utilize a breaker, appropriately rated as directed by the TVSS manufacturer, to connect the TVSS to the MCC. The TVSS shall be located directly adjacent to the circuit breaker.
 - .4 The TVSS shall be included and mounted within the MCC by the manufacturer of the MCC where shown on the drawings.
 - .1 The complete MCC including the TVSS shall be CSA/cUL listed.

2.8 POWER METER (MCC-L71.PM)

- .1 Where indicated on the drawings, provide a microprocessor based multifunction power meter.
- .2 Requirements:
 - .1 Multifunction electrical measurement on 3 phase power systems.
 - .2 User programmable for voltage range to any PT ratio.
 - .3 Integrated display.
 - .4 Accept a direct voltage input range of up to 347 Volts Line to Neutral, and a range of up to 600 Volts Line to Line.
 - .5 Accept a current input of up to 5 Amps nominal, 10 Amps full scale.
 - .6 Programmable for current to any CT ratio. The use of DIP switches for selecting
 - .7 fixed ratios shall not be acceptable.
 - .8 Maximum burden of 0.0625 VA at 10 Amps.
 - .9 The meter shall have an accuracy of +/- 0.25% or better for volts and amps, and
 - .10 1.5% for power and energy functions.
 - .11 The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.
 - .12 Function Requirements:
 - .1 Volts, Amps, kW, kVAR, PF, kVA (per phase)
 - .2 Frequency, kWh, kVAh, kVARh
 - .3 Harmonics measurement, individual, even, and odd, up to 15th.
 - .13 Operating Temperature:
 - .1 -20°C to +60°C ambient.
- .3 Communications ports:
 - .1 RS-485 supporting Modbus/RTU.
 - .2 10 Mbps or 10/100 Mbps Ethernet supporting Modbus/TCP.
- .4 Acceptable Products:

- .1 Schneider Electric PM8000 series.
- .2 Or approved equal in accordance with B7.

2.9 VOLTAGE MONITORING RELAY, ESL-L712

- .1 Requirements,
 - .1 Suitable for direct connection to MCC bus having nominal operating voltage of 600 V line-to-line.
 - .2 Adjustable nominal input voltage via potentiometer from 500 V to 600V.
 - .3 Undervoltage trip point:
 - .1 Adjustable from 88% to 92% of nominal voltage.
 - .2 Voltage unbalance:
 - .1 Adjustable from 2% to 10%.
 - .3 Phase loss detection:
 - .1 Triggered upon $\geq 15\%$ unbalance.
 - .2 Response time ≤ 200 msec.
 - .4 Trip delay:
 - .1 Adjustable from 1 to 30 sec.
 - .5 Automatic reset (restart) delay:
 - .1 Adjustable from 0.6 to 64 sec.
 - .2 Adjustable random restart delay from 3 to 15 sec.
 - .6 Faults stored in non-volatile memory.
 - .1 Storage of the last 10 faults.
 - .7 Status and faults displayed on LED readout.
 - .8 Remote reset input.
 - .9 CSA approved.
 - .4 Relay output:
 - .1 Equipped with, at minimum, one Form C electromechanical dry contact output for monitoring.
 - .2 Relay contact to be normally open, held-closed during normal operation, and open upon an alarm condition.
 - .3 Actuate relay on any of the following:
 - .1 Phase A-B, B-C, or C-A voltage less than 575 V.
 - .2 Voltage unbalance greater than 10%.
 - .4 Rated at 10A resistive @ 250 VAC, 6A inductive (0.4 PF) @ 250 VAC.
 - .5 Mechanical life of 1×10^7 operations.
 - .5 Acceptable products:
 - .1 Littlefuse DLMHBRAAA.
 - .2 Or approved equal in accordance with B7.

2.10 PROCESS METERS (VIC-L010-1, VIC-L010-2, VIC-L020-1, VIC-L020-2, VIC-L030-1 & VIC-L030-2)

- 1 Display digital reading of process value and provide control of output relays based on input.
- .2 Display:
 - .1 Dual-line 6-digit
 - .2 Type: Alpha-numeric, LED.
 - .3 Update rate: 5/second (200 ms) minimum.
 - .4 Character colour: red.
- .3 Features:
 - .1 Internal 24V dc loop power supply for providing loop power to external devices.
- .4 Analog Inputs:
 - .1 0-20 mA, 4-20 mA, +/- 10V, 0-5V, 1-5V field selectable.
 - .2 Input impedance:
 - .1 Voltage ranges: > 500k Ω .
 - .2 Current ranges: 50 - 100 Ω .
- .5 Discrete Inputs:
 - .1 Allows for external interlock of output relays
- .6 Output relays:
 - .1 Qty 4, Form C, unless otherwise noted.
 - .2 Electrical rating: 3 Amps at 30 VDC and 125/250 VAC resistive.
- .7 Analog Outputs:
 - .1 Isolated 4-20 mA
 - .2 Settable to input process variable
- .8 Mounting: panel mount, 1/8 DIN (92 mm x 45 mm) cutout.
- .9 Power supply: 85-265 VAC.
- .10 Manufacturer and model:
 - .1 Precision Digital PD6000-6R7
 - .2 Or approved equal in accordance with B7.

2.11 MOTOR STARTERS AND DEVICES

- .1 Equip the MCC with combination starters as specified and shown on the drawings.
- .2 Refer to Section 26 29 10 – Motor Starters to 600 V.

2.12 STARTER UNIT COMPARTMENTS

- .1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive

contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

- .2 Unit mounting:
 - .1 Engaged position - unit stabbed into vertical bus.
 - .2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.
 - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
 - .4 Stab-on connectors free-floating tin-plated clips, self-aligning, backed up with steel springs.
- .3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.
- .4 Hinge unit doors on same side.
- .5 Overload relays manually reset from front with door closed.
- .6 Pushbuttons and indicating lights mounted on door front.
- .7 Devices and components by one manufacturer to facilitate maintenance.
- .8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.
- .9 Control wiring shall be extended from each starter module to the control terminal section, including all auxiliary contacts. A multi unit style terminal block having screw type terminal connections shall be installed on standoff supports on back plate.
- .10 All terminals shall be number coded or otherwise suitably identified to indicate which section or module of the MCC they are associated with and their function.
- .11 Complete control wiring diagrams for each starter with conductor identification clearly shown shall be affixed to the interior cover of the starter section or provide a book of wiring diagrams for all starters in each MCC.
- .12 Primary and secondary high rupturing capacity (HRC) fusing shall be installed on the control transformer.
- .13 Equip door of each individual unit with a removable plate replaceable with similar plate complete with pushbuttons, pilot lights or selector switches as required. Use pilot lights of push-to-test type and push button of heavy-duty oil tight construction.

2.13 WIRING IDENTIFICATION

- .1 Provide wiring identification in accordance with Section 26 05 00- Common Work Results for Electrical.

2.14 EQUIPMENT IDENTIFICATION

- .1 Identify Motor Control Centre with nameplates as follows:
 - .2 Nameplates:
 - .1 Lamacoid 3 mm thick plastic lamacoid nameplates, white face, black lettering, mechanically attached with self tapping screws.

- .3 NAMEPLATE SIZES
 - .1 Motor control centre main nameplate 70 x 120 mm 1 line 40 mm high letters
 - .2 Individual compartment nameplates 30 x 90 mm 3 lines 5 mm high letters
 - .3 Compartment Device namplates 30 x 25 mm 2 lines 3 mm high letters
- .4 Wording on nameplates to be approved by Contract Administrator prior to manufacture.
- .5 Allow for average of twenty-five (25) letters per nameplate.
- .6 Identification to be English.

2.15 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint exterior light grey to ANSI 61 grey enamel, unless otherwise specified.
 - .2 Paint interior white, unless otherwise specified.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during construction.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

2.16 SOURCE QUALITY CONTROL

- .1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.
- .2 Contract Administrator to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

2.17 SPARE PARTS

- .1 One (1) set of fuses of each type and size.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for motor control centres installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Contract Administrator.
 - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 INSTALLATION

- .1 Provide housekeeping pad below the MCC lineups as per the drawings.
-

- .2 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.
- .3 Make field power and control connections as indicated.
- .4 Ensure correct overload heater elements are installed.
- .5 Coordinate concrete pad with bevelled edges as shown on the Drawings, sized to suit MCCs, install and level channel sills and mount MCCs.

3.3 TESTING

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results – For Electrical.
- .2 Utilize test forms to be provided by the Contract Administrator. Complete test forms in full.
- .3 Provide separate completed test forms for each MCC starter section.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

3.5 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.

Part 2 Products

2.1 MATERIALS - GENERAL

- .1 NEMA 4X rated enclosure for all locations except within electrical rooms and control rooms.
- .2 NEMA 12 rated enclosures for devices within electrical rooms or control rooms unless otherwise specified.
- .3 Door: minimum 1 m wide, hinged, minimum 3 point latching, with padlocking means.
- .4 Door interlocks

2.2 TEMPORARY GENERATOR CONNECTION JUNCTION BOX (JB-L72)

- .1 600V, 200A, 3P
 - .2 5052 Aluminum Construction
 - .3 Type 3R Weatherproof Enclosure (30”H x 24”W x 8”D)
 - .4 Wall–Mount Design
 - .5 Certified to cULus Standards
 - .6 Dead Front Cover
 - .7 Colour Coded Camlock Receptacles
 - .8 Standard Mechanical Lugs Kit
 - .9 Angled Camlock Plate for Secure Connection
 - .10 Cable Holder to Prevent Tampering or Theft
 - .11 Bottom Cable Access Door
 - .12 Stainless Steel Hinges with Removable Pins
-

- .13 Door c/w 3 PT. SS Pad-Lockable Handle
- .14 Manufacturer: Foxfab – FFCC-C1 or approved equal.

Part 3 Execution

3.1 INSTALLATION

- .1 Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.
- .2 Mount equipment in enclosure.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No.42-10 (R2015), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA-C22.2 No.42.1-13 (R2017), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA-C22.2 No.55-15, Special Use Switches.
 - .4 CSA-C22.2 No.111-18, General-Use Snap Switches (Trinational standard with UL 20 and NMX-J-005-ANCE)

Part 2 Products

2.1 SWITCHES

- .1 15 A, 120 V, single pole, double pole, three-way, four-way industrial grade switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111 as required.
- .2 Manually-operated general purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver cadmium oxide contacts.
 - .3 Fully enclosed with urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Brown toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.
- .5 Acceptable materials: Hubbell 1200 Series or equivalent.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
-

- .1 Ivory or Brown urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Brown urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Acceptable materials: Hubbell 5252 or equivalent.

2.3 COVER PLATES

- .1 Stainless steel or pvc cover plates for wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .5 Weatherproof double lift spring-loaded stainless steel or pvc cover plates, complete with gaskets for duplex receptacles as indicated on the drawings.
- .6 Weatherproof spring-loaded stainless steel or pvc cover plates complete with gaskets for single receptacles or switches as indicated on the drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 01 - Common Work Results - Electrical.
 - .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
-

- .2 Mount receptacles at height in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .4 Mount lighting fixture receptacles local to fixtures.
- .3 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .4 Install a permanent label or lamacoid for all wiring devices indicating the circuit(s) contained within.
 - .1 Example: L73-2 (Panel L73, circuit 2)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical
- .2 Section 26 28 14 - Fuses - Low Voltage.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4-16, Enclosed and Dead-front Switches.
 - .2 CSA C22.2 No.39-13 (R2017), Fuse holder Assemblies.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Enclosure types.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 sized as per drawings.
 - .2 Provision for padlocking in off switch position by three locks.
 - .3 Mechanically interlocked door to prevent opening when handle in ON position.
 - .4 Fuses: size as indicated on drawings, in accordance with Section 26 28 14 - Fuses - Low Voltage.
 - .5 Fuse holders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
 - .6 Quick-make, quick-break action.
 - .7 ON-OFF switch position indication on switch enclosure cover.
-

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches as indicated and in accordance with the manufacturer's recommendations.
- .2 Mount securely such that top of switch is a maximum of 1600 mm (63") above finished floor. Provide a minimum of 1000 mm (39") clear floor space in front of the switch.

3.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results – Electrical.
- .2 Nameplate for each disconnect switch Size 8 engraved in accordance with Section 26 05 00 - Common Work Results – Electrical. Indicate disconnect equipment number, voltage, phase and MCC source feed

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections Division 26, Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.14-18, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000 (R2005), Controllers, Contactors and Overload Relays Rated 600 V.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.
- .3 Include operating information required for start-up, synchronizing and shut-down of generating units.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location, off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect contactors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.
-

- .2 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .4 Mount in NEMA 4 Enclosure
- .5 Include following options in cover:
 - .1 Red or Green indicating lamp, as indicated.
 - .2 Stop-Start pushbutton, as indicated.
 - .3 Hand-Off-Auto selector switch, as indicated.
 - .4 On-Off selector switch, as indicated.
- .6 Control transformer: in accordance with Section 26 29 03- Control Devices, factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Size 4 nameplate as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with 26 05 00- Common Work Results for Electrical.

3.2 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by contactor installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections Division 26, Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.14-18, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Include schematic, wiring, interconnection diagrams.

1.4 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00- Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for control devices for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials indoors, off ground, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control devices from nicks, scratches, and blemishes.
-

- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to NEMA ICS 1 CSA C22.2 No.14.
- .2 Convertible contact type: contacts field convertible from NO to NC, permanent magnet latched electrically held, double-voltage type with sliding barrier to permit access to contacts only or coil only, with pneumatic, solid state timer. Coil rating: overlap type.

2.2 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 PUSHBUTTONS

- .1 Operator mushroom type. Black, with 1-NO and 1-NC, labels as indicated. Stop pushbuttons coloured red, labelled "Stop".

2.4 SELECTOR SWITCHES

- .1 Standard 2 position labelled as indicated.

2.5 INDICATING LIGHTS

- .1 Standard, full voltage, type, lens colour: as indicated, supply voltage: as indicated, lamp voltage: labels as indicated.

2.6 CONTROL AND RELAY PANELS

- .1 CSA Type 4 sheet steel enclosure with hinged padlock able access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.7 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 600V, 60 Hz ac.
- .3 Secondary: 120 V, AC.
- .4 Rating: 50VA.
- .5 Secondary fuse: 3A.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices installation in accordance with manufacturer's written instructions.
-

- .1 Visually inspect substrate in presence of Contract Administrator.
- .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, and control devices.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

3.4 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

- .1 National Electrical Manufacturer’s Association (NEMA)
 - .1 NEMA Standards Publication ICS 2-2000: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.

1.4 EXTRA MATERIALS

- .1 Provide listed spare parts for each different size and type of starter:
 - .1 3 contacts, stationary.
 - .2 3 contacts, movable.
 - .3 1 contacts, auxiliary.
 - .4 1 control transformer.
 - .5 1 operating coil.
 - .6 2 fuses.
 - .7 10% indicating lamp bulbs used.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to NEMA ICS 2-2000
-

2.2 FULL VOLTAGE MAGNETIC STARTERS

- .1 UL/CSA listed, NEMA size as shown on the drawings.
 - .1 Smallest size of starter: NEMA size 1, unless otherwise indicated
 - .2 IEC rated starters are not acceptable.
- .2 Short Circuit Current Rating (SCCR):
 - .1 The Short Circuit Current Rating (SSCR) of the assembly must equal or exceed 18 kA.
- .3 Magnetic of size, type, rating and enclosure type as indicated with components as follows:
 - .1 All coils to be epoxy coated.
 - .2 Contactor solenoid operated, rapid action type.
 - .3 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .4 Wiring and schematic diagram inside starter enclosure in visible location.
 - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .6 Transient suppressors shall be supplied for all coils in each individual starter unit.

2.3 FULL VOLTAGE REVERSING STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Intelligent electronic motor overload protective relay complete with a Modbus/TCP communication interface to connect to the control system PLC.
 - .1 Acceptable Product: Schneider Electric Tesys T
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter.
- .3 Accessories:
 - .1 Pushbuttons and selector switches: heavy duty oil tight labelled as indicated.
 - .2 Indicating lights: heavy duty oil tight type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
-

- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

3.2 MOTOR STARTER TESTING

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results – For Electrical.
- .2 Perform complete testing of motor starter operation, including but not limited to:
 - .1 Simulating a soft starter module fault to ensure the starter can be reset and put back into operation.
 - .2 Manual startup and shutdown.
 - .3 Automatic startup and shutdown.
- .3 Utilize test forms to be provided by the Contract Administrator. Complete test forms in full. Submit test results to the Contract Administrator.
- .4 Contract Administrator and/or City of Winnipeg will be required to witness motor starter testing in person. Provide a minimum of two (2) weeks notice prior to performing testing of motor starters.
- .5 Provide separate completed test forms for each MCC starter.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.
 - .2 Operate switches, contactors to verify correct functioning.
-

- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Technical requirements related to the design and supply of Variable Frequency Drives (VFD), including all equipment, manufacture, assembly, factor, wiring, inspection, testing and delivery.

1.2 REFERENCE STANDARDS

- .1 CSA, Canadian Standards Association
- .2 NEMA, National Electrical Manufacturer Association
- .3 IEEE, The Institute of Electrical and Electronics Engineers
- .4 Other, Local Power Utility and Telephone Utility Guidelines for Harmonic Distortion.

1.3 DESIGN REQUIREMENTS

- .1 Provide equipment layout drawing detailing
 - .1 The dimensions, physical arrangement of major components, and the degree of compartmentalization and physical segregation provided between components
- .2 Front layout of the panel
- .3 When air-cooled systems are provided, the following shall also be shown:
 - .1 air inlet and outlet passages
 - .2 cooling fans
 - .3 filters.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings including:
 - .1 Panel layout.
 - .2 Wiring diagrams:
 - .1 AutoCAD versions of the VFD schematic drawings will be provided upon request.

1.5 PARTS AVAILABILITY

- .1 Guarantee that parts for the drive units be available for a minimum of ten years from time of delivery.

1.6 DESIGN REQUIREMENTS

- .1 Ventilation system designed for ambient temperature range of 10°C to 35°C. temperature not to exceed 45°C.
-

Part 2 Products

2.1 VARIABLE FREQUENCY DRIVES

- .1 Variable speed controller shall be electronic adjustable frequency and voltage output unit.
 - .2 Designed to operate standard squirrel cage induction motor with a 1.15 S.F. or definite purpose motors meeting NEMA MG1 Part 31.
 - .3 Harmonic loading will not exceed a motor service factor of 1.0.
 - .4 Products shall comply with IEEE standard 519.
 - .5 CSA certified.
 - .6 The VFD shall employ a minimum of 6-pulse pulse width modulated (PWM) system utilizing insulated Gate Bipolar Transistors (IGBT) power switching device and come complete with line reactors.
 - .7 Be capable of re-accelerating the driven equipment, following voltage dips greater than 20% of the rated input power supply, of up to 5 seconds duration, without the need to come to a complete stop. Vendor shall indicate the maximum time delay before re-acceleration begins following restoration of the supply voltage.
 - .8 Be capable to continue operation without coming to a standstill or resulting in process shutdown, following any momentary voltage dips in the input power supply, auxiliary power supply, or both, of less than 20% rated voltage, which last for less than 0.5 second.
 - .9 Designed to provide output requirements dictated by the speed/torque characteristics of motor and driven equipment over the entire speed range. The motors may be supplied by others.
 - .10 VFD shall convert the line input power to adjustable AC voltage and frequency output power. The output power shall be controlled such that permissible volts/Hertz ratio is not exceeded throughout the specified operating speed range, over a voltage range of $\pm 10\%$ and frequency variation of $\pm 5\%$.
 - .11 The VFD output frequency shall not deviate more than $\pm 1\%$ of any given set point within the operating frequency range.
 - .12 The VFD shall be provided with radio interference suppression and limit radio interference values to within the limits of local code requirements.
 - .13 Input Run Command signal will be a 24Vdc discrete signal. Provide a 24Vdc relay in the VFD control compartment.
 - .14 Input frequency setting signal will be 0-10 VDC and 4-20 mA. Output speed and current monitoring signals will be 4-20 mA.
 - .15 Enclosure
 - .1 VFD shall be installed in Type 12 wall mounted enclosure within the electrical room.
 - .2 Filters to be provided for any forced air-cooled enclosures as required by the supplier. VFD(s) shall be suitable for the location installed and shall be able to operate under these conditions with no special cleaning requirements
 - .16 Operational features
-

- .1 Integral flush mounted keypad on enclosure door for programming, monitoring, and operating the drive, accessible through password or other acceptable security measure only.
- .2 Integral selector switches and pushbuttons, where shown on the drawings: heavy duty, oil-tight, 30mm.
- .17 Diagnostic features
 - .1 Integral long life LED indicating lights on enclosure door.
 - .2 Indicating lights as follows:
 - .1 Running (Red)
 - .2 VFD Fault (Orange)
- .18 Acceptable manufacturer:
 - .1 Schneider Electric Altivar 600 series
 - .2 This product was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.
- .19 Purchase or Quotation:
 - .1 All requests for purchase or quotation shall reference RFP 756-2013 to receive standardized pricing that the City has negotiated with the vendor.
 - .2 Contact: Schneider Electric, 21 Omands Creek Blvd, Winnipeg, MB.
 - .3 The Bidder's bid price shall reflect the discounted equipment price. The City will review the purchase price for standardized equipment to ensure the applicable discount factor has been applied.

2.2 TERMINALS

- .1 Terminals as follows:
 - .1 Feed-through: Phoenix Contact 3046184 or approved equal in accordance with B7,
 - .2 Potential earth: Phoenix Contact 3046207 or approved equal in accordance with B7,
 - .3 Fused: Phoenix Contact 3046142 with 3036806 or approved equal in accordance with B7,
 - .4 End plate: Phoenix Contact 3047141 or approved equal in accordance with B7.

2.3 COOLING SYSTEM

- .1 Perform heat load analysis to determine air-cooling requirements.
 - .2 Air-cooled converters shall meet the following:
 - .1 Redundant cooling fans
 - .2 Cooling fan operates when pump is started from VFD or bypass system or when enclosure reaches hi temperature.
 - .3 Provide adjustable hi temperature switch, with minimum range 10°C to 30°C.
-

2.4 WIRING

- .1 Utilize the following wire colours for the types of voltage/signals indicated:
 - .1 120VAC Line: Black
 - .2 120VAC Control: Red
 - .3 120VAC Neutral: White
 - .4 24VDC Supply: Blue
 - .5 24VDC Control: Blue
 - .6 24VDC Common: Brown
 - .7 24VAC Supply: Black
 - .8 24VAC Control: Red
 - .9 24VAC Neutral: White
 - .10 10VDC Supply: Blue
 - .11 0-10VDC Signal: Blue
 - .12 10VDC Common: Brown
 - .13 Intrinsically Safe: Light Blue
 - .14 4-20mA Signal: White (+), Black (-)
 - .2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.
 - .3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.
 - .4 All wires and cables inside the VFD panels shall be identified on both ends with non-erasable markers from.
 - .5
 - .6 Identification shall follow the supplied documents, such as wiring diagrams.
 - .1 Label both ends of each wire.
 - .2 Utilize machine printed non-slip labels.
 - .3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.
 - .7 Individual conductors or wires exiting a cable shall be identified using non-erasable markers.
 - .8 The routing of all analog, digital, and power cable wiring inside VFD panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying. All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.
 - .9 All analog signal wiring shall be 18 AWG shielded twisted pairs such as Belden No. 8760, or an approved equivalent in accordance with B7. Shield wires exiting the jacket must be covered with a black heat shrink, and the overall cable at the jacket end must also be covered with a heat shrink.
-

- .10 All 24 VDC or 120 VAC discrete signal panel wiring shall be 16 AWG TEW stranded conductor.
 - .1 Increase the size of power wiring, 12 AWG minimum.
- .11 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.
- .12 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door. Each end of the loop shall be properly supported.
- .13 Ethernet Patch Cords
 - .1 Requirements:
 - .1 CAT-6.
 - .2 Jacket colour: Blue.
- .14 Wiring Duct
 - .1 All wires shall be run in narrow slot wiring duct such as Panduit or an approved equivalent in accordance with B7
 - .2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails.
 - .3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 10 cm.
 - .4 120 VAC wires cannot share wiring duct with 10 VDC, 24 VDC or 4-20 mA wires, but can cross their path.

2.5 SPARE PARTS

- .1 Provide, at minimum, the following spare parts:
 - .1 One cooling fan
 - .2 All control fuses
 - .3 One N.O. and N.C. contact block for control switches
 - .4 One form "C" relay
- .2 Spare parts to be provided in a sealed plastic bag taped to side of enclosure interior

Part 3 Execution

3.1 INSTALLATION

- .1 VFD cabinets shall be mounted in such a way that there is adequate room for ventilation and no build up of heat. The minimum clearance in front of VFDs is 1 m.

3.2 CONFIGURATION

- .1 Submit settings sheet for review.
 - .2 Configure VFD parameters as specified on settings sheet.
 - .3 Include settings sheets in the O&M manuals
-

3.3 TESTS

- .1 VFD units are to be factory tested prior to shipment. Provide confirmation from factory of actual tests completed and results.
- .2 Confirm VFD capability to continue operation without coming to a standstill, following any momentary voltage dips in the input power supply, auxiliary power supply or both of less than 20% rated voltage, which last for less than 0.5 seconds.
- .3 Confirm VFD capability to automatically re-accelerate following loss of voltage for up to five seconds.
- .4 Field testing
 - .1 Provide on-site start-up, fine-tuning, commissioning, operator training, and instruction.
 - .2 Full-load functional test of the VFD shall be performed. The test shall prove the correct operation of all control functions, auxiliaries, protective systems, alarms and metering.
 - .3 Ensure shaft to ground voltages do not exceed 1.5 V at any speed or load requirement.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-97, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4-92, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Surge Voltages in Low-Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM F1137-88(1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 United States of America, Federal Communications Commission (FCC)
 - .1 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.
- .3 Photometric data to include: VCP Table and spacing criterion.

Part 2 Products

2.1 LAMPS

- .1 Lamps shall be as indicated on luminaire schedule on drawings.

2.2 LED DRIVER

- .1 LED Driver: CSA certified, energy efficient type, IC electronic.
 - .1 Rating: 120 V, 60 Hz.
 - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
 - .3 Start-up ambient temperature of -20°C for indoor luminaires, and -40°C for outdoor luminaires.
 - .4 Power factor: minimum 95% with 95% of rated lamp lumens.
 - .5 Harmonics: 10 % maximum THD.
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- .6 Estimated lifespan equal or greater than LED lamps of respective luminaire.
- .7 Sound rated: Class A.
- .8 Mounting: integral with luminaire.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINAIRES

- .1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
- .2 Install rigid PVC conduit or Teck 90 cable for luminaires.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling.
- .2 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors (Nylon shields not acceptable) or as recommended by Anchor Construction Industrial Building Products Ltd for the specific surface & equipment being installed.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 If there is potential of Asbestos Electrical Contractor must use a proper collection boot and HEPA vacuum whenever drilling of holes in facility.
- .5 All steel channel support for wall and surface mounted luminaires to be PVC coated strut.
- .6 All RGS conduit stem threaded on both sides shall be PVC coated. All hardware shall be rated for the application environment.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for emergency lighting systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 21 - Wires and Cables (0-1000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-M1985(R1999), Unit Equipment for Emergency Lighting.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

1.5 WARRANTY

- .1 For batteries, the 12 months warranty period prescribed in subsection GC32.1 of General Conditions "C" is extended to 120 months, with no-charge replacement during the first 5 years and pro-rate charge on the second 5 years.

Part 2 Products

2.1 EQUIPMENT

- .1 Battery Unit
 - .1 Emergency lighting equipment: to CSA C22.2 No.141.
 - .2 Supply voltage: 120 V, ac.
 - .3 Output voltage: 12 V dc.
 - .4 Operating time: 60 min.
 - .5 NEMA 4X rated weatherproof, fully gasketed
 - .6 Liquid-tight, momentary push button test switch
 - .7 Signal lights: solid state, for 'AC ON' and 'Charge'.
 - .8 Battery: sealed, maintenance free.
 - .9 Charger: fully automatic, current limited charger.
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- .10 Battery protection: a low voltage battery protection circuit to disconnect the load when the battery reaches the end of discharge.
 - .11 Lamp heads: integral on unit and remote, fully adjustable. Lamp type: LED, 6 W.
 - .12 Large magnum terminal screw type connectors for remote load connection.
 - .13 Automatic Self Testing Feature that test once a month, every 6 months and 12 months c/w visual and audible alarm and should indicate the following at a minimum:
 - .1 Battery Failure
 - .2 Battery Disconnect
 - .3 Charger Failure
 - .4 Lamp Failure
 - .5 Service Alarm
 - .6 AC on
 - .7 Charger on
 - .14 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
 - .15 Finish: Grey.
 - .16 Options required:
 - .1 Automatic test self-diagnostic
 - .2 Ammeter and Voltmeter
 - .3 Line cord & plug
 - .4 A.C./D.C. Terminal block capable of accepting #10 AWG Cu. Wire
 - .5 Audible alarm, Audible emergency
 - .6 Six (6) circuit fused internal distribution
 - .7 Internal thermostatically controlled battery heater
 - .8 Infrared remote test
 - .9 Lamp disconnect (internal)
 - .10 Octagon box mount (line cord delete)
 - .11 RFI suppressors.
 - .12 Time delay
 - .13 Twist lock plug
 - .2 Remote Lamp Heads
 - .1 Supply voltage: 12 V dc
 - .2 CSA C22.2 No.141-15 approved
 - .3 Rated for wet location
 - .4 Polycarbonate enclosure, fully gasketed housing
 - .5 Fully adjustable lamps
 - .6 Double heads
 - .7 Black color
-

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized in accordance with manufacturer's recommendations to minimize voltage drop.

Part 3 Execution

3.1 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.47-13 (R2018), Air-Cooled Transformers (Dry Type).
 - .2 CSA C9-17, Dry-Type Transformers.
 - .3 CAN/CSA-C802.2-18, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)
- .3 Canada's Energy Efficiency Act and Energy Efficiency Regulations

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store and protect dry type transformers from nicks, scratches, and blemishes.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN DESCRIPTION

- .1 XFMR-L73.
 - .1 Type: ANN.
 - .2 1 phase, 15kVA, 600V:120/240V, 60Hz
 - .3 Voltage taps: Minimum two taps above and two taps below at 2.5% increments, full capacity.
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- .4 Insulation Class: 220°C
 - .5 Temperature rise: 150°C
 - .6 Basic Impulse Level (BIL): standard.
 - .7 Hipot: standard.
 - .8 Average sound level: standard.
 - .9 Impedance at 17 degrees C: standard.
 - .10 Enclosure: NEMA 1.
 - .11 Mounting: floor or wall (as indicated on drawings).
 - .12 Finish: in accordance with Section 26 05 00- Common Work Results for Electrical.
 - .13 Copper windings.
 - .14 Lifting hooks for lifting complete transformer assembly.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Label size: 7.
- .3 Indicate equipment identifier, KVA rating, primary and secondary voltage.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Contract Administrator.
 - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA as indicated on drawings.
 - .2 Mount dry type transformers above 75 kVA on floor.
 - .3 Ensure adequate clearance around transformer for ventilation.
 - .4 Install transformers in level upright position.
 - .5 Remove shipping supports only after transformer is installed and just before putting into service.
 - .6 Loosen isolation pad bolts until no compression is visible.
 - .7 Make primary and secondary connections in accordance with wiring diagram.
 - .8 Energize transformers after installation is complete.
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- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 TESTING

- .1 Utilize test form provided. Complete test form in full.
- .2 Perform an insulation-resistance test. Individually test each winding with all other windings grounded, and test winding to winding, with both windings ungrounded. The test voltage shall be 1000 VDC, unless otherwise indicated by the manufacturer. The test duration shall be one minute.
- .3 Measure and record the voltage on the primary and secondary of the transformer. Adjust the tap position as required. Record final tap position and voltage.

Schedule 26 12 17-1: Transformers

Identifier	Location	Size	Voltage	Enclosure Type
XFMR-L73	Main Floor	15 kVA	600:120/240V, 1Ø	CSA 1

3.4 CLEANING

- .1 Progress Cleaning:
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.29-15, Panelboards and Enclosed Panelboards.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store and protect panelboards from nicks, scratches, and blemishes.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

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- .2 240 V panelboards: bus and breakers rated for 10 kA.
 - .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
 - .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
 - .5 Minimum of 2 flush locks for each panel board.
 - .6 Two keys for each panelboard and key panelboards alike.
 - .7 Copper bus with neutral of equal ampere rating of mains.
 - .8 Mains: suitable for bolt-on breakers.
 - .9 Trim with concealed front bolts and hinges.
 - .10 Trim and door finish: baked enamel.
 - .11 Isolated ground bus.
 - .12 Include grounding busbar with minimum 3 terminals for bonding conductor equal to breaker capacity of the panel board.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02- Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

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- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed Departmental Representative.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00- Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2016).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Include time-current characteristic curves for breakers with ampacity of 100 A and over.
 - .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 2 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
 - .5 Name and address of building where circuit breakers will be installed.
-

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Ground-fault circuit-interrupters, Circuit breakers, and Moulded-case circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .5 Circuit breakers with interchangeable trips as indicated.

2.2 MCC-L71.MCB (MCC-L71 MAIN BREAKER)

- .1 Requirements:
 - .1 Frame Size: 225 Amps
 - .2 Sensor Rating: 225 Amps
 - .3 Interrupting Rating: 14 kA @ 600 VAC
 - .4 Trip Unit Type: Electronic LSI, Factory Sealed
 - .5 Long Time PU: 0.42 – 1.00 A * Sensor Rating (Adjustable)
 - .6 Long Time Delay: 0.5 – 24 sec (Adjustable)
 - .7 Short Time PU: 1.5 – 10 * LTPU (Adjustable)
 - .8 Short Time Delay: 0.0 to 0.4 sec (Adjustable)
 - .9 Instantaneous: 2 – 15 * Sensor Rating (Adjustable)
 - .10 Poles: 3
 - .11 Model: Schneider Electric PowerPact P series with Micrologic 5.0 A (Ammeter) series trip unit or approved equal in accordance with B7.
-

2.3 THERMAL MAGNETIC BREAKERS < 100A

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .2 Requirements:
 - .1 Trip Rating: As shown on the drawings.
 - .2 Interrupting Rating: 14 kA @ 600 VAC
 - .3 Type: Thermal Magnetic
 - .4 Poles: As shown on the drawings.
 - .5 Model: Schneider Electric PowerPact H series or approved equal in accordance with B7.

2.4 OPTIONAL FEATURES

- .1 As indicated.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 On circuit breakers with adjustable protection settings, set the protection settings as per the specifications and/or drawings.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 This section covers items common to sections of Division 40. This section supplements requirements of Division 1.

1.2 CODES AND STANDARDS

- .1 Do complete installation in accordance with the latest version of CSA C22.1 except where specified otherwise.
- .2 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work.

1.3 DRAWINGS AND SPECIFICATIONS

- .1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested and ready for operation.
- .2 These Specifications and the Drawings and Specifications of all other divisions shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings, but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.
- .3 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.
- .4 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting Bid, in accordance with B4.

1.4 CARE, OPERATION AND START-UP

- .1 Instruct City maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

1.5 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
 - .2 Pay associated fees.
 - .3 Notify Contract Administrator of changes required by Electrical Inspection Department prior to making changes.
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- .4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.6 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

1.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.8 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
- .2 Nameplates:
 - .1 Lamicaid 3 mm thick plastic lamicaid nameplates, white face, black lettering, mechanically attached with self tapping screws.

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters

- .3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.
 - .4 Allow for average of twenty-five (25) letters per nameplate.
 - .5 Identification to be English.
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1.9 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders and branch circuit wiring.
 - .1 Wire tags to be heat shrink type with black letters on white background.

1.10 SUBMITTALS

- .1 Prior to delivery of any Products to job Site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 1.
- .2 Submit Shop Drawings (including Product Data) for all equipment as required in each Section of this Specification.
- .3 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.
- .4 The term “Shop Drawing” means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work. Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to Design Drawings and Specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the contract price. If adjustments affect the value of the Work state such in writing to the Contract Administrator prior to proceeding with the Work.
- .5 Manufacture of Products shall conform to revised Shop Drawings.

1.11 RECORD DRAWINGS

- .1 The Contractor shall keep one (1) complete set of white prints at the Site during work, including all addenda, change orders, Site instructions, clarifications, and revisions for the purpose of Record Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents. Record Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

1.12 O&M MANUAL

- .1 Operations and Maintenance Manuals
 - .1 Refer to Section 01 78 00 for general O&M Manual requirements.
 - .2 In addition to the general requirements, provide the following information:
 - .1 Table of Contents – Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.
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- .2 Systems Descriptions – A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
 - .3 Manuals containing all pertinent information, drawings and documents of the Contractor’s supply and/or documentation included with the instruments supplied by others, such as:
 - .1 Mechanical drawings of the equipment.
 - .2 Installation drawings and procedures.
 - .3 Instrument model numbers.
 - .4 Equipment specifications.
 - .5 Detailed utility requirements.
 - .6 Replacement parts list with model numbers.
 - .7 Recommended preventative maintenance frequency.
 - .8 Troubleshooting procedures.
 - .9 Procedures for dismantling.
 - .10 Procedure to operate the equipment/instruments.
 - .11 Recommended cleaning procedure.
 - .12 Recommended list of supplies to be used in conjunction with the operation and maintenance of the equipment.
 - .13 Recommended spare parts list
 - .4 A copy of all wiring diagrams complete with wire coding.
 - .5 Include type and accuracy of instruments used.
 - .6 Set of final reviewed Shop Drawings.
 - .7 Testing documentation including:
 - .1 Loop Check Report
 - .2 PLC Software Operation and Maintenance Manual:
 - .1 To be provided by the Contract Administrator.
 - .3 HMI Operation and Maintenance Manual:
 - .1 To be provided by the Contract Administrator.

1.13 MEASUREMENT AND PAYMENT:

- .1 Payment will be based on Form B, Item 35, as accepted and measured by the Contract Administrator.
 - .1 A maximum of 95% may be submitted for progress payments prior to the total completion of the associated services, including the provision of as-built drawing mark-ups and O&M manuals.

Part 2 Products

2.1 NOT USED

- .1 Not Used.
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Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 FAT: Factory Acceptance Test

1.2 DESIGN REQUIREMENTS

- .1 Develop a demonstration and test procedure, along with test forms, for the FAT.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit the following for review at least 15 Working Days prior to FAT.
 - .1 Detailed test procedure and test forms for review.
 - .1 Incorporate all changes to the procedure and test forms requested by the Contract Administrator.
- .3 The following, will be provided by the Contract Administrator on the date of the FAT:
 - .1 Detailed listings of all control logic and software utilized to implement the control sequences, for the scenarios demonstrated as part of the FAT. Listings are to be neatly organized and commented as required. All supporting documents, including variable listings are to be included.

1.4 CLOSEOUT SUBMITTALS

- .1 Include all FAT documentation and test forms in the O&M manuals.

1.5 DEMONSTRATION AND TESTING

- .1 The purpose of testing is to ensure all status signals, alarm signals, controls, and interlocks defined in the Metcalfe Lift Station Control Narrative (“Control Narrative”) within the PLC are conveyed to the City’s SCADA HMI system via the cellular communication link. This shall be performed by the Contract Administrator in conjunction with the City of Winnipeg personnel. Allow up to three (3) representatives to attend and assist each FAT testing session at no additional cost.
- .2 The location of the FAT will be in a Contractor supplied facility, within Winnipeg, Manitoba, Canada.
- .3 Correct deficiencies at no additional cost and re-test until satisfactory performance is obtained.
- .4 Acceptance of tests during the FAT will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

1.6 COMPLETION OF FAT

- .1 The FAT is considered to be complete only when full approval of the Contract Administrator has been received by the Contractor. The FAT results shall be sealed by a professional engineer licensed to practice in Manitoba.
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- .2 Schedule additional re-tests at no additional cost until approval is obtained.

Part 2 Products

2.1 NONE USED.

- .1 None Used.

Part 3 Execution

3.1 DEMONSTRATION SYSTEM

- .1 Setup the complete automation system in the Contractor's facility, in a manner to allow for the complete and expeditious testing of the system and associated programming.

3.2 PROCEDURES

- .1 All tests shall be documented.
- .2 Produce test forms to allow for recording the results of the simulations and tests.
- .3 All points to the SCADA system will be tested with the assistance of City personnel.
- .4 Advise Contract Administrator of the date of testing. Contract Administrator may, at their discretion, observe factory acceptance testing based on the completeness of the submittal or other factors.
- .1 Demonstration tests to include:
- .1 Testing of all discrete physical inputs with the use of wire jumpers.
- .1 Confirm that the City's SCADA system is able to see the state transition.
- .2 Confirm that the light on the front of the control panel illuminates (where a light is provided).
- .2 Testing of all discrete outputs by forcing the outputs in the PLC software and confirming the output is active using a pilot light or multi-meter.
- .1 Confirm that the City's SCADA system is able to see the state transition.
- .3 Testing of all analog inputs by using a 4-20mA or 0-10V process simulator (multi-meter with signal generating functions).
- .1 Test the input at 0%, 50%, and 100% of full scale.
- .2 Test the under range (0.0 - 3.9 mA) and overrange (20.1 – 24.0 mA) operation.
- .3 Confirm that the City's SCADA system as able to see each of the 0%, 50%, and 100% of full scale values as they are tested.
- .4 Testing of all analog outputs by forcing the outputs in the PLC software and measuring the value with a multi-meter.
- .1 Test the output at 0%, 50%, and 100% of full scale.
- .2 Confirm that the City's SCADA system as able to see each of the 0%, 50%, and 100% of full scale values as they are tested.
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- .5 Testing of physical pushbuttons, selector switches, and pilot lights on the control panel(s).
 - .6 Testing of the PSTN (dial-up) modem by providing a temporary external telephone line connection to the modem and allowing for the City's SCADA system to dial out and connect to the PSTN modem for confirmation that the PLC status and alarm signals can be read.
 - .1 Testing of all status and alarm signals is not required. Test only a small sample of signals, including at least two discrete points and two analog points.
 - .7 Testing of control/interlock functions
 - .1 Testing of pump operation in PLC Mode.
 - .2 Testing pump operation in local mode when controlled by LIC-L100-1.
 - .3 Testing pump operation in local mode when controlled by LIC-L100-2.
 - .8 Testing of panel mounted local HMI.
 - .9 Testing of DNP3 parameters.
 - .2 Demonstration tests need not include:
 - .1 Connection of instruments to the control panel.
 - .2 Configuration of instruments.
 - .5 The Contract Administrator may request additional tests and simulations at the FAT. No additional payment shall be made for additional minor tests.
 - .6 The Contract Administrator will review the system, simulations, and test results. Incorporate comments and feedback from the Contract Administrator into the system design.

3.3 Evaluation

- .1 All evaluations will be pass/fail.
- .2 The Contractor is expected to ensure that all required demonstrations are fully operable and meet required specifications, prior to the FAT. Upon failure of a required demonstration in the FAT, the Contractor shall provide subsequent re-tests to the satisfaction of the Contract Administrator.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit commissioning plans and procedures, in writing, at least 20 Working days prior to commissioning.

1.2 CLOSEOUT SUBMITTALS

- .1 Final Report:
 - .1 Include measurements, final settings and certified test results.
 - .2 Include completed commissioning forms
 - .3 Bear signature of commissioning technician and supervisor
 - .4 Provide "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications as set during commissioning and submit to the Contract Administrator in accordance with Section 01 78 00 – Closeout Submittals.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.3 COMMISSIONING FORMS

- .1 The Contract Administrator will provide a base set of standard commissioning forms. Additional forms will be required and must be prepared by the Contractor. The Contractor shall fill out separate commissioning forms for each piece of equipment.
- .2 Supplement the provided forms as required to make a complete commissioning report package. Utilize the specifications, drawings, and Metcalfe Lift Station Control Narrative (“Control Narrative”) as the basis for preparation of the additional commissioning forms.

1.4 COMMISSIONING

- .1 Carry out commissioning under direction of the Contract Administrator and in the presence of representatives of the Contract Administrator and the City.
 - .2 Inform, and obtain approval from the Contract Administrator in writing at least 14 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
 - .3 Correct deficiencies and re-test until satisfactory performance is obtained.
 - .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
 - .5 Perform tests as required.
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1.5 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by the Contract Administrator.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 STATUS PRIOR TO COMMISSIONING

- .1 Prior to commissioning, ensure that the following is completed:
 - .1 Installation of all panels and completion of all wiring connections.
 - .2 Testing wiring for continuity from the field device to the control panel.
 - .3 Automation panels are cleaned (interior and exterior)

3.2 PROCEDURES

- .1 Provide a minimum of one qualified technician to test and commission the control system.
 - .2 Test each I/O point from the instrument to the City's SCADA HMI.
 - .1 Verify DNP3 parameters, coordinate with City's of Winnipeg personnel to verify all DNP3 addresses are mapped properly to SCADA.
 - .2 Tests to be performed in conjunction with City of Winnipeg personnel to verify alarm and status signals on the City's SCADA HMI.
 - .3 Test both states of discrete points.
 - .4 Test, at minimum, two values for analog points plus zero and full scale readings (at minimum four values total).
 - .5 Test all control and interlock functions.
 - .6 Test pump operation in auto mode.
 - .7 Test pump operation in manual mode when controlled by LIC-L100-1.
 - .8 Test pump operation in manual mode when controlled by LIC-L100-2.
 - .3 Test each piece of equipment individually for complete functionality.
 - .4 Completely test the E-Stop functionality of each piece of equipment, as provided.
 - .5 Where software logic is provided in the PLC, all modifications to the software program to bypass interlocks or sensors shall be recorded and documented clearly in a separate document, and in the PLC software.
 - .1 Any software bypasses that remain, prior to leaving site, must be authorized by the Contract Administrator or designated representative.
 - .6 All deficiencies must be corrected by the Contractor.
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- .7 Commission each system using procedures prescribed by the Contract Administrator.
 - .8 Optimize operation and performance of systems by fine-tuning control loops and PID values.
 - .9 Complete local HMI test.

3.3 SYSTEM SOFTWARE

- .1 Load PLC system with appropriate program and/or configuration as per the included the Metcalfe Lift Station Control Narrative (“Control Narrative”), fully tested and approved as part of the software FAT.
 - .1 Any changes made to the software after the FAT must be submitted for review and approval of the Contract Administrator.
 - .2 Any changes made to the software after the FAT must be subject to re-commissioning to ensure proper system operation.
- .2 Any issues identified on site must be communicated to the Contract Administrator. Approval is required prior to making any modifications.
- .3 The Contractor is reminded that this facility is critical to operation of the City’s wastewater pumping station.

3.4 CHECKLISTS, FORMS, AND REPORTS

- .1 Complete checklists, forms, and reports for each instrument, loop, and control device.
 - .1 Instrument Loop Checklist.
 - .2 Discrete Device Checklist.

3.5 DEMONSTRATION

- .1 Demonstrate to the Contract Administrator operation of systems including sequence of operations under all potential conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-2009, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant.
- .3 Operating conditions: -40 to +55°C with 5 - 95% RH (non-condensing) unless otherwise specified.

2.2 EMERGENCY STOP PUSHBUTTONS (HSS-L010-1, HSS-L020-1, HSS-L030-1, HSS-L010-2, HSS-L020-2, HSS-L030-2, HSS-L010-3, HSS-L020-3, HSS-L030-3)

- .1 Supply and install enclosed two-position maintained emergency stop operator stations for the lift pumps P-L01, P-L02 and P-L03 as indicated on the drawings.
 - .2 Requirements:
 - .1 Type: Push-Pull / Twist to release
 - .2 Ingress Protection: NEMA 4X
 - .3 Contact Life: 1,000,000 cycles
 - .4 Mechanical Life: 250,000 cycles
 - .5 Contact Rating: 10 A
 - .6 Contact Configuration: As shown on the drawings
 - .7 Illumination: Not required unless otherwise indicated.
 - .3 Acceptable Products:
 - .1 Schneider Electric Harmony 9001 K Series,
 - .2 Allen-Bradley 800H series,
 - .3 Or approved equal in accordance with B7.
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Part 3 Execution

3.1 INSTALLATION

- .1 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .2 Readily accessible to allow for unhindered operation and servicing.
- .3 Wall installation:
 - .1 Located as shown on the drawings.
 - .2 Securely mounted.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes:
 - .1 Process instrumentation

1.2 REFERENCES

- .1 National Electrical Manufacturer's Association (NEMA)
 - .1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-C22.1-2021, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.3 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Manufacturer's Instructions:
 - .1 Include manufacturer's installation instructions for specified equipment and devices in O&M Manuals.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant.
- .3 Operating conditions: 0 +5°C with 5 - 95% RH (non-condensing) unless otherwise specified.
- .4 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 FLOAT SWITCHES (LSHH-L101, LSH-L501, LSH-L502)

- .1 Requirements:
 - .1 Suspended mechanical float switch
 - .2 Fluid: Wastewater
 - .3 Temperature Range: 0°C to +50°C
 - .4 Output: Form C dry contact
 - .5 Protection: IP68
 - .6 Approvals: CSA or cUL
 - .2 Acceptable products:
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- .1 Flygt ENM-10,
 - .2 Or approved equal in accordance with B7.

2.3 LEVEL TRANSMITTERS (LIT-L100-1, LIT-L100-2)

- .1 Application: Differential pressure cell for measurement of wet well level via hydrostatic head pressure measurement.
 - .2 Service:
 - .1 Fluid: Wastewater
 - .2 Fluid Temperature: -10°C to 50°C
 - .3 Sensing range: 0 - 240 inches water (inH2O)
 - .3 Sensor/Transmitter:
 - .1 Enclosure Material: Die-cast aluminum
 - .2 Seal Diaphragm: Stainless Steel,
 - .3 Measuring cell filling: Silicone oil,
 - .4 Ingress Protection: IP66,
 - .5 Power Supply: 10.5 – 45 Vdc (loop powered),
 - .6 Output Signal: 2 wire, 4-20 mA with HART,
 - .7 Electrical Connection: Screwed gland ½-14 NPT, screw terminals,
 - .8 Accuracy: ≤ 0.065%
 - .9 Display: Included
 - .10 Explosion protection: None
 - .11 Mounting Flange: ASME B16.5, 76.2 mm (3 inch), Class 150
 - .4 Manifold: Block and bleed
 - .5 Acceptable Products:
 - .1 Siemens SITRANS P DS III,
 - .2 This product was standardized by the City via RFP 449-2014. No alternates or substitutes will be accepted.
 - .6 Purchase or Quotation:
 - .1 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.
 - .2 Contact: Trans-West Company Inc., 126 Bannister Road, Winnipeg, MB.
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- .3 The Bidder's bid price shall reflect the discounted equipment price. The City will review the purchase price for standardized equipment to ensure the applicable discount factor has been applied.

2.4 ELECTROMAGNETIC FLOWMETERS (FE/FIT-L012, FE/FIT-L022, FE/FIT-L032)

- .1 Service:
- .1 Fluid: Raw sewage (wastewater)
 - .2 Fluid Temperature: -10°C to 50°C
 - .3 Ambient Temperature: 0° to 40°C
 - .4 Pressure: 0 to 100 kPa
- .2 Accuracy:
- .1 ±0.4% ±1 mm/sec
- .3 Sensor Requirements:
- .1 Internal diameter: 406 mm (16")
 - .2 Flange material: Carbon Steel
 - .3 Flange type: Class 150
 - .4 Electrodes: Hastelloy C
 - .5 Grounding: Grounding Rings (to be included)
 - .6 Area Classification: Unclassified
 - .7 Enclosure Rating: NEMA 4X
 - .8 Approvals: CSA of equivalent
 - .9 All flow tubes shall be hydrostatically tested to 1.5 times their rated pressure.
 - .10 Provide epoxy paint coating for the entire flow sensor.
- .4 Transmitter Requirements:
- .1 Mounting: Wall (remote from flow sensor)
 - .2 Conduit/cable Entry: 12mm (1/2") NPT
 - .3 Display Language: English
 - .4 Local Display: LCD
 - .5 Local Control: Keypad
 - .6 SENSORPROM Memory Unit to be included.
 - .7 Programming and configuration:
 - .8 Fully configurable via transmitter keypad
 - .9 Configurable via HART field communicator on 4-20mA output loop (HART field communicator not included)
 - .10 Units of Operation:
 - .1 Flow rate: l/s
 - .2 Flow totalizer: m3
 - .11 Power Supply: 24 Vdc
 - .12 Output:
 - .13 4-20 mA with HART for flow rate
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- .14 Pulse output for flow totalization
 - .15 Enclosure Rating: NEMA 4X
 - .5 Cable (between flow sensor and transmitter)
 - .1 Installation: Conduit
 - .2 Purpose: Signal and coil drive
 - .3 Length: 30 meters (per flowmeter)
 - .4 Gauge: As per manufacturer's recommendations.
 - .6 Acceptable products:
 - .1 Siemens SITRANS F M MAG 5100 W series flow sensor,
 - .2 Siemens SITRANS F M MAG 6000 series transmitter,
 - .3 Siemens Remote Wall Mount Kit FDK:085U1053,
 - .4 Siemens Cable Kit,
 - .5 This product was standardized by the City via RFP 449-2014.
No alternates or substitutes will be accepted.
 - .7 Purchase or Quotation:
 - .1 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.
 - .2 Contact: Trans-West Company Inc., 126 Bannister Road, Winnipeg, MB

2.5 STATION MAIN WATER LOW PRESSURE SWITCH (PSL-L526)

- .1 Requirements:
 - .1 Pressure Range: 0 to 100 PSI (adjustable).
 - .2 Service: Domestic Water.
 - .3 Enclosure Rating: NEMA Type 4X
 - .4 Output: Qty 1, SPDT dry contact, 10A at 125 VDC.
 - .5 Electrical Connection: ½" NPT (female).
 - .6 Process Connection: ½" NPT (female).
 - .7 Mounting: Pipe.
 - .8 Approvals: CSA and/or cUL.
- .2 Acceptable Products:
 - .1 United Electric J6 266 1070.
 - .2 Or approved equal in accordance with B7.

2.6 HVAC DUCT TEMPERATURE SENSORS (TE-L600)

- .1 Requirements:
 - .1 Sensor: 1097 ohms @ 25°C.
 - .2 Insertion: 150 mm duct mount with wiring box.
 - .3 Mounting: Duct
 - .4 Operating Range: -40°C to +121°C
 - .2 Acceptable products:
 - .1 Honeywell C7031B ,
 - .2 Or approved equal in accordance with B7.
-

2.7 HVAC FILTER DIFFERENTIAL PRESSURE SWITCH (PDSH-L660)

.1 Requirements:

- .1 Type: Electro-mechanical
- .2 Dry Contact: SPDT, rated for at least 0.2 Amps at 24VDC
- .3 Operating Temperature: 0°C to +35°C, minimum
- .4 Set Point: 125 Pa (0.5 “w.c) (adjustable)
- .5 Pressure Range: As Required
- .6 Enclosure Rating: NEMA 4 or NEMA 4X
- .7 Approvals: CSA or cUL
- .8 Mounting: Duct or Wall

.2 Acceptable products:

- .1 United Electric H100K-540,
- .2 Dwyer ADPS-04-1-N,
- .3 Or approved equal in accordance with B7.

2.8 HVAC AIR FLOW SWITCH (FSL-L643 FSL-L652)

.1 Requirements:

- .1 Type: Electro-mechanical
- .2 Dry Contact: SPDT, rated for at least 0.2 Amps at 24VDC
- .3 Operating Temperature: 0°C to +35°C, minimum
- .4 Enclosure Rating: NEMA 4 or NEMA 4X
- .5 Approvals: CSA or cUL
- .6 Mounting: Duct

.2 Acceptable products:

- .1 In accordance with B7.

2.9 TEMPERATURE TRANSMITTER (TT-L010-1, TT-L010-2, TT-L020-1, TT-L020-2, TT-L030-1, TT-L030-2)

.1 Requirements:

- .1 Mounting: Wall
- .2 Protection: NEMA 4 or IP67 Enclosure
- .3 Power Supply: Loop powered
- .4 Output Signal: 4-20 mA, 2-wire
- .5 Accuracy: 0.2 degrees C over range of 0 to 70 degrees C.
- .6 Stability: 0.02 degrees C drift per year.

.2 Acceptable products:

- .1 Siemens SITRANS TH300.

2.10 TEMPERATURE SENSOR WITH INTEGRAL TRANSMITTER (TT-L671, TT-L681, TT-L691, TT-L692)

.1 Requirements:

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- .1 RTD's: 100 ohm platinum element with strain minimizing construction, 3 integral anchored lead wires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
 - .2 Mounting: Wall
 - .3 Protection: NEMA 4 or IP67 Enclosure
 - .4 Power Supply: Loop powered
 - .5 Output Signal: 4-20 mA, 2-wire
 - .6 Accuracy: 0.2 degrees C over range of 0 to 70 degrees C.
 - .7 Stability: 0.02 degrees C drift per year.
 - .8 Sensor: Integral ceramic probe, 100 mm in length.

.2 Acceptable products:

- .1 Siemens SITRANS TH300.

2.11 AMBIENT TEMPERATURE SWITCHES – DUAL SWITCH OUTPUT (TSL-L600 AND TSH-L600)

.1 Requirements:

- .1 Functionality: Field adjustable switches, independently adjustable.
- .2 Outputs: Qty 2, SPDT dry contacts. (Dual setpoints)
- .3 Operating Temperature: -40°C to +40°C minimum.
- .4 Sensor: Local.
- .5 Mounting: Wall.
- .6 Enclosure Rating: NEMA 4X.
- .7 Approvals: CSA or cUL.

.2 Acceptable products:

- .1 United Electric B402-120,
- .2 Or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
 - .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
 - .3 Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.
 - .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
 - .5 Electrical:
 - .1 Complete installation in accordance with Section 26 05 01 - Common Work Results – Electrical.
 - .2 Provide complete conduit/cable system to link instrumentation and the control panel(s).
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- .3 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .4 Maximum conduit fill not to exceed 40%.
 - .5 Design drawings do not show conduit layout.

3.2 TEMPERATURE SWITCHES AND SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Mount in readily accessible location to allow for quick easy replacement and servicing without special tools or skills.
- .3 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .4 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross-sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
- .5 Field adjust setpoint on temperature switches as per the drawings.
- .6 Make adjustments as directed by the Contract Administrator.

3.3 PRESSURE SWITCHES AND TRANSMITTERS

- .1 Mount in readily accessible location to allow for quick easy replacement and servicing without special tools or skills.
- .2 Field adjust setpoint on pressure switches as per the drawings.
- .3 Make adjustments as directed by the Contract Administrator.

3.4 INSPECTION AND INSTRUCTION

- .1 Provide for a factory-trained representative who shall give instructions regarding the installation of the equipment.
 - .2 The factory-trained representative shall visit the site as required to ensure that the installation work is being performed in a proper and workmanlike manner. Allow for a minimum of one (1) full working day.
 - .3 The factory-trained representative shall be present to supervise the commissioning, initial operation, and functional testing of the equipment.
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3.5 IDENTIFICATION

- .1 Identify field devices with lamacoids. Install in a conspicuous location.

3.6 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 40 80 11 - Automation Commissioning.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Process Control Devices including damper actuators.

1.2 REFERENCES

- .1 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-2021, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.3 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Manufacturer's Instructions:
 - .1 Include manufacturer's installation instructions for specified equipment and devices in O&M Manuals.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.
- .3 Operating conditions: 0 – 32 degrees C with 5 - 95% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 HVAC CONTROLLERS (TIC- L600)

- .1 General: digital, stand alone, configurable controller
 - .2 Power supply: 24 VAC.
 - .3 Sensor Inputs:
 - .1 Two (2) 1097 Ohms PTC at 25°C.
 - .2 Sensed temperature range: -51°C to +132°C.
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- .4 Discrete Inputs: One (1) 18V, 3.5 mA for monitoring dry contact
 - .5 Mounting: Wall
 - .6 Enclosure: NEMA Type 1, minimum
 - .1 Honeywell T775U2006,
 - .2 Or approved equal in accordance with B7.

2.3 ELECTRONIC DAMPER ACTUATORS, MODULATING (FV-L641, FV-L642, FV-L651)

- .1 Requirements:
 - .1 Direct mount proportional type.
 - .2 Spring return type for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Torque as indicated on the mechanical drawings.
 - .4 Damper actuator to drive damper from full open to full closed in less than 150 seconds.
 - .5 Spring return to drive damper from full open to full closed in less than 25 seconds at normal room temperature.
 - .6 Angle of Rotation: 90° minimum, adjustable with mechanical stops.
 - .7 Direction of Rotation: Field configurable.
 - .8 Shaft Diameter: 8.0mm to 16.0mm (3/8" to 5/8").
 - .9 Electrical Connection: 0.9 metres (3 ft), 18 AWG, plenum rated cable.
 - .10 Overload protection: Required.
 - .11 Auxiliary Switches: Not required.
 - .12 Power supply as indicated on the drawings
 - .13 Operating range: 0 - 10 or 2 - 10 VDC as indicated on the drawings.
 - .14 Position Feedback: Required, 0-10 VDC output.
 - .15 Operating Temperature: -30°C to +50°C.
 - .16 Housing: NEMA 2 or IP54 or better.
 - .17 CSA or cUL.
 - .18 Acceptable Manufacturer:
 - .1 Belimo,
 - .2 Johnson Controls,
 - .3 Or approved equal in accordance with B7.

2.4 ELECTRIC DUCT HEATER CONTROL (HCE-L61)

- .1 Modulating 0-10 VDC signal from Temperature Controller TY-L611.
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2.5 UNIT HEATER CONTROLLER (TS-L631)

- .1 Temperature controlled by wall mounted thermostat provided by unit heater manufacturer.

2.6 PROCESS METERS (LIC-L100-1, LIC-L100-2)

- .1 Display digital reading of process value and provide control of output relays based on input.
- .2 Display:
 - .1 Type: Alpha-numeric, LED.
 - .2 Update rate: 5/second (200 ms) minimum.
 - .3 Character colour: red.
- .3 Features:
 - .1 Internal 24V dc loop power supply for providing loop power to external devices.
- .4 Analog Inputs:
 - .1 0-20 mA, 4-20 mA, +/- 10V, 0-5V, 1-5V, 0-10V, field selectable.
 - .2 Input impedance:
 - .1 Voltage ranges: > 1 M Ω .
 - .2 Current ranges: 50 - 100 Ω .
- .5 Discrete Inputs:
 - .1 Allows for external interlock of output relays
- .6 Output relays:
 - .1 Qty 4, Form C, unless otherwise noted.
 - .2 Electrical rating: 3 Amps at 30 VDC and 125/250 VAC resistive.
- .7 . Analog Outputs:
 - .1 Isolated 4-20 mA.
 - .2 Settable to input process variable.
- .8 Mounting: panel mount, 1/8 DIN (92 mm x 45 mm) cut out.
- .9 Power supply: 24 V dc.
- .10 Manufacturer and model:
 - .1 Precision Digital PD6000-7H7.
 - .2 Or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
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- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
 - .3 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
 - .4 Electrical:
 - .1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
 - .2 Install communication wiring in conduit or utilizing ACIC cabling.
 - .1 Provide complete conduit /cable system to link instrumentation and the control panel(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
 - .5 Terminate devices with leads in junction boxes with terminals.
 - .1 Wire nuts are not permitted.
 - .2 Protect leads in flexible conduit.

3.2 IDENTIFICATION

- .1 Identify devices with lamacoids. Mount in a conspicuous location.

3.3 TESTING AND COMMISSIONING

- .1 Calibrate and test control devices for accuracy and performance in accordance with Section 40 80 11 – Automation Commissioning.

3.4 UNIT HEATER CONTROL

- .1 Temperature controlled by wall mounted thermostat provided by unit heater manufacturer. Mount thermostat in the location shown on the drawings.

3.5 ELECTRIC DUCT HEATER HCE-L61 CONTROL

- .1 Modulating 0-10 VDC signal from Temperature Controller TY-L611.

3.6 MAIN FLOOR VENTILATION CONTROL

- .1 Automatic control of outdoor air, mixed air, and exhaust air dampers based on occupied/unoccupied status.
 - .1 Occupied
 - .1 Duct heater HCE-L61 setpoint: 15°C (adj.).
 - .2 Damper FV-L641: OPEN.
 - .3 Damper FV-L642: CLOSED.
 - .4 Damper FV-L651: OPEN.
 - .5 Supply Fan SF-L64: ON.
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- .6 Damper FV-L651: weighted to provide station pressure of 25 Pa relative to the outdoor air pressure.
- .2 Unoccupied
 - .1 Duct heater HCE-L61 setpoint: 15°C (adj.).
 - .2 Damper FV-L641: 25% Outdoor Air.
 - .3 Damper FV-L642: 75% Recirculation.
 - .4 Damper FV-L651: 25% Outdoor Air.
 - .5 Supply Fan SF-L64: ON.
 - .6 Damper FV-L651: weighted to provide station pressure of 25 Pa relative to the outdoor air pressure.

3.7 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 C22.2 No.205-M1983(R2004), Signal Equipment.
- .2 International Electrotechnical Commission (IEC)
 - .1 IEC 61131, Programmable Controllers

1.2 DEFINITIONS

- .1 PLC: Programmable Logic Controller

1.3 PLC SYSTEM DESCRIPTION

- .1 For the purpose of this specification, the term PLC will be deemed to be synonymous.
- .2 The PLC consists of a controller and an I/O expansion module, mounted in control panel CP-L81.
- .3 The City utilizes a remote SCADA system that interfaces with the pumping station control system PLC via cellular and PSTN (telephone) links using DNP3 protocol.
- .4 The Contractor's responsibility on the SCADA system is limited to:
 - .1 Provision of an interface in the PLC for the SCADA system.
 - .2 Provide assistance during the testing of all status, alarm signals, and analog points between the PLC and the City's SCADA system via the cellular network during the Factory Acceptance Test. This work will be performed by the Contract Administrator and/or in conjunction with the City of Winnipeg.
 - .3 Provide assistance during the testing of all status, alarms, and DNP3 points in the mapping list between the PLC and the City's SCADA system via the cellular and PSTN network during commissioning. Functional check for control/interlock functions and individual points to the city's SCADA during commissioning. Ensure that DNP3 Communications are according to city's SCADA requirement. This work will be performed by the Contract Administrator and/or in conjunction with the City of Winnipeg.

1.4 SYSTEM ARCHITECTURE

- .1 Single PLC
 - .1 Local I/O expansion modules.
 - .2 No remote I/O.
 - .3 A minimum of 20% spare shall be provided within the chassis for the future addition of modules. Alternatively, space can be provided within the control panel for the addition of another PLC chassis in the future.
 - .4 Connected to the following:
 - .1 MDM01 – Cellular modem (supplied by the City).
 - .2 MDM02 – PSTN (telephone) modem.
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.3 Local panel mounted HMI - Schneider Electric, HMI GTO 6310

1.5 SOFTWARE OWNERSHIP

- .1 All PLC and HMI programming logic will be designed, and implemented by the Contract Administrator.
- .2 The City shall fully own all PLC programming logic supplied, and may utilize the software provided for any purpose including:
 - .1 Modification and revision.
 - .2 Use at other City facilities.
- .3 The City may turn the software over to a 3rd party, for use at any City owned facility.
- .4 Provide source code for all custom software and function blocks, or any other software logic utilized in the application.
 - .1 Source code for base function blocks provided by the PLC manufacturer are not required.

1.6 DESIGN REQUIREMENTS

- .1 Design of the complete operating PLC system will be by the Contract Administrator.
- .2 The design is to be based upon the supplied Control Narrative (5-0162L-A0002).
 - .1 Tag naming convention shall follow the City of Winnipeg's standard. Tags shall not conflict with the tag scheme utilized in the Metcalfe Lift Station Control Narrative document.
- .3 The PLC is utilized to control storm-water pumping for a municipal application. The consequences of system failure could be significant, and thus a high level of care, attention to detail, and testing is expected.
- .4 The PLC software design is to be supervised and approved (sealed) by a Professional Engineer licensed to practice in Manitoba.

1.7 SUBMITTALS

- .1 All submittals to be in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Stage 1:
 - .1 Submit product datasheets
 - .3 Stage 2 (provided by the Contract Administrator):
 - .1 Submit a PLC design criteria prior to initiating programming which includes:
 - .1 The general PLC program structure.
 - .2 The programming language (ie function block) to be utilized. Permission is required to use any other language other than FBD.
 - .3 A sample section of code.
 - .4 SCADA interface map.
 - .5 Variable naming methodology shall be to the City of Winnipeg's standard.
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- .6 HMI General Windows
 - .4 Stage 3 (provided by the Contract Administrator):
 - .1 Submit a 25% complete submittal, including:
 - .1 Software logic printout.
 - .2 HMI Windows
 - .2 The primary purpose of this submittal is to ensure that the methodology being utilized is as per requirements prior to the bulk portion of the work being completed. At this point, copies of code for similar pieces of equipment should not be completed.
 - .5 Stage 4 (provided by the Contract Administrator):
 - .1 Submit a 99% complete submittal a minimum of 20 Working days prior to the FAT, including:
 - .1 Complete software logic printout.
 - .2 SCADA interface map.
 - .3 All HMI Windows.

1.8 O&M MANUALS

- .1 PLC and HMI O&M manuals will be provided by the Contract Administrator.

Part 2 Products

2.1 PROGRAMMABLE LOGIC CONTROLLER

- .1 These products were standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.
 - .2 Part or Model numbers shall be as shown on the Control Panel drawings. Suitable product will be a PLC system produced by a major, international industrial automation vendor.
 - .3 Provide all required hardware for a complete installation.
 - .4 Modularity
 - .1 The construction of the PLC is to be an integrated processor, power supply, and I/O unit, utilizing additional separated I/O expansion modules that are located adjacent to the main unit on DIN rail.
 - .5 Self-Tests, Diagnostics and Failure Modes
 - .1 Integrity of controller hardware and software to be constantly monitored by an intrinsic series of continuously running self-tests and diagnostics.
 - .2 Immediately report abnormal results as system alarms.
 - .3 Have predictable failure mode upon an error. At a minimum, faults are to generate a system alarm.
 - .4 Equipment may have the ability to diagnose degradations to performance that may not yet adversely affect operator functions or be a permanent failure. When such conditions are automatically noted, the system is to journal the event in the
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Historian and have the capability to report such information selectively, as either a system alarm or a message on the programming workstation.

- .6 Processor:
 - .1 Memory
 - .1 Expandable Flash: 4 GB
 - .2 System Memory RAM: 10 kB
 - .3 Program RAM: 12 MB
 - .4 Data RAM: 1024 kB
 - .2 CPU Integrated Ethernet Ports:
 - .1 Quantity: 3
 - .2 Speed: 10/100 Mbps
 - .3 Connection: RJ45 connector
 - .3 Supported protocols:
 - .1 HTTP
 - .2 BOOTP/DHCP
 - .3 FTP
 - .4 NTP
 - .5 SMTP
 - .6 SBNO
 - .7 QoS
 - .8 RSTP
 - .9 Modbus/TCP
 - .10 EtherNet/IP
 - .4 CPU USB Ports:
 - .1 Qty 1, USB Port
 - .2 Connector: Type Mini-B
 - .3 Standard: USB 2.0
 - .4 Speed: 480 Mbps (full speed).
 - .5 CPU Visual Indicators:
 - .1 Run LED (RUN),
 - .2 Error LED (ERR),
 - .3 Input Output (I/O) LED,
 - .4 Download LED (DL),
 - .5 Backup LED (BKP),
 - .6 Sec LED, (SEC)
 - .7 Ethernet Mod Status LED (ETH MS)
 - .8 Ethernet Net Status LED
 - .6 Acceptable Products:
 - .1 Qty 1, Schneider Electric BME P58 3020 CPU
 - .2 No alternates or substitutes will be accepted.
 - .7 Communications Card
 - .1 Integrated Ethernet Ports
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- .1 Quantity: 1
 - .2 Speed: 10/100 Mbps.
 - .3 Connection: RJ45 connector.
 - .2 Serial Ports:
 - .1 Quantity: 1
 - .2 Connection: RS-232C/RS-485
 - .3 Type:
 - .1 Qty 1, RS-485, Half duplex.
 - .2 Qty 1, RS-232 or RS-485 Full or Half duplex.
 - .3 Qty 1, RS-232, Full or Half duplex.
 - .4 Baud Rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400.
 - .5 Parity: None, Even or Odd.
 - .6 Word Length: 8 bits.
 - .7 Stop Bits: 1/2 Bit.
 - .3 Supported Protocols:
 - .1 Modbus TCP/IP
 - .2 Ethernet TCP/IP
 - .3 RTU Protocols
 - .1 Built-in RTU protocols for serial or Ethernet communications
 - .2 IEC 60870-5-101 (master or slave)
 - .3 IEC 60870-5-104 (client or server)
 - .4 DNP3 serial (master or slave)
 - .5 DNP3 IP (client or server)
 - .6 Modbus TCP (client or server)
 - .4 IP Protocols:
 - .1 NTP
 - .2 FTP
 - .3 BootP client, DHCP/FDR client
 - .4 SNMP agent/client
 - .5 SOAP/XML server
 - .6 NMT
 - .4 Acceptable Products:
 - .1 Schneider Electric Modicon BMX NOR 0200H,
 - .2 No alternates or substitutes will be accepted.
 - .8 PLC Rack Power Supply
 - .1 Redundancy: Not Required.
 - .2 Requirements:
 - .1 Supply Voltage: 10 to 30 VDC
 - .2 Supply Protecting: Integral fuse or breaker.
 - .3 Output Voltage: As required.
 - .4 Output Current: As required.
 - .5 Integrated protection against overloads, short circuits, and overvoltage.
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- .3 Acceptable Products:
 - .1 Schneider Electric Modicon BME CPS 3020,
 - .2 No alternates or substitutes will be accepted.

 - .9 PLC Inputs and Outputs:
 - .1 Discrete Inputs (DI):
 - .1 Channels: 32
 - .2 Type: 24 VDC Positive logic (sink) module
 - .3 Input Impedance: 9.6 k Ω
 - .4 Current sinking: Required
 - .5 Threshold Input Value
 - .1 Logic State 0: 5V, <0.5mA
 - .2 Logic State 1: $\geq 11V$, >2mA
 - .6 Fuse Type
 - .1 Internal: None
 - .2 External: 1 fast blow 0.5A fuse for each 16-channel group
 - .7 Response Time: 4 ms (typical); 7 ms (maximum)
 - .8 Dielectric Strength:
 - .1 Primary/Secondary: 1500 VAC for 1 minute
 - .2 Between Groups: 500 VDC
 - .9 Indicating LEDs:
 - .1 Channel status (on/off) for each channel.
 - .10 Meet IEEE C37.90.1 surge withstand capability.
 - .11 Acceptable Products:
 - .1 Schneider Electric Modicon BMX DDI 3202K,
 - .2 No alternates or substitutes will be accepted.
 - .2 Discrete Outputs (DO):
 - .1 Channels: 16
 - .2 Type: 24 VDC positive logic static outputs
 - .3 Load Impedance: 48 Ω
 - .4 Max Current/Channel: 0.625 A
 - .5 Max Current/Module: 10 A
 - .6 Leakage Current
 - .1 Logic State 0: <0.5 mA
 - .7 Voltage Drop
 - .1 Logic State 1: <1.2V
 - .8 Fuse Type
 - .1 Internal: None
 - .2 External: 1 fast blow 6.3A fuse
 - .9 Response Time: 1.2 ms
 - .10 Dielectric Strength: 1500 VAC for 1 minute
 - .11 Indicating LEDs:
 - .1 Channel status (ON/OFF) for each channel.
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- .12 Acceptable Products:
 - .1 Schneider Electric Modicon BMX DDO 1602,
 - .2 No alternates or substitutes will be accepted.
 - .3 Analog Inputs (AI)
 - .1 Channels: 8 external
 - .2 Type: High level fast isolated inputs
 - .3 Input impedance:
 - .1 Voltage Inputs: 10 M Ω
 - .2 Current Inputs: Internal conversion resistor (250 Ω) + Internal protection resistor
 - .4 Resolution:
 - .1 15 bit + sign
 - .5 Accuracy:
 - .1 Voltage Inputs: +/- 0.075% at 25 °C; +/- 0.1% over temperature range.
 - .2 Current Inputs: +/- 0.15% at 25 °C; +/- 0.3% over temperature range.
 - .6 Nominal Read Cycle Time: 9ms for 8 channels.
 - .7 Acceptable Products:
 - .1 Schneider Electric Modicon BMX AMI 0810,
 - .2 No alternates or substitutes will be accepted.
 - .4 Analog Outputs (AO)
 - .1 Channels: 4
 - .2 Type: High level fast outputs
 - .3 Maximum load impedance:
 - .1 Voltage Output: 1 K Ω minimum
 - .2 Current Output: 500 Ω maximum
 - .4 Resolution: 15 bit + sign
 - .5 Accuracy:
 - .1 +/- 0.10% at 25°C.
 - .2 +/- 0.20% over temperature range.
 - .6 Response time: less than 2ms for a 0-100% step.
 - .7 Acceptable Products:
 - .1 Schneider Electric Modicon BMX AMO 0410,
 - .2 No alternates or substitutes will be accepted.
 - .10 Expansion I/O Modules:
 - .1 Backplane Expander:
 - .1 Product Compatibility:
 - .1 BMXXBP0400
 - .2 BMXXBP0600
 - .3 BMXXBP0800
 - .4 BMXXBP1200
 - .2 Electrical Connection:
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- .1 2 female SUB-D 9
 - .3 Indicating LEDs:
 - .1 1 LED green for operating status (RUN) bus
 - .2 1 LED red for collision error (COL) rack
 - .3 4 LEDs green for rack addresses status
 - .4 Acceptable Products:
 - .1 Schneider Electric Modicon BMX XBE 1000,
 - .2 No alternates or substitutes will be accepted.
 - .2 Termination Resistors:
 - .1 Acceptable Products:
 - .1 Schneider Electric TSX TLY EX,
 - .2 No alternates or substitutes will be accepted.
 - .3 Expansion Bus Cordset:
 - .1 Acceptable Products:
 - .1 Schneider Electric BMX XBC 008K X-BUS Cordset,
 - .2 No alternates or substitutes will be accepted.
 - .11 Required Accessories:
 - .1 Include all accessories including cables, terminators, backplanes, memory, batteries, and other components required to make the system operable.
 - .12 Acceptable Products:
 - .1 Controller: Schneider Electric Modicon M580 PLC.
 - .2 I/O Cards: Schneider Electric X80
 - .3 No alternates or substitutes will be accepted.

2.2 PLC PROGRAMMING SOFTWARE

- .1 These products were standardized by the City via RFP 756-2013 and will be provided by the Contract Administrator. No alternates or substitutes will be accepted.
 - .1 Utilize Schneider Electric EcoStruxure Control Expert (latest version).
 - .2 EcoStruxure Control Expert programming software and licenses are not included.

2.3 USB MEMORY STICK

- .1 A minimum 2GB USB memory stick will be provided by the Contract Administrator as part of the Commissioning process, with the following:
 - .1 Latest application program, with documentation.
 - .2 PLC hardware user manuals
 - .3 PLC software user manuals.
 - .2 Locate the memory stick in a pocket in the control panel.
-

Part 3 Execution

3.1 HARDWARE INSTALLATION

- .1 Install the PLC and associated components in Control Panel CP-L81 as per manufacturer instructions and recommendations.
- .2 Update the processor and all updatable modules with the latest firmware.

3.2 PLC PROGRAMMING SERVICES

- .1 To be provided by the Contract Administrator.

3.3 PLC COMMISSIONING SERVICES

- .1 Provide all required PLC commissioning services as per Section 40 80 11.
- .2 Upon completion of commissioning, Contract Administrator shall load latest software onto USB stick.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 All Control Panels shall be built by a CSA/cUL-approved manufacturer and shall bear the CSA/cUL seal with the manufacturer's file number.
- .2 All Control Panels shall be factory assembled and pre-wired. The Control Panel wiring shall be verified at the manufacturer's factory and completely tested before being shipped to the site.
- .3 Supply, install, wire and test all components inside the Control Panels according to the specifications herein and the drawings.

1.2 SUBMITTALS

- .1 Prior to construction:
 - .1 Submit product datasheets, and wait for approval, prior to construction of the Control Panels.
 - .1 AutoCAD drawings of the control panel can be provided to the Contractor if they are required to prepare their own drawing set due to CSA requirements.
 - .2 Submit stamped red-line mark-ups of the proposed modifications to the control panels. If significant modifications are proposed/required, AutoCAD drawings will be supplied to the Contractor for revision.
- .2 Prior to shipment:
 - .1 Submit electronic pictures of enclosure exterior and interior, including door interior.
 - .1 Pictures to be of sufficient resolution to read component labels.
 - .2 As-built drawings:
 - .1 Submit as-built drawings. Minor changes may be made via red-line mark-ups.
 - .2 Draft significant changes on AutoCAD drawings.
 - .3 Do not ship control panel until approval from Contract Administrator is received.

1.3 INSPECTION

- .1 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.
- .2 If requested, demonstrate and test the control panel in presence of the Contract Administrator designated representative.

Part 2 Products

2.1 GENERAL

- .1 Construction of the control panels is required, in accordance with the supplied drawings.
-

- .2 Control devices of each category shall be of same type and manufacturer.

2.2 ENCLOSURES

- .1 Install lamacoids as per the control panel layout drawings.
- .2 All indoor control panels shall be NEMA 12 or as shown on drawings.
- .3 All enclosure angles and cut-outs shall be free of dents, gouges or weld marks, and shall present a clean, smooth appearance.
- .4 No screws, fittings or other fastenings shall be used on external panel faces, which must be free of any marks, scratches or defaults.
- .5 The door is to be a minimum fourteen (14) gauge steel plate, full height and flush with adjacent surfaces.
- .6 The exterior of the control panel shall be painted ANSI 61 grey.
- .7 The interior of the control panel shall be painted gloss white.
- .8 All control panel doors shall be 900 mm (36 inches) wide maximum.
- .9 All control panel doors shall open through 180 degrees without restriction.
- .10 All control panels of a depth greater than or equal to twelve (12) inches shall be equipped with a fluorescent lighting device located in the cabinet's upper portion with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.
- .11 Enclosure brand shall be Hoffman or an approved equal in accordance with B7.

2.3 POWER SOURCE

- .1 Each power source must be protected by a CSA approved circuit breaker or fuse.
- .2 The location of each power source must be clearly shown.
- .3 Panels powered by more than 1 electrical source shall display on their door; "Caution: This panel is electrically powered by more than one source".

2.4 COMPONENTS

- .1 Unless written approval for use of unapproved components is received from the owner, all electrical materials (e.g., conduit, fittings, wireways, etc.) shall be CSA or cUL approved.
 - .2 Rails (DIN Rails)
 - .1 Rails used must be DIN Rail style TS 35mm, slotted.
 - .2 When used to mount terminals, rails shall be mounted on straight raisers (Rail support / Mounting feet) so as to raise them to the same height as the highest adjacent wiring duct.
-

- .3 Raisers (Rail support / Mounting feet) shall not be used when rail hosts heavy components.
 - .3 Terminals
 - .1 Requirements:
 - .1 TS-35 DIN Rail mounting.
 - .2 Voltage rating:
 - .1 600V for general control circuits.
 - .2 600V for power circuits.
 - .3 Manufacturer: Phoenix Contact or approved equal in accordance with B7.
 - .2 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.
 - .3 Each terminal shall bear an identification number on both sides.
 - .4 Drawings and templates supplied may not detail all hardware components such as labels, stoppers, rail lifters, end plates, separators, etc. The supplier must supply and install such components when required.
 - .4 Ground Bus Bar
 - .1 Supply a ground bus bar in each control panel as indicated on the drawings.
 - .2 Requirements:
 - .1 Tapped holes with screws.
 - .2 Bar to have sufficient connection points for all cables entering the control panel, plus 25% spare.
 - .3 Maximum one wire termination per screw.
 - .5 Pushbutton, Switch and Indicator Light
 - .1 When required, all control panel pushbuttons, switches and indicator lights shall be at least NEMA 12 (or better)-type devices.
 - .2 Manufacturer to be Schneider Electric or approved equal in accordance with B7.
 - .6 Programmable Logic Controllers
 - .1 As per section 40 94 43.
 - .7 Touch-screen HMI
 - .1 As per section 40 95 20.
 - .8 Annunciator Light Panel
 - .1 Lights: LED, Full Voltage, 30 x 30mm, colour and arranged as indicated on the drawings, engraved text as indicated on the drawings,
 - .2 Ratings: 24 VDC,
 - .3 Approvals: CSA,
 - .4 Manufacturer: IDEC SLC30 series. No substitutions will be accepted.
 - .9 General Purpose Relays
-

- .1 Coil Voltage: DPDT or as shown on drawings
 - .2 Indication: LED
 - .3 Diode: Provided
 - .4 Contact arrangement: As per drawings
 - .5 Contact Rating: 5A (120 VAC), 5A (24 VDC)
 - .6 Approvals: CSA
 - .7 Manufacturer: Omron or approved equal in accordance with B7.
- .10 24 VDC Uninterruptible Power Supply
- .8 Input: 100 - 240 VAC
 - .9 Output: 24 VDC, 10 A (adjustable 22.5-29.5 VDC)
 - .10 Battery: 7.2 Ah
 - .11 Monitoring outputs: 24 VDC, Alarm, Battery Mode, Battery Charge
 - .12 Manufacturer: Phoenix Contact
 - .13 Model: QUINT-UPS/24DC/24DC/10 (2320225) with QUINT-BAT/PB/24DC/12AH (1274119) or approved equal in accordance with B7.
- .11 Process Meters (LIC-L100-1, LIC-L100-2)
- .1 Display digital reading of process value and provide control of output relays based on input.
 - .2 Display:
 - .1 Type: Alpha-numeric, LED.
 - .2 Update rate: 5/second (200 ms) minimum.
 - .3 Character colour: red.
 - .3 Features:
 - .1 Internal 24V dc loop power supply for providing loop power to external devices.
 - .4 Analog Inputs:
 - .1 0-20 mA, 4-20 mA, +/- 10V, 0-5V, 1-5V, 0-10V, field selectable.
 - .2 Input impedance:
 - .1 Voltage ranges: > 1 M Ω .
 - .2 Current ranges: 50 - 100 Ω .
 - .5 Discrete Inputs:
 - .1 Allows for external interlock of output relays
 - .6 Output relays:
 - .1 Qty 4, Form C, unless otherwise noted.
 - .2 Electrical rating: 3 Amps at 30 VDC and 125/250 VAC resistive.
 - .7 Analog Outputs:
 - .1 Isolated 4-20 mA
 - .2 Settable to input process variable
-

- .8 Mounting: panel mount, 1/8 DIN (92 mm x 45 mm) cutout.
 - .9 Power supply: 24 V dc.
 - .10 Manufacturer and model:
 - .1 Precision Digital PD6000-7H7
 - .2 Or approved equal in accordance with B7.
 - .12 Cellular Modem:
 - .1 Supplied by City.
 - .13 PSTN Modem:
 - .1 Type: PSTN modem / Ethernet Switch
 - .2 Protocol: PPP (point-to-point)
 - .3 Maximum data rate: 56 kbps
 - .4 Compatibility: V.90, V.34, V.32, V.32 bis, V.22 bis, V.21
 - .5 Ports:
 - .1 Ethernet:
 - .1 Quantity: 5
 - .2 Speed: 10/100 Mbit (automatic negotiation)
 - .3 Connector: RJ45
 - .2 Telephone:
 - .1 Line (input), Phone (output)
 - .2 Connector: RJ11
 - .6 Supply Voltage: 24 Vdc
 - .7 Operating Temperature: -40 to +75°C
 - .8 Mounting: 35mm DIN Rail
 - .9 Approvals: CSA
 - .10 Model: Phoenix Contact PSI-DATA/BASIC-MODEM/RS232 (2313067) or approved equal in accordance with B7.
 - .8 Grounding
 - .1 All control panel components shall be adequately grounded in accordance with the component manufacturer, especially control system components.
 - .2 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.
 - .3 Where ground bars are installed on to the rear or side wall of the enclosure, seal screw penetrations to maintain enclosure rating.
 - .9 Wiring
 - .1 Panel wiring shall be installed in a neat and orderly manner.
 - .2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.
-

- .3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.
 - .4 All wires and cables inside the control panels shall be identified on both ends with non-erasable markers.
 - .5 Identification shall follow the supplied documents, such as wiring diagrams.
 - .1 Label both ends of each wire.
 - .2 Utilize machine printed non-slip labels. Wrap-around or self-adhesive markers shall not be permitted.
 - .3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.
 - .6 Individual conductors or wires exiting a cable shall be identified using nonerasable markers.
 - .7 The routing of all analog, digital, and power cable wiring inside control panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying.
 - .8 All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.
 - .9 All analog signal wiring shall be 18 AWG shielded twisted pairs such as Belden No. 8760, or an approved equivalent. Shield wires exiting the jacket must be covered with a black heat shrink, and the overall cable at the jacket end must also be covered with a heat shrink.
 - .10 All 24 VDC or 120 VAC discrete signal panel wiring shall be 14 AWG TEW stranded conductor.
 - .1 Increase the size of power wiring, 12 AWG minimum.
 - .11 All 120 VAC power wiring shall be 14 AWG TEW stranded conductor, minimum.
 - .12 All 24 VDC and 24 VAC power wiring shall be 12 AWG TEW stranded conductor, minimum.
 - .13 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.
 - .14 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door such that there is sufficient slack to minimize strand fatigue and breaking. Each end of the loop shall be properly supported.
 - .15 Ethernet Patch Cords
 - .1 Requirements:
 - .1 Cat-6A.
 - .2 Jacket colour: Blue.
 - .16 Wiring Duct
 - .1 All wires shall be run in narrow slot wiring duct such as such as Panduit or an approved equivalent in accordance with B7.
 - .2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails.
 - .3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 10 cm.
-

- .4 120 VAC wires cannot share wiring duct with 10 VDC, 24 VDC or 4-20 mA wires, but can cross their path.
- .5 All DC, AC, and thermocouple wiring shall be routed in separate wireways to prevent signal interference.
- .17 Wire ties shall be non-metallic.
- .18 Wiring shall be arranged to be readily accessible for inspection and maintenance.
- .19 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.
- .10 Overcurrent Protection
 - .1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.
- .11 Internal Lighting
 - .1 Difficulties resulting from electrical noise generated by fluorescent lamps shall be corrected.
- .12 Cooling and Heating Systems
 - .1 Control panels shall be designed for the environmental conditions of the installation location. Cooling and heating systems shall be in accordance with the specific NEMA rating required by NEMA ICS 6 and NEMA 250.

Part 3 Execution

3.1 COMPONENT INSTALLATION

- .1 Components on the front of the panel shall be identified with an individual permanent nameplate installed in an organized manner. The nameplate must identify the component's function.
 - .2 Each component inside the control panel shall be identified with a nameplate corresponding to the drawings.
 - .3 All non-DIN rail mountable devices in the control panel shall be mechanically affixed to the back panel with either tapped or self-tapping screws.
 - .4 All control devices shall be mounted so that any component can be replaced without removing the sub-panel or other components.
 - .5 Components and/or auxiliary instruments mounted at the rear of the panel shall be readily accessible and their installation shall not be affected by, or interfere with the removal of any panel instrument.
 - .6 Nameplates shall be made of lamacoid material with a white background and engraved black letters for internal and external components. Nameplates must resist harsh industrial conditions.
 - .7 Supply and install all required fuses.
 - .8 Control devices must be spaced adequately to allow for cooling, replacement, servicing, and wiring access.
-

- .9 Control devices shall be grouped according to voltage and function to reduce electrical noise.
- .10 Cutouts for instruments shall be within the tolerances specified by the instrument manufacturer.
- .11 If cutouts are specified for future instruments, the cutouts shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.
- .12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.
- .13 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.
- .14 Ample space shall be provided for the entrance of external cables into the panel and for routing the cables to terminating points within the panel.

3.2 IDENTIFICATION

- .1 Perform terminal identification using a computerized device. Handwriting is not acceptable.
- .2 Label wires and terminals as shown on drawings.
- .3 Install label above each terminal block with terminal block name.

3.3 TESTING

- .1 Testing of the control panels shall be completed to the greatest extent possible prior to the FAT, and shall include at minimum:
 - .1 Provide a signed and dated inspection sheet with all tests performed listed on it.
 - .2 The list of the various test procedures described hereunder is not restrictive, and does not relieve the control panel manufacturer of his responsibility to perform any other work that is not mentioned but requested to verify the good operation of the control panels.
 - .3 Isolate all instruments and components of the control panels as required to protect them from any damage during tests.
 - .4 Provide the services of qualified personnel as well as tools and equipment required to perform all tests and inspection of the control panels.
 - .5 Tests to include:
 - .1 Power supply functionality
 - .2 PLC component functionality
 - .3 Point to point tests of all inputs and outputs
 - .4 Power terminal voltage verification
 - .5 Relays and switches functionality
 - .6 Receptacle and lighting functionality
-

- .7 Modem and Ethernet switch functionality.
- .6 If the panel is modified after tests have been performed, tests shall be repeated at no additional cost.

3.4 SHIPMENT

- .1 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.
- .2 Shipment of any panel having shortages of equipment shall be approved in writing by the City.

3.5 SPARE COMPONENTS

- .1 Supply two spares of each fuse type and rating. Place in a clear plastic bag and attach to the panel door interior

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to the Contract Administrator, 30 working days prior to anticipated date of beginning of training.
 - .1 List name of trainers, and type of visual and audio aids to be used.

1.2 QUALITY ASSURANCE

- .1 Provide competent instructor(s) thoroughly familiar with all aspects of the instrumentation system installed in the facility.
- .2 Contract Administrator reserves right to approve instructors.

1.3 INSTRUCTION

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of the system installed.

1.4 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials necessary for training.
- .2 Supply manual for each trainee, describing in detail data included in the training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.5 TRAINING PROGRAM

- .1 Operations Training
 - .1 Location: Metcalfe Lift Station.
 - .2 Duration: Four hours.
 - .3 Number of trainees: Coordinate with Contract Administrator prior to training.
 - .4 Audience: Operations and maintenance personnel.
 - .1 Content:
 - .1 General system overview.
 - .2 Description of system components.
 - .3 Presentation of the control panel and system operation.
 - .4 Presentation on the pump VFD starters and system operation.

1.6 MONITORING OF TRAINING

- .1 Contract Administrator to monitor training program and may modify schedule and content.
-

- .2 In the event that the Contract Administrator or City are unsatisfied with the training, make changes to the training program as required and repeat the training.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Not Applicable.

Part 3 Part 3 EXECUTION

3.1 TRAINING

- .1 Provide on-site training to City personnel, as indicated above.

END OF SECTION

Part 1 General

1.1 MAINTENANCE SERVICES

- .1 Not required.

1.2 SUPPORT SERVICES

- .1 Duration:

- .1 The duration of support services is to extend during the Warranty period (one year past Total Performance)

- .2 Requirements:

- .1 Provide telephone support for all products supplied (during regular business hours).
- .2 Respond to emergency service calls (during regular business hours).

- .3 Telephone Support:

- .1 Telephone support to utilize service personnel knowledgeable in the products and have the required troubleshooting skills.
- .2 No payment will be made for telephone support during the warranty period.

- .4 Emergency Service Calls:

- .1 Respond to service calls from the City when the system is not functioning correctly.
- .2 Qualified control personnel to be available to provide on-site service upon a critical failure, whenever required.
 - .1 A critical failure is the inability to operate of any critical system supplied by the Vendor.

- .2 Critical systems include, but are not limited to:

- .1 Communication networks,
- .2 PLC system, and
- .3 Instrumentation.

- .3 Perform work continuously until system is restored to a reliable operating condition.

- .4 Response Time:

- .1 The response time to emergency service calls is to be less than four hours.

- .5 Record each service call request, when received separately on approved form and include:

- .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
-

- .8 Time and date of completion.
- .6 Costs:
 - .1 If the issue is determined to be due to poor workmanship or defect of the Contractor, no payment will be made to the Contractor.
 - .2 If the issue is determined to be due to failure of a physical component supplied, and covered under manufacturer's warranty, the Contractor will be paid for the service call.
 - .3 If the issue is determined to be due to an issue outside of the Contractor's responsibility, the Contractor will be paid for the service call.
 - .4 Payment will be based upon the rates specified in Form B.
 - .5 If the service call is subsequent to Total Performance, submit an invoice, based upon the established rates to the City.

Part 2 Part 2 Products

2.1 NOT APPLICABLE.

- .1 Not applicable.

Part 3 Part 3 Execution

3.1 NOT APPLICABLE.

- .1 Not applicable.

END OF SECTION
