

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 2020-01-31.
- .2 City of Winnipeg Specification CW1110.

1.3 ADMINISTRATIVE

- .1 Submit to the Contract Administrator submittals required by Specifications 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 review is complete.
- .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.
- .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 drawings" as defined in the City's General Conditions for Construction (Revision 2020-01-31) means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada 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 Documents.
 - .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.

- .7 Operating weight.
- .8 Wiring diagrams.
- .9 Single line and schematic diagrams.
- .10 Relationship to adjacent work.
- .10 After the Contract Administrator's review, distribute copies as required.
- .11 Submit electronic copy of Shop Drawings for each requirement requested in Specification sections and as the Contract Administrator may reasonably request.
- .12 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.
- .13 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 [3] years of date of contract award for project.
- .14 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 project contract complete with project name.
- .15 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 Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .16 Submit electronic copies of manufacturer's field reports for requirements requested in Specification sections and as requested by the Contract Administrator.
- .17 Submit documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .18 Submit electronic copies of operation and maintenance data for requirements requested in Specification sections and as requested by the Contract Administrator.
- .19 Delete information not applicable to project.
- .20 Supplement standard information to provide details applicable to project.
- .21 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 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Contract Administrator's.
- .3 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
- .6 Make changes in samples which Contract Administrator may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.6 MOCK-UPS

- .1 Erect mock-ups in accordance with 01 45 00- Quality Control .

1.7 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic progress photographs to the Contract Administrator.
- .2 Frequency of photographic documentation: weekly & as directed by Contract Administrator.
 - .1 Upon completion of: foundation prior to backfill, reinforcing steel prior to concrete casting, framing and other works prior to concealment.

1.8 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

1.9 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.

1.10 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.

1.11 CLOSEOUT SUBMITTALS

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

1.12 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

Part 1 General

1.1 RELATED REQUIREMENTS

- .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 Health and Safety Work Plan and provide comments to Contractor within three (3) business days.
- .6 The Contract Administrator’s review of Contractor's final Health and Safety 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 Health and Safety meeting with the Contract Administrator prior to commencement of Work.

1.6 REGULATORY REQUIREMENTS

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

1.7 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety 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 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 Health and Safety 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 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province of Manitoba and advise the Contract Administrator verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise the Health and Safety Co-ordinator and follow procedures in accordance with Acts and Regulations of 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 site-specific Contractor's Health and Safety Plan.
 - .5 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 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 Work is designated for special tests, inspections, or approvals by the Contract Administrator or inspection authorities.
- .3 If 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 Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, the City shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by the Contract Administrator for purpose of inspecting and/or testing portions of Work. The Contract Administrator will be copy furnished of 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 cost. 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 relax the Contractor's responsibility to perform Work in accordance with Contract Documents.
- .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.
- .2 Co-operate to provide reasonable facilities for such access.

1.4 REJECTED WORK

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

1.5 REPORTS

- .1 Submit four [4] copies of 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.
- .2 Provide copies to subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

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 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 work expeditiously.
- .3 Remove from site all such work 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 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 Documents. Do not unreasonably encumber premises with products.
- .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 project site including fire route access.

1.6 OFFICES

- .1 Provide 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 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 a table suitable for site meetings and reviewing drawings with the Contract Administrator.

1.7 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.

1.8 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.

1.9 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by the Contract Administrator.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 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.
- .7 Construct access and haul roads necessary.
- .8 Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.

- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control should be adequate to ensure safe operation at all times.

1.10 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.

1.11 FACILITY ELECTRICAL SUPPLY AND DISTRIBUTION

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

1.12 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.

1.13 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

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 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, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

1.7 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.8 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.9 FIRE ROUTES

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

1.10 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.

1.11 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

1. GENERAL

1.1 SURVEY REFERENCE POINTS

- .1 Primary horizontal and vertical survey reference points have been established by the Contract Administrator as specified in the Contract Documents. The Contract Administrator is responsible for the accuracy of the primary survey reference points.
- .2 Locate, confirm, and protect primary reference points prior to starting Work on the Site. Preserve permanent reference points during construction.
- .3 Make no changes to or relocations of the primary survey reference points without prior written authorization of the Contract Administrator.
- .4 Report to the Contract Administrator when a reference point is lost or damaged, or requires relocation because of the Work.
- .5 Replace damaged reference points in accordance with the original survey control.

1.2 CONTRACTOR SURVEY WORK

- .1 Employ qualified construction surveyors to perform survey work.
- .2 Record survey data in accordance with standard survey methods in a form acceptable to the Contract Administrator.
- .3 Establish secondary survey reference points required for laying out and staking the Work and for checking tolerances. Be solely responsible for the accuracy of the secondary survey reference points and the layout, staking, and checking of the Work.
- .4 Establish lines, grades, and elevations, and locate and lay out the Work.
- .5 Provide final grade staking of each line, grade or elevation required for the Contract Administrator's checking of the work and for measurement for payment purposes. Maintain final grade stakes in place until the Contract Administrator has authorized their removal.
- .6 Provide such assistance as may be required by the Contract Administrator for carrying out surveys in Article 1.4.
- .7 Establish and maintain survey reference points in all work areas, including elevations and locations relative to established stationing and offset systems or otherwise required by the Contract Administrator. Provide reference points within 50 m horizontal distance and 2 m vertical distance of all locations where testing, observations of conditions, or other similar activities are undertaken by the Contract Administrator, such that the Contract Administrator can establish the location and elevations at those locations.

1.3 GLOBAL POSITIONING SYSTEMS (GPS)

- .1 If GPS controlled excavation and trimming equipment is utilized in conjunction with GPS final grade checking, the Contract Administrator may waive the requirement for final grade stakes if the accuracy and consistency of the final grade check can be demonstrated.

- .2 If the final grade stake requirement is waived, provide a surface grade sheet in electronic and hard copy of the electronic survey data in a format acceptable to the Contract Administrator.
- .3 The surface grade sheet to include the following minimum information:
 - .1 Station.
 - .2 Offset left or right of the centerline.
 - .3 Design elevation at the grade line break point.
 - .4 Actual elevation at the grade line break point.
 - .5 Deviation of the actual elevation from the design elevation.
 - .6 Indication if deviation is within specified tolerances.

1.4 CONTRACT ADMINISTRATOR'S SURVEY REQUIREMENTS

- .1 The Contract Administrator may carry out surveys, as the Contract Administrator deems necessary, to check the accuracy of the Contractor's layout and stakes.
- .2 The Contract Administrator will carry out surveys for the purpose of measuring the Work for payment.

1.5 SUBMITTALS

- .1 Provide the following submittals.
- .2 The name and address of the Contractor's surveyor to the Contract Administrator prior to commencing the Work at the Site.
- .3 When requested, submit a copy of reduced notes for surveys or portions of surveys to the Contract Administrator.
- .4 A certificate signed by the Contractor's surveyor confirming that the lines, grades, elevations, and dimensions of the completed Work are in conformance or not in conformance with the Contract Documents. Provide details of all non-conformances.
- .5 Electronic survey data files in a format acceptable to the Contract Administrator.

1.6 MEASUREMENT AND PAYMENT

- .1 Works described herein shall be considered incidental to the work. No additional payment will be made for Site Surveying.

2. PRODUCTS – NOT USED

3. EXECUTION – NOT USED

END OF SECTION

Approved: 2006-03-31

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of Project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of the City or separate Contractor.
- .3 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected Work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of City or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.2 MATERIALS

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00- Submittal Procedures.

1.3 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of Project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering Work; maintain excavations free of water.

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill to complete Work.
- .2 Fit several parts together, to integrate with other Work.

- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Remove samples of installed Work for testing.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .10 Restore work with new products in accordance with requirements of Contract Documents.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material with approved fire stopping assembly.
- .13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .14 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by the Contract Administrator. Do not burn waste materials on Site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only and remove from Site.
- .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 and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19- Waste Management and Disposal.
- .7 Dispose of waste materials and debris off site.
- .8 Clean interior areas prior to start of finishing work and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 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.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed the Contract Administrator. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Vacuum clean and dust building interiors, behind grilles, louvres, and screens.

- .8 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .9 Clean roofs, downspouts, and drainage systems.
- .10 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .11 Remove snow and ice from access to building.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling or reuse in accordance with Section 01 74 19- Waste Management and Disposal.

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 SECTION INCLUDES

- .1 Text, schedules, and procedures for systematic Waste Management Program for construction, deconstruction, demolition, and renovation projects that may include:
 - .1 Diversion of Materials;
 - .2 Materials Source Separation Program (MSSP); and
 - .3 Canadian Governmental Responsibility for the Environment Resources.

1.2 DEFINITIONS

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction.
- .3 Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .4 Recyclable: Ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- .5 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .6 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.
- .7 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for the purpose of reuse or recycling.
- .8 Source Separation: Acts of keeping different types of waste materials separate beginning from the first time they become waste.

1.3 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.

1.4 MATERIALS SOURCE SEPARATION PROGRAM

- .1 Prepare Material Source Separation Program and have ready for use prior to Project start up.
- .2 Implement Material Source Separation Program for waste generated on Project in compliance with approved methods and as reviewed by Contract Administrator. Provide

on Site facilities for collection, handling and storage of anticipated quantities of reusable and recyclable materials.

- .3 Provide containers to deposit reusable and recyclable materials.
- .4 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .5 Locate separated material(s) in area(s) which minimize material damage.
- .6 Collect, handle, store on Site and transport off site, salvaged materials in separate condition.
- .7 Transport to approved and authorized recycling facility.
- .8 Collect, handle, store on Site and transport off site, salvaged materials in combined condition.
- .9 Ship material(s) to Site operating under Certificate of Approval or as directed by the City of Winnipeg.
- .10 Materials must be immediately separated into required categories for reuse or recycling.

1.5 WASTE PROCESSING SITES

- .1 Identify appropriate waste processing sites, based on municipal requirements, as required.

1.6 STORAGE, HANDLING AND PROTECTION

- .1 Store materials to be reused, recycled, and salvaged in locations as directed by Contract Administrator.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store, and catalogue salvaged items.
- .4 Separate non salvageable materials from salvaged items. Transport and deliver non salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Contract Administrator.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
- .10 On Site source separation is recommended.
- .11 Remove co-mingled materials to offsite processing facility for separation.
- .12 Provide waybills for separated materials.

1.7 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.

- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner or excavation material into waterways, storm or sanitary sewers.
- .3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .4 Prepare project summary to verify destination and quantities on a material by material basis as identified in pre demolition material audit.
- .5 Dispose of waste in accordance with Municipal and Provincial regulations.

1.8 USE OF SITE AND FACILITIES

- .1 Execute Work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility and provide temporary security measures approved by Contract Administrator as required.

1.9 SCHEDULING

- .1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 APPLICATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work and leave Work area in clean and orderly condition.
- .2 Clean-up Work area as Work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

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 and Section E52 of the Bid Opportunity document.
- .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.
- .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.
 - .13 Final instrumentation set points including but not limited to:
 - .1 Unit
 - .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 System
- .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 troubleshooting; 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] days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .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, 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 Contractor's plans for attendance at four (4) and nine (9) month post-construction warranty inspections.
 - .4 Procedure and status of tagging of equipment covered by extended warranties.

- .5 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 for occupancy.
- .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 1042-2025 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 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 Section 01 91 13.13- Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 13.13- Commissioning (Cx) Plan.

- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 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 [facility] is 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.
- .6 The Contract Administrator will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by the 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 the 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 shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation the 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 the Contract Administrator for review and approval.
- .10 Ensure "As-Built" system schematics are available.
- .4 Inform the 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 the 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 four (4) weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to the 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 the Contract administrator where not specified and obtain written approval at least eight (8) weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by the Contract Administrator.

1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 13.16- Commissioning (Cx) 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 the Contract Administrator.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with 1042-2025 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: 1042-2025 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, Contract Administrator to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues 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 twenty-one (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 the Contract Administrator.
 - .3 Arrange for the Contract Administrator to witness tests.
 - .4 Obtain written approval of test results and documentation from the 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 the 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 the Contract Administrator after distinct phases have been completed and before commencing next phase.
- .4 Document require 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 the 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 the Contract Administrator.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by the Contract Administrator.
 - .3 If evaluation report concludes that major damage has occurred, the 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 the 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 to the 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 interim 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 the Contract Administrator at least twenty-one (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 the 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 The Contract Administrator and the City shall 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 the Contract Administrator within five (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 the Contract Administrator.
- .2 Report problems, faults or defects affecting Cx to the Contract Administrator in writing. Stop Cx until problems are rectified. Proceed with written approval from the 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 the 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 (Cx) - 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 the 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 the 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 the 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 1042-2025 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 Optimized life cycle costs.
 - .4 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 within eight (8) weeks of award of contract 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 the OCntract 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 the 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.
 - .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, is 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 Consultant and PWGSC Cx Manager 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 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.
 - .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
 - .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 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 the 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 pumps [P-L04]

- .3 HVAC systems:

- .1 HVAC systems
 - .1 Fans (SF-L61, EF-L62)
 - .2 Air conditioning unit (AC-L68)
 - .3 Unit Heaters (UH-L63, UH-L64, UH-L65)
 - .4 Duct Heaters (HCE-L67)
 - .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.

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 the Contract Administrator's satisfaction.
- .2 Contractor to use approved check lists.
- .3 Contract Administrator will 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 the Contract Administrator and does not form part of Cx specifications.
- .6 Contract Administrator will 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.
 - .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 the 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 the Contract Administrator prior to start of thirty (30) day Final Acceptance Test period.
 - .5 Perform final Cx and operational tests during demonstration period and thirty (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 switches: 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, following equipment, systems:
 - .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 the Contract Administrator.
- .4 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to the 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 reports.
 - .5 Contract Administrator reserves the 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 the 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, certify reported results of, Cx activities and forward to the 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 the Contract Administrator.
- .2 Tests to be witnessed by the City and the 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 the Contract Administrator for review.
- .4 Contract Administrator reserves the 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 and 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: sixty (60) days before start of Cx.
 - .2 Cx procedures: three (3) months after award of contract.
 - .3 Cx Report format: three (3) months after contract award.
 - .4 Submission of list of instrumentation with relevant certificates: twenty-one (21) days before start of Cx.
 - .5 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .6 Notification of intention to start Cx: fourteen (14) days before start of Cx.
 - .7 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed fourteen (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, Contractor's Cx agent, and will monitor progress of Cx against this schedule.

1.19 CX REPORTS

- .1 Submit reports of tests, witnessed and certified Cx agency to the 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 Interim 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 Refer to Section 01 91 13.18 – Commissioning Training.

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 the 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 1042-2025 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 the Contract Administrator. Check lists will be required during Commissioning and will be included in Operation and Maintenance Manual (O&M) 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 required project-specific Commissioning forms in electronic format complete with specification data. 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 the Contract Administrator, develop appropriate verification forms and submit to the Contract Administrator for approval prior to use.
 - .1 Additional commissioning forms to be in same format as provided by Contract Administrator.

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 with Specification data included.
 - .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 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 Operations and 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
 - .2 1042-2025 Bid Opportunity
 - .3 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 troubleshooting.
 - .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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Bid Opportunity 1042-2025 - 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

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .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 two (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 One (1) of each type of brick and concrete masonry unit specified, including special shapes.
 - .2 Two (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 Two (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.
 - .4 Samples: used for testing and when accepted become standard for material used.
- .5 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.
- .6 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.
- .7 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.
- .8 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.
 - .2 For testing to determine compliance with performance requirements. Perform following tests.
 - .1 For clay units, in addition to requirements set out in referenced CSA and ASTM Standards include data indicating initial rate of absorption.
 - .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 it's 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 Twelve (12) months warranty period shall be provided for Work under this Section.

1.11 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

- .1 Masonry materials are specified elsewhere in related Sections:

- .1 Section 042200 - Concrete Masonry Unit.
- .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 19 – 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 workday. 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 Section 04 05 00 - Common Work Results for Masonry
- .2 Section 04 22 00 – Concrete Masonry Unit

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .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 Samples: upon request, submit unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:
 - .2 Submit two (2) copies of WHMIS SDS in accordance with Section 01 35 29.06- Health and Safety Requirements. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .3 Samples:
 - .1 Samples: submit unit samples in accordance with Section 04 05 00- Common Work Results for Masonry, supplemented as follows:
 - .1 Submit two (2) 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 Develop Construction Waste Management Plan related to Work of this Section.
- .5 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.

1.7 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.

- .2 A maximum of ninety-five percent (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

- .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, Type N S.
 - .1 Use low VOC products.
 - .3 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.

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 exterior 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 workday. Anchor securely in position.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A167-15, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .4 ASTM A580/A580M-16, Standard Specification for Stainless Steel Wire.
 - .5 ASTM A641/A641M-(R2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .6 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - .7 ASTM A1022 16B, Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement.
- .2 Canadian Standards Association (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.
 - .2 Submit two (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 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 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 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.

1.7 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.

- .2 A maximum of ninety-five percent (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

- .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.
 - .4 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.
- .6 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 Conventional Bolts:
 - .1 Bolts: to ASTM F1554 Grade 36.
 - .2 Plate anchors: steel to ASTM A36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.
 - .3 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A36 bar stock.
- .8 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 D2240-15, Standard Test Method for Rubber Property - Durometer Hardness.
- .2 CSA Group
 - .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 two (2) samples of masonry accessories if requested 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.
 - .2 Composite flashings.
 - .3 Plastic and rubber 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 vents screens 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.

1.6 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

- .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 Sheet metal: galvanized steel.
 - .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 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 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 Section 04 05 00 - Common Work Results for Masonry
- .2 Section 04 05 13 - Masonry Mortar and Grouting
- .3 Section 04 05 19 - Masonry Anchorage and Reinforcing
- .4 Section 04 05 23 - Masonry Accessories

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM E336-11, Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings.
- .2 CSA Group
 - .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 masonry unit 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 masonry unit 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 masonry unit.
 - .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 masonry unit in individual cardboard packaging provided by manufacturer until units are ready to be installed.
 - .7 Store and protect concrete masonry unit 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.

1.6 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

- .1 Standard concrete block units: to CAN/CSA-A165 CAN/CSA-A165 CAN/CSA-A165.
 - .1 Classification: H / 15 / A / M.
 - .2 Dimensions Nominal:
 - .1 Structural Walls: 200 mm wide x 200 mm high x 400 mm long.
 - .2 Exterior Veneer: 100 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.
 - .4 Colour:
 - .1 Structural Walls: none
 - .2 Exterior Veneer: Charcoal Grey

2.2 REINFORCEMENT

- .1 Reinforcement in accordance with Section 040519 - 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 masonry unit and in accordance with manufacturer's written recommendations and instructions.

2.8 TOLERANCES

- .1 Tolerances for standard concrete masonry unit 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 masonry unit 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 as indicated on drawings.
 - .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 and conduits.
- .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 Install movement joints and keep free of mortar where indicated.
- .6 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.
- .7 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .8 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .9 Tamp units firmly into place.
- .10 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .11 Tool exposed joints concave; strike concealed joints flush.
- .12 After mortar has achieved initial set up, tool joints.
- .13 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 11- Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Standard Concrete Masonry Unit:
 - .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 11- Cleaning.
 - .3 Waste Management: separate waste materials for recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.13 PROTECTION

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

END OF SECTION

1. GENERAL

1.1 RELATED SECTIONS

.1 Not Applicable

1.2 REFERENCES

.1 Canadian Standards Association (CSA):

- .1 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .2 CAN/CSA-S157, Strength Design in Aluminum.
- .3 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.
- .4 CSA W59.2, Welded Aluminum Construction.
- .5 CSA W55.3 - Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings

.2 Canadian General Standards Board (CGSB):

- .1 CAN/CGSB-1.108, Bituminous Solvent Type Paint.

.3 American Society for Testing and Materials (ASTM):

- .1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .2 ASTM A668M Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
- .3 ASTM A 490, Specification for Heat Treated, Steel Structural Bolts, 150 ksi (1035 Mpa) Tensile Strength.
- .4 ASTM A 490M, Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3 for Structural Steel Joints Metric.
- .5 ASTM B 209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.
- .6 ASTM B 210M, Specification for Aluminum-Alloy Drawn Seamless Tubes Metric.
- .7 ASTM B 211M, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire Metric.
- .8 ASTM B 316M Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods Metric

- .4 Aluminum Association, Inc. (AA):
 - .1 Designation System for Aluminum Finishes.
- .5 American Welding Society (AWS):
 - .1 AWS A5.10, Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods.

1.3 SHOP DRAWINGS

- .1 Shop Drawings:
 - .1 Submit shop drawings including fabrication and erection documents consisting of connection and design details, shop details, erection diagrams, erection procedures and material lists in accordance with Section 01330 – Submittals.
 - .2 Indicate cuts, copes, connections, holes, threaded fasteners, rivets, welds and other items. Indicate welds using welding symbols as shown in Appendix A of CSA W59.2.
 - .3 Submit description of methods, sequence of erection and type of equipment to be used in erecting structural aluminum.

1.4 SAMPLES

- .1 Not Applicable.

1.5 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Miscellaneous Metals, Metal Fabrications, Metal Repairs” and “Hatches, Grating, Stairs, Ladders, Rails, Bollards”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
 - 1.1.1 A maximum of ninety-five percent (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.

2. PRODUCTS

2.1 MATERIALS

- .1 Aluminum bar, rod, and wire: to ASTM B 211M.
- .2 Aluminum and Aluminum-Alloy Extruded Bar, Rods, Wire, Shapes, and Tubes: to ASTM B 221M.
- .3 Aluminum sheet or plate: to ASTM B 209M.
- .4 Aluminum drawn tubes: to ASTM B 210M.

- .5 Aluminum bolts and rivets: to ASTM B 316M
- .6 Aluminum welding wire: to AWS A5.10.
- .7 Stainless steel bolts: to AISI Steel Products Manual No. 13.
- .8 Steel bolts: to ASTM A 668M.
- .9 Bituminous paint: to CAN/CGSB-1.108, type 1, 2, without thinner.
- .10 Galvanizing hot dip galvanize steel bolts to CAN/CSA-G164, minimum zinc coating of 600g/m².
- .11 Grating:
 - .1 Aluminum Grating to be Type 30-102M.
 - .2 Bearing Bars: 6063T6
 - .3 Cross Bars: 6063T5
 - .4 Maximum allowable fibre stress: 82.82 Mpa
 - .5 Grating to have smooth top edge.
 - .6 Fasteners to be Type A fixing clip c/w stainless steel screw, nut, and washer.
 - .7 Size: 51 x 4.8 unless noted otherwise on drawings
 - .8 Hinges, fasteners and all hardware to be stainless steel
- .12 Ladders:
 - .1 Construct to PIP STE05501
 - .2 Applicable Equipment:
 - .1 Location:
 - .1 As shown on Drawings
 - .2 Specified Equipment: **Dry Well Ladders**
 - .1 Ladders: 6061 Aluminum
 - .2 Fasteners/Anchors: 304 Stainless Steel
 - .3 Exclude cage
 - .3 Specified Equipment: **Wet Well Ladders**
 - .1 NMS 055000 Metal Fabrication
- .13 Stairs
 - .1 Stairs sizes and framings as indicated on Drawings.
 - .2 Shop Drawings
 - .1 Submit shop Drawings in accordance with NMS 01300 Submittals
 - .2 Shop drawings shall be stamped by a professional engineer registered in the Province of Manitoba

- .3 Materials
 - .1 Aluminum Extruded Shapes: 6061 Alloy
 - .2 Fasteners: 304 Stainless Steel
- .4 Installation
 - .1 Install as indicated on Drawings.
 - .2 Bolt sections together in field.
- .14 Access Hatches:
 - .1 Install hatches where indicated on drawings.
 - .2 Applicable Equipment:
 - .1 Location:
 - .1 As shown on Drawings
 - .2 Specified Equipment: **AH-1**
 - .1 Manufacturer: MSU Mississauga Ltd. or approved equivalent.
 - .2 Model: M – Drainage Frame cast into concrete.
 - .3 Capacity: 12.0kPa minimum live load.
 - .4 Opening Size: 1580 mm x 1830 mm (confirm with engineer)
 - .5 Doors: 2 (overlap, seal joint)
 - .6 Lid thickness: 6.4mm minimum
 - .7 Finish: Factory Finish Aluminum
 - .8 Body: Aluminum: to ASTM B 221M or B 209M, Alloy 6351-T6.
 - .9 Tread Plate: Aluminum: ASTM B 221M or B 209M, Alloy 6061-T6.
 - .10 Miscellaneous: Fasteners, gas spring, and hold open arm in 316 stainless steel; hinges and slam lock in 304 stainless steel.
 - .11 Accessories:
 - .1 Padlock: Complete with master padlock and key. All hatches to be keyed alike
 - .12 Drain Outlet
 - .1 Outlet frame drain through curb to exterior.
 - .3 Specified Equipment: **AH-2**
 - .1 Manufacturer: MSU Mississauga Ltd. or approved equivalent.
 - .2 Model: BD – Bolt down
 - .3 Capacity: 7.5kPa minimum live load.
 - .4 Opening Size: 950 mm x 1130 mm (site confirm opening)
 - .5 Doors: 2 (overlap, seal joint)
 - .6 Lid thickness: 6.4mm minimum
 - .7 Finish: Factory Finish Aluminum
 - .8 Body: Aluminum: to ASTM B 221M or B 209M, Alloy 6351-T6.
 - .9 Tread Plate: Aluminum: ASTM B 221M or B 209M, Alloy 6061-T6.
 - .10 Miscellaneous: Fasteners, gas spring, and hold open arm in 316 stainless steel; hinges and slam lock in 304 stainless steel.

- .11 Accessories:
 - .1 Padlock: n/a
- .12 Drain Outlet
 - .1 n/a

2.2 FABRICATION

- .1 Fabricate in accordance with CAN/CSA-S157 and in accordance with shop drawings.

2.3 FINISHES

- .1 Plain mill finish, unless otherwise indicated.

3. EXECUTION

3.1 GENERAL

- .1 Structural aluminum work: in accordance with CAN/CSA-S157.
- .2 Welding: in accordance with CSA W59.2.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.2 for fusion welding of aluminum and/or CSA W55.3 for resistance welding of structural components.
- .4 Paint aluminum surfaces in contact with concrete with two (2) coats of alkali resistant bituminous paint.

3.2 ERECTION

- .1 Erect structural aluminum as indicated and in accordance with CAN/CSA-S157 and approved erection drawings.
- .2 Field cutting or altering structural members: to approval of the Engineer.

3.3 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship may be carried out by testing laboratory designated by Engineer.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Engineer.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 The Contract Documents applied to the Work of this Section.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A53/A53M-18, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless;
 - .2 ASTM A269/A269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service;
 - .3 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength; and
 - .4 ASTM A108-18, Standard Specification for Steel Bar, Carbon and Alloy, Cold-finished.
- .2 CSA Group
 - .1 CAN/CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel;
 - .2 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles;
 - .3 CAN/CSA-S16-14, Design of Steel Structures;
 - .4 CAN/CSA S167-17, Strength Design in Aluminum;
 - .5 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding; and
 - .6 CSA W59-18, Welded Steel Construction (Metal Arc Welding).

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data
 - .1 Submit Product Data
 - .2 Submit data sheets for all materials specified in this section.
 - .3 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .4 Certificates:
 - .1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Fabricator and welders must be certified in accordance with CSA and the Canadian Welding Bureau.

1.5 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 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job Site.
 - .2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.
 - .3 Store materials off ground in a dry, well-ventilated area.
 - .4 Replace defective or damaged materials with new.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from Site and dispose of packaging materials at appropriate recycling facilities.

1.7 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Miscellaneous Metals, Metal Fabrications, Metal Repairs" and "Hatches, Grating, Stairs, Ladders, Rails, Bollards". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

- .1 All material shall be of a type acceptable to the Contract Administrator and shall be subject to inspection and testing by the Contract Administrator.
- .2 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W/350W.
- .3 Steel pipe: to ASTM A53/A53M, galvanized finish.

- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series.
- .6 Bolts: to ASTM A307.
- .7 Anchor bolts and fasteners: ASTM F1554 Grade 36 (galvanized); ASTM F3125 A325 (galvanized); ASTM A276, Type 316 stainless steel, of ample section to safely withstand the forces created by operation of the equipment or the load to which they may be subjected. Existing concrete shall be scanned for rebar location prior to ancho installation in order to avoid interfering and damaging the rebar.
- .8 Aluminum: to CSA S157 and the Aluminum Association Specifications for Aluminum Structures.
- .9 Aluminum plates: type 6061-T651. Aluminium plate shall have an approved raised multi-grip pattern.
- .10 Aluminum welding: CAN W59.2.
- .11 Stainless steel tubing: to ASTM A269, Type 302.
- .12 Paint: Monorail Beams - epoxy paint system as indicated on structural drawings and in this specification section or approved equivalent in accordance with B7; Color: safety yellow, black (crane beams capacity wording)
- .13 Monorail crane beam trolley: Main Floor crane beam, Motor Room crane beam, and Pump Room crane beam: OZ1PBT by OZ Lifting Products (1 per each crane beam, capacity as per drawings).

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Confirm measurements for all fabrications before fabricating.
- .3 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as noted.
- .4 Where possible, fit and shop assemble Work, ready for erection.
- .5 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.
- .6 Remove and grind smooth burrs, filings, sharp protrusions and projections from metal fabrications to prevent possible injury.
- .7 Angle frames shall be of the same material as the cover plate (except for existing frames designated on the drawings for re-use), and cover plates shall be hinged and be supplied with lifting handles, as shown on the drawings. Exterior covers shall be supplied with a hasp for a padlock.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating six hundred (600) g/m2 to CAN/CSA-G164.

- .2 Paint for shop primed ferrous metal surfaces: MPI EXT 5.1D Alkyd G5 (semigloss) finish, premium grade. Color schedule will be provided by the Contract Administrator.
- .3 Zinc primer: zinc rich, ready mix.
- .4 Galvanized Steel (monorail support beams)
 - .1 Remove oil or soap film with detergent or emulsion cleaner.
 - .2 Lightly abrasive blast with a fine abrasive in accordance with SSPC SP-16 guidelines to achieve a profile of 40 - 75 µm (1.5 - 3.0 mils). When light abrasive blasting is not possible, galvanizing can be treated with a suitable zinc phosphate conversion coating.
 - .3 Apply one base coat of Amerlock 2 Epoxy paint, 75-125 µm (3.0 - 5.0 mils). Colour: Safety Yellow.
 - .4 Apply one finish coat of Durethane, 75-125 µm (3.0 - 5.0 mils). Colour: Safety Yellow.
 - .5 For crane capacity wording, apply two coats of Amerlock 2 Epoxy paint, 100 µm per coat dry film thickness. Colour: black. Select font size and location to be in conspicuous space.

2.4 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of bituminous paint:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.5 ACCESS LADDERS

- .1 Construct to PIP STE05501
 - .1 Applicable Equipment:
 - .1 Location:
 - .1 As shown on Drawings
 - .2 Specified Equipment: **Wet Well Ladder**
 - .1 Ladders: 316 Stainless Steel
 - .2 Fasteners/Anchors: 316 Stainless Steel
 - .3 Exclude cage

2.6 STAIRS

- .1 See NMS 051410 Structural Aluminum

2.7 ACCESS COVERS

- .1 See NMS 051410 Structural Aluminum

2.8 PIPE BOLLARDS

- .1 Construct as shown on Drawings.
- .2 Steel pipe: double strong, diameter as indicated, hot-dip galvanized.

- .3 Concrete: Type HS or HSb sulphate resistant, minimum twenty (20) MPa.

2.9 GUARDRAILS, HANDRAILS AND GATES

- .1 Steel pipe: diameter as indicated, hot-dip galvanized after fabrication.
- .2 Fabricate and install pipe rails to be removable as indicated on Drawings. Sleeve to be secured in concrete slab.
- .3 Fully assembled gate shall be capable of swinging in either direction by inverting installation position. Gate size shall be laterally adjusted from minus 32 mm (1-1/4 inch) to plus 64 mm (2-1/2 inch).
- .4 Approved Product: GuardDog Self-Closing Safety Gate
 - .1 Standards: System shall have top and mid rail in accordance with OSHA Standards - 29 CFR 1910.29 (b)(1)(2)
 - .2 Width: As indicated on Drawings.
 - .3 Height:
 - .1 Top Rail: 1067 mm (42 inches), minimum.
 - .2 Bottom Rail: 533 mm (21 inches).
 - .4 Hardware: Provide the following:
 - .1 Gate Hardware: U-Bolts.
 - .2 Universal Hinge Assembly: Fits railing types up to 51 mm (2 inches) O.D. or flat surface mounting.
 - .3 Railing adapter kit.
 - .4 Self-Closing Springs: Two stainless steel torsion springs.
 - .5 Material: Mild steel, hot-dip galvanized with powder-coated finish.

Part 3 Execution

3.1 ERECTION - GENERAL

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Contract Administrator such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA S1, or weld.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

- .8 Install access hatch frames square and level at the locations show on the drawings. Embed anchors in concrete as shown on the drawings. Install covers and adjust hardware to proper function.
- .9 Install suitable trolleys on all monorail crane beams and ensure their proper and safe operation.
- .10 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .1 Primer: maximum VOC limit 250g/L to GS-11.

3.2 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.3 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 06 05 73 Wood Treatment: Treated wood, fasteners and connectors for rough carpentry.
- .4 Section 07 21 16 Blanket Insulation: Insulation for wood framed cavities.
- .5 Section 07 26 00 Vapour Retarders: Vapour retarder installation in wood framed assemblies.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/National Particleboard Association (ANSI/NPA)
 - .1 ANSI/NPA A208.1-[2009] Particleboard.
- .2 ASTM International
 - .1 ASTM A123/A123M-[15] , Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A153/A153M-[09] Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .3 ASTM A307-[14] Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - .4 ASTM A653/A653M-[15] , Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM D 5055-[13e1] , Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .6 ASTM D 5456-[14b] , Standard Specification for Evaluation of Structural Composite Lumber Products.
 - .7 ASTM F1667-[13] Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-[M87] , Hardboard.
 - .2 CAN/CGSB-71.26-[M88] , Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .4 Canadian Wood Council
 - .1 Wood Design Manual [2010 (R2014)] Edition
 - .2 Engineering Guide for Wood Frame Construction [2014]
- .5 CSA Group (CSA)
 - .1 CAN/CSA-A123.2-[03(R2013)] , Asphalt Coated Roofing Sheets.
 - .2 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.

- .3 CSA O86-14 Engineered Design in Wood
- .4 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
- .5 CSA O121-08(R2013), Douglas Fir Plywood.
- .6 CSA O141-05(R2014), Softwood Lumber.
- .7 CSA O151-09(R2014), Canadian Softwood Plywood.
- .8 CSA O153-13, Poplar Plywood.
- .9 CSA O325-07(R2012), Construction Sheathing.
- .10 CAN/CSA-S406-92(R2008), Construction of Preserved Wood Foundations.
- .6 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber [2010] .
- .7 National Research Council Canada (NRC)
 - .1 National Building Code of Canada [2015] (NBC).

1.3 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.

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 wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include manufacturer's pre-engineered floor, ceiling and roof joist span charts, and manufacturer's pre-engineered installation details.
 - .3 Submit certified test reports for prefabricated structural members from approved independent laboratory indicating compliance with specifications for specified performance characteristics and physical properties.
 - .4 Submit CCMC Product Evaluation Report for engineered wood products.
 - .5 Submit manufacturer's installation instructions.
- .3 Shop Drawings:
 - .1 For structural applications, submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Include on drawings:
 - .1 Design data in accordance with CAN/CSA-O86 and CWC Engineering Guide for Wood Frame Construction.
 - .2 Indicate configuration and spacing of joists, hanger and connector types, fasteners, locations and design values; bearing details.

- .3 Submit stress diagrams or print out of computer design indicating design loads for members. Indicate allowable load and stress increase.
- .4 Indicate arrangement of webs or other members to accommodate ducts and other specialties.

1.5 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store materials off ground with moisture barrier at both ground level and as a cover forming a well-ventilated enclosure, with drainage to prevent standing water.
 - .3 Store wood I-beams and I-joists on edge.
 - .4 Stack, lift, brace, cut and notch engineered lumber products in strict accordance with manufacturer's instructions and recommendations.
 - .5 Store and protect architecturally exposed lumber from nicks, scratches, and blemishes.
 - .6 Replace defective or damaged materials with new.
 - .7 Store separated reusable wood waste convenient to cutting station and work areas.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Remove from Site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on Site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused wood materials from landfill to approved facility
- .5 Do not dispose of preservative treated wood through incineration.
- .6 Do not dispose of preservative treated wood with materials destined for recycling or reuse.
- .7 Dispose of treated wood, end pieces, wood scraps and sawdust at approved sanitary.
- .8 Dispose of unused wood preservative material at official, approved hazardous material collections site.
- .9 Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in other locations where they will pose health or environmental hazard.

1.7 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Building Construction”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 LUMBER MATERIAL

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content nineteen percent (19%) or less in accordance with following standards:
 - .1 CAN/CSA-O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips and fascia backing:
 - .1 Board sizes: "Standard" or better grade.
 - .2 Dimension sizes: "Standard" light framing or better grade.

2.2 PANEL MATERIALS

- .1 Canadian softwood plywood (CSP): to CSA O151, standard construction.
- .2 Fire retardant treated plywood to be G1S – Good One Side: BC fir plywood with smooth sanded surface on one (1) side suitable for painting and be pressure impregnated with fire-retardant chemicals in conformance with CAN/CSA-O80 Series-M, “Wood Preservation”, and have a flame-spread rating not more than twenty-five (25).

2.3 ACCESSORIES

- .1 Nails, spikes and staples: to CSA B111, hot dipped galvanized.
- .2 Bolts: 12.5 millimetres diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .4 All interior fasteners to be type 304 stainless steel.

2.4 WOOD PRESERVATIVE

- .1 Surface-applied wood preservative: copper naphthenate or five percent (5%) pentachlorophenol solution, water repellent preservative.
- .2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used, pentachlorophenol-treated wood must be covered with two (2) coats of an appropriate sealer.

- .3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

Part 3 Execution

3.1 PREPARATION

- .1 Treat surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum three (3) minute soak on lumber and one (1) minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Treat material as indicated and as follows:
 - .1 Curbs, nailers, sleepers on roof deck and parapets.
 - .2 Wood furring within outside surface of exterior masonry and concrete walls.
 - .3 All wood in contact with unfinished concrete or masonry.

3.2 INSTALLATION

- .1 Install furring and blocking as required to space-out and support fascia, soffit, siding and other work as required.
- .2 Align and plumb faces of furring and blocking to tolerance of one (1): six hundred (600).
- .3 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other Work.
- .4 Install fascia backing and nailers, and other wood supports as required and secure using galvanized steel fasteners.
- .5 Use caution when working with particle board. Use dust collectors and high quality respirator masks.
- .6 Sheathing
 - .1 Install plywood sheathing with surface grain at right angles to roof framing, and in accordance with requirement of the National Building Code, and to the plywood manufacturer's recommendations.

3.3 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other Work.

3.4 SCHEDULES

- .1 Provide electrical equipment backboards for mounting electrical and telecommunications/data equipment as indicated.

- .2 Use nineteen (19) millimetres thick fire retardant treated plywood on nineteen (19) by thirty-eight (38) millimetres furring spaced at maximum three hundred (300) millimetres centres and at vertical edges of mounting board.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- 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 11- Cleaning.

3.6 WASTE MANAGEMENT

- .1 Separate waste materials for recycling in accordance with Section 01 74 19- Waste Management and Disposal.
- .2 Re-use scrap lumber to the greatest extent possible. Separate scrap lumber for use on site as accessory components, including: shims, bracing, and blocking.
- .3 Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill. Prevent saw dust and wood shavings from entering the storm drainage system.
- .4 Do not burn scrap lumber that has been pressure treated.
- .5 Do not send lumber treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 The Contract Documents applied to the Work of this Section.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA O80 Series-08, Wood Preservation.
 - .2 CSA O86 Consolidation-09, Engineering Design in Wood.
 - .3 CSA O141-05(R2009), Softwood Lumber.
 - .4 CSA S307-M1980(R2001), Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings.
 - .5 CSA S347-99(R2009), Method of Test for Evaluation of Truss Plates Used in Lumber Joints.
 - .6 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
- .2 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada [2015] (NBC).
 - .2 Canadian Construction Materials Centre (CCMC)-on-line edition, Registry of Product Evaluations.
 - .3 Manitoba Building Code (MBC).
- .4 Truss Plate Institute of Canada (TPIC)
 - .1 TPIC - 2007, Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses (Limit States Design).

1.3 DESIGN REQUIREMENTS

- .1 Design trusses, bracing, blocking and bridging in accordance with CAN/CSA-O86.1 for loads indicated and minimum uniform and minimum concentrated loadings stipulated in NBC commentary.
- .2 Limit live load deflection to 1/360 of span where plaster gypsum board ceilings are hung directly from trusses.
- .3 Limit live load deflections to 1/240 of span unless otherwise specified or indicated.
- .4 Provide camber for trusses as required.

1.4 SOURCE QUALITY CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.

- .2 Certify preservative and fire retardant treated wood in accordance with CAN/CSA-O80 Series.

1.5 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 wood trusses 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 Include on drawings:
 - .1 Each erection shop drawing submission showing connection details.
 - .2 Indicate special structural application and specification as according to local authorities having jurisdiction.
 - .3 Indicate TPIC Truss Design Procedure and CSA O86 Engineering Design in Wood and specific CCMC Product Registry number of the truss plates
 - .4 Indicate species, sizes, and stress grades of lumber used as truss members. Show pitch, span, camber, configuration and spacing of trusses. Indicate connector types, thicknesses, sizes, locations and design value. Show bearing details. Indicate design load for members.
 - .5 Submit stress diagram or print-out of computer design indicating design load for truss members. Indicate allowable load and stress increase.
 - .6 Provide certification that trusses meet requirements of CSA S307 and CSA S347.
 - .7 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
 - .8 Show location of lateral bracing for compression members.
 - .9 Test reports: submit certified test reports for prefabricated wood trusses from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .10 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .11 Instructions: submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Fabricator for trusses to show evidence of quality control program such as provided by regional wood truss associations, or equivalent.

- .2 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.

1.7 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood trusses from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Provide bearing supports and bracings. Prevent bending, warping and overturning of trusses.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

1.8 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 DESIGN REQUIREMENTS

- .1 Design light metal plate connected wood trusses in accordance with TPIC truss design procedures for wood truss chords and webs in accordance with engineering properties in CSA O86.
- .2 Design light metal plate connected wood trusses in accordance with TPIC truss design procedures for truss joint designs to test engineering properties in accordance with CSA S347 and listed in CCMC Registry of Product Evaluations.
- .3 Design trusses in accordance with CSA O86.1 for loads indicated by National Building Code of Canada (NBC), Climatic Information for Building Design in Canada and minimum uniform and minimum concentrated loadings stipulated in NBC commentary.
- .4 Limit live load deflection to 1/360th of span where ceilings are hung directly from trusses.
- .5 Limit live load deflections to 1/180th of span unless otherwise specified or indicated.
- .6 Provide camber for trusses as indicated.

- .7 Design for equipment loads as indicated on Drawings.

2.2 MATERIALS

- .1 Lumber: Spruce (S-P-F) species, No. 1 grade, softwood, S4S, with maximum moisture content of nineteen percent (19%) at time of fabrication and to following standards:
 - .1 CAN/CSA-O141; and
 - .2 NLGA (National Lumber Grading Association), Standard Grading Rules for Canadian Lumber.
- .2 Fastenings: to CAN/CSA-O86.1.

2.3 FABRICATION

- .1 Fabricate wood trusses in accordance with reviewed shop drawings.
- .2 Provide for design camber and roof slopes when positioning truss members.
- .3 Connect members using metal connector plates.

2.4 SOURCE QUALITY CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.
- .2 Certify by agency accredited by Standards Council of Canada that fire retardant treated wood in accordance with CAN/CSA O80 Series.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product 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 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 datasheet.

3.3 ERECTION

- .1 Erect wood trusses in accordance with reviewed shop drawings.
- .2 Handling, installation, erection, bracing and lifting in accordance with manufacturers instructions.

- .3 Make adequate provisions for handling and erection stresses.
- .4 Exercise care to prevent out-of-plane bending of trusses.
- .5 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed.
- .6 Install permanent bracing in accordance with reviewed shop drawings, prior to application of loads to trusses.
- .7 Do not cut or remove any truss material without approval of Contract Administrator.
- .8 Remove chemical and other surface deposits on treated wood, in preparation for applied finishes.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
 - .2 Manufacturer's field services: 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 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.
- .2 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within three (3) days of review and submit immediately to Contract Administrator.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- 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 11- Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19- Waste Management and Disposal.
 - .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 Section 04 22 00 – Concrete Unit Masonry
- .2 Section 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 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 board insulation and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two (2) copies of WHMIS SDS in accordance with Section 01 35 29.06- Health and Safety Requirements.
 - .3 Indicate VOC's during application and curing.
- .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.

1.8 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Building Construction” and “Subgrade Lift Station Envelope Construction”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 INSULATION

- .1 Extruded polystyrene (XPS): to CAN/ULC-S701
 - .1 Type:
 - .1 Below roads or structurally loaded pads: Type 4.
 - .2 Exterior walls above and below grade: Type 2.
 - .2 Compressive strength:
 - .1 Type 4: 25 psi
 - .3 Thickness: as indicated.

- .4 Size: 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.
 - .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 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 or as indicated on drawings. 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 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
 - .1 Leave Work area clean at end of each day.
- .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 SCOPE

- .1 This Section describes the requirements for blanket insulation applied to inside walls and attic space.

1.2 REFERENCE STANDARDS

- .1 National Building Code of Canada (NBC).
- .2 ASTM International
 - .1 ASTM C553-13, Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 ASTM C665-12, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .3 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
- .3 CSA Group
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S702-[2012] , Standard for Mineral Fibre Insulation 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 blanket insulation and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports:
 - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

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 materials 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.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

1.5 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 INSULATION

- .1 Batt and blanket mineral fibre: to ASTM C665 and CAN/ULC S702.
 - .1 Type: Owens Corning Pink Fibre glass or approved equal in accordance with B7.
 - .2 Thickness: Sufficient thickness to obtain total insulation value RSI 7.04 (R40) in the ceiling assembly, and to fill cavities as indicated on Drawings.

2.2 ACCESSORIES

- .1 Type: as recommended by manufacturer.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions and data sheets.

3.2 INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C1320.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Do not compress insulation to fit into spaces.

- .4 Keep insulation minimum seventy-five (75) millimetres from heat emitting devices such as recessed light fixtures, and minimum fifty (50) millimetres from sidewalls of chimneys and Type B vents.
- .5 Do not enclose insulation until it has been inspected and approved by Contract Administrator.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- 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 11- Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 21 016 – Blanket Insulation.

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
 - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

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

1.4 QUALITY ASSURANCE

- .1 Mock-Ups:
 - .1 Submit mock-ups if requested in accordance with Section [01 45 00- Quality Control] .
 - .2 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.
 - .3 Mock-up will be used to judge quality of work, substrate preparation, and material application.
 - .4 Locate where indicated.
 - .5 Allow 24 hours for inspection of mock-up by Contract Administrator before proceeding with vapour barrier work.
 - .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Remove mock-up and dispose of materials when no longer required.

1.5 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 in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

1.6 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 SHEET VAPOUR BARRIER

- .1 Polyethylene film: to CAN/CGSB-51.34, six (6) mil (0.15 millimetres) thick.

2.2 PEEL AND STICK MEMBRANE

- .1 Air/vapour barrier : SBS Rubberized asphalt compound laminated to plastic sheet membrane
- .2 Approved Product: Henry Blueskin SA Self Adhered Air and Vapour Membrane or approved equal.

2.3 TRANSITION MEMBRANE AND BASE FLASHING

- .1 Transition membrane to span gaps between dissimilar surfaces in key areas such as wall-to-window frames, wall-to-slab, wall-to-roof junction, base flashings at masonry walls, flashings at stone sills and joints between dissimilar materials etc.): Bakor Blueskin SA, one (1.0) millimetres thick, self-adhered EPDM membrane flashing.

2.4 ACCESSORIES

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, cloth fabric duct tape type recommended by vapour barrier manufacturer, two (2) inches (fifty (50) millimetres)

wide for lap joints and perimeter seals, one (1) inch (twenty-five (25) millimetres) wide elsewhere.

- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.
- .3 Staples: minimum ¼ inch (six (6) millimetres) leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Sheet Vapour Barrier:
 - .1 Ensure services are installed and inspected prior to installation of retarder;
 - .2 Install sheet vapour retarder on warm side of exterior wall assemblies to form continuous retarder;
 - .3 Use sheets of largest practical size to minimize joints; and
 - .4 Inspect for continuity. Repair punctures and tears with sealing tape before Work is concealed.
- .2 Transition Membranes:
 - .1 Verify that surfaces and conditions are ready to accept the Work of this section. Notify Contract Administrator in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrate
 - .2 Apply in accordance with manufacturer's written instructions and stipulated environmental conditions;
 - .3 Overlap and seal to adjacent surfaces for continuous gap free installation; and
 - .4 Do not conceal with new construction until inspected.

3.2 PERIMETER SEALS

- .1 Seal perimeter of sheet vapour barrier as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.3 LAP JOINT SEALS

- .1 Seal lap joints of sheet vapour barrier as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.

- .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 ELECTRICAL BOXES

- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
 - .1 Install moulded box vapour barrier Wrap boxes with film sheet providing minimum twelve (12) inches (three hundred (300) millimetres) perimeter lap flange; and
 - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- 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 11- Cleaning.
 - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 74 19- Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SCOPE

- .1 The scope of this section generally includes but not limited to:
 - .1 Underlayment;
 - .2 Roof panel clip system; and
 - .3 Roof panel.

1.2 REFERENCE STANDARDS

- .1 Design of cladding system in accordance to the latest edition of:
 - .1 CSA-S136 for the design of Cold Formed Steel Structural Members;
 - .2 Canadian Sheet Steel Building Institute Standards 10M and 20M; and
 - .3 National Building Code of Canada.
- .2 Aluminum Association (AA)
 - .1 DAF-45-R03, Designation System for Aluminum Finishes - 9th Edition.
 - .2 ASM-35-October 2000, Specifications for Aluminum Sheet Metal Work in Building Construction, Section 5.
- .3 ASTM International
 - .1 ASTM A606-01, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance;
 - .2 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
 - .4 ASTM D523-89(2008), Standard Test Method for Specular Gloss.
 - .5 ASTM D822-01(R2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.13-M87, sealing compound, one component, silicone base, chemical curing;
 - .2 CAN/CGSB-19.24-M90, sealing compound, multi-component, chemical curing;
 - .3 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement.
 - .4 CAN/CGSB-37.29-M89, Rubber-Asphalt Sealing Compound.
 - .5 CAN/CGSB-51.32- M77, Sheathing, Membrane, Breather Type.
 - .6 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.
- .5 CSA Group (CSA)
 - .1 CSA A123.3-05(2010), Asphalt Saturated Organic Roofing Felt.

- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .7 Canadian Roofing Contractors Association (CRCA):
 - .1 Roofing Specifications Manual 1997.

1.3 DESIGN REQUIREMENTS

- .1 Design roof system to resist:
 - .1 Snow loads and snow build-up and rain load, expected in this geographical region OBC climatic data, fifty (50) year probability;
 - .2 Wind loads, positive and negative, expected in this geographical region climatic data, fifty (50) year probability; and
 - .3 Dead load of roof system.
- .2 Deflection of the roof system is not to exceed 1/180 of the span for the specified live loading.
- .3 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and night-time sky heat loss.
 - .1 Temperature Change (Range): twenty (20) degrees Celsius, ambient; forty (40) degrees Celsius, material surfaces.

1.4 SAMPLES

- .1 Submit samples of standard coloured metal roof for review by the Contract Administrator, prior to fabrication.

1.5 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 sheet metal roofing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Proof of manufacturer's CCMC listing and listing number.
 - .3 Submit two (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 Indicate arrangement of pre-finished Roof Sheet, including joints, types and locations of supports, fasteners, flashing, gutters, mitres and all metal components related to the roof installation. Include for underlayment as part of the roof system.

- .4 Samples:
 - .1 Submit 300 x 300 mm samples of each sheet metal material.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store components and materials in accordance with panel manufacturer's recommendations and protect from elements.
- .2 Protect prefinished steel during fabrication, transportation, Site storage and erection, in accordance with CSSBI Standards.
- .3 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .4 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .5 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect sheet metal roofing from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .6 Develop Waste Management Plan related to Work of this Section.

1.7 GUARANTEE

- .1 For the Work in this Section, warranty by installer against defects or deficiencies in materials or workmanship shall be for a period of one (1) year from date of substantial completion.

1.8 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 ROOF SYSTEM COMPONENTS

- .1 Roof System: Tradition 100-4 on Solid Substrate by Vicwest.
 - .1 Underlayment: Membrane shall be Ice and Water Shield by W.R. Grace or an approved equal.
- .2 Clip System:

- .1 Thermally responsive clips to be fabricated from a minimum of 0.91 millimetres (.036 inches) steel, with minimum Z275 galvanized coating designed to accommodate expansion and contraction of the roof sheet.
- .2 Roof Fasteners: As specified by manufacturer, to resist wind uplift and sliding snow forces.
- .3 Prefinished Roof Sheet, exposed to exterior.
 - .1 Profile: Tradition 100-4, with I-style ribs at four (400) millimetres spacing.
 - .2 Panel: Z275 galvanized (zinc coated) sheet steel conforming to ASTM A653M structural quality Grade 230 having a nominal core thickness 0.76 millimetres (0.030 inches).
- .4 Snap Cap:
 - .1 Provide twenty-five (25) millimetres high snap caps for full length of the roof panel and retained by panel clips, fabricated from Z275 galvanized (zinc coated) sheet steel conforming to ASTM A653M structural quality Grade 230 having a minimum nominal core thickness 0.61 millimetres (0.024 inches). Finish and colour to match roof sheet.

2.2 PANEL FINISHES

- .1 Coating: Prepainted with WeatherX™ on interior face.

2.3 COLOUR

- .1 Colour to be selected from the manufacturer's standard colour range.

2.4 ACCESSORIES

- .1 Flashing: Formed from same materials as the roof sheet. Custom fabricated to suit architectural details, as required.
- .2 Closures: Foam and metal closures to suit profiles selected, to manufacturer's recommendations.
- .3 Sealants: In accordance with manufacturer's recommendation and Section 07 92 10 – Joint Sealing.
- .4 Ventilated ridge cap: prefinished, brake formed, purpose made flashing to provide continuous air vent, incorporating drip edge, snow baffle and mesh material to allow unrestricted venting of attic space while preventing insect, rain and snow from entering. Colour and finish to match roofing.
- .5 Snow fence: Continuous double bar snow fence supported on zinc die cast metal brackets. Rails formed of swaged galvalume tubes connected with concealed joiners and pinned. Brackets secured with stainless steel screws through neoprene washers through the roofing material into solid wood blocking.
- .6 Touch-up paint: as recommended by sheet metal roofing manufacturer.

2.5 FABRICATION

- .1 Fabricate roof components to comply with dimensions, profiles, gauges and details as shown on the Shop Drawings, including fascia and soffit panels and all companion flashing.
- .2 Fabricate all components of the system in the factory, ready for field installation.
- .3 Provide roof sheet and all accessories in longest practicable length to minimize field lapping of joints.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine Work of other sections upon which Work of this Section depends.
- .2 Report all discrepancies to Contract Administrator before beginning Work on the roof system.

3.2 INSTALLATION

- .1 Roof Materials:
 - .1 Underlayment: Install underlayment fully adhered to solid substrate according to manufacturer's recommendations. Ensure all joints are properly lapped and sealed. Tie in with barriers on adjacent surfaces to ensure airtight construction. Provide a continuous seal around all openings in the insulated metal roof system.
 - .2 Clip: Attach Tradition clips using fasteners as recommended by the manufacturer, to suit the substrate.
- .2 Roof Panel Installation:
 - .1 Install exterior prefinished roof panels on panel support clips, using manufacturer's proper construction procedure. Ensure metal roofing sheet side-lap is positively retained by clips, and proper sheet coverage is maintained.
 - .2 Install the snap-cap at all side laps as shown on the approved Shop Drawings. Mitre snap-cap as required to resist water entry.
 - .3 Where indicated on approved Shop Drawings, secure the end-lap of metal roofing sheets in accordance with the manufacturer's Specifications and details to provide a weather-tight seal. Exposed fasteners to match colour of the roof sheet.
 - .4 Provide notched and formed closures, sealed against weather penetration, at changes in pitch, and at ridges and eaves, where required.
 - .5 Install all companion flashing, gutters, ventilators as shown on the Shop Drawings. Use concealed fasteners when possible. Exposed fasteners to match colour of roof sheet.

3.3 CLEANING

- .1 Clean exposed panel surfaces in accordance with manufacturer's instructions.

- .2 Repair and touch up with colour matching high grade enamel minor surface damage, only where permitted by the Contract Administrator and only where appearance after touch-up is acceptable to Contract Administrator.
- .3 Replace damaged panels and components that, in opinion of the Contract Administrator, cannot be satisfactorily repaired.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 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 D4587-11 Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
 - .3 ASTM F1667-15 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
 - .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.

1.6 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 SHEET METAL

- .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 CGSB37-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 Section 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 C919-08, 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 two (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 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.

1.9 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Building Construction” and “Subgrade Lift Station Envelope Construction”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

- .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 B7.
- .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 B7.
- .2 For joints between exterior doors, windows, ductwork, etc., and adjacent materials: Dow Corning No. 795 or approved equal in accordance with B7.

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 Section 08 71 00 - Door Hardware

1.2 WORK INCLUDED

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

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM B29-03, Standard Specification for Refined Lead.
 - .3 ASTM B749-03, 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.

1.8 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 ACCEPTABLE MANUFACTURERS

- .1 Macotta
- .2 Allmar
- .3 Shanahans
- .4 Or approved equal in accordance with B7.

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 - FARMES

- .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 Section 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.

1.11 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

- .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 FASTENINGS

- .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 REQUIREMENTS

- .1 Bid Opportunity 1042-2025
- .2 Section 04 22 00 - Concrete Unit Masonry
- .3 Section 05 50 00 - Metal Fabrications

1.2 WORK INCLUDED

- .1 Moisture testing of substrates.
- .2 Surface preparation of substrates as required for acceptance of paint, including cleaning, small crack repair, patching, caulking and making good surfaces and areas limits defined under Master Painters Institute Repainting Maintenance Manual requirements.
- .3 Specific pre-treatments noted herein or specified in the Master Painters Institute Repainting Manual requirements.
- .4 Sealing/touch-up, spot priming, and/or full priming surfaces for repainting in accordance with Master Painters Institute Repainting Maintenance Manual requirements.
- .5 Provision of safe and adequate ventilation as required where toxic and/or volatile/flammable materials are being used over and above temporary ventilation supplied by others.
- .6 Prepare surfaces which are to receive finish. Surfaces include the underside of steel deck, steel joists and concrete masonry unit.
- .7 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, Method 24 (for 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.
- .2 Materials (primer, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with the latest edition of the Master Painters Institute Approved Product List and shall be from a single manufacturer for each system used.
- .3 Paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in Master Painters Institute Maintenance Repainting Manual and shall be compatible with other coating materials as required.
- .4 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.
- .5 Retain purchase orders, invoices and other documents to prove conformance with noted Master Painters Institute requirements when requested by Contract Administrator.
- .6 Standard of Acceptance: When viewed using final lighting source surfaces shall indicate the following:
 - .1 Walls: No defects visible
 - .2 Ceilings: No defects visible
 - .3 Final coat to exhibit uniformity of colour and sheen across full surface area.

1.5 COLOR 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.

Room Color Schedule

Area	Finish
Superstructure Masonry Walls	Flat White
Superstructure Exterior Brick	Color to be selected by Owner; Apply anti-graffiti Coating according to 09 96 50
Superstructure Ceilings	Flat White
Substructure Concrete Walls	Flat White
Substructure Concrete Ceilings	Flat White

Concrete Floors	Resinous Epoxy Flooring according to 09 67 23 - Grey
Stairs, Ladders and Rails	Safety Yellow

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 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.

1.9 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.

1.10 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:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour number[s].
 - .4 MPI Environmentally Friendly classification system rating.

1.11 MAINTENANCE MATERIAL SUBMITTALS

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

1.12 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Building Construction" and "Subgrade Lift Station Envelope Construction". Said price

shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.

- .2 A maximum of ninety-five percent (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

- .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 B7.

2.2 INTERIOR PAINTING SYSTEMS

- .1 Applies to new finishes over previously unpainted surfaces or new shop primed surfaces to be field painted.
- .2 Refer to Room Finish Schedule on this specification for location.
- .3 Galvanized and non-galvanized metal: doors, frames, railings, structural and miscellaneous metals (within floor to underside of ceilings):
 - .1 Alkyd primer/sealer – One (1) coat; and
 - .2 Alkyd – G5 finish – Two (2) coats.
- .4 Gypsum board and exposed plywood: gypsum wall board, drywall, “sheet rock type material”, plywood and wood:

- .1 Latex primer/sealer – One (1) coat; and
- .2 Latex G3 finish – Two (2) coats.
- .5 Canvas and cotton coverings:
 - .1 Latex G1 finish – Two (2) coats.

2.3 INTERIOR RE-PAINTING SYSTEMS

- .1 Applies to previously painted surfaces, not new or shop primed.
- .2 Galvanized and non-galvanized metal: doors, frames, railings, misc. steel, pipes and ducts.
 - .1 All loose paint and material must be completely removed by means of wire brush. Comply with 3.2.
 - .2 Primer – Amerlock 2.
 - .3 Finish coat – Amerlock 400 Two-component, high solids epoxy coating.
- .3 Concrete and masonry surfaces:
 - .1 Latex block filler – One (1) thick coat to fill pores; and
 - .2 Latex G3 finish – Two (2) coats.
- .4 Canvas and cotton coverings:
 - .1 Latex G1 finish – Two (2) coats.

2.4 EXTERIOR PAINTING AND REPAINTING SYSTEMS

- .1 Galvanized Metal:
 - .1 Galv, metal primer - One (1) coat; and
 - .2 Alkyd G5 level finish – Two (2) coats.

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.
- .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 No repainting Work shall commence until such adverse conditions and defects have been corrected and surfaces and conditions are acceptable to the Contract Administrator. Commencement of Work shall not be held to imply acceptance of surfaces except as qualified herein.
- .4 Degree of surface deterioration shall be assessed using Master Painters Institute Identifiers and Assessment criteria indicated in the Master Painters Institute Maintenance Repainting Manual. Master Painters Institute degree of surface deterioration ratings and descriptions are as follows:

<u>CONDITION</u>	<u>DESCRIPTION</u>
DSD-0	Sound surface (includes visual (aesthetic) defects that do not affect film's protective properties).
DSD-1	Slightly Deteriorated Surface (indicating fading; gloss reduction, slight surface contamination, minor pin holes scratches, etc.)
DSD-2	Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, staining, etc.).
DSD-3	Severely Deteriorated Surface (heavy peeling, flaking, cracking, scratches, scuffs, abrasion, small holes and gouges).
DSD-4	Substrate Damage (repair or replacement of surface required by others).

.5 Beginning of installation means acceptance of existing surfaces.

3.2 CLEANING AND PREPARATION OF SURFACES

.1 Clean and prepare interior surfaces to be repainted in accordance with Master Painters Institute Maintenance Repainting Manual requirements. Refer to Master Painter Institute Manual in regard to specific requirements and as follows:

- .1 Remove dust, dirt and surface debris by vacuuming, wiping dry, clean cloths or compressed air.
- .2 Remove chipped, loose, scaling sealants and caulking materials, fasteners, adhesive residues etc. or other surface blemishes which would impair the final results.
- .3 Patch small holes and depressions in drywall finishes with appropriate patching compound and sand flush with adjacent finish.
- .4 Wash surfaces with biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and surface contaminants.
- .5 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- .6 Allow surfaces to drain completely and to dry thoroughly. Allow sufficient drying time and test surfaces using an electronic moisture meter before commencing work.
- .7 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water-based paints.
- .8 Many water-based paints cannot be removed with water once dried. Minimize the use of kerosene or such organic solvents to clean up water-based paints.

- .2 Impervious Surfaces: remove mildew by scrubbing with a solution of TSP and bleach. Rinse with clean water and allow surface to dry completely.
- .3 Insulated Surfaces: remove dirt, grease and oil from canvas and cotton insulated coverings.
- .4 Galvanized surfaces: remove surface contamination and oils from surfaces and wash with solvent. Apply a coat of etching type primer.
- .5 Zinc coated surfaces: remove surface contamination and oils from surfaces and prepare for priming in accordance with metal Manufacturer's recommendations.
- .6 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.
- .7 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.
- .8 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.
- .9 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.
- .10 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 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 Removal of electrical cover plates, light fixtures, surface hardware on doors, fittings and fastenings shall be done prior to undertaking re-painting operations by Contractor. Items shall be securely stored and re-installed by Contractor after painting is completed.
- .4 Collect cotton waste, cloths and material which may constitute a fire hazard, place in closed metal containers and remove daily from Site.

3.5 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.

3.6 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
 - .1 One (1) coat latex block filler
 - .2 Two (2) coats alkyd enamel semi-gloss finish
 - .4 Concrete Floors, Curbs, and Equipment Bases:
 - .1 Two (2) coats Epoxy Flooring
 - .1 Approved Product: Sikafloor 261 or approved equivalent.
 - .5 Concrete Walls:
 - .1 Two (2) coats alkyd enamel semi-gloss finish

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.
- .2 Section 09 01 90.63 – Painting and Repainting

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 manufacture'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.

- .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 from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

1.8 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Building Construction” and “Subgrade Lift Station Envelope Construction”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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.
 - .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 PRODUCT DATA

- .1 Submit manufacturer's printed product literature, specifications, and application instructions to Contract Administrator before commencing application per Section 09 01 90.63 – Painting and Repainting.

1.2 ENVIRONMENTAL CONDITIONS

- .1 Maintain ambient and structural base temperature at installation area within limits specified by coating manufacturer. Apply coating during dry weather. Do not apply coating to wet or damp surfaces.

1.3 PROTECTION

- .1 Protect plants and vegetation that might be damaged by coating. Protect surfaces not intended to have application of one (1) coating. Provide adequate ventilation or isolation measures to protect against toxic fumes.

Part 2 Products

2.1 MATERIALS

- .1 Applied to exterior masonry and exposed concrete surfaces that have been cleaned and prepared by sandblasting or wire-wheel grinding following manufacturer's instructions.
- .2 Graffiti-resistant coating: one component, water-based, non-sacrificial, clear penetrating sealer and liquid repellent.
- .3 Acceptable products: Fabrikem Fabrishield Paint Repellent PR-61 for clay brick.
- .4 Or approved equal

Part 3 Execution

3.1 PREPARATION

- .1 Prepare and clean substrate surfaces in accordance with coating manufacturer's instructions.
- .2 Mix and prepare coatings to manufacturer's instructions.
- .3 Take moisture tests on substrate to receive coating to ensure moisture levels are within limits specified by manufacturer.

3.2 APPLICATION

- .1 Apply coating using low pressure spraying apparatus, at recommended coverage rate for product and substrate.

- .2 Apply uniform, even coat to fully wet substrate, without flooding or rundowns.
- .3 Allow area to dry completely before applying additional coats.

3.3 SCHEDULE

- .1 Apply graffiti-resistant coating to clay brick.

Part 4 Measurement and Payment

4.1 METHOD OF MEASUREMENT AND PAYMENT

- .1 Graffiti-Resistant Coatings

The supply and installation of graffiti-resistant coatings shall be considered incidental to the Contract Lump Sum Price for “Building Construction”.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 07 84 00 – Firestopping
 - .2 Section 09 22 16 – Non-Structural Metal Framing
 - 1.2 Reference Standards
 - .1 National Fire Protection Association (NFPA):
 - .1 NFPA 10-2022, Standard for Portable Fire Extinguishers
 - .2 ULC Standards (ULC):
 - .1 CAN/ULC-S115:2023, Standard Method of Fire Tests of Firestop Systems
 - .2 CAN/ULC-S503:25, Standard for Carbon-Dioxide Fire Extinguishers
 - .3 CAN/ULC-S504-12-R2018, Standard for Dry Chemical Fire Extinguishers
 - .4 CAN/ULC-S507:2025, Standard for Water Fire Extinguishers
 - .5 CAN/ULC-S508:2023, Standard for the Rating and Fire Testing of Fire Extinguishers
 - .6 CAN/ULC-S532-2007-R2023, Standard for the Regulation of the Servicing of Portable Fire Extinguishers
 - .7 CAN/ULC-S554:2016, Standard for Water Based Agent Fire Extinguishers
 - .8 CAN/ULC-S566:2025, Standard for Halocarbon Clean Agent Fire Extinguishers
 - 1.3 Action and Informational Submittals
 - .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data: Submit manufacturer’s product literature and data sheets. Include product characteristics, performance criteria, listed temperature range, dimensions, colours, finishes, and limitations.
 - .1 Portable fire extinguishers: Indicate capacity.
 - .2 Extinguisher Cabinets in Fire-Resistance Rated Walls: Indicate listing by organization acceptable to the authority having jurisdiction (AHJ).
-

- .3 Shop Drawings: Submit schedule of portable fire extinguisher types, extinguisher cabinet types, finishes, accessories, and dimension from finished floor to top of portable fire extinguisher for each room/area.
 - .4 Manufacturers' Instructions: Submit manufacturer's installation instructions, special handling criteria, and recommendations for owner's regular inspection and testing of portable fire extinguishers.
 - .5 Qualification Statements: When requested, submit evidence of installer's qualifications.
- 1.4 Closeout Submittals
- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals, and as follows:
 - .1 Operation and Maintenance Data: Submit portable fire extinguisher manufacturer's instruction manual describing installation, operation, inspection, and maintenance; refill or recharge schedules; and re-certification requirements.
 - .2 Submit a permanent file record in accordance with NFPA 10 for each portable fire extinguisher with the following information:
 - .1 Maintenance date and name of person and agency performing the maintenance, if applicable.
 - .2 Date of the last recharge and name of person and agency performing the recharge, if applicable.
 - .3 Hydrostatic retest date and name of person and agency performing the hydrostatic test, if applicable.
 - .4 Description of dents remaining after passing of the hydrostatic test, if applicable.
 - .2 Warranty Documentation: Submit manufacturer's warranties.
- 1.5 Maintenance Material Submittals
- .1 Space Parts: Supply one extra key for each type of lockable extinguisher cabinet. Label keys with the associated room identification number.
- 1.6 Quality Assurance
- .1 Qualifications:
 - .1 Manufacturers: Provide all extinguisher cabinets of the same type from a single manufacturer.
-

- .2 Installer: Holding an approval certificate of training from a public post-secondary educational institution, and employed by an agency that is certified annually by a recognized certification body as being compliant with CAN/ULC-S532.

1.7 Delivery, Storage, and Handling

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements, and as follows:
 - .1 Package and handle extinguisher cabinets to avoid scratching paint and glazed materials. Store extinguisher cabinets to avoid corrosion and portable fire extinguishers to avoid freezing.
 - .2 Maintain portable fire extinguishers in operating condition.

1.8 Site Conditions

- .1 Ambient Conditions: Install portable fire extinguishers after indoor temperatures are maintained within manufacturer's recommended range.

1.9 Warranty

- .1 Manufacturer's Warranty: Warranty portable fire extinguishers against defects in materials and fabrication for three years.

2. PRODUCTS

2.1 Description

- .1 Regulatory Requirements: Provide portable fire extinguishers that are listed and labelled in accordance with National Fire Code 2020, and conform to CAN/ULC-S508.
- .2 Portable fire extinguishers and extinguisher cabinets marked in accordance with recommendations of NFPA 10 and CAN/ULC-S508 including the following:
 - .1 Listing and labeling organization of extinguisher.
 - .2 Protect category, type of extinguisher.
 - .3 Extinguisher classification.
 - .4 Performance and fire test standards of extinguisher.

2.2 Portable Fire Extinguishers

- .1 Multi-Purpose Dry Chemical Extinguishers: To CAN/ULC-S504, stored pressure rechargeable type with hose and shut-off nozzle, brass valve, ULC listed.
 - .1 ULC Classification: Class A, B, and C fires.
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- .2 Capacity: As indicated on Drawings.
- .3 Cylinder Finish: Polyester powder coat paint, red colour.
- 2.3 Accessories
 - .1 Extinguisher Hangers: To NFPA 10, factory fabricated, type recommended by extinguisher manufacturer, steel with polyester powder coat paint or stainless steel.
- 2.4 Identification
 - .1 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for future service dates on tag/label. A bar coding system may be used if acceptable to AHJ.
- 3. EXECUTION
- 3.1 Installation
 - .1 Mount portable fire extinguishers in cabinets and on brackets at locations indicated on Drawings and in accordance with NFPA 10.
 - .1 Place portable fire extinguisher with operating instruction label facing outward. Do not obstruct the view of the operating instructions label with maintenance labels, test labels, or other labels.
- 3.2 Cleaning
 - .1 Perform in accordance with Section 01 74 00 – Cleaning, and as follows:
 - .1 Remove fingerprints from extinguisher cabinets and clean glazing.

END OF SECTION

- 1. GENERAL
 - 1.1 Related Requirements
 - .1 Division 09 - Interior Painting
 - .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
 - 1.2 Reference Standards
 - 1.3 Administrative Requirements
 - .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning on-site installation, with contractor's representative and Consultant in accordance with Division 01 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.
 - 1.4 Action and Informational Submittals
 - .1 Submit in accordance with Division 01 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit a copy of WHMIS SDS in accordance with Division 01 - Health and Safety Requirements.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details, accessories, mounting arrangements, operating and maintenance clearances.
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- .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.
 - .4 Instructions: submit manufacturer's installation instructions.
 - .5 Manufacturers' Field Reports: manufacturers' field reports specified.
 - 1.5 Closeout Submittals
 - .1 Submit in accordance with Division 01 - Closeout Submittals.
 - .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
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- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .5 Approvals:
 - .1 Submit a copy of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
 - .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .7 Site records:
 - .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
 - .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Consultant for approval and make corrections as directed.
-

- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
 - .9 Submit copies of as-built drawings for inclusion in final TAB report.
 - 1.6 Maintenance Material Submittals
 - .1 Submit in accordance with Section Division 01 - 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 glass for each gauge glass.
 - .4 One spare regenerating valve for each type of water softener.
 - .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
 - .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.
 - 1.7 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section Division 01 - 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 and in a dry location and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - 2. PRODUCTS
 - .1 Not Used.
-

- 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 Consultant.
 - .2 Inform Consultant 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 Consultant.
 - 3.2 Painting Repairs and Restoration
 - .1 Do painting in accordance with Division 01 - 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 Sealing Mechanical Penetrations
 - .1 Fire-rated walls: Seal penetrations through fire-rated walls using intumescent fire-rated sleeves to maintain the integrity of fire separation.
 - .2 Exterior Walls: Seal penetrations through exterior walls using water resistive barrier or with a self-adhering membrane to maintain thermal barrier and prevent moisture ingress.
 - .3 Roofs: Seal penetrations through roof using metal flashings on all surfaces such as cant edges, sleepers and cap type, wall junctions, roof dividers, roof control joints, and as otherwise are required to provide flashing type protection to details. Unless otherwise directed extend all flashings down to 10 mm above the horizontal portion of the roof. Additionally, install counter and base flashings unless otherwise directed by the Consultant.
 - 3.4 System Cleaning
 - .1 Clean interior and exterior of all systems including strainers.
 - 3.5 Field Quality Control
 - .1 Site Tests: conduct following tests in accordance with Section Division 01 - Quality Control and submit report as described in PART 1 -ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 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 - ACTION AND INFORMATIONAL 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.

3.6 Demonstration

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Water meter, strainer and backflow preventer.
 - .2 Seal water assemblies.
- .3 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.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Consultant will record these demonstrations on video tape for future reference.

3.7 Closeout Activities

- .1 Commissioning Reports: in accordance with Section 22 08 00 - Commissioning of Plumbing.
- .2 Training: provide training in accordance with Section 22 08 00 - Commissioning of Plumbing.

3.8 Cleaning

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

3.9 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- .3 Repair damage to adjacent materials caused by installation.

END OF SECTION

1. GENERAL
 - 1.1 Summary
 - .1 This Section includes requirements for selective demolition and removal of plumbing, sprinkler systems and related mechanical components and incidentals required to complete work described in this Section ready for new construction.
 - 1.2 Related Requirements
 - .1 Section 02 41 13 - Selective Site Demolition
 - .2 Section 02 41 16 - Structure Demolition
 - .3 Section 02 41 19.13 - Selective Building Demolition
 - .4 Section 02 41 19.16 - Selective Interior Demolition
 - .5 Section 02 41 00.08 - Demolition - Minor Works
 - .6 Section 02 42 00 - Removal and Salvage of Construction Materials
 - .7 Section 02 81 00 - Hazardous Materials
 - .8 Section 02 82 00.02 - Asbestos Abatement - Intermediate Precautions
 - .9 Section 22 05 00 - Common Work Results for Plumbing
 - 1.3 Definitions
 - .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
 - .2 Remove: Planned deconstruction and disassembly of plumbing items from existing construction taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
 - .3 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
 - .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
 - .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
-

- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCBs, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.
 - 1.4 Reference Standards
 - .1 CSA Group (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
 - 1.5 Action and Informational Submittals
 - .1 Provide submittals in accordance with 22 05 00 – Common Work Results for Plumbing.
 - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 - 1.6 Administrative Requirements
 - .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
 - .2 Scheduling: Account for Owner's continued occupancy requirements during selective demolition with and schedule staged occupancy and worksite activities as a defined
 - 1.7 Quality Assurance
 - .1 Regulatory Requirements: Perform work of this Section in accordance with the following:
 - .1 Provincial/Territorial Workers' Compensation Boards/Commissions.
 - .2 Provincial/Territorial Occupational Health and Safety Standards and Programs.
 - 1.8 Site Conditions
 - .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
 - .2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Consultant if materials suspected of containing hazardous substances are encountered and perform the following activities:
 - .1 Refer to Division 01 - Regulatory Requirements for directives associated with specific material types.
-

- .2 Hazardous substances will be as defined in the Hazardous Products Act.
- .3 Stop work in the area of the suspected hazardous substances.
- .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
- .5 Hazardous substances will be removed by Contractor under a separate contract or as a change to the Work.
- .6 Proceed only after written instructions have been received from Consultant.

1.9 Salvage and Debris Materials

- .1 Demolished items become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Owner's property.

2. PRODUCTS

2.1 Materials

- .1 General Patching and Repair Materials: Refer to Division 02 - Selective Building Demolition and Division 02 - Selective Interior Demolition for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 Plumbing Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction
- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

3. EXECUTION

3.1 Examination

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Consultant will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.
-

3.2 Preparation

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify Consultant and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Owner and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify Consultant and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 Execution

- .1 Demolition and Removal: Coordinate requirements of this Section with information contained Division 02 - Selective Building Demolition and Division 02 - Selective Interior Demolition and as follows:
 - .1 Disconnect and cap mechanical services in accordance with requirements of local Authority Having Jurisdiction.
 - .2 Do not disrupt active utilities without the approval of the Owner.
 - .3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
 - .4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.
 - .5 At end of each day's work, leave worksite in safe condition.
 - .6 Perform demolition work in a neat and workmanlike manner:
-

- .1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
- .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

3.4 Closeout Activities

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Division 02 - Removal and Salvage of Construction Materials.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 22 05 00 - Common Work Results for Plumbing
 - 1.2 Reference Standards
 - .1 ASTM International (ASTM)
 - .1 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .2 American Water Works Association (AWWA)
 - .1 ANSI/AWWA C700-20, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
 - .3 CSA Group (CSA)
 - .1 CSA-B64 Series-21, Backflow Preventers and Vacuum Breakers.
 - .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.4 Closeout Submittals
 - .1 Submit in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.5 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 2. PRODUCTS
 - 2.1 Back Flow Preventers
 - .1 Domestic water back flow preventers: severe hazard reduced pressure backflow preventer to CSA-B64 Series, double check valve assembly back flow preventer with intermediate atmospheric vent or vacuum breaker.
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- .2 Make and Model: Watts LF909 or equivalent.
 - 2.2 Vacuum Breakers
 - .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.
 - 2.3 Pressure Regulators
 - .1 Capacity: to suit service.
 - .1 Inlet pressure: 1034 kPa.
 - .2 Outlet pressure: 413 kPa.
 - .2 Bronze bodies, screwed: to ASTM B62
 - .3 Semi-steel spring chambers with bronze trim.
 - .4 Make and Model: Watts LF5UB or equivalent.
 - 2.4 Interior 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.
 - 2.5 Water Meters
 - .1 Displacement type to ANSI/AWWA C700.
 - .2 Capacity: to suit service.
 - 2.6 Strainers
 - .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
 - .2 Bronze body, screwed ends, with brass cap.
 - .3 Make and Model: Watts LF351 or equivalent.
 - 2.7 Solenoid Valve
 - .1 Pilot operated 2-position normally closed.
 - .2 Stainless steel body, screwed ends, PTFE seals, 120 volt AC, 60 Hz actuator.
 - .3 Makes and Model: ASCO Series 210 or equivalent.
-

- 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 Install in accordance with National Plumbing Code of Canada (NPC), provincial codes, and local authority having jurisdiction.
 - .2 Install in accordance with manufacturer's instructions and as specified.
 - 3.3 Back Flow Preventers
 - .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
 - .2 Pipe discharge to sump pit.
 - 3.4 Interior Hose Bibbs and Sediment Faucets
 - .1 Install at bottom of risers, at low points to drain systems, and as indicated.
 - 3.5 Strainers
 - .1 Install with sufficient room to remove basket for maintenance.
 - 3.6 Water Meters
 - .1 Install water meter as indicated.
 - 3.7 Solenoid Valves
 - .1 Install solenoid valves as indicated.
 - 3.8 Start-up
 - .1 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.
 - .4 Water treatment systems operational.
 - .2 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 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
 - .3 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
 - .4 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.
 - .5 Pressure regulators, PRV assemblies:
 - .1 Adjust settings to suit locations, flow rates, pressure conditions.
 - .6 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.
 - .7 Hose bibbs, sediment faucets:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.
-

- .8 Water meters:
 - .1 Verify location and accessibility.
 - .2 Test meter reading accuracy.
- .9 Solenoid Valves:
 - .1 Verify operation of actuator and valve.
- 3.10 Closeout Activities
 - .1 Perform closeout activities in accordance with Section 22 05 00 - Common Work Results for Plumbing.
- 3.11 Cleaning
 - .1 Perform cleaning in accordance with Section 22 05 00 - Common Work Results for Plumbing.

END OF SECTION

- 1. GENERAL
 - 1.1 Related Requirements
 - .1 Division 07 - Firestopping
 - .2 Division 09 - Joint Sealants
 - .3 Section 22 05 00 - Common Work Results for Plumbing
 - .4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
 - 1.2 Definitions
 - .1 For the purposes of this Section:
 - .1 Concealed means insulated mechanical services in suspended ceilings, or in non-accessible chases, or in furred-in spaces.
 - .2 Exposed means not concealed.
 - .3 Jacketing is synonymous with insulation cladding and lagging.
 - .4 Mineral fibre is synonymous with glass fibre, rock wool, or slag wool.
 - 1.3 Reference Standards
 - .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IES 90.1-2022, Energy Standard for Buildings Except Low-Rise Residential Buildings
 - .2 ASTM International (ASTM):
 - .1 ASTM C335/C335M-17, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
 - .2 ASTM C411-19, Standard Specification for Hot-Surface Performance of High-Temperature Thermal Insulation
 - .3 ASTM C449/C449M-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .4 ASTM C533-17, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
 - .5 ASTM C547-22a, Standard Specification for Mineral Fiber Pipe Insulation
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- .6 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
 - .7 ASTM C1136-21, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
 - .8 ASTM C1729-21, Standard Specification for Aluminum Jacketing for Insulation
 - .9 ASTM C1767M-21, Standard Specification for Stainless Steel Jacketing for Insulation
 - .3 Midwest Insulation Contractors Association (MICA):
 - .1 North American Commercial and Industrial Insulation Standards (NACIIS) Manual, 9th edition
 - .4 ULC Standards (ULC):
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC-S702.1-14, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.5 Quality Assurance
 - .1 Qualifications:
 - .1 Installer: Specialist in performing work of this Section with at least three years successful experience in this type and size of project.
 - 1.6 Closeout Submittals
 - .1 Submit in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.7 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 22 05 00 – Common Work Results for Plumbing.
-

2. PRODUCTS

2.1 Description

.1 Regulatory Requirements:

.1 Combustible piping materials, including adhesives in accordance with CAN/ULC-S102:

.1 Flame-spread rating: Maximum 25.

.2 Smoke developed classification: Maximum 50.

2.2 Insulation

.1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.

.2 Type 1: Rigid moulded mineral fibre with factory-applied vapour retarder jacketing.

.1 Mineral fibre: To ASTM C547.

.2 Maximum "k" factor: 0.035 W/m×°C.

.3 Service Temperature: up to 150°C.

.3 Type 2: Glass mineral wool with factory-applied vapour retarder jacketing.

.1 Mineral fibre: To ASTM C547.

.2 Maximum "k" factor: 0.035 W/m×°C.

.3 Service Temperature: -40°C to 100°C.

.4 Type 3: Rigid moulded hydrous calcium silicate

.1 Insulation: To ASTM C533-17

.2 Maximum "k" factor: 0.058 W/m×°C.

.3 Service Temperature: up to 750°C.

.5 Type 4: Buried insulation, elastomeric closed cell

.1 Insulation: To ASTM C534, ASTM C411

.2 Maximum "k" factor: 0.036 W/m×°C.

.3 Service Temperature: -183°C to 125°C

- .6 Type 5: Flexible unicellular tubular elastomer.
 - .1 Insulation: With vapour retarder jacket.
 - .2 Maximum "k" factor: 0.040 W/m×°C
 - .3 Certified by manufacturer as free of potential stress corrosion cracking corrosive substances.
 - 2.3 Jacketing
 - .1 Polyvinyl Chloride (PVC) Jacketing:
 - .1 One-piece moulded type, in accordance with ASTM C921, with pre-formed shapes as required.
 - .2 Colours: As selected by Consultant from manufacturer's standard colour range.
 - .3 Minimum service temperature: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: Maximum 0.02 perm.
 - .6 Thickness: 0.38 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Pressure sensitive vinyl tape in matching colour.
 - .8 Covering adhesive: Compatible with insulation.
 - .2 ABS Plastic Jacketing:
 - .1 One-piece moulded type, in accordance with ASTM C921, with pre-formed shapes as required.
 - .2 Colours: As selected by Consultant from manufacturer's standard colour range.
 - .3 Minimum service temperature: -40°C.
 - .4 Maximum service temperature: 82°C.
 - .5 Moisture vapour transmission: Minimum 0.012 perm.
 - .6 Thickness: Minimum 0.75 mm.
 - .7 Fastenings:
-

- .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Pressure sensitive vinyl tape in matching colour.
 - .8 Locations:
 - .1 For outdoor use only.
 - .3 Canvas Jacketing: 220 g/m² cotton, plain weave, and treated with diluted fire retardant.
 - .1 Lagging adhesive: Compatible with insulation.
 - .4 Aluminum Jacketing: To ASTM C1729.
 - .1 Thickness: Minimum 0.50 mm sheet. Thickness based on the outer diameter of the insulation in accordance with ASTM C1729.
 - .2 Finish: As selected by Consultant from manufacturer's finishes.
 - .3 Joining: Longitudinal and circumferential slip joints with 50-mm laps.
 - .4 Fittings: Minimum 0.5 mm-thick die-shaped fitting covers with factory-attached protective liner.
 - .5 Jacket banding and mechanical seals: Stainless steel, 19 mm wide, minimum 0.5 mm thick at 300 mm spacing.
 - .6 Jacketing elbows: Factory fabricated, same material as adjacent straight jacketing, 2-piece, smooth finish.
 - 2.4 Accessories
 - .1 Weatherproof Sealant for Jackets Installed Outdoors: In accordance with Division 07 - Joint Sealants.
 - .2 Tape: Self-adhesive, aluminum, plain, minimum 50 mm wide.
 - .3 Contact Adhesive: Quick setting type.
 - .4 Canvas Adhesive: Washable.
 - .5 Tie Wire: Stainless steel, minimum 1.5 mm diameter.
 - .6 Bands: Stainless steel, 19 mm wide, minimum 0.5 mm thick.
 - .7 Thermal Insulating and Finishing Cement: To ASTM C449, air drying type, on mineral wool.
 - .8 Vapour Retarder Lap Adhesive: Water-based and fire retardant type, compatible with insulation.
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- .9 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
 - .10 Outdoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
 - 3. EXECUTION
 - 3.1 Preparation
 - .1 Verify that pressure testing of piping systems and adjacent equipment is complete, witnessed, and certified.
 - .2 Verify that surfaces are clean, dry, and free from foreign material.
 - 3.2 Installation
 - .1 Install to manufacturer's instructions and in accordance with MICA, NACIIS Manual.
 - .2 Provide two layers of insulation with staggered joints when required nominal wall thickness exceeds 75 mm.
 - .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .4 Install piping insulation continuous through wall and ceiling openings and sleeves, except where firestopping is required. Coordinate with Division 07 – Firestopping.
 - .5 Supports and Hangers:
 - .1 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .2 Install hangars and supports outside vapour retarder jacket.
 - .3 Apply high compressive strength insulation that is suitable for piping service at oversized saddles and shoes where insulation saddles have not been provided.
 - .6 Insulate 3 m portion of sanitary vents measured from roof outlet back.
 - .7 Insulate 3 m portion of storm sewer piping measured from point of entry at roof.
 - 3.3 Installation – Removable Pre-fabricated Insulation and Enclosures
 - .1 At expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.
-

- .1 Install components to permit movement of expansion joints and to permit periodic removal and replacement without damage to adjacent insulation.
- .2 Install insulation, fastenings, and finishes that are compatible with piping system.
- .3 Install PVC insulation jacketing.

3.4 Installation – Elastomeric Insulation

- .1 Insulation to remain dry.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 Piping Insulation Schedule

- .1 Includes valves, valve bonnets, strainers, flanges, and fittings, unless otherwise specified.
- .2 Securements: Tape at 300 mm on centre.
- .3 Seals: Vapour retarder lap seal adhesive, vapour retarder lagging adhesive.
- .4 Provide insulation thickness as listed in the following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.
 - .3 Insulation thickness (mm):

Application	Piping Insulation Type	Run-out	Pipe sizes (NPS) to 1	Pipe sizes (NPS) 1 1/4 to 2	Pipe sizes (NPS) 2 1/2 to 4	Pipe sizes (NPS) 5 & over
Domestic Hot Water and Recirculation	Type 1	25 mm	25 mm	25 mm	38 mm	38 mm
Domestic Cold Water	Type 2	12 mm	25 mm	25 mm	25 mm	25 mm
Buried Domestic Water	Type 4	38 mm	64 mm	64 mm	76 mm	89 mm
Domestic Water in Unconditioned Spaces	Type 2	38 mm	64 mm	64 mm	76 mm	89 mm
Sanitary Vents	Type 2	25 mm	25 mm	25 mm	25 mm	25 mm
Storm and Sanitary in Unconditioned Spaces	Type 2	25 mm	25 mm	25 mm	25 mm	25 mm

Emergency Generator Exhaust	Type 3	75 mm	75 mm	100 mm	100 mm	100 mm
Refrigerant	Type 5	25 mm	25 mm	38 mm	38 mm	38 mm

.5 Emergency generator exhaust insulation includes mufflers, catalytic converters, and all associated piping.

.1 Do not insulate flexible belows, sensors, drains or test ports.

.6 Finishes:

.1 Emergency Generator Exhaust: Aluminum.

.2 Exposed indoors: Canvas.

.3 Concealed, indoors: Canvas on valves, fittings. No additional finish.

.4 Outdoors, above grade: Aluminum jacketing.

.5 Outdoors, below grade: Waterproof ABS jacketing.

.6 Finish attachments: Stainless steel bands, at 150 mm on centre.

.7 Seals: Closed.

.7 Provide heat tracing cable beneath insulation on water, sanitary and storm piping in unconditioned spaces, including unconditioned crawlspaces, in accordance with Section 23 05 33 - Heat Tracing for Piping.

3.6 Cleaning

.1 Perform cleaning in accordance with Section 22 05 00 - Common Work Results for Plumbing.

END OF SECTION

1. GENERAL
 - 1.1 Summary
 - .1 Section Includes: Materials and installation for plumbing pumps.
 - 1.2 Related Requirements
 - .1 Section 22 05 00 - Common Work Results for Plumbing.
 - .2 Section 23 05 13 - Common Motor Requirements.
 - 1.3 Reference Standards
 - .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.5 Closeout Submittals
 - .1 Submit in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.6 Quality Assurance
 - .1 Health and Safety: Do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.
 - 1.7 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 2. PRODUCTS
 - 2.1 Sump Pump Submersible
 - .1 Capacity: as indicated.
 - .2 Construction: simplex CSA approved, housing epoxy coated cast-iron, stainless-steel shaft, non-clog bronze impeller, mechanical shaft seal.
 - .3 Motor: as indicated, hermetically sealed, with automatic overload protection.
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- .4 Control: buoyant case and switch.

- 3. EXECUTION

- 3.1 Installation

 - .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
 - .2 Ensure pump and motor assembly do not support piping.
 - .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

- 3.2 Site Quality Control

 - .1 Site Tests/Inspection:
 - .1 Check power supply.
 - .2 Check starter protective devices.
 - .2 Start-up, check for proper and safe operation.
 - .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
 - .4 Adjust flow from water-cooled bearings.
 - .5 Adjust impeller shaft stuffing boxes, packing glands.

- 3.3 Cleaning

 - .1 Perform cleaning in accordance with Section 22 05 00 - Common Work Results for Plumbing.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 22 05 00 - Common Work Results for Plumbing
 - .2 Section 23 05 15 - Common Installation Requirements for HVAC Pipework
 - .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
 - .4 Section 22 31 16 - Domestic Water Softeners
 - .5 Division 33 - Site Water Utility Distribution Piping
 - .6 Division 33 - Incoming Site Water Utility Distribution Piping
 - 1.2 Reference Standards
 - .1 American Society of Mechanical Engineers International (ASME):
 - .1 ANSI/ASME B16.15-2024, Cast Copper Alloy Threaded Fittings, Classes 125 and 250
 - .2 ANSI/ASME B16.18-2021, Cast Copper Alloy Solder Joint Pressure Fittings
 - .3 ANSI/ASME B16.22-2021, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - .4 ANSI/ASME B16.24-2021, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500
 - .2 ASTM International (ASTM):
 - .1 ASTM D2467-24, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - .2 ASTM A269/A269M-25, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
 - .3 ASTM A403/A403M-25, Wrought Austenitic Stainless Steel Piping Fittings
 - .4 ASTM B88M-20, Standard Specification for Seamless Copper Water Tube (Metric)
 - .3 CSA Group (CSA):
 - .1 CSA B137.6-23, Chlorinated polyvinylchloride (CPVC) pipe, tubing, and fittings for hot-and cold-water distribution systems
-

- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
 - .5 National Research Council (NRC):
 - .1 National Plumbing Code of Canada (NPC) 2020
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.4 Closeout Submittals
 - .1 Submit in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 2. PRODUCTS
 - 2.1 Piping
 - .1 Domestic cold-water systems, within building.
 - .1 Poly vinyl chloride (PV) plastic pipe, schedule 80: to ASTM D2467
 - .2 Copper tube, hard drawn, type L: to ASTM B88M
 - .2 Seal water systems.
 - .1 Stainless steel (SS) 316/316L seamless tubing, schedule 80: to ASTM A269/A269M
 - 2.2 Fittings
 - .1 Poly vinyl chloride (PV) plastic fittings, schedule 80: to ASTM D2467
 - .2 Stainless steel (SS) 316/316L butt weld, schedule 80: to ASTM A403/A403M
 - .3 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24
 - .4 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15
 - .5 Cast copper, solder type: to ANSI/ASME B16.18
 - .6 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22
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2.3 Joints

- .1 Teflon tape: for threaded joints.
- .2 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.
- .3 PVC pipe solvent cement: to CSA B137.6
- .4 Stainless steel (SS) 316/316L butt weld, schedule 80: to ASTM A403/A403M
- .5 Solder: 95/5 tin copper alloy.

2.4 Ball Valves

- .1 Poly vinyl chloride (PV) plastic pipe:
 - .1 To ASTM D2467.
 - .2 PVC body, PVC ball, EDPM packing, EDPM seat, and ABS handle.
- .2 Stainless steel (SS) 316/316L tubing:
 - .1 Stainless steel body, ball and stem, PTFE packing and seat, stainless steel handle.

3. EXECUTION

3.1 Installation

- .1 Install in accordance with NPC and local authority having jurisdiction.
 - .2 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
 - .3 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
 - .4 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.
 - .5 Valves:
 - .1 Isolate equipment, fixtures and branches with ball valves.
-

3.2 Pressure Tests

- .1 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.

3.3 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.

3.4 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.

3.5 Disinfection

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
- .2 Coordinate with Division 33 - Site Water Utility Distribution Piping and Division 33 - Incoming Site Water Utility Distribution Piping.
- .3 Upon completion, provide laboratory test reports on water quality for Consultant approval.

3.6 Start-up

- .1 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.
 - .2 Provide continuous supervision during start-up.
 - .3 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 Bring DWH storage tank up to design temperature slowly.
 - .4 Monitor piping systems for freedom of movement, pipe expansion as designed.
 - .5 Check control, limit, safety devices for normal and safe operation.
 - .4 Rectify start-up deficiencies.
- 3.7 Performance Verification
- .1 Scheduling:
 - .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 Sterilize domestic water systems for Legionella control.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.
 - .6 Check for proper operation of water hammer arrestors. For each washroom run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .7 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.
- 3.8 Operation Requirements
- .1 Coordinate operation and maintenance requirements including cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.
-

- .2 Operational requirements in accordance with Section 22 05 00 - Common Work Results for Plumbing, include:
 - .1 Cleaning materials and schedules.
 - .2 Repair and maintenance materials and instructions.
- 3.9 Cleaning
 - .1 Perform cleaning in accordance with Section 22 05 00 - Common Work Results for Plumbing.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 22 05 00 - Common Work Results for Plumbing.
 - 1.2 Reference Standards
 - .1 ASTM International (ASTM)
 - .1 ASTM D2564-20, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
 - .2 The American Society of Mechanical Engineers (ASME)
 - .3 CSA Group (CSA)
 - .1 CAN/CSA-Series B1800-21, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
 - .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.4 Closeout Submittals
 - .1 Submit in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 - 1.5 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 22 05 00 – Common Work Results for Plumbing.
 2. PRODUCTS
 - 2.1 Plastic Pipe and Fittings
 - .1 Sanitary drainage: Schedule 40 PVC DWV piping to CAN/CSA B1800.
 - .1 Joints:
 - .1 Solvent weld for PVC: to ASTM D2564
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- .2 Sight glass: Clear Schedule 40 PVC DWV piping to CAN/CSA B1800.
 - .1 Joints:
 - .1 Solvent weld for PVC: to ASTM D2564
- 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 National Plumbing Code and local authority having jurisdiction.
- 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 that cleanout rods can probe as far as the next cleanout, at least.
 - .2 Test to ensure traps are fully and permanently primed.
 - .3 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).
- 3.5 Cleaning
 - .1 Perform cleaning in accordance with Section 22 05 00 - Common Work Results for Plumbing.

END OF SECTION

- 1. GENERAL
- 1.1 Use of Systems
 - .1 Use of new and or existing permanent heating, cooling, and or ventilating systems for supplying temporary heat or ventilation is not permitted.
- 2. PRODUCTS
 - .1 Not Used.
- 3. EXECUTION
 - .1 Not Used.

END OF SECTION

- 1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC.
 - 1.2 Definitions
 - .1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:
 - .1 Rigid supply and return ductwork;
 - .2 Flexible ductwork;
 - .3 Mixing plenum boxes;
 - .4 Return air plenums including ceiling plenums;
 - .5 Cooling and heating coils and compartments;
 - .6 Condensate drain pans, eliminator blades and humidifiers;
 - .7 Fans, fan blades and fan housing;
 - .8 Filter housing and frames;
 - .9 Acoustically insulated duct linings;
 - .10 Diffusers, registers and terminal units;
 - .11 Dampers and controls;
 - 1.3 Reference Standards
 - .1 National Air Duct Cleaners Association (NADCA)
 - .1 ACR Standard, 2021 edition: Assessment, Cleaning and Restoration of HVAC Systems.
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Closeout Submittals
 - .1 Submit in accordance with Section 23 05 00 – Common Work Results for HVAC.
-

- .2 Post Cleaning Inspection Report: submit 4 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
 - .1 Name and address of facility;
 - .2 Name and address of HVAC cleaning contractor;
 - .3 Description of HVAC systems with identifying systems cleaned;
 - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
 - .5 Comments complete with photographs of each sampling location and other observed system features;
 - .6 Identify systems tested, observations, actions taken and recommendations for future maintenance.

 - 1.6 Extra Materials
 - .1 Extra Stock Materials:
 - .1 Supply 4 extra filter sets for each HVAC System cleaned.
 - .2 Ensure filters are correct match, size, type and configuration of existing HVAC Systems.

 - 1.7 Quality Assurance
 - .1 Contractor: Verification of membership in NADCA.
 - .2 Project Co-ordinator: Air System Cleaning Specialist (ASCS) certified by NADCA on full time basis.

 - 2. PRODUCTS

 - 2.1 Access Doors and Panels
 - .1 Equipment Access Doors and Panels: construct from same materials as equipment panelling complete with sealing gasket and positive locking device.
 - .1 Size access doors and panels in equipment to allow for inspection and cleaning.
 - .2 Ductwork Access Doors: construct access doors from 1.27 mm minimum galvanized sheet steel with gasketed seal.
 - .1 Ensure access door is 25 mm greater in every dimension than access opening.
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- .2 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.
 - 2.2 System Filters
 - .1 Supply and install new filters for each HVAC System cleaned.
 - 2.3 Air Duct Cleaning Equipment
 - .1 Manually propelled full contact brushes:
 - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
 - .1 Ensure brushes are sized to fit various duct sizes in HVAC system.
 - .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
 - .2 Brushes: manually propelled with integrally-mounted drive and nylon, polypropylene, or other non-metallic material bristles.
 - .1 Ensure drive has capacity to continue to push brush after bristles are distorted.
 - .2 Replace worn and ineffective brushes when required.
 - 2.4 HEPA Filter Evacuation Fan
 - .1 Evacuation Fan: includes fan, HEPA filter, flexible hose and motor capable of maintaining debris and particulates airborne in airstream until they reach evacuation fan and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain evacuation fan and HEPA filter to run efficiently.
 - 2.5 HEPA Vacuum Unit
 - .1 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.
 - 3. EXECUTION
 - 3.1 Preparation
 - .1 Close down HVAC system.
-

- .2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
 - .1 Control devices;
 - .2 Fire and smoke control dampers;
 - .3 Balancing dampers: indicate and record positions for resetting;
 - .4 Air volume control boxes: indicate and record positions for resetting;
 - .5 Fire alarm devices;
 - .6 Monitoring devices and controls;
 - .3 Cut openings in equipment panels and ductwork for access to system interior.
 - .1 Square or rectangular opening sizes: 200 mm minimum each side.
 - .2 Circular opening sizes: 200 mm minimum diameter.
 - .4 Installation of Access Doors in Ductwork: install access doors in ductwork where required to facilitate system inspection and cleaning.
 - .1 Install access doors for inspection and cleaning of equipment as follows:
 - .1 Heating and cooling coils;
 - .2 Fan units;
 - .3 Filters;
 - .4 Dampers;
 - .5 Sensors;
 - .2 Access door installation is not permitted in flexible ductwork.
 - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.
 - .5 Remove and reinstall ceiling tiles and panels to gain access to HVAC system as required.
 - .1 Replace ceiling tiles and panels damaged or soiled by air duct cleaning procedures.
-

- 3.2 Examination/Pre-Cleaning Inspection
 - .1 Verification of Conditions:
 - .1 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.
 - .2 Evaluation and Assessment:
 - .1 Identify location and type of internal components.
 - .2 Identify extent of potential problems.
 - 3.3 Duct Cleaning
 - .1 Do duct cleaning in accordance with NADCAACR Standard
 - .2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zones which has already been cleaned.
 - .1 Isolate zone of duct using closed-cell polyurethane foam or air inflated zone bag before cleaning.
 - .3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.
 - .4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.
 - .5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square meter.
 - .6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square meter.
 - .7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.
 - .1 Pass brushes through sections as often as necessary to achieve required cleanliness.
 - .2 Change brush sizes as required to ensure positive contact with duct and component interiors.
 - .3 Clean corners and pockets where dirt and debris can accumulate.
 - .8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.
 - .9 Clean diffusers, registers, louvers, and other terminal units.
-

- .10 Advise Consultant 72 hours minimum before deactivation of fire alarm and smoke detectors for duct cleaning operations.
 - 3.4 Components and Equipment Cleaning
 - .1 Brush and vacuum coils, humidifiers, air handling unit enclosures, and heat exchanger surfaces to achieve required cleanliness.
 - .2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Consultant for cleaning.
 - .1 Pressure wash with water and cleaning solution until required cleanliness is achieved.
 - .2 Clean equipment and components in place only if there is no hazard to adjacent materials.
 - .3 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows and only after written approval from Consultant:
 - .1 Fan blades;
 - .2 Dampers;
 - .3 Turning vanes;
 - .4 Controls;
 - .5 Sensor bulbs;
 - .6 Fire alarms;
 - .7 Smoke detectors;
 - 3.5 Field Quality Control/Final Inspections
 - .1 Post Cleaning Inspection: carry out final inspection using visual inspection methods after final cleaning has been completed.
 - .1 Carry out video survey as directed by Consultant.
 - .2 Include in final survey areas inspected by Contractor prior to cleaning.
 - .3 Identify on HVAC system record drawings access points used for inspection and cleaning.
 - .4 Reset components including dampers and sensors, which have been disturbed during cleaning operations.
-

3.6 System Startup

- .1 Install new system filters after cleaning operations are completed.
- .2 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.
- .3 Restart each HVAC system.

3.7 Cleaning

- .1 Perform cleaning in accordance with Section 22 05 00 - Common Work Results for Plumbing.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
 - 1.2 Action and Informational Submittals
 - .1 Submit in accordance with Division 01 - Submittal Procedures.
 - .2 Product Data: Submit manufacturer's instructions, product literature, and data sheets for products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 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.
 - 1.3 Closeout Submittals
 - .1 Submit in accordance with Division 01 - Closeout Submittals.
 - .2 Operation and Maintenance Data: submit operation and maintenance data and incorporate into manual.
 - .1 Operation and maintenance manual approved by, and final copies submitted to Consultant before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
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- .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .5 Approvals:
 - .1 Submit draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
 - .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .7 Site records:
 - .1 Consultant will provide a set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
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- .2 Transfer information to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
 - .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Consultant for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
 - .9 Submit copies of as-built drawings for inclusion in final TAB report.
 - 1.4 Maintenance Material Submittals
 - .1 Submit in accordance with Division 01 - Closeout Submittals.
 - .2 Supply spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
 - .6 One set of belts for each size of belt driven equipment.
 - .7 One fusible link for every ten fire dampers installed.
 - .8 One seat and washer for each size and type of valve.
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- .3 Supply one set of special tools required to service equipment as recommended by manufacturers.
 - .4 Supply one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.
 - 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section Division 01 - 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 and in a dry location and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - 2. PRODUCTS
 - 2.1 Materials
 - .1 HVAC Equipment:
 - .1 Refrigerant:
 - .1 HCFC based refrigerant.
 - .2 HFC based refrigerant.
 - 3. EXECUTION
 - 3.1 Examination
 - .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
-

3.2 Site Quality Control

- .1 Site Tests: conduct following tests in accordance with Division 01 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

3.3 Adjusting

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Perform painting in accordance with Division 01 - Interior Painting.
- .3 Restore finishes which have been damaged to a "like new" condition.

3.4 Cleaning

- .1 Perform cleaning of ductwork and air handling equipment in accordance with Section 23 01 31 – Air Duct Cleaning for HVAC Systems.
- .2 Progress Cleaning: clean in accordance with Section Division 01 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section Division 01 - Cleaning.

3.5 Demonstration

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
 - .2 Trial usage to apply to following equipment and systems:
 - .1 Supply and exhaust fans.
 - .2 Duct heaters.
 - .3 Unit heaters.
 - .4 Motorized dampers.
 - .3 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.
 - .4 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.
 - .5 Instruction duration time requirements as specified in appropriate Sections.
 - .6 Contractor will record these demonstrations for future reference.
-

3.6 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- .3 Repair damage to adjacent materials caused by installation.

END OF SECTION

1. GENERAL

1.1 Summary

- .1 This Section includes requirements for selective demolition and removal of heating, ventilation and air conditioning systems, controls and automated automation components, and related mechanical components and incidentals required to complete work described in this Section.

1.2 Related Requirements

- .1 Section 02 41 19.13 - Selective Building Demolition
.2 Section 02 41 19.16 - Selective Interior Demolition
.3 Section 02 42 00 - Removal and Salvage of Construction Materials
.4 Section 02 81 00 - Hazardous Materials
.5 Section 02 82 00.02 - Asbestos Abatement - Intermediate Precautions
.6 Section 23 05 00 - Common Work Results for HVAC

1.3 Definitions

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
.2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
.3 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
.4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
.5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
.6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled
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improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.4 Reference Standards

.1 CSA Group (CSA):

.1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.5 Action and Informational Submittals

.1 Provide submittals in accordance with 23 05 00 – Common Work Results for HVAC.

.2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 Administrative Requirements

.1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

.2 Scheduling: Account for Owner's continued occupancy requirements during selective demolition with and schedule staged occupancy and worksite activities as a defined

1.7 Quality Assurance

.1 Regulatory Requirements: Perform work of this Section in accordance with the following:

.1 Provincial/Territorial Workers' Compensation Boards/Commissions.

.2 Provincial/Territorial Occupational Health and Safety Standards and Programs.

1.8 Site Conditions

.1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.

.2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Consultant if materials suspected of containing hazardous substances are encountered and perform the following activities:

.1 Refer to Division 01 - Regulatory Requirements for directives associated with specific material types.

.2 Hazardous substances will be as defined in the Hazardous Products Act.

.3 Stop work in the area of the suspected hazardous substances.

- .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
- .5 Hazardous substances will be removed by Contractor under a separate contract or as a change to the Work.
- .6 Proceed only after written instructions have been received from Consultant.

2. PRODUCTS

2.1 Materials

- .1 General Patching and Repair Materials: Refer to Division 02 - Selective Building Demolition and Division 02 - Selective Interior Demolition for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

3. EXECUTION

3.1 Examination

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Consultant will not consider claims for extras for work or materials necessary for proper execution and completion of the Contract that could have been determined by a site visit.

3.2 Preparation

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify Consultant and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and
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await additional instructions before resuming demolition work specified in this Section.

.3 Prevent debris from blocking drainage inlets.

.4 Protect mechanical systems that must remain in operation.

.2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Owner and users is minimized and as follows:

.1 Prevent debris from endangering the safe access to and egress from occupied buildings.

.2 Notify Consultant and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 Execution

.1 Demolition and Removal: Coordinate requirements of this Section with information contained in Division 02 - Selective Building Demolition and Division 02 - Selective Interior Demolition and as follows:

.1 Disconnect and cap gas supply and electrical services in accordance with requirements of local Authority Having Jurisdiction.

.2 Do not disrupt active or energized utilities without approval of the Owner.

.3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.

.4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.

.5 At end of each day's work, leave worksite in safe condition.

.6 Perform demolition work in a neat and workmanlike manner:

.1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

3.4 Closeout Activities

.1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except

where explicitly noted otherwise for materials being salvaged for reuse in new construction in accordance with Division 02 - Removal and Salvage of Construction Materials.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Reference Standards
 - .1 CSA Group (CSA):
 - .1 CSA C390:10, Test methods, marking requirements, and energy efficiency levels for three-phase induction motors
 - .2 National Research Council Canada (NRC):
 - .1 National Energy Code of Canada for Buildings 2020 (NECB)
 - .3 National Electrical Manufacturers Association (NEMA):
 - .1 ANSI/NEMA MG 1-2021, Motors and Generators
 - .2 NEMA MG 10009-2022, Energy Management Guide for Selection and Use of Single-Phase Motors
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Closeout Submittals
 - .1 Submit in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Maintenance Materials Submittals
 - .1 Supply one set of spare belts for each set installed in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.6 Quality Assurance
 - .1 Where multiple motors are required for the same application, provide the same manufacturer’s motor model for all identical conditions.
 - .2 Health and Safety Requirements: Comply with Division 01 - Health and Safety Requirements.
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- 1.7 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 2. PRODUCTS
 - 2.1 Regulatory Requirements
 - .1 Comply with NECB 2020.
 - 2.2 Motors
 - .1 Provide motors for mechanical equipment as specified in other Sections.
 - .2 Motors: High efficiency, in accordance with NECB requirements.
 - .3 Motor Speed: as indicated on drawings.
 - .4 Motors under 373 W (1/2 hp): To NEMA MG 10009, speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
 - .5 Motors 373 W (1/2 hp) and larger: To ANSI/NEMA MG 1, and CSA C390, squirrel cage induction, speed as indicated, continuous duty, drip-proof, ball bearing, maximum temperature rise 40°C, 3 phase, voltage as per electrical drawings, motor windings inverter rated class F, unless otherwise indicated.
 - .6 Temporary Motors: Motor with adequate performance for temporary use.
 - 2.3 Belt Drives
 - .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
 - .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
 - .3 For motors under 7.5 kW (10 hp): Standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified motor rpm.
 - .4 For motors 7.5 kW (10 hp) and over: Sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
 - .5 Determine correct sheave size during commissioning.
 - .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
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- .7 Provide motor slide rail adjustment plates to allow for center line adjustment.
 - 2.4 Drive Guards
 - .1 Provide guards for unprotected drives.
 - .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame
 - .2 Minimum 1.2-mm-thick sheet metal tops and bottoms
 - .3 38-mm diameter holes on both shaft centers for insertion of tachometer
 - .4 Removable for servicing
 - .3 Drive Guards: Designed to allow motor maintenance (lubrication and use of test instruments) with guards in place.
 - .4 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6-mm-thick galvanized mild steel
 - .2 Fasten securely in place
 - .3 Removable for servicing
 - .5 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19-mm mesh
 - .2 Net free area of guard: not less than 80% of fan openings
 - .3 Fasten securely in place
 - .4 Removable for servicing
 - 3. EXECUTION
 - 3.1 Installation
 - .1 Install according to manufacturer's instructions and supplemented by the requirements of the Contract Documents.
 - .2 Locate motors with adequate access space to allow safe and unimpeded maintenance services.
 - .3 Install with minimum interference with other equipment and services.
 - .4 Install belt guards to allow movement of motors for adjusting belt tension.
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- .5 Fasten motors and equipment securely in place.
 - .6 Replace temporary motors with specified motors.
- 3.2 Cleaning
- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Division 05 – Structural Steel for Buildings
 - .2 Section 22 11 16 – Domestic Water Piping
 - .3 Section 23 31 13 – Metal Ducts
 - 1.2 Reference Standards
 - .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-2024, Power Piping.
 - .2 ASTM International (ASTM)
 - .1 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A563/A563M-24, Standard Specification for Carbon and Alloy Steel Nuts.
 - .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2018, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
 - .4 National Research Council Canada (NRC)
 - .1 National Building Code of Canada (2020) (NBC)
 - .2 National Plumbing Code of Canada 2020 (NPC).
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Closeout Submittals
 - .1 Submit in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
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- 2. PRODUCTS
 - 2.1 System Description
 - .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58
 - .2 Performance Requirements:
 - .1 Design supports and hangers to withstand seismic acceleration and velocity forces.
 - 2.2 General
 - .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58 and ANSI B31.1.
 - 2.3 Inserts
 - .1 Inserts shall be galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
 - .2 Size inserts to suit threaded hanger rods.
 - 2.4 Hanger Rods
 - .1 Threaded rod material to MSS SP58.
 - .2 Ensure that hanger rods are subject to tensile loading only.
 - .3 Provide linkages where lateral or axial movement of pipework is anticipated.
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2.5 Pipe Hangers and Supports

- .1 Sway braces for seismic restraint systems to withstand seismic acceleration and velocity forces.
- .2 Use insulation shields for insulated pipework.
- .3 Oversize pipe hangers and supports.
- .4 Design hangers and supports so that they cannot become disengaged by the movements of supported pipes.
- .5 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
- .6 Hangers:
 - .1 Pipe sizes 15 mm to 40 mm: Adjustable wrought steel ring.
 - .2 Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes 150 mm Over: Adjustable wrought steel clevis.
 - .3 Pipe sizes 150 mm: Adjustable steel yoke and cast-iron roll.
 - .4 Pipe sizes 150 mm and above: Trapeze hangers, steel channels with welded spacers and hanger rods, cast iron roll and stand.
- .7 Wall Supports:
 - .1 Pipe Sizes to 80 mm: Cast iron hook.
 - .2 Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast-iron roll for hot pipe sizes 150 mm and over.
- .8 Floor Supports:
 - .1 Pipe Sizes to 100 mm and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.
 - .2 Hot Pipe Sizes 150 mm and over: Adjustable cast iron roll and stand, steel screws and concrete pier or steel support.
- .9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69

2.6 Riser Clamps

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.
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- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
 - .3 Bolts: to ASTM A307
 - .4 Nuts: to ASTM A563/A563M
 - 2.7 Insulation Protection Shields
 - .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span
 - .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69
 - 2.8 Equipment Supports
 - .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Division 05 - Structural Steel for Buildings. Submit calculations with shop drawings.
 - 2.9 Equipment Anchor Bolts and Templates
 - .1 Provide templates to ensure accurate location of anchor bolts.
 - 2.10 House-Keeping Pads
 - .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 100 mm larger than equipment; chamfer pad edges.
 - .2 Concrete: Division 03 - Cast-in-Place Concrete.
 - 2.11 Sleeves
 - .1 General: install where pipes and ducts pass through masonry, concrete structures, fire rated assemblies, and as indicated.
 - .2 Materials:
 - .1 Pipes: Form with schedule 40 steel pipe or 1.2 mm galvanized steel.
 - .2 Roof Drains: form sleeves with 0.7 mm thick sheet steel galvanized with Z275 zinc coating to ASTM A653M.
 - .3 Ducts: Form sleeves with galvanized steel.
 - .3 Construction:
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- .1 Use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
 - .2 Extend sleeves 25 mm above potentially wet floors.
 - .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
 - .5 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for fire stopping.
 - .2 Maintain the fire-resistance rating integrity of the fire separation.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.
 - 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 Inserts
 - .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
 - .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over 100 mm or ducts over 1500 mm wide.
 - .3 Where concrete slabs form the finished ceiling, finish inserts flush with slab surface.
 - 3.3 Pipe Hanger and Support Spacing
 - .1 Support horizontal steel and copper piping as follows:
 - .1 15 mm to 40 mm: 10 mm hanger rod, 1.8 m spacing.
 - .2 50 mm to 65 mm: 10 mm hanger rod, 3.0 m spacing.
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- .3 80 mm to 100 mm: 16 mm hanger rod, 3.6 m spacing.
 - .4 150 to 300 mm: 22 mm hanger rod, 4.3 m spacing.
 - .5 350 to 450 mm: 25 mm hanger rod, 6.1 m spacing.
 - .2 Install hangers to provide minimum 12 mm clear space between finished covering and adjacent work.
 - .3 Within 300 mm of each elbow.
 - .4 Hangers are to be vertically adjustable 40 mm minimum after piping is erected.
 - .5 Support vertical piping at every floor. Support vertical soil pipe at each floor at hub.
 - .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - .7 Where practical, support riser piping independently of connected horizontal piping.
 - .8 Provide additional supports for concentrated loads such as valves, specialties and pipe fittings or changes in direction.
 - .9 Support horizontal cast iron sanitary pipe and storm sewer pipe that is buried or in crawlspaces as follows:
 - .1 At intervals not exceeding 3.0 m.
 - .2 At each pipe section
 - .3 At each change in direction
 - .4 At each branch connection
 - .10 Support plastic horizontal exposed sanitary pipe and storm sewer pipe that is buried or in crawlspaces as follows:
 - .1 At intervals not exceeding 1.2 m
 - .2 At the ends of branches
 - .3 At changes of direction or at traps more than 1 m from the fixture drain
 - 3.4 Low Velocity Duct Hangers and Supports
 - .1 Hanger Minimum Sizes:
 - .1 Up to 750 mm wide: 25 x 1.6 mm at 3 m spacing.
 - .2 790 to 1200 mm wide: 40 x 1.6 mm at 3 m spacing.
-

- .2 Horizontal Duct on Wall Supports Minimum Sizes:
 - .1 Up to 450 mm wide: 40 x 1.6 mm or 25 x 25 x 3 mm at 2.4 m spacing.
 - .2 480 x 1000 mm wide: 40 x 40 x 3 mm at 1.2 m spacing.
 - .3 Vertical Duct on Wall Supports Minimum Sizes at 3.65 m spacing:
 - .1 Up to 610 mm wide: 40 x 1.6 mm.
 - .2 640 to 900 mm wide: 25 x 25 x 3 mm.
 - .3 940 to 1200 mm wide: 30 x 30 x 3 mm.
 - .4 Over 1520 mm wide: 50 x 3 mm.
 - .4 Vertical Duct Floor Supports Minimum Sizes, riveted or screwed to ducts:
 - .1 Up to 1520 mm wide: 40 x 40 x 3 mm.
 - .2 Over 1520 mm wide: 50 x 3 mm.
 - 3.5 Medium and High Velocity Duct Hangers and Supports
 - .1 Hanger Minimum Sizes:
 - .1 Up to 900 mm wide: 2 at 25 x 1.6 mm at 3 m spacing.
 - .2 940 x 1520 mm wide: 2 at 25 x 1.6 mm at 2.4 m spacing and 50 x 50 x 6 mm trapeze.
 - .3 1550 x 3050 mm wide: 2 at 38 x 2.6 mm at 2.4 m spacing and 50 x 50 x 7 mm trapeze.
 - .4 3070 x 6700 mm wide: 3 at 10 mm diameter at 1.2 m spacing and 65 x 65 x 5 mm trapeze.
 - .2 Round Duct Hangers Minimum Sizes at 3 m spacings:
 - .1 Up to 460 mm diameter: 25 x 1.6 mm.
 - .2 480 to 900 mm diameter: 25 x 2.6 mm.
 - .3 940 to 1270 mm diameter: 40 x 2.6 mm.
 - .4 1300 to 2130 mm diameter: 2 at 40 x 2.6 mm from girth reinforcing angle.
 - .3 Vertical Duct Floor Supports Minimum Sizes:
 - .1 Up to 1220 mm wide: 40 x 40 x 3 mm.
-

- .2 Over 1220 mm wide: 50 x 50 x 30 mm.
 - .3 Rivet to duct and tie angles together with rod, angles, or band Iron.
 - .4 Angle reinforcing may be used for support omitting trapeze.
- 3.6 Hanger Installation
- .1 Install hanger so that rod is vertical under operating conditions.
 - .2 Adjust hangers to equalize load.
 - .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- 3.7 Sleeves
- .1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
 - .2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.
 - .3 Where piping or ductwork passes through floor, ceiling, or wall, close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.
 - .4 Install chrome plated escutcheons where piping passes through finished surfaces.
- 3.8 Horizontal Movement
- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
 - .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.
- 3.9 Final Adjustment
- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
 - .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
-

- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.
- 3.10 Cleaning
 - .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Reference Standards
 - .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS)
 - .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020 (NBC).
 - 1.2 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.3 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 2. PRODUCTS
 - 2.1 General
 - .1 Size and shape of bases type and performance of vibration isolation as indicated.
 - 2.2 Elastomeric Pads
 - .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
 - .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
 - .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
 - .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.
-

2.3 Elastomeric Mounts

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 Springs

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for outdoor installations.
- .4 Colour code springs.

2.5 Spring Mount

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

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 Installation

- .1 Seismic control measures to meet requirements of NBC.
 - .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
-

- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
 - .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
 - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
 - .5 Where isolation is bolted to floor use vibration isolation rubber washers.
 - .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.
- 3.3 Cleaning
- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Reference Standards
 - .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-20, Natural Gas and Propane Installation Code.
 - .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2025, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2024, Standard for the Installation of Standpipe and Hose Systems.
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Quality Assurance
 - .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.
 - 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 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 Use maximum of 25 letters/numbers per line.
 - .4 Locations:
 - .1 Terminal cabinets, control panels: 20 x 100 mm, 5 mm letters.
 - .2 Equipment in Mechanical Rooms: 35 x 200 mm, 20 mm letters.
 - 2.3 Piping Systems Governed by Codes
 - .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1.
 - .2 Propane gas: to CSA/CGA B149.1.
 - .3 Sprinklers: to NFPA 13
 - .4 Standpipe and hose systems: to NFPA 14
 - 2.4 Identification of Piping Systems
 - .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
 - .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
 - .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3
-

- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
 - .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
 - .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
 - .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Consultant.
 - .2 Background, lettering, and arrow colour marking and legends for piping systems:
-

Contents	Background	Lettering & Arrows	Legend
Domestic cold water supply	Green	White	DOM. CWS
Waste water	Green	White	WASTE WATER
Storm water	Green	White	STORM
Sanitary	Green	White	SAN
Plumbing vent	Green	White	SAN. VENT
Refrigeration suction	Yellow	Black	REF. SUCTION
Refrigeration liquid	Yellow	Black	REF. LIQUID
Engine exhaust	Yellow	Black	ENGINE EXHAUST
Natural gas	to Codes	to Codes	to Codes
Gas regulator vents	to Codes	to Codes	to Codes

2.5 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.
- .3 Legends for ductworks systems:

Contents	Legend
Supply Air	SUPPLY AIR
Outdoor Air	OUTDOOR AIR
General Exhaust Air	EXHAUST AIR
Transfer Air	TRANSFER AIR
Combustion Air	COMBUSTION AIR
Combustion Exhaust Air	COMBUSTION EXHAUST AIR

2.6 Valves, Controllers

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

- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
 - 2.7 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.
 - 2.8 Language
 - .1 Identification in English.
 - 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 Division 09 - Interior Painting has been completed.
 - 3.3 Installation
 - .1 Provide ULC and or CSA registration plates as required by respective agency
 - 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 long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 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.
- .9 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 Valves, Controllers

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 Cleaning

- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Reference Standards
 - .1 Associated Air Balance Council (AABC):
 - .1 ANSI/AABC National Standards for Total System Balance, Seventh Edition, 2016.
 - 1.3 Administrative Requirements
 - .1 Coordination:
 - .1 Test and balance each system independently and where interlocked with other systems, in unison with those systems.
 - .2 Scheduling:
 - .1 Schedule time required for work of this Section (including repairs, and re-testing) into Project schedules to ensure completion before scheduled completion date.
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - .2 Submit proposed methodology and procedures for performing work of this Section.
 - .3 Before starting work of this Section, submit names and documented qualifications of personnel to perform work of this Section.
 - .4 Submit list of instruments and include serial numbers and calibration certificates.
 - .5 Preliminary Report: Submit for checking and approval by Consultant before submission of formal report. Include:
 - .1 Details of instruments used
 - .2 Details of procedures employed
 - .3 Calculations procedures
 - .4 Summaries
-

- .6 Testing and Balancing Report:
 - .1 Format in accordance with ANSI/AABC National Standards for Total System Balance and show results in SI units.
 - .2 Include:
 - .1 Project record drawings
 - .2 System schematics
 - .3 Submit a digital copy of the report to Consultant, in English, complete with table of contents.
 - 1.5 Quality Assurance
 - .1 Regulatory Requirements: Test and balance systems regulated by codes to the satisfaction of the authority having jurisdiction.
 - .2 Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience, certified by AABC.
 - .3 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
 - 2. PRODUCTS
 - .1 Not used.
 - 3. EXECUTION
 - 3.1 Preparation
 - .1 During construction, coordinate location and installation of measurement and balancing devices, equipment, accessories, measurement ports, and fittings.
 - .2 Calibrate instruments in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
 - .3 Calibrate instruments within three months of work. Submit certificate of calibration.
 - .4 Notify Consultant seven days before start of work.
-

- 3.2 Verification of Conditions
 - .1 Verify that building is substantially complete, including:
 - .1 Installation of ceilings, doors, windows, and other construction affecting the Work.
 - .2 Application of weatherstripping, sealing, and sealants.
 - .3 Pressure, leakage, and other tests specified elsewhere in Division 23.
 - .4 Provisions for Work are installed and operational.
 - .2 Verify proper, normal, and safe operation of mechanical and associated electrical and control systems affecting Work including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place are clean.
 - .2 Duct systems are clean.
 - .3 Ducts, air shafts, and ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, and volume control dampers are installed and open.
 - .6 Coil fins are combed and clean.
 - .7 Access doors are installed and closed.
 - .8 Outlets are installed and volume control dampers are open.
 - 3.3 System Start-up
 - .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
 - .2 Follow special start-up procedures specified in equipment Sections.
 - 3.4 Adjusting
 - .1 Operate systems as required to perform the work and as required by Consultant for verification of reports.
-

- .2 Test to verify proper and safe operation, to determine actual point of performance, and to evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
 - .3 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.
 - .4 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.
 - .5 Equipment Noise: Measure noise from equipment as scheduled.
- 3.5 Air Systems
- .1 Test and balance air systems to ANSI/AABC National Standards for Total System Balance.
 - .2 Take measurements as appropriate for application, including but not limited to 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, and vibration.
 - .3 Document locations of equipment measurements in report, including:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, and other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
 - .3 Main ducts, main branch, sub-branch, and terminals (grille, register or diffuser).
 - .4 Smoke Management Systems: Test for proper operation of all smoke and fire dampers, detectors, sensors, installed as component parts of air systems specified in Division 23.
- 3.6 Tolerances
- .1 Laboratory HVAC systems: +10%, -0% of design.
 - .2 HVAC systems: +5%, -5% of design.
 - .3 Hydronic systems: +/-10% of design.
 - .4 Accuracy: +/-2% of actual values.
- 3.7 Site Quality Control
- .1 Reported results may be subject to verification by Consultant. Verify number and location of results as directed by Consultant.
 - .2 Provide personnel and instrumentation to verify up to 30% of reported results.
-

- .3 Repeat work as required until results fall within specified performance values.
- 3.8 Closeout Activities
- .1 After work is completed to satisfaction of Consultant replace drive guards, close access doors, lock devices in set positions, and 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.
- 3.9 Maintenance
- .1 Participate in systems checks twice during Warranty Period - #1 approximately three months after acceptance and #2 within one month of termination of Warranty Period.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
 - 1.2 Reference Standards
 - .1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 ANSI/SMACNA 016-2012, HVAC Air Duct Leakage Test Manual
 - 1.3 Administrative Requirements
 - .1 Sequencing:
 - .1 Test ducts before installation of insulation or other forms of concealment.
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - .2 Submit details of test instruments to be used at least three months before anticipated start date.
 - .3 Certificates: Submit instrument calibration certificates no more than 28 days before start of tests.
 - .1 Submit manufacturers' site reports to Consultant.
 - 1.5 Quality Assurance
 - .1 Work of this Section shall be performed by an agency complying with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Health and Safety: Comply with Division 01 - Health and Safety Requirements.
 2. PRODUCTS
 - 2.1 Test Instruments
 - .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
-

- .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
 - .2 Test Apparatus Accuracy: Within +/-3% of flow rate and pressure.
 - .3 Calibration: Calibrate instruments at minimum interval of six months and submit certificates of calibration.
 - 3. EXECUTION
 - 3.1 Tolerances
 - .1 System leakage tolerances specified are stated as percentage of total flow rate handled by the system. Pro-rate specified system leakage tolerances.
 - .2 Leakage Rates: Leakage shall not exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: Leakage -2%.
 - .2 VAV box and duct on downstream side of VAV box: Leakage 2%.
 - .3 Large low pressure duct systems up to 500 Pa: Leakage 2%.
 - .4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1%.
 - .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.
 - 3.2 Testing
 - .1 Test when ambient temperature will not affect effectiveness of seals and gaskets.
 - .2 Test flexible connections to VAV boxes.
 - .3 Test lengths of ducts consistent with test equipment capacity.
 - .4 Test fittings, branch ducts, tap-ins.
 - .5 Repair leaks and repeat tests until specified pressures are attained.
 - .6 Base partial system leakage calculations on ANSI/SMACNA 016.
-

- .7 Seal leaks that can be heard or felt, regardless of their contribution to total leakage. Retest after seals have cured.
- 3.3 Cleaning
 - .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
 - 1.2 Definitions
 - .1 For purposes of this Section:
 - .1 "Concealed" – means 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" – means insulation material, fasteners, jackets, and other accessories.
 - .4 "Jacketing" – synonymous with cladding and lagging.
 - 1.3 Reference Standards
 - .1 ASTM International (ASTM):
 - .1 ASTM C335/C335M-23, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
 - .2 ASTM C449-07 (R24), Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .3 ASTM C916-20, Standard Specification for Adhesives for Duct Thermal Insulation
 - .4 ASTM C921-10 (2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
 - .5 ASTM C1338-19 (R22), Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
 - .6 ASTM C1729-21, Standard Specification for Aluminum Jacketing for Insulation
 - .7 ASTM C1767M-21, Standard Specification for Stainless Steel Jacketing for Insulation
 - .2 Midwest Insulation Contractors Association (MICA):
 - .1 National Commercial and Industrial Insulation Standards Manual
-

- .3 ULC Standards (ULC):
 - .1 CAN/ULC-S102-2019 (R2024), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC-S702.1-2014, Standard For Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 2. PRODUCTS
 - 2.1 Duct Insulation
 - .1 Mineral Fibre: Glass fibre, rock wool, or slag wool.
 - .2 Fire/Smoke Rating: To CAN/ULC-S102.
 - .1 Maximum flame-spread rating: 25.
 - .2 Maximum smoke developed classification: 50.
 - .3 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.
 - .4 Type: Mineral fibre blanket to CAN/ULC S702.1 faced with factory applied vapour retarder jacket.
 - .1 Maximum "k" factor: 0.038 W/m°C.
 - .2 Service temperature: -40°C to 65°C
 - .3 Surface finish: Air stream side coated or mat faced to prevent fibre erosion.
 - 2.2 Jackets
 - .1 Canvas jacketing: 220 g/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.
-

2.3 Accessories

- .1 Vapour Retarder Lap Adhesive: Water based, fire retardant type, and compatible with insulation.
- .2 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: Hydraulic setting on mineral wool, to ASTM C449.
- .4 Outdoor Vapour Retarder Finishes:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing Fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: Self-adhesive, aluminum, plain, 50-mm-wide minimum.
- .6 Contact Adhesive: Quick-setting
- .7 Canvas Adhesive: Washable.
- .8 Tie wire: 1.5-mm stainless steel.
- .9 Banding: 19-mm-wide, 0.5-mm-thick stainless steel.
- .10 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on both faces of insulation.
- .11 Fasteners: 4-mm-diameter pins with 35-mm-diameter clips, length to suit thickness of insulation.

3. EXECUTION

3.1 Preparation

- .1 Verify that pressure testing of ductwork systems is complete, witnessed, and certified.
- .2 Verify that surfaces are clean, dry, and free from foreign material.

3.2 General

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standard and as indicated except as specified otherwise.
- .2 Line inside of ducts where indicated.

3.3 Duct Insulation

- .1 Install to manufacturer's instructions, and in accordance with MICA National Commercial and Industrial Insulation Standards Manual.
-

- .2 Apply materials in accordance with manufacturer's instructions.
 - .3 Use two layers of insulation with staggered joints when required nominal thickness exceeds 75 mm.
 - .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes. Duct insulation shall be continuous through wall and ceiling openings and sleeves, except where firestopping is required.
 - .1 Ensure hangers and supports are outside vapour retarder jacket and in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .5 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
 - .6 Fasteners: Install at 300-mm on centre in horizontal and vertical directions, minimum two rows each side.
 - .7 At chilled ductwork, secure with banding. Fasteners penetrating puncturing the underlying vapour barrier are not acceptable.
 - .8 Where acoustic and thermal insulation has been indicated, the thickness of thermal insulation may be reduced by the thickness of specified acoustic insulation.
- 3.4 Site Quality Control
- .1 Non-Conforming Work:
 - .1 Replace insulation with vapour barrier damage and moisture-saturated insulation.
-

3.5 Ductwork Insulation Schedule

.1 Insulation Types and Thicknesses: Conform to following table:

Service Type	Insulation Type	Insulation Thickness (mm)
Exhaust and relief within 3 m of exterior opening	Thermal Insulation	25
Relief ducts and plenums	Thermal Insulation	25
Combustion air	Thermal Insulation	25
Outdoor air	Thermal Insulation	50
Mixing plenums	Thermal Insulation	50
Supply air plenums	Thermal Insulation	25
Supply ducts	Thermal Insulation	25
Supply and return ducts exposed to outdoors	Thermal Insulation	100
Supply ducts, where indicated on drawings	Acoustic Insulation	25
Return ducts, where indicated on drawings	Acoustic Insulation	25

3.6 Cleaning

.1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC.
 - 1.2 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.3 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
2. PRODUCTS
 - 2.1 Thermostat (Low Voltage)
 - .1 Low voltage wall thermostat:
 - .1 For use on 24V circuit at 1.5A capacity.
 - .2 With heat anticipator adjustable 0.1 to 1.2 A.
 - .3 Temperature setting range: 10 degrees C to 25 degrees C.
 - .4 Without sub-base.
 - .5 Four position fan switches for "Low- Medium-High-Off" fan switch.
 - .6 24-hour programmable schedule.
 - 2.2 Thermostat (Remote Bulb)
 - .1 Line voltage remote bulb type thermostat with:
 - .1 30A rating on 120V.
 - .2 3 m copper capillary tube nylon coated.
 - .3 Moisture and dust-resistant enclosure.

2.3 Low Limit Temperature Alarm

.1 Low limit temperature alarm with:

- .1 Rating: 10.2A at 120V.
- .2 Sensing bulb and 1.5 m long capillary tube.
- .3 Switching action: manual.
- .4 Temperature setting range: 0 degrees C to 15 degrees C.

2.4 High Limit Temperature Alarm

.1 High limit temperature alarm with:

- .1 Rating 10A at 120V.
- .2 Positive lock-out.
- .3 Manual reset only after 14 degrees C drop-in temperature.
- .4 Cutout setting: 50 degrees C.

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for electric and electronic control systems installation in accordance with manufacturer's instructions.

- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied Consultant.

3.2 Installation

- .1 Install control devices.
 - .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.
 - .3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.
-

END OF SECTION

1. GENERAL
 - 1.1 Summary
 - .1 Section Includes: materials and installation for piping, valves and fittings for NG and LPG fired equipment.
 - .2 Where noted as Natural Gas or Gas Propane Systems are to be installed in accordance with this section, and as per code.
 - 1.2 Related Requirements
 - .1 Section 23 05 00 – Common Work Results for HVAC.
 - 1.3 Reference Standards
 - .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.5-2020, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24, Metric/Inch Standard
 - .2 ASME B16.18-2021, Cast Copper Alloy Solder Joint Pressure Fittings
 - .3 ASME B16.22-2021, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - .4 ASME B18.2.1-2012 (R2021), Square and Hex Bolts and Screws Inch Series
 - .2 ASTM International (ASTM):
 - .1 ASTM A47/A47M-99(2022)E01, Standard Specification for Ferritic Malleable Iron Castings
 - .2 ASTM A53/A53M-24, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
 - .3 ASTM B75M-20, Standard Specification for Seamless Copper Tube
 - .4 ASTM B837-19, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems
 - .3 CSA Group (CSA):
 - .1 CAN/CSA B149.1:20, Natural Gas and Propane Installation Code Handbook
 - .2 CSA W47.1:19 (R2024), Certification of Companies for Fusion Welding of Steel
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- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Administrative Requirements
 - .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week before beginning work of this Section and on-site installations in accordance with Division 01 - Project Meetings.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
 - .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.
 - 2. PRODUCTS
 - 2.1 Pipe
 - .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS2 1/2 and over, plain end.
 - .2 Copper tube: to ASTM B837
 - 2.2 Jointing Material
 - .1 Screwed fittings: pulverized lead paste.
 - .2 Welded fittings: to CSA W47.1
 - .3 Flange gaskets: non-metallic flat.
 - .4 Brazing: to ASTM B837.
-

2.3 Fittings

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M
 - .5 Bolts and nuts: to ASME B18.2.1
 - .6 Nipples: schedule 40, to ASTM A53/A53M
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18
 - .2 Wrought copper fittings: to ASME B16.22

2.4 Valves

- .1 Provincial Code approved, lubricated plug type.

2.5 Regulators

- .1 Generator pressure regulator:
 - .1 Direct acting, self-operating, spring loaded, adjustable regulator.

3. EXECUTION

3.1 Piping

- .1 Install in accordance with applicable Provincial/Territorial Codes, and CAN/CSA B149.1, supplemented as specified.
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.2 Valves

- .1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.
 - .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.
-

- 3.3 Regulators
 - .1 Install regulators where indicated and in accordance with AHJ requirements.
 - .2 Install regulators with shutoff valves upstream or downstream where required for maintenance and isolation, or as indicated.
- 3.4 Site Quality Control
 - .1 Site Tests and Inspections:
 - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
 - .2 Obtain reports within 3 days of review and submit immediately to Consultant.
 - .3 PV procedures:
 - .1 Test performance of components.
- 3.5 Adjusting
 - .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.
 - .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.
- 3.6 Painting
 - .1 Outdoors: Full painting for corrosion protection.
 - .2 Indoors: Painting required for identification in accordance with Section 23 05 53 – Identification for HVAC, Piping, and Equipment.
- 3.7 Cleaning
 - .1 Cleaning: in accordance with CAN/CSA B149.1, supplemented as specified.
 - .2 Perform cleaning in accordance with Section 23 05 00 – Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Reference Standards
 - .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.22-2021, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings
 - .2 ASME B16.24-2021, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500
 - .3 ASME B16.26-2024, Cast Copper Alloy Fittings for Flared Copper Tubes
 - .4 ASME B31.5-2022, Refrigeration Piping and Heat Transfer Components
 - .2 ASTM International (ASTM):
 - .1 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength
 - .2 ASTM B280-23, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
 - .3 CSA Group (CSA):
 - .1 CSA B52-20, B52 Package, Mechanical Refrigeration Code
 - .4 Environment Canada (EC):
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Closeout Submittals
 - .1 Provide closeout submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
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- 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 2. PRODUCTS
 - 2.1 Tubing
 - .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280, type ACR.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5
 - 2.2 Fittings
 - .1 Service: design pressure 2070 kPa and temperature 121°C.
 - .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22
 - .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
 - .3 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A307, heavy series
 - .4 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26
 - 2.3 Pipe Sleeves
 - .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.
 - 2.4 Valves
 - .1 22 mm and under: Class 500, 3.5 MPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
-

- .2 Over 22 mm: Class 375, 2.5 MPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

 - 3. EXECUTION

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

 - 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 datasheet.

 - 3.3 General
 - .1 Install in accordance with CSA B52, EPS 1/RA/1 and ASME B31.5.

 - 3.4 Brazing Procedures
 - .1 Bleed inert gas into pipe during brazing.
 - .2 Remove valve internal parts, solenoid valve coils, sight glass.
 - .3 Do not apply heat near expansion valve and bulb.

 - 3.5 Piping Installation
 - .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction
 - .2 Hard drawn copper tubing: do not bend. Minimize use of fittings.
 - .3 Insulated refrigerant piping in accordance with Section 23 07 19 - HVAC Piping Insulation. Recover refrigerant piping exposed to outdoors or sunlight with aluminum jacketing.
-

- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m³/s at minimum load. Connect upstream of traps on large riser.
 - 3.6 Pressure and Leak Testing
 - .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
 - .2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively
 - .3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.
 - 3.7 Site Quality Control
 - .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
 - .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.
 - .3 Use copper lines of largest practical size to reduce evacuation time.
 - .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
 - .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
 - .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 hours.
-

- .2 Break vacuum with refrigerant to 14 kPa.
- .3 Final to 5 Pa absolute and hold for at least 12 hours.
- .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
- .5 Submit test results to Consultant.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Consultant.
- 3.8 CLEANING
 - .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Division 07 - Joint Sealants
 - .2 Division 09 - Fire Stopping
 - .3 Section 23 05 00 - Common Work Results for HVAC
 - .4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
 - .5 Section 23 05 94 - Pressure Testing of Ducted Air Systems
 - 1.2 Reference Standards
 - .1 ASTM International (ASTM)
 - .1 ASTM A480/A480M-24, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-22, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2020.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Delivery, Storage and Handling
 - .1 Provide closeout submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
-

2. PRODUCTS

2.1 Seal Classification

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
2500	A
1500	A
1000	A
750	B
500	C
250	C
125	C
125	Unsealed

.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 sealant, tape, or combination thereof.
- .3 Class C: transverse joints and connections made airtight with gaskets, sealant, tape, or combination thereof. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

2.2 Sealant

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 Tape

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

- 2.4 Duct Leakage
 - .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.
 - 2.5 Fittings
 - .1 Fabrication: to SMACNA.
 - .2 Radiused elbows:
 - .1 Rectangular: standard radius, centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius, centreline radius: 2 times diameter.
 - .3 Mitred elbows, rectangular:
 - .1 To 407 mm: with single thickness turning vanes.
 - .2 Over 407 mm: with double thickness turning vanes.
 - .4 Branches:
 - .1 Rectangular main and branch: with 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
 - .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
 - .6 Offsets:
 - .1 Full radiused elbows as indicated.
 - .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.
 - 2.6 Fire Stopping
 - .1 Retaining angles around duct, on both sides of fire separation in accordance with Division 07 - Fire Stopping.
 - .2 Coordinate with Division 07 - Fire Stopping to ensure fire stopping materials and installation does not distort duct.
-

- 2.7 Galvanized Steel
 - .1 Lock forming quality: to ASTM A653/A653M, zinc coating.
 - .2 Thickness, fabrication and reinforcement: to SMACNA.
 - .3 Joints: to SMACNA.
 - 2.8 Hangers and Supports
 - .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 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 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
 - 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 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .4 Install breakaway joints in ductwork on sides of fire separation.
 - .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
 - 3.3 Hangers
 - .1 Install hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
-

3.4 Sealing and Taping

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

3.5 Leakage Tests

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 Do leakage tests in sections.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Do not install additional ductwork until trial test has been passed.
- .5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .6 Complete test before performance insulation or concealment Work.

3.6 Cleaning

- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Reference Standards
 - .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2020.
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 2. PRODUCTS
 - 2.1 General
 - .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.
 - 2.2 Flexible Connections
 - .1 Frame: galvanized sheet metal frame 25 mm thick with fabric clenched by means of double locked seams.
 - .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².
 - 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 complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - 2.4 Instrument Test Hand Holes
 - .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.
 - 2.5 Instrument Test Sample Ports
 - .1 16 mm galvanized threaded port complete with threaded plug.
 - .2 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.
 - 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 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
-

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:

.1 Size:

- .1 1000 x 1000 mm for person size entry.
- .2 500 x 500 mm for servicing entry.
- .3 300 x 300 mm for viewing.
- .4 As indicated.

.2 Locations:

- .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 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:
 - .2 For temperature readings:
- 3.3 Cleaning
 - .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

- 1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Reference Standards
 - .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2020.
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Closeout Submittals
 - .1 Provide closeout submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 2. PRODUCTS
 - 2.1 General
 - .1 Manufacture to SMACNA standards
 - 2.2 Splitter Dampers
 - .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
 - .2 Double thickness construction.
 - .3 Control rod with locking device and position indicator.
 - .4 Rod configuration to prevent end from entering duct.
 - .5 Pivot: piano hinge.
 - .6 Folded leading edge.
-

- 2.3 Single Blade Dampers
 - .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
 - .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
 - .3 Locking quadrant with shaft extension to accommodate insulation thickness.
 - .4 Inside and outside nylon end bearings.
 - .5 Channel frame of same material as adjacent duct, complete with angle stop.
 - 2.4 Multi-Bladed Dampers
 - .1 Factory manufactured of material compatible with duct.
 - .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA
 - .3 Maximum blade height: 150 mm.
 - .4 Bearings: self-lubricating nylon.
 - .5 Linkage: shaft extension with locking quadrant.
 - .6 Channel frame of same material as adjacent duct, complete with angle stop.
 - 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 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
 - 3.2 Installation
 - .1 Install where indicated.
-

- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
 - .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
 - .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
 - .5 Dampers: vibration free.
 - .6 Ensure damper operators are observable and accessible.
 - .7 Corrections and adjustments conducted by Consultant.
- 3.3 Cleaning
- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - .2 Section 23 33 00 - Air Duct Accessories
 - 1.2 Reference Standards
 - .1 ASTM International (ASTM)
 - .1 ASTM A653/A653M-23, 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 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Closeout Submittals
 - .1 Provide closeout submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 2. PRODUCTS
 - 2.1 Multi-Leaf Dampers
 - .1 Opposed and or parallel blade type as indicated.
 - .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
 - .3 Pressure fit self-lubricated bronze bearings.
 - .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
 - .5 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
-

- .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.
 - .6 Dimensions: as indicated.
 - 2.2 Back Draft Dampers
 - .1 Automatic gravity operated, multi leaf, steel construction with nylon bearings, spring assisted or counterweighted, as indicated.
 - 2.3 Relief Dampers
 - .1 Automatic multi-leaf steel dampers with ball bearing centre pivoted and counterweights set to open at indicated static pressure.
 - 2.4 Damper Operators
 - .1 Voltage: as indicated.
 - .2 Two-position actuators: Single direction, spring return or reversing type.
 - .3 Modulating actuators:
 - .1 Capable of stopping at numerous points across full movement range and starting in either direction from any point in range.
 - .2 Control input signal: Proportional Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for 0- to 10 or 2- to 10 VDC and 4- to 20-mA signals.
 - .4 Position feedback:
 - .1 Where indicated, equip two-position actuators with auxiliary switches or other positive means of a position indication signal for remote monitoring of open and close position.
 - .2 Where indicated, equip modulating actuators with analog position feedback through voltage signal for remote monitoring.
 - .5 Fail safe:
 - .1 Where indicated, provide actuator to fail to an end position.
 - .2 Mechanical spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
 - .6 Damper attachment: Unless otherwise required for damper interface, provide actuator designed to directly couple to damper shaft without need for connecting linkages.
-

- .7 Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of -30°C to 50°C.
- .8 Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5% to 95% relative humidity, non-condensing.
- .9 Enclosure:
 - .1 Suitable for ambient conditions encountered by application.
 - .2 NEMA Type 1 for indoor installation in an equipment enclosure.
 - .3 NEMA Type 2 for indoor and protected applications.
 - .4 NEMA Type 4 or Type 4X for outdoor and unprotected applications.
- .10 Stroke time:
 - .1 Specified Equipment: FV-L741.
 - .1 Operate damper from fully closed to fully open within 7 seconds.
 - .2 Otherwise:
 - .1 Operate damper from fully closed to fully open within 90 seconds.
 - .2 Operate damper from open closed to fully closed within 90 seconds.
 - .3 Move damper to fail-safe position within 30 seconds.

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 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

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 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - .2 Section 23 05 13 - Common Motor Requirements for HVAC Equipment
 - .3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
 - .4 Section 23 33 00 - Air Duct Accessories
 - 1.2 Reference Standards
 - .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):
 - .1 ANSI/AMCA Standard 99-16, Standards Handbook
 - .2 ANSI/ASHRAE 51-16 (ANSI/AMCA 210-16), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
 - .3 ANSI/AMCA Standard 300-24, Reverberant Room Method for Sound Testing of Fans
 - .4 ANSI/AMCA Standard 301-22, Methods for Calculating Fan Sound Ratings from Laboratory Test Data
 - .2 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual, current edition
 - .1 MPI #18, Primer, Zinc Rich, Organic
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Maintenance Materials
 - .1 Supply: One set of belts for each size of belt driven equipment.
 - 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
-

2. PRODUCTS

2.1 Performance Criteria

- .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.
 - .1 Capacity: flow rate, total static pressure, external static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .2 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
 - .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Provide unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 Fans General

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers.
 - .3 Sizes as indicated.
 - .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, inlet outlet dampers and vanes and as indicated.
 - .3 Factory primed before assembly in colour standard to manufacturer.
 - .4 Scroll casing drains: as indicated.
 - .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
 - .6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 - .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.
-

2.3 In-Line Centrifugal Fans

.1 Fan wheels:

.1 Welded steel or aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 40% of first critical speed.

.3 Backward inclined blades, as indicated.

.2 Casings: welded steel with welded motor support, hinged access plates, streamlined inlet cone and discharge bell sections and integral silencer casing.

.3 Blade material: steel or aluminum.

.4 Hub material: steel or aluminum.

.5 Supports:

.1 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.

.6 Bearings: ball or roller with extension tubes to outside of casing.

.7 Belt drive:

.1 Drive adjustable blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for HVAC fans installation in accordance with manufacturer's instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 Fan Installation

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

- .2 Provide sheaves and belts required for final air balance.
 - .3 Bearings and extension tubes to be easily accessible.
 - .4 Access doors and access panels to be easily accessible.
- 3.3 Anchor Bolts and Templates
- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.
- 3.4 Cleaning
- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

- 1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - .2 Product Data:
 - .1 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
 - 1.3 Maintenance Material Submittals
 - .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Division 01 - Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.
 - 1.4 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
-

- 2. PRODUCTS
 - 2.1 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.
 - 2.2 General
 - .1 To meet capacity, as indicated.
 - .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
 - .3 Concealed manual volume control damper operators.
 - .4 Colour: as directed by Consultant.
 - 2.3 Manufactured Units
 - .1 Grilles, registers, and diffusers of same generic type, products of one manufacturer.
 - 2.4 Supply Grilles and Registers
 - .1 General: with opposed blade dampers.
 - .2 Unless otherwise indicated: aluminium, 25 mm border, double deflection with airfoil shape, horizontal face and vertical rear bars. Model: as indicated.
 - 2.5 Return and Exhaust Grilles And Registers
 - .1 General: with opposed blade dampers.
 - .2 Unless otherwise indicated: aluminium, 25 mm border, single deflection with airfoil shape, horizontal face and vertical rear bars. Model: as indicated.
-

- 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 instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
 - 3.2 Installation
 - .1 Install in accordance with manufacturer's instructions.
 - .2 Install with oval head screws in countersunk holes where fastenings are visible.
 - .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
 - .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.
 - 3.3 Cleaning
 - .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Division 07 – Sheet Metal Flashing and Trim
 - .2 Division 09 – Exterior Painting
 - .3 Section 23 05 00 - Common Work Results for HVAC
 - 1.2 Reference Standards
 - .1 Air Movement and Control Association (AMCA):
 - .1 ANSI/AMCA Standard 500-L-23, Laboratory Methods of Testing Louvers for Rating
 - .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ASHRAE Handbook 2024 – HVAC Applications
 - .3 ASTM International (ASTM):
 - .1 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .2 ASTM E90-23, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .3 ASTM E413-22, Classification for Rating Sound Insulation
 - .4 ASTM E2886/E2886M-20, Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement
 - .4 Fenestration and Glazing Industry Alliance (FGIA, formerly AAMA):
 - .1 AAMA 2605-22, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
 - .5 National Fire Protection Association (NFPA):
 - .1 NFPA 96-2024, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
 - .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
-

- .1 ANSI/SMACNA 006-2020, HVAC Duct Construction Standards – Metal and Flexible
 - 1.3 Administrative Requirements
 - .1 Coordination:
 - .1 Coordinate installation of exterior louvres and vents with Division 07.
 - .2 Coordinate compatibility of factory-applied primer with finish paints indicated in Division 09 – Exterior Painting.
 - 1.4 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - .2 Product Data:
 - .1 Show anchorage details, elevations, sections, and specific details for each louvre. Include a list of all louvres and their locations in the Project using the identification numbers on the Drawings.
 - .2 Indicate the following:
 - .1 Pressure drop
 - .2 Face area
 - .3 Free area
 - 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 2. PRODUCTS
 - 2.1 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 an independent testing agency signifying adherence to codes and standards.
 - 2.2 Gooseneck Hoods
 - .1 Thickness of Metal: To ASHRAE Handbook – HVAC Applications, TC4.3 and SMACNA.
-

- .2 Fabrication: To ASHRAE and ANSI/SMACNA 006, chapter 5.
 - .3 Joints: To ASHRAE and SMACNA and or proprietary manufactured duct joint.
 - .4 Supports: To ASHRAE and ANSI/SMACNA 006, chapter 5.
 - .5 Screens: Integral bird screens made of a minimum 2-mm diameter aluminum wire.
 - .1 Intake Screens: 19-mm mesh aperture.
 - 2.3 Fixed Louvres - Aluminum
 - .1 Construction: Welded with exposed joints ground flush and smooth.
 - .2 Material: Extruded aluminum alloy 6063-T5, 6063-T6, or 6061-T6.
 - .3 Blade: Acoustically insulated airfoil blades, reinforcing bosses and maximum blade length of 1500-mm.
 - .4 Frame, head, sill and jamb: 300-mm-deep one-piece extruded aluminum, minimum 3-mm thick with approved slot for sealant, integral to unit.
 - .5 Mullions: At a maximum 1500-mm centres.
 - .6 Fastenings: Aluminum nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, stainless steel washer and aluminum body.
 - .7 Screen: 2-mm diameter wire aluminum bird screen on inside face of louvres in formed U-frame.
 - .1 Exhaust Screens: 12-mm mesh aperture.
 - .2 Intake Screens: 19-mm mesh aperture.
 - .8 Finish: Prime coated, ready for finish painting in accordance with Section 09 91 13 - Exterior Painting.
 - .9 Colour: As selected by Consultant from manufacturer's standard colour range.
 - .10 Acoustic performance: 22 dB transmission loss at 1000 Hz octave band tested in accordance with ASTM E413.
 - 3. EXECUTION
 - 3.1 Examination
 - .1 Verification of Conditions: Verify that conditions of substrates previously installed are acceptable for louvres, intakes, and vents installation in accordance with manufacturer's instructions.
-

- .1 Inform Consultant of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 Installation

- .1 Perform in accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with sealant to ensure weather tightness.
- .4 Install screens where indicated. Where screen joints are unavoidable, overlap edges and ends by a minimum of 25 mm.

3.3 Cleaning

- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
- 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
- 1.2 Reference Standards
 - .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 52.2-2017, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
 - .2 National Fire Protection Association (NFPA)
 - .1 NFPA 96-2024, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - .3 Underwriters' Laboratories of Canada (ULC)
 - .1 ULC -S111-13-(R2024), Standard Method of Fire Tests for Air Filter Units.
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Maintenance Material Submittals
 - .1 Extra Materials:
 - .1 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .2 Spare filters: in addition to filters installed immediately prior to acceptance, supply 1 complete set of filters for each.
 - 1.5 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.

- 2. PRODUCTS
 - 2.1 General
 - .1 Media: suitable for air at 100% RH and air temperatures between -40 and 50°C.
 - .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
 - .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.
 - 2.2 Accessories
 - .1 Holding frames: permanent "T" section or channel section construction of galvanized steel or extruded aluminum, 1.6 mm thick, except where specified.
 - .2 Seals: to ensure leakproof operation.
 - .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
 - .4 Access and servicing: through doors/panels on each side of filter bank.
 - 2.3 Cotton Panel Filters
 - .1 Disposable pleated reinforced cotton dry media.
 - .2 Holding frame: galvanized steel, or slide in channel for side access.
 - .3 Performance:
 - .1 Average atmospheric dust spot efficiency 30% to ANSI/ASHRAE 52.2.
 - .2 Average synthetic dust weight arrestance 90% to ANSI/ASHRAE 52.2.
 - .4 Fire Rated: to ULC -S111
 - .5 Nominal thickness: 50 mm.
 - 3. EXECUTION
 - 3.1 Examination
 - .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for filter installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
-

- .3 Proceed with installation only after unacceptable conditions have been remedied.
- 3.2 Installation General
- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.
- 3.3 Replacement Media
- .1 Replace media with new upon acceptance.
 - .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.
- 3.4 Cleaning
- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - .2 Section 23 09 33 – Electric and Electronic Control System for HVAC.
 - .3 Section 23 23 00 – Refrigerant Piping
 - 1.2 Reference Standards
 - .1 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
 - .1 ANSI/AHRI 210/240-2023, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
 - .2 American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ANSI/ASHRAE):
 - .1 ANSI/ASHRAE Standard 15-2024, Safety Standard for Refrigeration Systems
 - .3 CSA Group (CSA):
 - .1 CSA C656-14 (R2023), Performance Standard for Split-System and Single-Package Air Conditioners and Heat Pumps
 - .4 National Fire Protection Association (NFPA):
 - .1 NFPA 90A-2024, Standard for the Installation of Air-Conditioning and Ventilating Systems
 - .2
 - .3
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Closeout Submittals
 - .1 Provide closeout submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
-

2. PRODUCTS

2.1 Ductless Split Air-Source Heat Pumps

.1 General:

.1 Packaged unit consisting of indoor refrigerant compressor/fan section with coil, outdoor unit, and factory charged, refrigerant as indicated.

.1 Mount: wall, ceiling or floor as indicated.

.2 Provide AHRI certified Products.

.2 Performance: Ratings to CSA C656.

.1 Electrical: as indicated.

.2 Cooling capacity: as indicated.

.1 Cooling seasonal performance (SEER): Minimum 18.

.3 Heating capacity: as indicated.

.1 Heating seasonal performance factor (HSPF): Minimum 8.2.

.4 Supplementary heating capacity: as indicated.

.3 Compressor/Fan Section:

.1 Compressor: Welded hermetic with internal vibration isolation, crankcase heater, 'slugging' protection, internal high pressure protection, motor with thermal and current sensitive overload devices and start assist device. Multi-speed control.

.2 Fan: Centrifugal type, forward curved, statically and dynamically balanced. Mount impeller on solid steel shaft running on heavy duty ball bearings with an average life of 200 000 hours.

.3 Cabinet: Galvanized steel, with easily removable panels arranged for servicing components, insulated with 25-mm thick 35 kg/cm³ density neoprene coated fibreglass insulation.

.4 Air filter: Replaceable, washable, and easily accessible.

.5 Components: Reversing valve, suction line accumulator, with controls or devices to prevent rapid compressor cycling, liquid line filter-drier, refrigerant line tubing, fittings and service ports.

.4 Outdoor unit:

- .1 Casing: Bonderized steel, with easily removable panels arranged for servicing all components, baked enamel finish.
 - .2 Coil: Aluminum plate fins mechanically bonded to seamless copper tubing.
 - .3 Factory-installed refrigerant metering device with removable internal components for servicing and mounted on liquid service valve.
 - .4 Brass service valves with refrigerant line fittings terminating at an easily accessible location.
 - .5 Grille: Vinyl-coated steel.
 - .6 Fan: Propeller, lubricated direct driven from factory, inherently protected, and resiliently mounted motor.
 - .7 Base: Stand to elevate unit.
 - .5 Refrigerant piping: Pipe and fittings to Section 23 23 00 – Refrigerant Piping.
 - .6 Controls: Factory wired.
 - .1 Indoor thermostat: Remote wall-mounted in accordance with Section 23 09 33 – Electric and Electronic Control System for HVAC.
 - .2 Safety devices: Low pressure switch, compressor malfunction warning device, refrigerant leak detection, demand defrost, automatic defrost control to operate every 90 min for not more than 10 minutes when suction temperature is below set point.
 - .1 Auto restart after power outage.
 - .7 Accessories:
 - .1 Drain pans: Provide condensate drain pans under indoor coils. Allow access for easy cleaning.
 - .2 Remote controller: Radio frequency type, selectable, minimum 10 m range.
 - .3 Wi-Fi module: BACnet capable control module for integration in Energy Management Control System.
 - 3. EXECUTION
 - 3.1 Examination
 - .1 Verification of Conditions: Verify that conditions of substrate previously installed are acceptable for heat pump installation in accordance with manufacturer's instructions.
-

- .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
- 3.2 Installation
- .1 Install in accordance with manufacturer's instructions and ANSI/ASHRAE Standard 15.
 - .2 Install outdoor units on wall mount with vibration isolation. Coordinate installation with siding.
 - .3 Secure with hold-down bolts in accordance with manufacturer's recommendations.
 - .4 Make piping connections.
 - .5 Ensure nothing obstructs access to components or removal of components for servicing.
- 3.3 Start-Up and Commissioning
- .1 Test units in full heating load and full cooling load conditions. Confirm sufficient flow in the heating and chilled water loops to prevent any pressure alarms.
 - .2 Coordinate interface with building Energy Management Control System to verify proper integration of controls.
 - .3 Submit written start-up and commissioning reports to Consultant.
- 3.4 Cleaning
- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
 - .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
 - .4 Section 26 05 00 - Common Work Results for Electrical
 - 1.2 Reference Standards
 - .1 CSA Group (CSA):
 - .1 CSA C22.2 No.155-M86 (R2022), Electric Duct Heaters
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - .2 Shop Drawings:
 - .1 Submit drawings showing:
 - .1 Element support details.
 - .2 Unit support.
 - .3 Internal components wiring diagrams.
 - .2 Submit duct heater schedule indicating quantities, sizes, mounting arrangement and the following performance data:
 - .1 Electrical: total kW rating, voltage, phase.
 - .2 Heater element watt/density.
 - .3 Controller type.
 - .4 Number of stages and kW rating.
 - .5 Minimum operating airflow.
 - .6 Maximum discharge temperature.
 - .7 Pressure drop at operating airflow.
-

- .8 Accessories included.
 - 1.4 Delivery, Storage, and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 2. PRODUCTS
 - 2.1 Open Coil Duct Heaters
 - .1 Duct heater approved to CSA C22.2 No.155 and listed for zero clearance to combustible material.
 - .2 Performance/Design Criteria:
 - .1 Refer to duct heater schedule for size, electrical requirements (volts, phases), capacity (kW), operating airflow, controller type, number of stages and special accessories.
 - .2 Heater Element Watt/Density: maximum 242 W/mm².
 - .1 Provide derated coils with low-watt density and low airflow controls when faced velocities are lower than 2.0 m/s or duct heaters are used in variable-air-volume applications.
 - .3 Heater Rated Load: provide built-in load fuses for duct heaters with rated load exceeding 48 Amps.
 - .4 Modular Construction: when duct heater modules are assembled on site for large applications, design and construct assembly to operate as a single heater.
 - .5 Disconnect Switch: provide main disconnect for each duct heater assembly.
 - .3 Construction:
 - .1 Frame: corrosion-resistant galvanized steel.
 - .2 Heating elements: helical coils of high grade nickel-chrome alloy resistance wire supported and insulated by floating ceramic bushings fastened to the frame and supporting brackets.
 - .3 Coil terminal pins: mechanically secured and insulated from the frame with high temperature ceramic bushings.
 - .4 Mounting: as indicated on duct heater schedule.
 - .5 Protective Screens: installed on both sides of heater.
-

.4 Safety Controls:

- .1 High Temperature Cutouts: include fail-safe thermal protection devices which automatically de-energize the heater on overheating condition.
 - .1 Primary High Limit Switch: automatic reset disc type thermal cutout.
 - .2 Secondary High-Limit Switch: additional manual reset disc type thermal cutout for duct heaters of 30 kW and less.
- .2 Airflow Proving Switch: diaphragm type air pressure switch with automatic reset, screw type setpoint adjustment and static pressure probe; switch to de-energize duct heater circuits in case of insufficient air flow.

.5 Panel:

- .1 Factory mounted enclosure with terminal blocks for single point power connections and connection of wiring to thermostat, airflow proving switch and/or external controls.
- .2 Remote mounted panel as indicated with terminal strips in heater terminal box for power and control wiring.
- .3 All built-in controls and electrical components to be factory mounted and wired inside the panel; wiring to be terminated on clearly identified terminal blocks.
- .4 Provide unit specific wiring diagram permanently attached inside the panel.

.6 Controls:

- .1 Duct heater to include the following built-in controls: magnetic contactors, control transformer, safety controls and controllers.
- .2 Controller Type: as indicated on duct heater schedule.
 - .1 Proportional Control: single-stage proportional control providing full modulation of the heater's capacity.

2.2 Accessories

- .1 Provide accessories where indicated on duct heater schedule.
 - .2 Pilot Lights: factory mounted and wired on heater panel showing staging, power supply status, overheating condition, no airflow, heating status.
 - .3 Thermostats: low voltage electronic thermostat compatible with duct heater controller.
 - .1 Room Thermostats: ventilated casing with adjustable setpoint.
 - .2 Duct Thermostats: insertion type with casing and adjustable setpoint.
-

- 3. EXECUTION
 - 3.1 Examination
 - .1 Verification of Conditions: verify site conditions are acceptable for duct heater installation in accordance with manufacturer's written instructions.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.
 - 3.2 Installation
 - .1 Perform installation in accordance with manufacturer's instructions.
 - .2 Locate duct heater in accordance with manufacturer's minimum recommended distances for operation, service access and unit removal.
 - .3 Provide additional hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment where duct heater weight cannot be supported solely by existing duct.
 - .4 Make power and control connections to CSA C22.2 No.155
 - .5 Verify that ductwork and casings are free of debris before operating and testing duct heaters.
 - 3.3 Site Quality Control
 - .1 Duct Heater Controls: test operation of safety controls and duct heater staging/modulation by simulating a demand from the local thermostat or external control signal.
 - .2 Site Adjustments: test and adjust airflow controls during system testing, adjusting and balancing in coordination with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .3 Submit test report and include copy with Operations and Maintenance Manuals.
 - 3.4 Cleaning
 - .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

1. GENERAL
 - 1.1 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC
 - .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
 - .3 Section 23 09 33 - Electric and Electronic Control System for HVAC
 - 1.2 Reference Standards
 - .1 CSA Group (CSA)
 - .1 CSA C22.2 No.46-13 (R2022), Electric Air-Heaters.
 - .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-2024, Enclosures for Electrical Equipment (1000 V Maximum).
 - 1.3 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.4 Closeout Submittals
 - .1 Provide closeout submittals in accordance with Section 23 05 00 – Common Work Results for HVAC.
 - 1.5 Delivery, Storage and Handling
 - .1 Deliver, store and handle materials in accordance with Section 23 05 00 – Common Work Results for HVAC.
 2. PRODUCTS
 - 2.1 Unit Heaters
 - .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
 - .2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.
 - .3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.
 - .1 Built-in fan motor thermal overload protection.
-

- .4 Hangers: as per manufacturer recommendations and Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
 - .5 Elements: mineral insulated stainless-steel sheath with steel brazed fins.
 - .6 Cabinet: Steel, 1.2 mm thick, fitted with brackets for rod or wall mounting.
 - .1 Phosphatized and finished with baked enamel, standard colour.
 - 2.2 Controls
 - .1 Remote low voltage thermostat in accordance with Section 23 09 33 - Electric and Electronic Control System for HVAC, coordinate installation with Division 26 installer.
 - 3. EXECUTION
 - 3.1 Examination
 - .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for unit heaters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
 - 3.2 Installation
 - .1 Suspend unit heaters from ceiling or mount on wall as indicated.
 - .2 Install thermostats in locations indicated.
 - .3 Make power and control connections.
 - 3.3 Field Quality Control
 - .1 Perform tests in accordance with Division 26 - 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 Ensure heaters and controls operate correctly.
-

3.4 Cleaning

- .1 Perform cleaning in accordance with Section 23 05 00 - Common Work Results for HVAC.

END OF SECTION

Part 1 General

1.1 GENERAL

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

1.2 CODES AND STANDARDS

- .1 Do complete installation in accordance with 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.
- .3 Unless otherwise indicated, all references to "Canadian Electrical Code" or "CEC" shall mean the edition of the Canadian Electrical Code, Part I, CSA C22.1, and the variations made thereto by Manitoba regulation, which are in force on the date of bid closing for the Contract.
- .4 All electrical products shall be tested, certified and labeled in accordance with a certification program accredited by the Standards Council of Canada (at a minimum, STANDATA Section 2 – Electrical System Equipment). Where a product is not so labeled, provide written approval by the authority having jurisdiction.
- .5 Submit to The City, copy of electrical permit obtained from authority having jurisdiction.
- .6 If authority having jurisdiction conducts an electrical inspection, submit copy of certificate of acceptance provided by authority having jurisdiction.
- .7 All equipment supplied to have 75°C termination ratings and suitable for connection of copper or aluminum conductors.
- .8 All cable ampacities in the drawings and specifications are based on equipment termination ratings of 75°C. Should equipment be provided with a different rating it is the Contractors responsibility to size cable accordingly to meet the electrical code requirements.

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.
- .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 Contract Document.
- .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 in the generator building is NEMA 12 unless otherwise specified.
- .4 Minimum enclosure type to be used in the lift station is NEMA 3R unless otherwise specified.

1.7 ELECTRICAL EQUIPMENT MODIFICATION

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

1.8 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 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.

1.9 EQUIPMENT IDENTIFICATION

- .1 Refer to City of Winnipeg Electrical Design Guidelines section 2.3 for Identification Lamacoid Requirements.

1.10 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.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

1.11 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible, after equipment is installed.

1.12 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department and the Contract Administrator.
- .2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping screws, 20mm text.

1.13 WALL MOUNTED DRAWINGS

- .1 Provide drawings in plexiglass holder adjacent to the main electrical distribution.
 - .1 Plexiglass holder to be designed for the purpose and allow for easy replacement of the drawing.
 - .2 Size: 432 x 279 mm minimum size.
- .1 Single Line Diagram
- .2 Process P&ID

1.14 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

1.15 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights.
 - .1 Panelboards: 1800 to top
 - .2 Transformers: 2400 to bottom (when wall mounted above panelboard)
 - .3 Light switches: 1420 to top
 - .4 Wall receptacles: 900 to top
 - .5 Control panels: 1800 to top
 - .6 Emergency lights: 2400 (minimum)
 - .7 Emergency stop switches: 900 to top
 - .8 Motor disconnect switches: 1800 to top

1.16 CONDUIT AND CABLE INSTALLATION

- .1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.
- .2 For walls, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 100 mm above finished floor level.
- .3 Fire stop opening with ULC approved assembly for the installation conditions.

1.17 FIELD QUALITY CONTROL

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties
- .2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province of Manitoba.

1.18 TESTING

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

- .2 Prior to energizing any portion of the electrical system, perform megger tests on all parts of the distribution system. Results shall meet the requirements of the CEC, authority having jurisdiction and the Contract Documents.
- .3 Test results shall be consolidated into a typed report and included in the Operation and Maintenance Manuals.

1.19 SUBMITTAL

- .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 Submit Shop Drawings (including Product Data) for all equipment as required in each Section of this Specification. At minimum the following should be included in each submission.
- .3 Submit shop drawings, product data and samples of equipment and materials. Shop drawings to include but not be limited to the following:
 - .1 Complete product part numbers for each piece of equipment
 - .2 Corresponding equipment tag numbers with part numbers
 - .3 Product specification sheets indicating product features and options
 - .4 Dimensions in metric measurement (mm or meters)
 - .5 Weights in metric measurement
 - .6 Wiring/interconnection diagrams with manufacturer terminals numbers
 - .7 Any additional information requested by The City or The Citys representative

1.20 AS-BUILT MARKUPS

- .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 Markups**. 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 Markups** to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.
- .2 **Provide red line as-built markups in pdf format to Contract Administrator. MPE will prepare Record Drawings based on the Contractor as-built markups.**
- .3 Record actual locations of all pull boxes, panelboards, luminaires, feeders, electrical equipment and electrical site services.
- .4 Record any changes to circuit designations.
- .5 Include on **as-built markups**, revisions due to engineering change orders, site alterations, additions and field ordered changes made during construction.
- .6 Record any changes to control circuit wiring including but not limited to terminal numbering, wire and cable labels, interconnect wiring between equipment.
- .7 Record any changes to schedules including panel, luminaire, mechanical, and conduit

/cable schedules.

1.21 OPERATION AND MAINTENANCE DATA

- .1 Provide the following for all systems and components:
 - .1 Manufacturer's product data, including performance curves, schematics, and wiring diagrams for all electrical control systems.
 - .2 Manufacturer's installation instructions.
 - .3 Manufacturer's operation instructions.
 - .4 Manufacturer's maintenance instructions, including complete parts list for all serviceable components.
- .2 Provide a comprehensive list of subcontractors and suppliers who supplied and installed systems and components.
- .3 Provide copies of all inspection certification reports from authorities having jurisdiction.
- .4 Reference Section 40 05 01

1.22 COMMISSIONING

- .1 Commission all instruments as described in Section 26 91 90 and 40 80 11.
- .2 Retain the services of the equipment Manufacturers Technical Representative as required in each specification section.
- .3 Upon completion of construction, all circuits are to be operational and all instruments operating within manufacturer's specifications.
- .4 Prior to notifying The City's Representatives Commissioning Team to begin commissioning activities, verify all control logic, inputs, and outputs, and complete Record Drawings as described in this section.
- .5 Electrical controls, circuits and systems shall be tested by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates in accordance with the contract drawings and the description of operation for the equipment. Where field conditions prevent actual equipment functioning during testing, the contractor shall simulate the intended operating condition in the associated control circuits.
- .6 The contractor shall locate the cause of any malfunction and make the necessary wiring and / or equipment changes or corrections to obtain the particular systems intended operation as defined by the contract drawings. Such changes shall be included in the test report.
- .7 Control Panels shall be operated through all design functions. This shall include remote operation of all equipment and actuation of alarms and indicating devices according to design requirements.
- .8 Complete operation tests shall be given to all relays, and control devices to show that the equipment performs all design functions and meets design and procurement specifications.

- .9 During start-up, assist Commissioning Team in debugging system operation and correct any deficiencies and omissions which appear.

1.23 AMBIENT ENVIRONMENT

- .1 Unless otherwise indicated, supply equipment enclosures, boxes, electrical materials and products suitable for ambient environment of the following areas:

Area	General Classification	Equipment Enclosure Type	Cable / Raceway
1. Outdoor Areas	Wet	NEMA 4	Note 1
2. Sewage Wet Well	Zone 1 (Division 1)	See CEC Section 18	PVC coated Rigid aluminum, TECK, See Note 2
3. Dry Well	Ordinary	NEMA 12	Note 1
4. Main Floor	Ordinary	NEMA 12	Note 1

Note 1 Install cable or conduit type as per drawings.
 Note 2 Seal all conduits with poured EYS conduit seals (or similar).

1.24 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

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, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 38, Thermoset-Insulated Wires and Cables.
- .3 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.
- .4 CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.
- .5 City of Winnipeg
 - .1 Identification Standard – 510276-0000-40ER-0002.
 - .2 Tag Naming Standard – 612620-0014-40ER-0001.
 - .3 Electrical Design Guide – 5102786-0000-47ER-0001.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Contract Document.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 BUILDING WIRES

- .1 Wire: to CAN/CSA-C22.2 No. 38
- .2 Conductors:
 - .1 Size as indicated. Minimum size: 12 AWG.
 - .2 Stranded for 10 AWG and larger.
 - .3 Copper conductors.

- .3 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.
- .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 **TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 1000V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: 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 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 VFD CABLE

- .1 Cable to:
 - .1 CAN/CSA-C22.2 No. 38.
 - .2 CAN/CSA-C22.2 No. 174.
 - .3 CAN/CSA-C22.2 No. 230.
- .2 Conductors:
 - .1 Grounding conductors: Three copper, symmetrically located in continuous contact with the copper tape shield or continuous aluminum armour.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 1000V.
- .4 Shield: Continuous copper tape shield with 50% overlap or continuous (non-interlocked) aluminum armour.
- .5 Armour: aluminum, interlocking or continuous.
- .6 Overall covering: polyvinyl chloride material.

- .7 Approved for six-pulse VFD use.
- .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.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .9 Connectors:
 - .1 Watertight, approved for the cable.

2.4 600V TECK90 CONTROL CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Grounding conductor, copper.
- .3 Conductors, copper, size as indicated.
- .4 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 600V.
- .5 Armour: interlocking aluminum
- .6 Shielding as indicated on the drawings.
- .7 A higher level of shielded cable may be substituted for unshielded, or overall shielded cable, unless otherwise specified, provided that all appropriate shield grounding, as required by the Contract Administrator, is performed. All subsequent related changes, such as required conduit size, fittings, etc. are the responsibility of the Contractor.
- .8 Overall covering: thermoplastic polyvinyl chloride material.
- .10 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.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .11 Connectors:
 - .1 Watertight, approved for the cable.

2.5 300V ACIC/CIC CONTROL CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.
- .2 Conductors, copper, size as indicated. 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 A higher level of shielded cable may be substituted for unshielded, or overall shielded cable, unless otherwise specified, provided that all appropriate shield grounding, as required by the Contract Administrator, is performed. All subsequent related changes, such as required conduit size, fittings, etc. are the responsibility of the Contractor.
- .12 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.
- .13 Connectors:
 - .1 Watertight, approved for the cable.

2.6 WIRING IDENTIFICATION

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

Part 3 Execution

3.1 GENERAL

- .1 Do not splice cables. A continuous length is required for all feeds.
- .2 Install in accordance with manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.

3.2 INSTALLATION OF BUILDING WIRES

- .1 Install in conduit as per Section 26 05 34.

3.3 INSTALLATION OF ARMoured CABLE AND TECK CABLE 0 -1000 V

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 - 1000 V.
- .3 Where surface mounted, provide clamps spaced a maximum of 1 m apart.
- .4 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute.
- .5 Investigate resistances less than 50 megaohms, or deviations between parallel conductors. Conductors with insulation resistance values, at one minute, less than 25 megaohms, or that deviate from other similar conductors by more than 50% will be rejected.

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 SUBMITTALS

- .1 Provide submittals in accordance with Contract Document.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 REFERENCES

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

1.3 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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 6 AWG, complete with insulated supports, fastenings, connectors.
- .5 Ground Grid: Copper galvanized rods, installed as indicated on drawings.
- .6 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 EQUIPMENT GROUNDING AND BONDING

- .1 Install grounding connections to transformers.
- .2 Install bonding connections to all electrical equipment.
- .3 Include a separate green bonding wire in all power conduits including branch circuit wiring sized according to the largest power conductor in the conduit:
 - .1 8 AWG green ground wire for up to 4 AWG power conductors.
 - .2 6 AWG green ground wire for up to 2 AWG power conductors.

3.2 GROUNDING BUS

- .1 Install copper grounding bus mounted inside the service entrance compartment of the MCC.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections as indicated on drawings.

3.3 FIELD QUALITY CONTROL

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

3.4 INSTALLATION

- .1 Comply with requirements of CSA C22.2 No. 0.4-M1982 and Canadian Electrical Code.

- .2 Install complete permanent grounding system including electrodes, conductors, connectors and accessories. Where EMT is used, run ground wire in conduit.
- .3 Protect exposed ground conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes using thermite welding.
- .5 Use mechanical connectors for ground connection to equipment provided with lugs.
- .6 Solder joints are not permitted.
- .7 Install bonding wire in flexible metal conduit connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate insulated bonding conductor in conduit runs installed in concrete which is subject to moisture penetration and underground.
- .9 Install a separate insulated bonding conductor in all RPVC conduit runs.
- .10 Install insulated copper bonding conductor in all cable tray, mechanically fixed to the trays at a minimum of 2 meter intervals.
- .11 Install connectors in accordance with manufacturer's instructions.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as indicated. Ensure telephone grounding system is in accordance with telephone company requirements.

END OF SECTION

Part 1 General

1.1 MEASUREMENT AND PAYMENT

- .1 Common Work Results for the work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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/ inside panels, 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 galvanized anchors.
- .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 Maximum spacing between conduit supports:
 - .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
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole aluminum straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole aluminum straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 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.
- .8 For surface mounting of two or more conduits use channels, with maximum centre spacing as indicated above.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Touch up abraded surfaces and cut ends of galvanized members with an approved galvanizing repair compound.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and components for splitters, junction, pull boxes, and cabinets.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.76, Splitters

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Contract Document.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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.

2.3 600V CUSTOMER SERVICE TERMINATION ENCLOSURE (CSTE-L70)

.1 Requirements:

- .1 Rating: 600V, 600A, 3 phase, 4 wire.
- .2 Short Circuit Current Rating: 25 kA minimum
- .3 Service Entrance Rated.
- .4 Main Disconnect:
 - .1 In accordance with 26 28 23
- .5 Meter socket: 7-jaw with insulated neutral.
- .6 Provision for utility metering PTs (potential transformers).
- .7 Provision for utility metering CTs (current transformers).
 - .1 Metering CTs not included in contract.
 - .2 Provide copper bus bars to jumper across CT openings.
- .8 Compartments and sections:
 - .1 Breaker Section
 - .2 Metering Section
- .9 All compartments and sections to be barriered from adjoining sections.
- .10 Copper bus.
- .11 Insulated neutral.
- .12 Provision for factory-installed neutral-ground link.
- .13 Enclosure Rating: NEMA Type 3R.
- .14 Mounting: Wall Mount
- .15 Cable Entry: Bottom.
- .16 Doors: stays to hold compartment doors in 110 degrees open position.

.2 Manufacturer:

- .1 Strong Electric,
- .2 JRS Industrial & Power Solutions
- .3 Or approved equal in accordance with B7.

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 except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .4 Install terminal blocks as indicated in Type T cabinets.
- .5 All enclosures shall suit the environment where they are installed as follows:
 - .1 CSA/ NEMA 1 metal enclosures when installed inside panel
 - .2 CSA/ NEMA 3R (WP) metal enclosures when installed outdoors
 - .3 CSA/ NEMA 7 (XP) metal enclosures when installed in hazardous classified areas.
- .6 Refer to specification 26 05 01 for further details.

3.2 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install size 3 identification labels indicating system voltage and phase.
- .3 Install a permanent label or lamacoid on the cover of all junction boxes indicating the circuit(s) contained within.
 - .1 Example: L73-2 (Panel L73, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-21, Canadian Electrical Code, Part 1.

1.2 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .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 FOR METAL CONDUIT

- .1 General Requirements:
 - .1 Acceptable materials:
 - .1 Cast Aluminum
 - .2 Cast ferrous alloy with corrosion resistant epoxy coating.
 - .2 Finish: Epoxy Enamel
 - .3 Suitable for threaded rigid conduit
 - .4 Mounting lugs as required.

- .5 Wet location covers for all locations unless otherwise approved by the Contract Administrator.
- .6 To CSA 22.2
- .2 Specific Requirements:
 - .1 In Panel Outlets:
 - .1 Crouse Hinds VXF/VFT series
 - .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 Crouse Hinds FS/FD series with factory threaded hubs and mounting feet for surface wiring of receptacles.
 - .2 Single gang unless specified otherwise.
 - .3 Wet location covers for all locations below grade.
 - .4 Manufacturer / Model:
 - .1 Crouse Hinds FS/FD series
 - .2 Or approved equal in accordance with B7.
 - .5 Device Boxes in classified areas:
 - .1 Crouse Hinds 'explosion-proof' rated.

2.3 SURFACE MOUNTED OUTLET BOXES FOR PVC CONDUIT

- .1 General Requirements:
 - .1 To CSA 22.2 No. 18.
 - .2 Acceptable Materials: 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 equivalent in accordance with B7.
 - .2 Device Boxes:
 - .1 IPEX FX/FD series
 - .2 Or approved equivalent 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 FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices in Panels.
- 2.8 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**
 - .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.
- 2.9 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 35 mm and pull boxes for larger conduits.
 - .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 All boxes for outlets and devices shall suit the environment where they are installed as follows:
 - .1 CSA/ NEMA 1 metal enclosures when installed inside panel
 - .2 CSA/ NEMA 4 (WP) stainless steel enclosures when installed outdoors
 - .3 CSA/ NEMA 7 (XP) metal enclosures when installed in hazardous classified areas.
- .2 Support boxes independently of connecting conduits.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work. Vacuum clean interior of outlet boxes before installation of wiring devices.
- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .6 Provide permanent label or lamacoid for all device boxes indicating the circuit(s) contained within.
 - .1 Example: M73-2 (Panel M73, circuit 2)

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CAN/CSA C22.2 No. 45.1, Electrical Rigid Metal Conduit – Steel.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
 - .5 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT) and Fittings (Binational Standard, with UL 1696).

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Contract Document.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 CONDUITS

- .1 Minimum conduit size: 19 mm, unless specifically indicated on the drawings or approved by the Contract Administrator.
- .2 Rigid metal conduit: to CSA C22.2 No. 45.1, aluminum, threaded,
- .3 Electrical Metallic Tubing CAN/CSA C22.2 No. 83, aluminum threaded.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

- .5 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .6 PVC coated Rigid Aluminum: to CSA C22.2 No. 45.1
- .7 PVC coated Rigid Aluminum: to CSA C22.2 No. 45.1

2.2 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.

2.3 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.

2.4 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 Utilize insulated grounding bushings at all enclosure entries.
- .4 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.5 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.

2.6 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 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 Equipment Monorails.
- .3 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 Minimum conduit size for lighting and power circuits: 19 mm.
- .6 Mechanically bend steel conduit over 19 mm dia.
- .7 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .8 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .9 Dry conduits out before installing wire.
- .10 Do not include more than the equivalent of four (4) quarter bends. Provide pull boxes as required.
- .11 Ensure electrical continuity in all conduit systems.
- .12 All conduit shown exposed in finished areas is to be free of unnecessary labels and trade marks.
- .13 Seal conduits with duct seal where conduits are run between heated and unheated areas. Where conduits, cables, or cable trays pierce fire separations, seal openings with Dow Corning 3-6548 sealant. Seal all conduits entering or leaving hazardous classified areas

with approved seals.

- .14 EYS seal conduits after explosion-proof boxes towards unclassified areas. Add Chico compound to stop migration of hazardous gases only after all tests and commission is successfully done.
- .15 Where conduits pass through walls, group and install through openings. After all conduits shown on the Drawings are installed, close wall openings with material compatible with the wall construction.
- .16 Install fish cord in empty conduits.
- .17 Install ground wire in all conduits. Size ground wire as per CEC Table 17.
- .18 Underground conduits: Slope conduits to provide drainage, use waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.3 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 Provide a separate ground wire within rigid conduit, bonded to motor frames and system ground.
- 7 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

3.4 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 below, table 4-5 of the CoW Electrical Design Guide.

Table 4-5 : Conduit Colour Bands

System	Prime Band	Aux. Band
Medium Voltage (> 750 V)	Orange	
347/600 V	Yellow	
208/120/240 V Power	Black	
UPS 208/120/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (< 50 V)	Blue	Orange
Intrinsically Safe	Blue	White
Grounding	Green	
Fibre Optic Cable	Purple	

3.5 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

3.6 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.

3.7 LIQUID-TIGHT AND EXPLOSION-PROOF FLEXIBLE CONDUIT

- .1 Use as LT raceways at all motors, pipe-mounted control devices, and other devices subject to movement or water when located in non-classified areas.
- 2 Use as XP raceways at all motors, pipe-mounted control devices, and other devices subject to movement when located in classified areas.
- .3 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.
- .4 Provide a separate ground wire within flexible conduit, bonded to motor frames and system ground.

3.8 CONCEALED CONDUIT

- .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.

3.9 CONDUIT 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.

3.10 CONDUIT 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.

3.11 INSTALLATIONS IN CATEGORY 1 AND 2 LOCATIONS

- .1 As per CEC section 22.
- .2 Arrange to provide drainage at frequent intervals to suitable locations.
- .3 Equip with approved fittings to permit the moisture to drain out of the system.
- .4 Install the conduit with a minimum of 12 mm space from the supporting surface.
- .5 Install every joint to be water-tight.
- .6 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 HAZARDOUS ZONE 1 AND 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 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

1.2 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 CABLE PROTECTION

- .1 38 x 190 mm planks pressure treated, water repellent preservative.

Part 3 Execution

3.1 DIRECT BURIAL OF DUCTS IN TRENCHES

- .1 After sand base in trenches is in place, lay ducts maintaining 75 mm clearance from each side of trench to nearest cable. Maintain a burial depth of 1M throughout its length. Do not pull ducts into trench.
- .2 Provide offsets for thermal action and minor earth movements.
- .3 Minimum permitted radius 6 times diameter of ducts or in accordance with manufacturer's instructions.
- .4 Duct separation:
 - .1 As shown on drawings.
- .5 After sand protective cover specified in Section 31 23 10 - Excavating, Trenching and Backfilling, is in place, install continuous row of 38 x 190 mm pressure treated planks as indicated to cover length of run.

3.2 CONCRETE ENCASED DUCTS IN TRENCHES UNDER VEHICULAR AREAS

- .1 Follow steps 1 thru 5 as stated in item 3.1 above.
- .2 Concrete encase with top and bottom reinforcements all ducts when running under or crossing vehicular traffic/ paved roadway areas

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 NETA ATS-2017, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems, 2017 Edition

1.2 TESTING REPORT

- .1 Prepare an overall inspection and test report that details all investigations and tests.
- .2 The Contractor shall furnish five paper copies and two electronic copies on CD of each final report.
 - .1 The electronic copies of the report, including the test forms, shall be provided in PDF format.
 - .2 The Microsoft Word version of the all completed test forms provided to the Contractor shall also be included on the CDs.
- .3 The report shall be neat and organized. Any omissions, inconsistencies, or incomplete work identified by the Contract Administrator shall be corrected and incorporated into the report in the appropriate section, and completely resubmitted.
- .4 A draft of each report shall be completed and sent to the Contract Administrator for review a maximum of one month after the completion of the inspections at the Site.
- .5 The final report shall be submitted a maximum of two weeks after the Contractor receives the mark-up of the draft report from the Contract Administrator.
- .6 The report shall include the following:
 - .1 Summary of project.
 - .2 Testing Equipment.
 - .3 Detail the type, manufacturer, model, and last calibration date of all testing equipment.
 - .4 Description of equipment tested.
 - .5 Description of all tests.
 - .6 Typed inspection forms including:
 - .1 Identification of the testing organization.
 - .2 Equipment identification.
 - .3 Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.

- .4 Date of inspections, tests, maintenance, and/or calibrations.
- .5 Identification of the testing technician.
- .6 Indication of inspections, tests, maintenance, and/or calibrations performed and recorded, along with charts, and graphs as applicable. All measurements and readings taken shall be noted for inclusion in the report. Where repairs are made, measurements and readings before and after the repair shall be included.
- .7 Indication of expected results, when calibrations are to be performed.
- .8 Indication of “as-found” and “as-left” results, as applicable.
- .7 Itemized list of all repaired deficiencies which shall include:
 - .1 Detailed description of the deficiency.
 - .2 The cost associated with the deficiency repair.
- .8 Itemized list of all un-repaired deficiencies encountered which shall include:
 - .1 Detailed description of the deficiency.

1.3 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

Part 3 Execution

3.1 SCOPE OF TESTING

- .1 MCC-L71 AND MCC L72E, including:
 - .1 Surge Protector
 - .2 Power Meter
 - .3 Power fail relay
 - .4 CTs

- .5 PTs (if present)
- .6 VFD feeder buckets – Pumps
- .7 Motor Starter – HVAC
- .8 Breakers
- .2 XFMR-L73, XMFR-L74, PNL-L75, PNL-L74 and PNL-L73
- .3 Motor, pump
- .4 Standalone VFD's
- .5 Motor, HVAC
- .6 Perform a harmonics measurement, at the following locations:
 - .1 MCC-L71 incoming feed.

3.2 INSPECTION, TESTING AND MAINTENANCE PROCEDURES

- .1 General
 - .1 All tests are based on NETA (InterNational Electrical Testing Association) standard ATS-2003. Where manufacturer's specifications, tolerances, and/or published data are not available, refer to the appropriate tables in ATS-2003.
 - .2 Torque all accessible bolted electrical connections. Additional requirements apply as specified.
 - .3 Utilize all drawings for reference while performing the specified electrical inspection work. Where the existing installation deviates from that shown on the drawings, mark-up the drawings with red pen as required to reflect the installation. Include the marked-up drawings in the report.
 - .4 The scope of required drawing checks is limited to the equipment and components that are part of the electrical inspection work.
 - .5 Any repairs made that affect the accuracy of the drawings shall be marked up on the drawings.
 - .6 Drafting of drawings is not required.
 - .7 All inspection values, readings, corrections, and assessments shall be clearly recorded for inclusion within the report.
 - .8 Where corrections or repairs are made, record both as found/as left test readings on the inspection sheet. If space is not provided on the inspection form, record the readings in the Note fields or on a separate sheet.

- .2 Inspection Forms
 - .1 The inspection forms to be completed by the Contractor are provided for reference in PDF format.
 - .2 Microsoft Word form templates will be provided prior to the work being initiated.
 - .3 Make appropriate print-outs of the inspection forms and utilize for entry of data and test results on site.
 - .4 Utilizing the Microsoft Word form templates, enter the data recorded manually into the forms electronically.
 - .5 Complete the inspection forms in the entirety and include them in the report.
 - .6 Submit electronic PDF copies of the inspection forms.
 - .7 The scope of work required in the specifications is in no way limited by the inspection forms, or spaces provided. Provide additional pages, documents, and forms as required to provide a complete report.
 - .8 The inspection forms may be updated during the Work by the City or Contract Administrator. Utilize the latest forms provided.
 - .9 Perform insulation resistance temperature correction calculations.

3.3 CABLES, < 1000 V (ALSO FEEDERS IN CONDUIT)

- .1 Inspection and testing shall be comprised of the following:
 - .1 For cables/wires 4/0 AWG or larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate and correct values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - .2 Torque all accessible bolted electrical connections.
 - .3 Inspect compression applied connectors for correct cable match and indentation.
 - .4 Inspect grounding and cable/conduit support.
 - .5 Verify that visible cable bends meet or exceed the minimum allowable bending radius.
 - .6 Measure length of cable/conduit and record in meters.
 - .7 If cables/wires are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.
 - .8 Perform an insulation-resistance test on each conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1000 megaohms. The voltage

applied shall be 500 Vdc for 300 V rated cables, and 1000 Vdc for 600 V or 1000 V rated cables.

3.4 SURGE ARRESTORS, LOW VOLTAGE

- .1 Inspection and testing shall be comprised of the following:
 - .1 Inspect physical and mechanical condition.
 - .2 Inspect anchorage, alignment, grounding, and required clearances.
 - .3 Clean the unit.
 - .4 Verify that arrestors are electrically connected in their specified configuration.
 - .5 Perform resistance measurements through bolted connections with a low resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - .6 Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
 - .7 Verify that stroke counter, if present, is correctly mounted and electrically connected.
 - .8 Perform insulation-resistance tests for one minute from each phase terminal to the case.
 - .9 Equipment rated $\geq 600\text{V}$, utilize a test voltage of 1000 VDC.
 - .10 Equipment rated $< 600\text{V}$, utilize a test voltage of 500 VDC.
 - .11 Test the grounding connection. Resistance between the arrester ground terminal and the ground system should be less than 0.5 ohm.

3.5 METERING DEVICES, DIGITAL

- .1 Inspection and testing shall be comprised of the following:
 - .1 Inspect physical and mechanical condition.
 - .2 Torque all bolted connections.
 - .3 Record the equipment nameplate data for inclusion in the report.
 - .4 Verify accuracy of voltage and current at a minimum of two points each.
 - .5 If required, calibrate meters in accordance with manufacturer's published data.

3.6 MOTORS, INDUCTION, AC, 600 V

- .1 Inspection and testing shall be comprised of the following:
 - .1 Note the equipment nameplate data for inclusion in the report.
 - .2 Inspect physical and mechanical condition.
 - .3 Inspect anchorage, alignment, and grounding.
 - .4 Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging. Air baffles and filter media should be clean. Cooling fans should operate. Slip ring wear and brushes should be within manufacturer's tolerances for continued use. Brush rigging should be intact.
 - .5 Clean the unit.
 - .6 Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - .7 Verify the application of appropriate lubrication and lubrication systems.
 - .8 Verify the absence of unusual mechanical or electrical noise or signs of overheating.
 - .9 Perform a rotation test to insure correct shaft direction.
 - .10 Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test voltage shall be in accordance with manufacturer's published data or 500 Vdc.
 - .1 Where possible, test each winding separately. Ground all windings not under test.
 - .2 Ensure all cables and accessories are disconnected during the test.
 - .3 For motors $\leq 150\text{kW}$ (200 HP), the test duration is to be one (1) minute. Calculate the dielectric absorption ratio.
 - .4 Correct test results to 40 °C.
 - .5 Investigate readings below 100 megaohms. Investigate dielectric absorption ratios less than 1.4 and polarization index ratios less than 2.0 for Class B insulation and Class F insulation.
 - .11 Where it is not possible to perform an insulation resistance test separately on each winding, perform a winding resistance test on each winding using a low-resistance ohmmeter.

- .12 Measure running voltage and current and evaluate relative to load conditions and nameplate full-load amperes. Utilize a true RMS meter.
 - .1 Where powered by a VFD with bypass, perform test with the motor powered by the VFD and by the bypass starter.
- .13 Perform insulation-resistance test on insulated bearings in accordance with manufacturer's published data, if applicable.
- .14 Perform resistance tests on resistance temperature detector (RTD) circuits. RTD circuits should conform to design intent and/or machine protection device manufacturer's specifications.

3.7 MOTOR STARTERS, 600 V

- .1 Inspection and testing shall be comprised of the following:
 - .1 Note the equipment nameplate data for inclusion in the report.
 - .2 Record all adjustable settings, size of overload, etc.
 - .3 Inspect physical and mechanical condition.
 - .4 Inspect anchorage, alignment, and grounding.
 - .5 Verify the unit is clean.
 - .6 Torque all accessible bolted power connections.
 - .7 Inspect contactors for evidence of overheating or stress.
 - .8 Visually inspect and exercise circuit breaker.
 - .9 If power fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

3.8 CIRCUIT BREAKERS, INSULATED CASE/MOLDED CASE, 600 V

- .1 Inspection and testing shall include the following:
 - .1 Note the equipment nameplate data for inclusion in the report.
 - .2 Record all adjustable settings.
 - .3 Inspect physical and mechanical condition.
 - .4 Inspect anchorage and alignment.
 - .5 Clean the unit.
 - .6 Torque all accessible bolted power connections.

- .7 Operate the circuit breaker to insure smooth operation.
- .8 Test all breakers utilizing the “Push-To-Trip” button, if equipped.
- .9 Move operating handle to the off and on position.

- .10 Restore breaker position to original position.
- .2 For cables 4/0 AWG and larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- .3 For breakers with a frame size greater or equal to 250A, or as specified elsewhere in the specification:
 - .1 Perform an insulation resistance test.
 - .2 Breakers rated < 600V, test voltage is to be 500 VDC.
 - .3 Breakers rated \geq 600V, test voltage is to be 1000 VDC.
 - .4 Perform a contact/pole-resistance test.

3.9 TRANSFORMERS, LOW VOLTAGE, DRY-TYPE

- .1 Inspection and testing shall be comprised of the following:
 - .1 Note the equipment nameplate data for inclusion in the report.
 - .2 Inspect physical and mechanical condition.
 - .3 Inspect anchorage, alignment, and grounding.
 - .4 Clean the unit.
 - .5 Torque all accessible bolted power connections.
 - .6 Record the tap setting.
 - .7 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Duration of the test is to be one minute. Calculate the dielectric absorption ratio.
 - .1 600 V windings shall be tested at 1000 Vdc.
 - .2 120/208 V windings shall be tested at 500 Vdc.

3.10 PANELBOARDS, LOW VOLTAGE

- .1 Inspection and testing shall be comprised of the following:
 - .1 Note the equipment nameplate data for inclusion in the report.
 - .2 Inspect physical and mechanical condition.

- .3 Inspect anchorage, alignment, and grounding.
- .4 Clean the unit.
- .5 Inspect breakers and verify mechanical operation by exercising all circuit breakers.
 - .1 Record breaker data on the inspection form.
 - .2 Test all breakers utilizing the “Push-To-Trip” button, if equipped.
 - .3 Move operating handle to the off and on position.
 - .4 Restore breaker position to original position.
- .6 Test main and feeder/load breakers with a frame size $\geq 250A$, or with long, short, or ground fault settings and complete a separate inspection form for each.
- .7 Torque all accessible bolted power connections including incoming, load neutral and ground connections.
- .8 Perform insulation-resistance tests on each bus phase with all other phases grounded.
- .9 The main breaker, if present, is to be open for the test. If no main breaker is present, disconnect the supply conductors.
- .10 Open all load breakers.
- .11 Test voltage for all 600/347 V panelboards to be 1000 Vdc.
- .12 Test voltage for all 120/208 V panelboards to be 500 Vdc.

3.11 GROUNDING SYSTEM

- .1 Inspection and testing shall be comprised of the following:
 - .1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system located in the MCC, 200A CSTE, etc. Investigate connections with a resistance greater than 0.5 milliohms.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 47, Air-Cooled Transformers (Dry Type).
 - .2 CSA C9, 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

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Contract Document including:
 - .1 manufacturer's instructions,
 - .2 printed product literature,
 - .3 data sheets,
 - .4 performance criteria,
 - .5 physical size,
 - .6 Finish,
 - .7 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 dry type transformers for incorporation into manual.

1.5 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.

1.7 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 TRANSFORMERS

- .1 XFMR-L74
 - .1 Type: ANN.
 - .2 Three phase, 600V input, 120/208 V output, 60 Hz.
 - .3 Voltage taps: 2.5% full capacity above and below normal.
 - .4 Windings: copper.
 - .5 Insulation: Class H, 220°C.
 - .6 Temperature rise: 115°C at continuous full load.
 - .7 Basic Impulse Level (BIL): standard.
 - .8 Hipot: standard.
 - .9 Average sound level: To meet the local municipal & building codes and meet at minimum the following criteria:

45 dB max. up to 45 kVA

50 dB max. up to 150 kVA
 - .10 Impedance at 17 degrees C: standard
 - .11 Mounting: Wall mounted as per drawings
 - .12 Nameplate to include actual transformer impedance (%Z).

- .13 Finish: in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Label size: 7.
- .3 Indicate equipment identifier, KVA rating, primary and secondary voltage.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA. Provide brackets and bolts for wall mounted transformers. Ensure all transformers have good ventilation.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Install non-combustible insulating board, extending 300mm around transformer on all sides, behind transformer to meet CEC code requirements.
- .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 Mount transformers to reduce direct and transmitted noise. Mount core and coils of transformers.
- .9 Make connections to transformers in flexible conduit, entering the enclosure below the coils and in the bottom 1/3 of transformer enclosure.
- .10 Energize transformers after installation is complete.
- .11 Adjust tap connections to give a continuous secondary voltage of 120 volts phase to neutral, under load.

3.2 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.

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 dry type transformers installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for standard and custom breaker type panelboards.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Contract Document including:
 - .1 Manufacturer's instructions,
 - .2 printed product literature.
 - .3 data sheets.
 - .4 product characteristics.
 - .5 performance criteria.
 - .6 physical size.
 - .7 Finish.
 - .8 limitations.
- .2 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

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 panelboards and SPD for incorporation into manual.

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 and protect panelboards from nicks, scratches, and blemishes.

.2 Replace defective or damaged materials with new.

1.6 MEASUREMENT AND PAYMENT

.1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.

.2 A maximum of ninety-five percent (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 PANELBOARDS, 240 V OR LESS (PNL-L74)

.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.

.2 120/208 V panelboards: bus and breakers rated for 10 kA (symmetrical) interrupting capacity.

.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 on the drawings.

.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 21- Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top of panel. 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 7 engraved as follows:
 - .1 Line 1 is to be the panel identifier on the drawings, for example “PNL-L74”.
 - .2 Line 2 is to be the voltage, for example “120/208V, 3Ø”.
 - .3 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.
 - .4 Nameplate for each circuit in distribution panelboards size 2 engraved 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 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.
 - .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 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 of two (2) metres to top of cover, as required by Code.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 TESTING

- .1 Test in accordance with Section 26 08 05.

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 panelboards installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Electrical Equipment Manufacturers Association of Canada (EEMAC)

1.2 COORDINATION

- .1 Coordinate installation with:
 - .1 Section 409513 - Automation - Control Panels
 - .2 Section 261217 – Transformers
 - .3 Section 262910 - Motor Starters
- .2 Mechanical Equipment Controls to provide a complete integrated functional system.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Contract Document including:
 - .1 manufacturer's instructions,
 - .2 printed product literature,
 - .3 data sheets,
 - .4 performance criteria,
 - .5 physical size,
 - .6 Finish,
 - .7 limitations.
- .2 Submit shop drawings in accordance with contract documents, stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .3 Submit full technical data, service and parts facilities complete with manufacturer's publish data.
- .4 Full shop drawings to be submitted for VFD equipment, submit as a minimum:
 - .1 Specification and Data Sheets.
 - .2 Manufacturer's published warranty documents.
 - .3 Shop drawings showing plan and elevation views with certified overall and interconnection point dimensions.

- .4 Interconnection wiring diagrams showing all external connections required; with all field wiring terminals marked in a consistent manner.
- .5 Manufacturer's installation instructions.
- .6 Manufacturer's recommended spare parts.
- .7 Complete parts list.

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 Two (2) Motor Control Centers as shown in the design drawings.
- .2 600 VAC, 60 Hz, 3 Phase, 4 Wire.
- .3 Neutral bus not required.

2.2 GENERAL DESCRIPTION

- .1 Compartmentalized vertical sections with common power busbars. Incoming and outgoing cable terminations and lugs shall be furnished and sized to accommodate the number and size of cables indicated on the contract drawings.
- .2 Floor mounting, free standing, enclosed dead front.
- .3 Indoor CSA gasketed enclosure.
- .4 Suitability for Service Entrance: Yes.
- .5 Maximum width as shown on drawings.
- .6 Wiring class: Class 1, Type B-D or B-T as shown on the drawings.
- .7 Compartment Nameplates:
 - .1 White background with black letters.
 - .2 Identification as indicated on the Drawings.
- .8 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
- .9 SCCR: 25 kA minimum.
- .10 Acceptable manufacturer:
 - .1 Schneider Electric Model 6.
 - .2 This product is standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.
- .11 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 bottom.
- .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 "MCC-L71".
 - .2 Line 2 is to be the voltage, for example "600V, 3-Phase".
 - .3 Line 3 is to be the rating, for example "600A, 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 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 EQUIPMENT 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 SURGE PROTECTION DEVICE (XS-L711)

- .1 Supply and install a Surge Protection Device (SPD) where shown on the drawings.
- .2 Requirements:
 - .1 SPD 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 creating any environmental hazards.

- .5 Protection Modes – The SPD 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 SPDs applied to the distribution system shall have a 20kA In rating regardless of their Type (includes Types 1 and 2) or operating voltage. SPDs 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 SPD Design:
 - .1 Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs 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. SPDs 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:
 1. 600V Equipment – Service Entrance: 240 kA
 2. 600V Equipment – Not Service Entrance: 120 kA
- .9 Installation Requirements:
 1. The SPD 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 SPD.
 3. Utilize a breaker, appropriately rated as directed by the TVSS manufacturer, to connect the SPD to the MCC. The SPD shall be located directly adjacent to the circuit breaker.
 4. The SPD 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 SPD 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 1.5% for power and energy functions.
 - .10 The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.
 - .11 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.
 - .12 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-L72E1)

.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 MOTOR STARTERS AND DEVICES

- .1 Equip the MCC with combination starters and bypass starters as specified and shown on the drawings.
- .2 Refer to Section 26 29 10 – Motor Starters to 600 V.

2.11 STARTER UNIT COMPARTMENTS

- .1 Units EEMAC size 5 and smaller, circuit breaker units 200A 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.

2.12 WIRING IDENTIFICATION

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

2.13 EQUIPMENT IDENTIFICATION

- .1 Identify Motor Control Centres 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 nameplates 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.

2.14 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.

2.15 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.

2.16 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 beveled 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 01- 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 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 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 COORDINATION

- .1 Coordinate size and depth of cabinets and enclosures with systems specified in other Sections which require enclosures.
- .2 Coordinate installation and identification of cabinets and enclosures with painting of mechanical and electrical work specified in Division 09.

1.2 SHOP DRAWING AND PRODUCT DATA

- .1 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.

1.3 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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.

2. Products

2.1 CABINETS AND ENCLOSURES - GENERAL

- .1 Cabinets and Enclosures: to CSA C22.2 No. 40-M1989 and as follows:
 - .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: hinged, minimum 3 point latching, with padlocking means.
 - .4 Door interlocks

3. Execution

3.1 INSTALLATION

- .1 Install surface or flush mounted cabinets at locations and heights indicated on drawings.
- .2 Assemble enclosure in accordance with manufacturer's instructions.
- .3 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 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)

1.3 COORDINATION

- .1 Coordinate installation of wiring devices and cover plates with site painting and finishing work specified in Division 09.

1.4 SHOP DRAWING AND PRODUCT DATA

- .1 Provide manufacturer's literature including applicable reference standards, performance and test data for following products:
 - .1 All switches.
 - .2 All receptacles.
 - .3 All plates.
 - .4 All dimmers.
 - .5 All photocells.

1.5 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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 alloy contacts.
 - .3 Fully enclosed with urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White 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: Leviton specification grade, Hubbell specification grade

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 (8) back wired entrances, four (4) side wiring screws; and
 - .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 White moulded housing;
 - .2 Suitable for No. 10 AWG for back and side wiring; and

- .3 Four (4) 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: Leviton specification grade, Hubbell specification grade.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Stainless steel or PVC cover plates for wiring devices.
- .3 Cover plates from one manufacturer throughout Project.
- .4 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .5 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .6 Weatherproof double lift spring-loaded stainless steel or PVC cover plates, complete with gaskets for duplex receptacles as indicated.
- .7 Weatherproof spring-loaded stainless steel or PVC cover plates complete with gaskets for single receptacles or switches.

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 for moulded-case circuit breakers and circuit breakers.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE-2016).

1.3 SUBMITTALS

- .1 Submit product data in accordance with Contract Document.
- .2 Include time-current characteristic curves for breakers with ampacity of ninety (90) A and over or with interrupting capacity of twenty-two thousand (22,000) A symmetrical (rms) and over at system voltage
- .3 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.
- .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.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, and 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 with temperature compensation for forty (40) degrees Celsius ambient.
- .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.
 - .1 Trip settings on breakers with adjustable trips to range from three (3) to eight (8) times current rating.
- .5 Circuit breakers to have minimum symmetrical rms interrupting capacity rating matching panel board or switchboard containing breaker.
- .6 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.
- .7 Include:
 - .1 On-off locking device.
 - .2 Neutral and Ground bus bars, fully rated.

2.2 Main Circuit Breaker (Within CSTE, CB-L70)

.1 Requirements:

- .1 Frame Size: 400 Amps
- .2 Sensor Rating: 400 Amps
- .3 Interrupting Rating: 25 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 L series with Micrologic 5.0 A (Ammeter) series trip unit or approved equal in accordance with B7.

2.3 MCC-L71.MCB (MCC-L71 MAIN BREAKER, CB-L71)

.1 Requirements:

- .1 Frame Size: 400 Amps
- .2 Sensor Rating: 400 Amps
- .3 Interrupting Rating: 25 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 L series with Micrologic 5.0 A (Ammeter) series trip unit or approved equal in accordance with B7.

2.4 MCC-L71.CB-L72-2 (ATS BREAKER)

.1 Requirements:

- .1 Frame Size: 400Amps
- .2 Sensor Rating: 400 Amps
- .3 Interrupting Rating: 25 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 L series or approved equal in accordance with B7.

2.5 MCC-L72E.CB-L01, L02 AND L03 (VFD BREAKERS)

.1 Requirements:

- .1 Frame Size: 100Amps
- .2 Sensor Rating: 100 Amps
- .3 Interrupting Rating: 25 kA @ 600 VAC
- .4 Trip Unit Type: Electronic LI, Factory Sealed
- .5 Long Time PU: 0.42 – 1.00 A * Sensor Rating (Adjustable)
- .6 Long Time Delay: 0.5 – 24 sec (Adjustable)
- .7 Instantaneous: 2 – 15 * Sensor Rating (Adjustable)
- .8 Poles: 3
- .9 Model: Schneider Electric PowerPact J series or approved equal in accordance with B7.

2.6 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: 25 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.

2.7 OPTIONAL FEATURES

- .1 As indicated

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 Identification: In accordance with Section 26 05 01 – Common Work Results – Electrical, provide lamacoid plate on or adjacent to each breaker showing load being fed. Example: “XFMR-L73”.
- .3 Set adjustable trip settings according to coordination study.

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.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for fused and non-fused disconnect switches.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches; and
 - .2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies

1.3 SUBMITTALS

- .1 Submittals in accordance with contract documents.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Enclosure types.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 DISCONNECT SWITCHES (DS-L01, DS-L02, DS-L03)

- .1 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 Quick-make, quick-break action.
- .5 Auxiliary contact for switch status.

- .6 ON-OFF switch position indication on switch enclosure cover.
- .7 Category 1 locations: NEMA 4.
- .8 Category 2 locations: NEMA 4x.
- .9 Ordinary locations: NEMA 12.
- .10 Acceptable Manufacturer: Square D, Eaton, Hubbell, Pass & Seymour, Leviton

2.3 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 PROCEDURES

- .1 Install disconnect switches as indicated and in accordance with the manufacturer's recommendations and as required by CSA C22.1.
- .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.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .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.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Contract Document.
- .2 Extra Materials:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide closeout submittals in accordance with Contract Document.
- .2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.

1.4 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.

1.5 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 CONTACTORS

- .1 UL/CSA listed, NEMA size as shown on the drawings.
- .2 Contactors: to CSA C22.2 No.14.
- .3 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in NEMA 4 Enclosure
- .6 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.
- .7 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.

3.2 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

- .4 Protect installed products and components from damage during construction.
- .5 Repair damage to adjacent materials caused by contactor installation.

3.4 FIELD QUALITY CONTROL

- .6 Perform tests in accordance with Section 26 05 01 - Common Work Results for Electrical and manufacturer's instructions.
- .7 Operate switches and contactors to verify correct functioning.
- .8 Perform starting and stopping sequences of contactors and relays.
- .9 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.14-10 , Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

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 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.

1.3 QUALITY ASSURANCE

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

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 control devices 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 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 control devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14.
- .2 Fixed contact plug-in type: general purpose heavy duty with two poles. Coil rating: 120V. Contact rating: 240V, 2A

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 2-NO and 2-NC contacts rated at 10A, AC/DC, labels as indicated. Stop pushbuttons coloured red. Start pushbuttons coloured green.

2.4 EMERGENCY STOP PUSHBUTTONS

- .1 Operator mushroom type, 2-position, Push-Pull operator, Red, with 1-NO and 1-NC contacts rated at 10A, AC/DC, labels as indicated.

2.5 SELECTOR SWITCHES

- .1 Maintained three (3) position labelled as indicated. heavy duty, thirty 30 mm, oil tight, operators wing lever contact arrangement as indicated, rated 120V, 10A, AC.

2.6 INDICATING LIGHTS

- .1 Standard, full voltage, LED type, lens colour: as indicated, supply voltage: as indicated, lamp voltage: as indicated, labels as indicated.

2.7 CONTROL AND RELAY PANELS

- .1 CSA Type 12 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.8 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 600V, 60 Hz ac.
- .3 Secondary: 120V, AC.
- .4 Rating: 150 VA, or larger as required.
- .5 Secondary fuse: ampacity as required.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

2.9 IDENTIFICATION

- .1 All control devices shall be labelled exactly as shown in the Drawings.

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 Consultant.
 - .2 Inform Consultant 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 Consultant.

3.2 INSTALLATION

- .1 Contractor is responsible for installation, wiring, testing, and assisting the City representative in commissioning of all HMI equipment, HMI communication equipment, PC equipment and Operator interfaces.
- .2 The Contractor shall supply and deliver to the City's Representative any HMI or PLC products identified herein for the purpose of programming. The City's Representative will advise the contractor when and which items will be required on a later date. The Contractor will pay all costs associated with handling, extended warranties, etc.
- .3 Contractor shall supply all required cabling to connect hardware above.

3.3 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, and control devices.
- .2 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.

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 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Contract Document.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Contract Document.
 - .1 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure type.
 - .5 Wiring diagrams for each type of starter.
 - .6 Interconnection diagrams.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Contract Document.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .3 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.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 FULL VOLTAGE MAGNETIC STARTERS

- .1 UL/CSA listed, NEMA size as shown on the drawings.
 - .1 Smallest size of starter: NEMA size 1.
 - .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 14 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.
 - .7 Mechanical and electrically interlock to defeat simultaneous starting the 2 contactors for reversing starters.

- .4 Combination type starters to include motor circuit interrupter.
- .5 Accessories:
 - .1 Selector switches and Pushbuttons: heavy-duty oil tight labelled as indicated.
 - .2 Indicating LED lights: heavy-duty oil tight type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contact unless otherwise indicated.

2.2 CONTROL TRANSFORMER

- .1 100VA minimum single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with primary and secondary fuses, installed in with starter.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.4 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.5 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 and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses and overload device elements are installed.
- .4 Confirm motor nameplate and adjust / replace overload device to suit.

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 Manual startup and shutdown in both VFD and bypass FVNR modes of operation.
 - .2 Automatic startup and shutdown in both VFD and bypass FVNR modes of operation.

- .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 for Electrical and manufacturer's instructions.
- .2 Operate switches and 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 SCOPE

- .1 Division 26 Contractor shall supply, install, wire and connect, and program all VFD controllers and indicated on the Drawings.

1.3 REFERENCES

- .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.

1.4 STANDARD MOTOR

- .1 All VFDs supplied under this Contract shall meet or exceed the following Specifications.
- .2 Provide a complete inventory (as specified) of spare cooling fans, and fuses, for each VFD supplied.
- .3 The adjustable frequency controller shall be designed to operate standard squirrel cage induction motor with a 1.15 S.F. or definite purpose motors meeting National Electric Manufacturers Association (NEMA) MG1 Part 31.
- .4 Harmonic loading will not exceed a motor service factor of one (1.0).
- .5 Products shall comply with Institute of Electrical and Electrical Engineers (IEEE) Standard 519.
- .6 VFD unit shall be Underwriters Laboratories (UL) listed and Canadian Standards Association (CSA) certified.
- .7 VFD unit shall comply with applicable requirements of the latest standards of CSA, American National Standards Institute (ANSI), IEEE and the Canadian Electrical Code.

1.5 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 Programming manuals for the equipment used
- .4 When air-cooled systems are provided, the following shall also be shown:
 - .1 air inlet and outlet passages
 - .2 cooling fans
 - .3 filters.

1.6 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.

1.7 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- .2 Include operation and maintenance data for each type and style of VFD.
- .3 Provide parameter settings for each VFD.

1.8 TESTS

- .1 Factory testing:
 - .1 VFD units are to be factory tested prior to shipment. Provide confirmation from factory of actual tests completed and results.
 - .2 Provide certified copies of production test results required by CSA and Electrical and Electronic Manufacturer's Association of Canada (EEMAC), prior to acceptance of the equipment.

- .2 Field testing:
 - .1 The VFD supplier shall provide on-Site start-up, fine-tuning, commissioning, operator training and instruction.
 - .2 The VFD supplier shall provide Site functionality test reports indicating loading/current levels during testing as well as control point proving results.
 - .3 The VFD supplier shall ensure shaft to ground voltages do not exceed 1.5 V at any speed or load requirement.
 - .4 Allow for all costs and labour for as many trips as necessary to complete requirements.
 - .5 It is the intent of this Specification to provide a VFD installation that does not adversely affect the electrical system. Included in the Contract Documents is information on the electrical system including:
 - .1 Single line Drawing.
 - .2 Additional information on electrical system layout and load profile.
 - .3 The VFD supplier can use this information to evaluate the predicted effect of the VFD installation on the electrical system and advise the Contract Administrator of these effects. For the purposes of analysis, the point of common coupling (PCC) will be taken as the secondary of the main distribution transformers.
- .3 Provide certified copies of all production test results required by CSA and NEMA.
- .4 Provide and complete the City of Winnipeg standard VFD test form.

1.9 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Provide listed spare parts for each different size and type of starter:
 - .1 Three (3) contacts, stationary.
 - .2 Three (3) contacts, movable.
 - .3 One (1) contacts, auxiliary.
 - .4 One (1) control transformers.
 - .5 One (1) operating coil.
 - .6 Two (2) fuses.
 - .7 Ten percent (10%) indicating lamp bulbs used

1.10 PARTS AVAILABILITY

- .1 Guarantee that parts for the drive units be available for a minimum of ten years from time of delivery.

1.11 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 (VFD-L01, VFD-L02 and VFD-L03)

- .1 Variable Frequency Drives supplied by Schneider Electric: Altivar 600 series.
 - .1 Purchasing and/or quotes shall reference the City of Winnipeg RFP 756-2013 for the City of Winnipeg discount pricing.
 - .2 No alternates or substitutes will be accepted.
 - .3 Contact: Schneider Electric, 21 Omands Creek Blvd, Winnipeg, MB.
 - .4 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 Variable speed controller shall be electronic adjustable frequency and voltage output unit.
- .3 The VFD shall employ a minimum 6-pulse pulse width modulated (PWM) inverter system utilizing Insulated Gate Bipolar Transistors (IGBT) power switching devices and come complete with line reactors.
- .4 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.
- .5 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.
- .6 The drive shall be rated for continuous duty while operating a NEMA design induction motor of the sizes and operating voltages as indicated on the Drawings over the entire speed range. Drive output shall be sized for a one (1.0) motor service factor. The VFD shall have a current rating at least ten percent (10%) in excess of the motor full load amp rating. Overload service factors of one hundred ten percent (110%) for thirty (30) minutes and one hundred thirty-five percent (135%) for one (1) minute must be provided to ensure adequate safety margins. VFD selection shall be based on load current at constant torque ratings. Do not size VFD's based on variable torque maximums.
- .7 Input voltage shall be as indicated on motor schedules and Drawings (line voltage variation plus or minus ten percent ($\pm 10\%$)) based on 347/600 volt systems (Not five hundred seventy-five (575) V). Line frequency variation plus or minus five percent ($\pm 5\%$).

Output voltage shall vary with motor speed to nominal motor voltage. Speed stability shall be plus or minus one percent ($\pm 1\%$) of any given set point within the operating frequency range. Drive shall match torque characteristic of load.

- .8 Input frequency setting signal will be selective between 4-20 mA or 0-10 v DC. Output speed monitoring signal shall be selective between 4-20 mA or 0-10 v DC.
- .9 The VFD shall be provided with radio interference suppression and limit radio interference values to within the limits of local code requirements.
- .10 VFD Input Run Command signal will be a 24Vdc discrete signal. Provide a 24Vdc relay in the VFD control compartment.
- .11 Enclosure:
 - .1 Drive shall be floor standing as indicated on Drawings. Filters to be provided for any forced air-cooled enclosures as required by the supplier. VFD(s) shall be suitable for mounting in a typical building electrical room and shall be able to operate under these conditions with no special cleaning requirements. VFD cabinets shall be mounted in such a way that there is adequate room for ventilation and no buildup of heat.
- .12 Protective devices to be incorporated are:
 - .1 Fast acting electronic circuit board protective devices for protection of electronic components.
 - .2 Three percent (5%) Line reactor.
 - .3 Three percent (3%) Load reactor.
 - .4 Integral electronic motor overload protection adjustable up to one hundred fifty percent (150%) of motor rating for sixty (60) seconds.
 - .5 Overcurrent instantaneous trip two hundred fifty percent (250%).
 - .6 Programmable short-circuit protection.
 - .7 Programmable ground fault protection.
 - .8 Overvoltage/overcurrent DC bus monitor/protection.
 - .9 Undervoltage protection.
 - .10 Loss of phase and phase unbalance protection.
 - .11 Inverter over-temperature protection.
 - .12 Capable of running without motor for start-up.

- .13 Maximum acceptable noise level is eighty (80) dBA at one (1) m.
- .13 Operation features:
 - .1 Integral flush mounted display in VFD cover with keypad for programming, monitoring and operating of drive, accessible through password or other acceptable security measure only. Remote keypads, completely duplicating functions of integral keypads, shall also be provided for all VFD(s) that are not normally accessible such as located inside MCCs, fan plenums, etc.
 - .2 Fault shutdown and indication.
 - .3 Automatic restart following power outage.
 - .4 Ability to disconnect motor load for setup or trouble.
 - .5 Manual speed control potentiometer mounted on VFD door.
 - .6 Adjustable maximum and minimum speed.
 - .7 Acceleration and deceleration time adjustment.
 - .8 Controller “stop” interlock from a NC dry contact.
 - .9 Drive fault contact.
 - .10 Stop/start forward/start reverse push buttons on keypad and VFD door as indicated on the drawings.
 - .11 Transient voltage protection.
 - .12 Provide three (3) dry “C” type contacts programmable for any combination of the following:
 - .1 Running (output frequency being generated).
 - .2 Pump ready signals.
 - .3 High vibration lockout.
 - .4 Fault lockout.
 - .5 Stopped.
 - .6 At speed.
 - .7 Under speed.
 - .8 Forward/Reverse.

- .9 Low reference.
- .10 Manual/Auto Mode.
- .11 Local/Remote Mode.
- .13 Soft start sequence.
- .14 Minimum of three (3) skip frequencies.
- .15 Indicating lights as follows:
 - .1 Running (Red)
 - .2 VFD Fault (Orange)
- .16 Provide Hand/Off/Auto selector switch. Keypad HOA is not an acceptable replacement.
- .17 Password protection of parameter programming or some method to prevent unauthorized changes.
- .18 Output speed monitoring signal to be selective between 4-20 mA or 0-10 V.
- .14 Environmental Capabilities: The drive shall operate without mechanical or electrical damage under any combination of conditions as follows:
 - .1 Ambient temperature minus zero (-0) degrees to forty (40) degrees Celsius.
 - .2 Humidity zero (0) to ninety percent (90%) (non condensing).
 - .3 Vibration up to 0.5 g.
 - .4 Altitude zero (0) to one thousand two hundred fifty (1,250) metres.
- .15 Diagnostic and indicating features:
 - .1 Power On indication;
 - .2 Percentage speed indicator;
 - .3 Overload indication;
 - .4 Short circuit indication;
 - .5 Ground fault indication;
 - .6 Overvoltage indication;

- .7 Undervoltage indication;
- .8 High temperature (controller);
- .9 AC voltmeter (output);
- .10 AC ammeter (output);
- .11 Inverter ready;
- .12 Inverter fault; and
- .13 External fault

- .16 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.

- .17 Wiring:
 - .1 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.
 - .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 Provide wire markers at both ends of all control wires.
 - .5 Control wiring shall be TEW one hundred five (105) degrees Celsius rise.
 - .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. Increase the size of power wiring to 12 AWG minimum.
- .11 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.
- .12 Ethernet Patch Cords
 - .1 Requirements:
 - .1 CAT-6.
 - .2 Jacket colour: Blue.
- .13 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.

2.2 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

Part 3 Execution

3.1 INSTALLATION

- .1 Identify mounting requirements and include all materials and labour, including concrete pads for all floor-mounted equipment.
- .2 Install VFD(s) in locations as indicated on Drawings, and connect up all necessary wiring. All VFD(s) are to be mounted in the electrical room. Follow manufacturer's recommendations for maximum distance between the VFD and the motor. The minimum clearance in front of VFDs is one (1) metre.
- .3 Connect VFD output to motor using drive rated cable.
- .4 Contractor shall connect all interlocks including (but not limited to) vibration switch, freeze stats, and fire alarms to the VFD. These interlocks will be active in both the Hand (local) and Auto (remote) configurations. Ensure high vibration interlock is installed and jumpered out as indicated on the drawings.
- .5 Contractor shall program all VFD parameters to provide operation as indicated in the plans and Specifications.
- .6 Contractor shall ensure that all control and stop commands shut down the drive as per manufacture's recommended procedure (example, ramp to stop, ramp and hold, or coast to stop). Contactors on the line or load side of the drive are not an approved method of control.
- .7 MCC circuit breaker, VFD and motor isolation switch are to be labelled with proper shutdown procedures.

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.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 – Common Work – Electrical.
- .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.
- .5 Contractor shall be responsible to bring Factory representative back to reset, repair, and re-commission the VFD during the two (2) year warranty period if problems arise with the normal operation of the VFD. This includes prevention of any motor shaft voltages exceeding 1.5 V when referenced to ground.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 26 05 01 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.5-[09], Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).
 - .2 CSA C22.2 No.178.1-[2007], Automatic Transfer Switches.
 - .3 CAN/CSA C60044-1-[07], Instrument Transformers.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-[1996(R2009)], Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

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 transfer switches 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.
 - .1 Indicate on drawings:
 - .1 Make, model and type.
 - .2 Single line diagram showing controls and relays.
 - .3 Description of equipment operation including:
 - .1 Automatic starting and transfer to standby unit and back to normal power.
 - .2 Test control.
 - .3 Manual control.
 - .4 Automatic shutdown.

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 transfer switches for incorporation into manual.
- .3 Detailed instructions to permit effective operation, maintenance and repair.
- .4 Technical data:
 - .1 Schematic diagram of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.
 - .3 Certified copy of factory test results.

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, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect transfer switches from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Automatic transfer switch: fully automatic electrically operated, mechanically held, for all load classes with normal and emergency supply as defined below. Switch to be complete with auxiliary engine starting contacts, full phase relay protection to operate on normal power voltage drop to 70 per cent on any phase. Detects when all three phases are present, have the correct sequence and detects if voltage or phase angle asymmetry is below set value. Transfer switch to be a contactor-based switch, not a breaker style type. The switch is to have the following ratings:
 - .1 Voltage (VAC): 347/600V
 - .2 Phase: 3
 - .3 Wire: 4
 - .4 Pole: 3
 - .5 Amperage (Amp): See Drawings
- .2 The electrical operator shall be a solenoid mechanism, momentarily energized. The transfer switch unit shall include both electrical and mechanical interlocks to prevent both sets of main

- contacts from being closed at the same time. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- .3 Provide time delay relays, adjustable from 10 seconds to 5 minutes to delay transfer from normal to standby until standby power source has obtained 90 per cent of rated voltage.
 - .4 Provide time delay relays, adjustable from 1 to 5 minutes, to delay transfer from standby to normal source
 - .5 Provide time delay relays, adjustable from 0 seconds to 5 minutes, to adjust time in neutral “off” position.
 - .6 Provide time delay relays, adjustable from 0 seconds to 5 minutes, to delay engine start contact.
 - .7 Provide time delay relays, adjustable from 10 seconds to 30 minutes for engine cool down.
 - .8 Fault level to match level of specified equipment fed from transfer switch.
 - .9 In cover of transfer switch provide red pilot light indicating emergency position of transfer switch complete with test switch to simulate a power failure.
 - .10 Provide two sets of normally open contacts, one on normal supply and the other on standby supply.
 - .11 Provide a set of normally open contacts for transfer switch controller alarm contacts.
 - .12 Provide time delay relays adjustable for 0-2 minutes, to delay transfer from load to neutral to load.
 - .13 Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all three phases and frequency. System status screens shall display a clear description of the active operating sequence and switch position.
 - .14 Inspections of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
 - .15 The controller’s sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

- .16 A 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port.
- .17 All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port. The time delay value displayed on the LCD or remote device shall be the remaining time until the next event occurs.
- .18 Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

	Parameter	Dropout/Trip	Pickup/Reset
.1	Under voltage	75 to 98%	85 to 100%
.2	Over voltage	106 to 135%	95 to 100% of trip
.3	Under frequency	95 to 99%	80 to 95%
.4	Over frequency	01 to 115%	105 to 120%
.5	Voltage unbalance	5 to 20%	3 to 18%

- .19 The automatic Transfer Switch control system shall provide as a minimum, four programmable 120V dry contact output relays as to indicate the following generator alarms:
 - .1 Automatic Transfer Switch fail to transfer or fault
 - .2 Automatic Transfer Switch normal source available
 - .3 Automatic Transfer Switch on Source 1
 - .4 Automatic Transfer Switch on Source 2
- .20 The Automatic Transfer Switch contactor mechanism shall include a means to manually operate the mechanism to transfer between Utility and Emergency sources with out the need to using control power. Provide manual operation tool (Switching Bar) safely secured inside Automatic Transfer Switch enclosure.
- .21 The transfer switch shall operate in open transition mode (break before make) in a syncing configuration.
- .22 The transfer switch shall be an automatic operation with bypass switch complete with two-sided by-pass with draw out ATS section, fixed or draw out bypass section. Bypass section to be physically isolated from ATS section to allow maintenance on either side.

2.2 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Contract Administrator.
- .2 Notify Contract Administrator [5] days minimum in advance of date of factory test.
- .3 Tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.

- .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
- .3 Check voltage sensing and time delay relay settings.
- .4 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.
 - .4 In-phase monitor operation.

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 transfer switches 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 Locate, install and connect transfer equipment as indicated.
- .2 Check relays and adjust as required to ensure correct operation.
- .3 Install and connect battery and remote alarms.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results for Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Manual" position and check to ensure proper performance.
- .5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
- .6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for [10] minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

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 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

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.
- .5 Canadian Standards Association (CSA International)
- .6 ICES-005, latest edition, Radio Frequency Lighting Devices.
- .7 Underwriters' Laboratories of Canada (ULC)

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .3 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.
- .5 Photometric data to include: VCP Table and spacing criterion.

1.3 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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.
 - .6 Estimated lifespan equal or greater than LED lamps of respective luminaire.
 - .7 Sound rated: Class A.
 - .8 Mounting: integral with luminaire.

2.3 LIGHTING CONTROL JUNCTION BOX (JB-L74)

- .1 Junction box shall be as indicated on drawings.
- .2 Exterior lighting 0-10V dimmer control
 - .1 Rating: 120 V, 60 Hz.
 - .2 Approved Equipment:
 - 1. Leviton IP710 or approved equivalent.
 - .3 Mounting:
 - 2. JBA-L74
- .3 Photocell
 - .1 Rating: 120 V, 60 Hz.
 - .2 Mounting:
 - 1. As indicated on drawings

2.4 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.5 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, 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.

3.5 CLEANING

- .3 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-M1985(R1999), Unit Equipment for Emergency Lighting.

1.2 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.

1.3 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.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Electrical Works Complete". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 EQUIPMENT

- .1 Battery Unit
 - .1 Emergency lighting equipment: to CSA C22.2 No.141.
 - .2 Supply voltage: 120 VAC.
 - .3 Output voltage: 12 VDC.
 - .4 Operating time: 60 min. minimum

- .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.
- .10 Battery protection: a low voltage battery protection circuit to disconnect the load when the battery reaches the end of discharge.
- .11 Lamp heads: 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 Head Lamps
- .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
- .3 Exit Lighting
- .1 Supply voltage: 120 VAC.
 - .2 Output voltage: 12 VDC.
 - .3 CSA C22.2 No.141-15 approved.
 - .4 Green running man pictograph.
 - .5 Rated for wet location
 - .6 NEMA 4X rated Polycarbonate enclosure, fully gasketed housing.
 - .7 Operating time: 60 min. minimum

- .8 Charger: fully automatic, current limited charger.
- .9 Lamp heads: two lamps integral on unit, fully adjustable. Lamp type: LED, 6 W.
- .10 Battery protection: a low voltage battery protection circuit to disconnect the load when the battery reaches the end of discharge.
- .11 Signal lights: solid state, for 'AC ON' and 'Charge'.

Part 3 Execution

3.1 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Install exit lighting and running man pictograph.
- .3 Direct heads.

3.2 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.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 40 95 13 – Control Panels
- .3 Section 40 30 02 – Controls Instrumentation

1.2 DESCRIPTION OF WORK INCLUDED

- .1 Work of this Section consists of supply and installation of instrumentation and control equipment as specified and as shown on the plans.
- .2 The work includes, but is not necessarily limited to, the following:
 - .1 Wiring of all process instrumentation including those devices supplied by other divisions.
 - .2 Training for plant operators as specified herein.
 - .3 Maintained service during construction and reconnection of existing CSO monitoring system to new PLC after changeover.
 - .4 Commissioning.
- .3 This section does not include devices or equipment for installation in the control panel as specified in Section 40 95 13 – Control Panels.

1.3 SUBMITTALS

- .1 The Contractor shall provide the following instrumentation plans as a minimum:
 - .1 Continued servicing plan for CSO monitoring system.
 - .2 Submit product data in accordance with Contract Document.
 - .3 Completed instrument record sheets.
 - .4 Communications system interface connection diagrams.
 - .5 Instrument calibration records.
 - .6 Instrumentation installation in process line detail plans.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Electrical Works Complete”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 GENERAL INSTRUMENT REQUIREMENTS

- .1 See Section 40 30 02 for instrumentation product specifications.
- .2 Unless otherwise specified, the Contractor shall provide instruments in accordance with the drawings and the following general requirements:
 - .1 Provide indicating transmitters on nearby wall in the vicinity of the instruments. Where there are multiple instruments in proximity, group indicating transmitters.
 - .2 Locate in a logical arrangement. For transmitter layout, mimic physical layout of process and/or process sequence.
 - .3 Provide CSA 4X enclosure for all instruments.
 - .4 Power supply is 120 VAC unless otherwise noted.
 - .5 For analogue instruments, provide 4 - 20 mA, linear, isolated output, capable of driving a minimum of 600 ohms.
 - .6 Instrumentation cable: to manufacturer’s recommendations and Code requirements.
 - .7 Provide all necessary brackets or stands to mount instrument.
 - .8 Supply any spare parts or calibration instruments required to commission instruments.
 - .9 Instrument tags will be generally to ISA 5.1, and supplied by instrument system supplier as required.
 - .10 All instruments in contact with the water shall be NSF 61 certified.
 - .11 Provide instruments with features and options to suit good practice in all applications.

Part 3 Execution

3.1 MATERIAL CONTROL

- .1 The Contractor shall provide all components (and software where required) as outlined in this Specification and shown on the Plans.
- .2 The Contractor shall co-ordinate with component and software suppliers and subcontractors to allow for timely and coordinated delivery, construction, testing, installation and programming of the control system as outlined in this Specification.
- .3 The Contractor shall identify all field instruments with a permanent, weatherproof label showing tag number and service. Use engraved lamacoid, or stamped stainless steel and fix with non-rusting screws or wire, or chain.

3.2 FABRICATION

- .1 The plans have been prepared using the latest information available from the component suppliers. Check these plans against the plans supplied with the components and make any necessary changes.
- .2 Obtain from the component suppliers, the manufacturer's wiring diagrams to determine the equipment terminals and record these terminal numbers on the wiring diagrams.
- .3 Identify jumper settings, switch settings, program entries, etc. necessary to complete the installation.

3.3 EQUIPMENT IDENTIFICATION

- .1 Refer to Section 26 05 01 – Common Work Results - Electrical.

3.4 INSTALLATION

- .1 Install according to supplied instructions. Follow manufactures recommendations regarding installation locations, mounting methods, connection methods, etc.
- .2 Commission all field wiring before terminating.
- .3 Do not energize the control system until authorized to do so by the Contract Administrator.
- .4 The Contractor shall co-ordinate the components of the instrumentation and control system to achieve a complete working system to the intent of this specification.
- .5 The Contractor shall provide supports or frames if not already supplied by the manufacturer of the equipment.
- .6 The Contractor shall obtain written permission from the Contract Administrator before fixing supports or frames to structural members.

- .7 Mount instruments in strict accordance with manufacturer's recommendations. The Contractor shall not mount any equipment on vibrating structures (eg. handrails) or below lines carrying corrosive chemicals or where condensation may occur.
- .8 The Contractor shall ensure instruments and their associated sensors are easily accessible for maintenance, calibration, withdrawal or replacement.
- .9 The Contractor shall install instruments as specified in accordance with plans and as required by process schematic.
- .10 Instruments are shown on the plans in their approximate locations. Exact location shall consider visibility, work space, and any special installation instructions.
- .11 Attach permanent tags.

3.5 INSTALLATION ACCEPTANCE FIELD TESTING, FINAL COMMISSIONING

- .1 The Contractor shall provide the services of qualified instrument technicians to commission and demonstrate the operation of the control system. The technicians shall include commissioning of all equipment including but not limited to equipment supplied in the Contract, existing equipment, City of Winnipeg supplied equipment, and equipment supplied by others.
- .2 Where specialized vendor assistance may be required, the Contractor shall ensure this is available during proposed commissioning period and pay for all costs associated with this assistance. This shall include assistance from the panel builder and system programmer.
- .3 All the equipment in this Contract shall be supplied so that installation can be carried out in a reasonably expeditious manner. The Contractor shall cooperate with the Contract Administrator, the City of Winnipeg and other trades and shall provide off-site and on-site installation supervisory assistance during the course of the work as detailed herein.
- .4 The Contractor shall complete instrument record sheets at the time of calibration and ensure all instruments meet specifications. The Contractor shall make record sheets available to the Contract Administrator during construction/installation period.
- .5 The Contractor shall confirm correctness of operation of all instrumentation and end devices.
- .6 The Contractor shall confirm correctness of operation of all instruments and end devices feeding into the control system PLC, HMI, or SCADA.
- .7 Mass balance shall be demonstrated under all operating scenarios. Flow, level, and pressure values shall be in agreement.
- .8 Prior to the commencement of software commissioning, the Contractor shall ensure that all deficiencies have been corrected without undo delay to the schedule of work.

- .9 The Contractor shall certify the following:
 - .1 That the equipment has been installed in accordance with the Contract Administrator's plans and recommended installation procedures, with any discrepancies reported to the Contract Administrator.
 - .2 That the equipment power and grounding requirements have been satisfied, with any discrepancies reported to the Contract Administrator.
 - .3 That all terminations to the equipment have been properly installed, with any discrepancies reported to the Contract Administrator.
 - .4 Calibration and adjustment of the equipment as required to place the equipment in trouble-free operation. Certified calibration reports for each instrument shall be provided. This calibration work shall be in addition to the factory calibration provided with each device when shipped.
 - .5 That the system is ready for final commissioning and program testing.
- .10 The Contractor shall prepare the various reports and certificates specified in this Section. One copy of each report and certificate shall be forwarded to the Contract Administrator and to the City of Winnipeg. Any discrepancies which require further action on the part of the Contract Administrator or the City of Winnipeg shall be clearly identified on the report or certificate.
- .11 Prior to commencement of PLC software commissioning, the Contractor shall ensure that all spare parts, expendables and test equipment pertinent to the equipment supplied by this section and being tested, are on site.
- .12 Test equipment shall include all necessary multi-meters, process instrument calibrators for 4 - 20 mA, 24 VDC devices, thermocouples signal generators. Test equipment shall be provided by the Contractor and shall remain the property of the Contractor at the end of all testing.
- .13 The Contractor shall provide assistance during commissioning and start-up related to any equipment supplied by the Contractor. This shall include the manual or automatic activation of field devices.
- .14 The Contractor shall demonstrate the integrity and functional operation associated with the wiring and equipment supplied by the Contractor, which is required to operate with the PLC software.
- .15 Refer to Section 40 95 13 – Control Panels, for testing and commissioning to be performed under that section which may require co-operation by verification personnel under this section.
- .16 The Contractor shall submit details on instrument wiring to Contract Administrator on request. Include information on raceway materials and sizes, cable and wire type and

numbers, manufacturer, model, markings, ratings, listings, etc. Indicate presence or absence of grounding, bonding, screening, and drain layers in cable construction. Indicate grounding arrangements on a per cable basis.

3.6 TRAINING

- .1 The Contractor shall provide one (1) day training to the City of Winnipeg's operating staff on the operation and maintenance of the system.
- .2 Training shall include for the use of both hardware, software and plant operations.
- .3 Training shall be on site with the installed equipment.

3.7 SPARES

- .1 The Contractor shall provide the following spare parts:
 - .1 One (1) years supply of expendable parts, or parts requiring regular replacement.
 - .2 Two of each type of fuse on equipment supplied under this section.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements for Control Systems.

.2 Related Sections:

.1 Section 40 05 54 - Controls: Identification.

.2 Section E11 – “Shop Drawings” of this Bid Opportunity.

.3 City of Winnipeg Electrical Design Guide.

.4 City of Winnipeg Automation Design Guide.

.5 City of Winnipeg Identification Standard.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).

.1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.

.4 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 The controls shall include but not be limited to:

.1 Level transmitters

.2 Flow transmitters

.3 Temperature transmitters

- .4 Float level switches
- .5 Pressure switches
- .6 PLC control panel
- .7 HVAC control panel
- .8 Termination of control wiring to terminals within existing field termination section.

1.4 SCOPE OF CONTROL WORK

- .1 Design and installation to be in accordance with the City of Winnipeg Electrical Design Guide and Identification Standard.
- .2 The Contractor shall engage a factory trained representative to supervise the installation, setup, calibrate and operationally verify and commission all instruments installed on site as well as the PLC control panel and CSO monitoring panel.
- .3 The Contractor shall provide a certified instrument technician in order to operate all field devices that are wired to the PLC control panel in order for City of Winnipeg staff to verify the loop is correctly wired.
- .4 The Contractor shall submit written reports identifying the commissioning work, together with any parameter settings and final adjustments.
- .5 The Contractor is responsible for the supply and installation of the RTU control panel, termination of field wiring for power, controls and instrumentation to the terminals within the RTU control panel. Coordinate all remote interface and alarm points with the City of Winnipeg.

1.5 SUBMITTALS

- .1 Make submittals in accordance with Section E11 – “Shop Drawings” of this Bid Opportunity.
- .2 Submit for review equipment list and system manufacturers 10 days after award of contract.

1.6 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Instrumentation (non-standardized)”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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

- .1 Not Used

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

3.2 PAINTING

- .1 Painting: as follows:
 - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
 - .2 Clean and prime exposed hangers, racks, fastenings, and other support components.
 - .3 Paint unfinished equipment interiors to EEMAC 2Y-1.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, the Control System Work and nameplates materials, colours and lettering sizes.
- .2 Related Sections.
 - .1 Section 40 05 01 - Controls: General Requirements.
 - .2 Section 40 05 01 - Common Work Results - Electrical.
 - .3 Section E11 – “Shop Drawings” of this Bid Opportunity.
 - .4 City of Winnipeg Electrical Design Guide.
 - .5 City of Winnipeg Identification Standard.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-06, The Canadian Electrical Code, Part I (20th Edition), Safety Standard for Electrical Installations.

1.3 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section E11 – “Shop Drawings” of this Bid Opportunity supplemented and modified by requirements of this Section.
- .2 Submit to Contract Administrator for approval samples of nameplates, identification tags and list of proposed wording.

1.5 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Instrumentation (non-standardized)”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 NAMEPLATES FOR PANELS

- .1 Provide panel identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for each panel size 4 engraved as indicated.
- .3 Nameplate for each panel mounted device size 2 engraved as indicated.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Provide field device identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for field device size 7 engraved as indicated.
- .3 Nameplate shall be attached by chain.

2.3 WIRING

- .1 Supply and install heat shrink labels on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each control panel.

Part 3 Execution

3.1 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Instrumentation devices integral to the Control System: transmitters, sensors, controls, meters, switches, dampers, damper operators, valves, valve actuators, and low voltage current transformers.
 - .2 Related Sections:
 - .1 Section 40 05 01 - Controls: General Requirements.
 - .2 Section 40 05 54 - Controls: Identification.
 - .3 Section 26 05 01 - Common Work Results - Electrical.
 - .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
 - .5 Section 26 27 26 - Wiring Devices.
 - .6 Section E11 – “Shop Drawings” of this Bid Opportunity.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 40 05 01 - Controls: General Requirements.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section E12 – “Shop Drawings” of this Bid Opportunity 177-2024 supplemented and modified by requirements of this Section.
- .2 Submit to Contract Administrator for approval samples of nameplates, identification tags and list of proposed wording.
- .3 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Contract Administrator, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Instrumentation (non-standardized)”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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, shockproof, vibration-proof, heat resistant assembly.
- .3 Operating conditions: -40 - 40 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including handheld transceivers.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

2.2 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 is 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.
 - .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 ELECTROMAGNETIC FLOWMETERS (FE-L012, FE-L022, FE-L032, FIT-L012, FIT-L022, 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 $\pm 0.4\% \pm 1$ mm/sec
- .3 Sensor Requirements:
 - .1 Internal diameter: 406 mm (16") unless otherwise indicated in the process drawings
 - .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
 - .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

2.4 LEVEL FLOAT SWITCHES (LSHH-L101, LSH-L501, LSH-L502, LSH-S663)

- .1 Requirements:
 - .1 Suspended mechanical float switch
 - .2 Liquid Density Measurement Range 0.95 – 1.10 g/cm³
 - .3 Temperature Range: 0°C to +50°C
 - .4 Output: Form C dry contact
 - .5 Protection: IP68
 - .6 Approvals: CSA or cUL
 - .7 Materials: Polypropylene body, EPDM rubber bending relief
 - .8 Voltage: 250 VAC
 - .9 Cable Length: Confirm prior to ordering
- .2 Approved Product: Flygt Model ENM-10

2.5 ELECTROMECHANICAL RELAYS

- .1 Requirements:
 - .1 Relays as noted on drawings.
 - .2 Contacts: rated at 5 amps at 120 Vac.
 - .3 Relays to have visual status indication.

2.6 STATION OCCUPANCY SWITCH (HS-L604-1, HS-L604-2)

- .1 Requirements:
 - .1 2 position toggle switch.
 - .2 2 pole.
 - .3 Enclosure Rating: NEMA Type 4X

- .4 Mounting: wall mounted as per drawings.

2.7 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.

2.8 SEAL WATER FLOW SWITCH (FSL-L011, FSL-L021, FSL-L031)

- .1 Requirements:
 - .1 Type: Thermal
 - .2 Dry Contact: SPDT, rated for at least 0.2 Amps at 24VDC
 - .3 Power: 24 VDC
 - .4 Operating Temperature: 0°C to +35°C, minimum
 - .5 Enclosure Rating: NEMA 4 or NEMA 4X
 - .6 Approvals: CSA or cUL
 - .7 Mounting: Pipe
 - .8 Accessories: Provide mounting hardware as required
 - .9 Size: 12mm
 - .10 Process Connection: ANSI Class 125/150; B16.5
 - .11 Flow Range: 0 to 1.2 L/s (0.5 to 19 USGPM)
- .2 Acceptable products:
 - .1 KOBOLD KAL-K
 - .2 Or approved equal in accordance with B7.

2.9 HVAC FILTER DIFFERENTIAL PRESSURE SWITCH (PDSH-L601)

- .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.

2.10 SEAL WATER SOLENOID (XV-L010, XV-L020, XV-L030)

- .1 Requirements:
 - .1 Solenoid valves to operate off 120VAC, 60Hz supply.
 - .2 Approvals: CSA or cUL
 - .3 Mounting: Pipe
 - .4 Accessories: Provide mounting hardware as required

2.11 HVAC AIR FLOW SWITCH (FSL-L613, FSL-L622)

- .1 Requirements:
 - .1 Type: Thermal
 - .2 Dry Contact: SPDT, rated for at least 0.2 Amps at 24VDC
 - .3 Power: 24 VDC
 - .4 Operating Temperature: 0°C to +35°C, minimum
 - .5 Enclosure Rating: NEMA 4 or NEMA 4X
 - .6 Approvals: CSA or cUL
 - .7 Mounting: Duct
 - .8 Accessories: Provide mounting hardware as required
 - .9 Size: 12mm
 - .10 Process Connection: ANSI Class 125/150; B16.5
 - .11 Flow Range: 1 to 15 m/s
- .2 Acceptable products:
 - .1 KOBOLD KAL-L
 - .1 Model: KAL-8155-C
 - .2 Or approved equal in accordance with B7.

2.12 ROOM TEMPERATURE RTD (TE-L600, TE-L635-1, TE-L635-2)

- .1 Requirements:
 - .1 Mounting: Wall mounted as indicated on drawings
 - .2 Protection: NEMA 4 or IP67 Enclosure
 - .3 RTD Type: 2-wire 100 Ohm Platinum

2.13 TEMPERATURE TRANSMITTER (TE-L010-1/2, TE-L020-1/2, TE-L030-1/2)

- .1 Requirements:
 - .1 Mounting: Wall
 - .2 Protection: NEMA 4 or IP67 Enclosure
 - .3 RTD Type: 3-wire 100 Ohm Platinum

2.14 TEMPERATURE SENSOR WITH INTEGRAL TRANSMITTER (TT-L661, TT-L691, TT-L692, TT-L635)

- .1 Requirements:
 - .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 TF.

2.15 AMBIENT TEMPERATURE SWITCHES – DUAL SWITCH OUTPUT (TSL-L600, 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. TSL-L600 to be mounted exterior to lift station as indicated.
 - .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.

2.16 COMBUSTIBLE GAS DETECTOR & SENSOR (AIT-L520, AE-L520-1, AE-520-2)

- .1 Requirements:
 - .1 Functionality: Field adjustable switches, independently adjustable.
 - .2 Discrete Outputs:
 - .1 Qty 3 dry-contact, output form C relays, configurable.
 - .1 Relay 1 function: Gas Alarm status (set for 10% of LFL)
 - .2 Relay 2 function: Gas Alarm status (set for 10% of LFL)
 - .3 Relay 3 function: Gas Detector Fail/Trouble status
 - .3 Analog Outputs: Qty 2, 4-20 mA
 - .1 Output 1 function: Generator Room Methane Gas Level
 - .2 Output 2 function: Generator Room CO Gas Level
 - .4 Power Supply: 24 VDC
 - .5 Operating Temperature: -40°C to +60°C minimum.
 - .6 Local LCD display showing % LFL
 - .7 Sensor: remote methane and CO sensors w/ junction box, locations as indicated on drawings.
 - .8 Factory calibrated sensors, ready to perform immediately after installation
 - .9 Local pushbuttons or infrared remote controller to facilitate on-site configuration and calibration.
 - .10 Provide methane and CO gas calibration kits for testing the gas sensor.
 - .11 Mounting: Wall.
 - .12 Enclosure Rating: NEMA 4X.
 - .13 Approvals: CSA or cUL.
- .2 Acceptable products:
 - .1 MSA ULTIMA X5000,
 - .2 The supply of gas detection equipment for the City of Winnipeg has been standardized under RFP 123-2014. No alternates or substitutes will be accepted.
- .3 Purchase or Quotation:
 - .1 All requests for purchase or quotation shall reference RFP 123-2014 to receive discount pricing that the City has negotiated with the Vendor.
 - .2 Contact: Darren Bye, 11061-269 St. Acheson, AB, T7X 6E1.
 - .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.

2.17 H2S GAS DETECTOR & SENSOR (AIT-L510, AE-L510-1, AE-L510-2)

- .1 Requirements:
 - .1 Functionality: Field adjustable switches, independently adjustable.
 - .2 Discrete Outputs:
 - .1 Qty 3 dry-contact, output form C relays, configurable.
 - .1 Relay 1 function: Gas Alarm status (set for 10% of LFL)
 - .2 Relay 2 function: Gas Alarm status (set for 10% of LFL)
 - .3 Relay 3 function: Gas Detector Fail/Trouble status
 - .3 Analog Outputs: Qty 2, 4-20 mA
 - .1 Output 1 function: Pump Room H2S Gas Level
 - .2 Output 2 function: Comminutor Chamber H2S Gas Level
 - .4 Power Supply: 24 VDC
 - .5 Operating Temperature: -40°C to +60°C minimum.
 - .6 Local LCD display showing % LFL
 - .7 Sensor: Qty 2, remote H2S sensors w/ junction box, locations as indicated on drawings.
 - .8 Factory calibrated sensor, ready to perform immediately after installation
 - .9 Local pushbuttons or infrared remote controller to facilitate on-site configuration and calibration.
 - .10 Provide methane gas calibration kit for testing the gas sensor.
 - .11 Mounting: Wall.
 - .12 Enclosure Rating: NEMA 4X.
 - .13 Approvals: CSA or cUL.
 - .2 Acceptable products:
 - .1 MSA ULTIMA X5000,
 - .2 The supply of gas detection equipment for the City of Winnipeg has been standardized under RFP 123-2014. No alternates or substitutes will be accepted.
 - .3 Purchase or Quotation:
 - .1 All requests for purchase or quotation shall reference RFP 123-2014 to receive discount pricing that the City has negotiated with the Vendor.
 - .2 Contact: Darren Bye, 11061-269 St. Acheson, AB, T7X 6E1.
 - .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.

2.18 CARBON MONOXIDE DETECTOR (AE-L530)

- .1 Requirements:
 1. Operating Voltage: 120 VAC, 60 Hz.
 2. Gas Sensor Requirement: Carbon Monoxide.
 3. Carbon Monoxide Audio Alarm rated at 85Db.
 4. Carbon Monoxide Visual LED Strobe Light Alarm.
 5. Battery Backup Required.
 6. Detector resets automatically when CO clears.
 7. Mounting: Ceiling.
 8. CSA Approved.
 9. Operating Ambient Conditions:
 - a. 4 to 38 degrees Celsius.
 - b. 10 to 95% relative humidity, non-condensing.
- .2 Acceptable Products
 1. Aartech Canada 7030BSLA.
 2. Or approved equal in accordance with B7.

2.19 WIRING

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #14 AWG Teck 90 Cu or RW90 Cu in conduit in accordance with Section 26 05 26 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 Analog input and output: shielded #18 minimum stranded twisted pair ACICCu.

Part 3 Execution

3.1 INSTALLATION

- .1 Instrument components are not specifically located on drawings, but located on drawings in the general vicinity. The instrument components shall be field located as defined by mechanical piping and in accordance with the following:
 - .1 Instrument components shall not be attached to vibrating equipment, but shall be remotely mounted to a solid structure or on approved instrument mounting stands.
 - .2 Location of instruments, when shown on the drawings, is only approximate. The Contractor is responsible for actual location of field devices and must avoid

- interferences between conduit, pipes, equipment and instruments while providing maximum accessibility.
- .3 Locate instruments components at eye level and in an easily accessible location.
 - .4 Instrument components that must be removed for servicing shall be installed with re-usable connectors, unions and flexible conduit.
 - .5 Electrical connections and terminations for field instruments and other field devices shall be in strict compliance with the manufacturer's instructions and loop drawings. This will include wire, wire termination, labelling, rigid and flexible conduit, fittings, and seals where required.
 - .2 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
 - .3 Support field-mounted panels, transmitters and sensors on wall or pipe stands with approved mounting brackets or stands at a nominal height of 1.4 meters off floor.
 - .4 Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.
 - .5 For instruments with pre-terminated cable lengths provide a junction box as close as practical to connect with armoured cable or cable in conduit.
 - .6 Allow for a variation of 3 meters from locations of devices as shown on drawings without extra cost provided pertinent information is provided prior to installation. Exact location will be determined by the installation of piping and mechanical equipment.
 - .7 Threaded fastenings for mounting instrument components shall have either lock nuts or double nuts.
 - .8 Cover locally mounted instrument components, after installation, with plastic bags to protect them from dust, dirt, paint spray, insulation materials, etc. Protect from mechanical damage.
 - .9 Set output pressure of local air sets to pressure recommended for instrument to which it is to be connected.
 - .10 Independently support solenoids, regulators or similar control devices on solid, vibration free structures and not on control valves. Minimize load on pneumatic tubing.
 - .11 Field instruments located outdoors shall be winterized to prevent process or measurement fluids from freezing. The use of steam or electrical tracing, fill fluids, or enclosures will be shown on the Installation Detail drawings.
 - .12 All instrument signal wiring and 120 Vac wiring shall be run by the Contractor from the field instrument to the field device as shown on the loop drawings. This includes wiring, rigid and flexible conduit, fittings and seals where shown. Conduit penetrations are not permitted into the top of any field junction box.
 - .13 Electrical:
 - .1 Provide and route all instruments, power and control signal cabling.
 - .2 Complete installation in accordance with Section 26 05 01 - Common Work Results -

Electrical.

- .3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Contract Administrator before beginning Work.
- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Control panels, field panels and OWS(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.
- .6 Install conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

3.2 INSTRUMENT SUPPORTS

- .1 Clean and paint fabricated galvanized carbon steel mounting stands and brackets.
- .2 Before a mounting stand is attached to a concrete floor the surface of the concrete to be in contact with grout shall be roughed and cleaned of all dirt, oil, grease and loose material.

3.3 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application 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.

3.4 PANELS

- .1 Arrange for conduit and tubing entry from bottom or either side.

- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.5 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.

3.6 CALIBRATION TAGGING

- .1 When satisfactorily inspected and calibrated, the item shall have a tag affixed to it in an immediately visible location, which shall indicate that the device has been calibrated, by whom and the date of the calibration. Calibration procedures and records shall be available to the Contract Administrator throughout the course of the project and shall be delivered to the Contract Administrator upon the completion of work.

3.7 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.

3.8 IDENTIFICATION

- .1 All field-mounted instrument items shall have an approved identification tag permanently attached by the Contractor upon completion of the initial inspection and calibration. This tag shall reflect the device's identification as shown on the appropriate drawing.
- .2 The tag will be permanently attached to the instrument with screws, rivets, or stainless steel or Monel wire, as appropriate. If an instrument is inside a protective enclosure or mounted behind a panel, instrument identity tags shall be mounted twice, once on the instrument and again on the enclosure. All instruments mounted on a control panel shall have an identity tag mounted on the instrument body and again on the face of the panel below the instrument face.
- .3 Identify field devices in accordance with Section 25 05 54 - Controls: Identification.

3.9 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 GENERAL

- .1 This Section covers items common to Sections of Division 40.

1.2 CODES AND STANDARDS

- .1 Do complete installation in accordance with 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.
- .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 Contract Document.
- .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.

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
- .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 Contract Document 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.
 - .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 The work described herein will be paid for under the Contract Lump Sum Price for “Instrumentation (non-standardized)”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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.

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 E11.
- .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 Submit the following, to be received 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 location of the FAT will be in a Contractor supplied facility, within Winnipeg, Manitoba, Canada.
- .2 The purpose of testing is to ensure all status signals, alarm signals, controls, and interlocks defined in the Conway 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.
- .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.
- .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 PROCEDURES

- .1 All tests shall be documented.
- .2 Produce test forms to allow for recording the results of the simulations and tests.
- .3 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 Complete demonstration of meeting the requirements of the applicable Functional Requirements Specification.
 - .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 is able to see each of the 0%, 50%, and 100% of full scale values as they are tested.
 - .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.
 - .10 Response times to operator actions.
 - .11 Controller processor spare capacity.
 - .12 Wireless Modem receiving and sending operation.
 - .13 Alarm system capabilities.
 - .14 System programming and configuration capability.
- .4 The Contract Administrator may request additional tests and simulations at the FAT.
 - .5 The Contract Administrator will review the system, simulations, and test results. Incorporate comments and feedback from the Contract Administrator into the system design.

3.2

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 Contract Document.
- .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 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications as set during commissioning and submit to the Contract Administrator in accordance with Contract Document.
 - .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 Conway 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.
- 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.
- 1.6 MEASUREMENT AND PAYMENT**
- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Instrumentation (non-standardized)”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
 - .2 A maximum of ninety-five percent (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 EQUIPMENT**
- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
 - .2 Test instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
 - .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 6 months prior to tests.
- 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 PLC and RIO drop.
 - .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 each piece of equipment individually for complete functionality.
 - .6 Test all control and interlock functions.
 - .7 Test pump operation in PLC auto mode.
 - .8 Test pump operation in auto mode when controlled by LIC-L100-1.
 - .9 Test pump operation in auto mode when controlled by LIC-L100-2.
 - .10 Completely test the E-Stop functionality of each piece of equipment, as provided.
 - .11 All modifications to the software program, to bypass interlocks or sensors, shall be recorded and documented clearly in a separate document, and the software.
 - .1 Any software bypasses that remain, prior to leaving site, must be authorized by the Contract Administrator.
 - .12 All deficiencies must be corrected by the Contractor.
 - .13 Commission each system using procedures prescribed by the Contract Administrator.
 - .14 Optimize operation and performance of systems by fine-tuning control loops and PID values.
 - .15 Complete local HMI test on both HMIs.

3.3 SYSTEM SOFTWARE

- .1 Load PLC system with appropriate program, 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 system.

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 contract document.

1.3 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Instrumentation (non-standardized)”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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-L010-2, HSS-L010-3, HSS-L020-1, HSS-L020-2, HSS-L020-3, HSS-L030-1, HSS-L030-2, HSS-L030-3)

- .1 Supply and install enclosed two-position maintained emergency stop operator stations for the lift pumps 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.

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 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.
- .3 NFPA 820-20: Fire Protection for Wastewater Treatment and Collection Facilities

1.3 SUBMITTALS

- .1 Submittals in accordance with Contract Document.
- .2 Submit commissioning plans and procedure, in writing, at least 20 Working days prior to commissioning.
- .3 Manufacturer's Instructions:
 - .1 Include manufacturer's installation instructions for specified equipment and devices in O&M Manuals.

1.4 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for “Instrumentation (non-standardized)”. Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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 BUILDING 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.
- .4 Discrete Inputs: One (1) 18V, 3.5 mA for monitoring dry contact
- .5 Mounting: wall
- .6 Enclosure: NEMA Type 1, minimum
 - .1 Honeywell T775M2030,
 - .2 Or approved equal in accordance with B7.

2.3 GENERATOR HVAC CONTROLLER (TIC-L630)

- .1 General: digital, stand alone, configurable controller
- .2 Power supply: 24 VAC.
- .3 Sensor Inputs:
 - .1 4-20mA input.
 - .2 Sensed temperature range: 0°C to +85°C.
- .4 Discrete Inputs: One (1) 18V, 3.5 mA for monitoring dry contact
- .5 Discrete Outputs: Two SPDT Contacts 10A @ 24 Vac (resistive)
- .6 Mounting: wall
- .7 Enclosure: NEMA Type 1, minimum
 - .1 Honeywell T775U2006,
 - .2 Or approved equal in accordance with B7.

2.4 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.
- .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 LIFT STATION VENTILATION CONTROL

- .1 Automatic control of outdoor air, mixed air, and exhaust air dampers based on occupied/unoccupied status, temperature, and gas detection.
 - .1 Occupied **OR** Outdoor Temperature > 10°C **OR** H2S gas detection > 10% LFL
 - .1 Duct heater HCE-L65 setpoint: 15°C (adj.).
 - .2 Damper FV-L611: OPEN.
 - .3 Damper FV-L612: CLOSED.
 - .4 Damper FV-L621: OPEN.
 - .5 HVAC fans: ON.
 - .1 Unoccupied **AND** Outdoor Temperature < 10°C **AND** H2S gas detection < 10% LFL
 - .1 Duct heater HCE-L67 setpoint: 15°C (adj.).
 - .2 Damper FV-L611: 50% Outdoor Air.
 - .3 Damper FV-L612: 50% Recirculation.
 - .4 Damper FV-L621: 50% Outdoor Air.
 - .5 HVAC fans: ON.

3.6 GENERATOR VENTILATION CONTROL

Generator Room Cooling Control:

- .1 Methane gas detection > 20% LFL **OR** Indoor temperature > 30°C
 - .1 Cooling damper FV-L632: OPEN.

GEN-L72 Cooling Control:

- .1 Generator Running **AND** Methane gas detection < 20% LFL
 - .1 Combustion damper FV-L631: OPEN.
 - .2 Intake, Exhaust, and Recirculation dampers FV-L633, FV-L634-1, FV-L634-2, FV-L634-3, : modulating to maintain set point programmed on TIC-L630.

Methane gas detection > 20% LFL (Alarm):

- .1 Upon gas detection generator is to be disabled via the emergency shutdown input.
- .2 All dampers open, excluding generator recirculation dampers.
- .4 Horn and Strobe alarm active.

.5 Alarm to latch and require manual reset

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 CSA C22.2 No. 205-17, 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 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 extension rack located in panel.
 - .2 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.

- .3 Connected to the following:
 - .1 MDM01 – Cellular modem (supplied by the City).
 - .2 MDM02 – PSTN (telephone) modem (to be supplied by contractor).
 - .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.
 - .1 Tag naming convention shall follow the City of Winnipeg's standard. Tags shall not conflict with the tag scheme utilized in the Conway Lift Station Control Narrative document.
- .3 The PLC is utilized to control wastewater 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 contract documents.
- .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.
 - .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 CONTROLLERS

- .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 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
 - .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 Modicon BME NOR 2200H, BMX NOR 0200H and BME NOC 0311 as shown,
 - .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.
 - .3 Acceptable Products:
 - .1 Schneider Electric Modicon BMX CPS 4022S for Main Rack, BMX CPS 3020 for Extension Rack
 - .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.
 - .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 Required Accessories:
 - .1 Include all accessories including cables, terminators, backplanes, memory, batteries, and other components required to make the system operable.

- .11 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 2 Execution

3.1 INSTALLATION

- .1 Contractor is responsible for installation, wiring, testing, and assisting the contract administrator in commissioning of all PLC equipment, PLC communication equipment, PC equipment and Operator interfaces as per manufacturer instructions and recommendations.
- .2 Update the processor and all updatable modules with the latest firmware.
- .3 The Contractor shall supply and deliver to the contract administrator any of the computer and PLC products identified herein for the purpose of programming. The contract administrator will advise the contractor when and which items will be required on a later date. The Contractor will pay all costs associated with handling, extended warranties, etc.
- .4 Contractor shall supply all required cabling to connect hardware above.

3.2 PLC PROGRAMMING SERVICES

- .1 The contract administrator (MPE a Division of Englobe) will be responsible for programming of the PLC, HMI, and network equipment.

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 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA)
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum)
- .4 Canadian Standards Association (CSA International).
 - .1 CSA-C22. 1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standards for Electrical Installations.

1.2 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 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.

1.3 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 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.

1.4 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.

1.5 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Instrumentation (non-standardized)". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.
- .2 A maximum of ninety-five percent (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 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 (CP-L81, CP-L82)

- .1 Install lamacoids as per the 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 panels 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 Component mounting plates shall be three (3) mm thick steel and shall be painted with one (1) coat of primer and one (1) coat of white baked enamel.
- .12 Enclosure shall be as indicated on the bill of materials or equivalent.

2.3 POWER SOURCE

- .1 Each power source must be protected by a CSA approved circuit breaker.
- .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 City, 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.
 - .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 equivalent.
- .6 Programmable Logic Controllers:
 - .1 As per section 40 94 43.
- .7 Touch-screen HMI
 - .1 As per section 40 94 43.
- .8 Wireless Modem:
 - .1 As per Contract Document.
- .9 General Purpose Relays:
 - .1 Type: DPDT or as shown on drawings.
 - .2 Indication: LED.
 - .3 Diode: Provide
 - .4 Coil Voltage: As per drawings.
 - .5 Contact Rating: 5A (120 VAC), 5A (24 VDC).
 - .6 Approvals: CSA.
 - .7 Manufacturer: Omron or approved equal.
- .10 24 VDC Power Supplies:
 - .1 Input: 100 - 240 VAC
 - .2 Output: 24 VDC, 10 A (adjustable 22.5-29.5 VDC)

- .3 Battery: 12 Ah
- .4 Monitoring outputs: 24 VDC, Alarm, Battery Mode, Battery Charge
- .5 Manufacturer: Phoenix Contact
- .6 Model: QUINT-UPS/24DC/24DC/10 (2320225) with a 12AH (CP-L81) backup battery as shown on the bill of materials or approved equal in accordance with B7.
- .11 Process Meters (LIC-L100-1, LIC-L100-2)
 - .1 See Section 40 30 02
- .12 Cellular Modem:
 - .1 Supplied by City.
- .13 PSTN Modem:
 - .1 Power Supply range: 10 – 40 Vdc regulated
 - .2 SIA protocol and Contact ID support for alarm equipment.
 - .3 Mounting: DIN rail mounted
 - .4 Manufacturer: Bausch Datacom
 - .5 Model: PSTN 485 SIA
- .14 Antenna:
 - .1 SharkFin Antenna
 - .2 Frequency Range: 698-960, 1710-2170, 2500-3800 MHz
 - .3 Operational Band: 2G/3G/4G, LTE
 - .4 Impedance: 50 Ω
 - .5 Manufacturer: Sierra Wireless
 - .6 Model: 6001120

2.5 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.

2.6 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 from.
- .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.
 - .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 non-erasable 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. 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.

- .8 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.
- .9 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.
- .10 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.
- .11 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.
- .12 Ethernet Patch Cords
 - .1 Requirements:
 - .1 Cat-6A.
 - .2 Jacket colour: Blue.

2.7 Wiring Duct:

- .1 All wires shall be run in narrow slot wiring duct such as Panduit or an approved equivalent.
- .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 4-20mA wires, but can cross their path.
- .5 All DC, AC, and thermocouple wiring shall be routed in separate wireways to prevent signal interference.
- .6
 - .8 Wire ties shall be non-metallic.
 - .9 Wiring shall be arranged to be readily accessible for inspection and maintenance.
 - .10 The wiring arrangement shall not interfere with access to panel mounted devices or spaces for future equipment.

2.8 Overcurrent Protection

- .1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

2.9 Internal Lighting

- .1 Difficulties resulting from electrical noise generated by fluorescent lamps shall be corrected.

2.10 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.
- .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 terminals as shown on drawings.
- .3 Install label above each terminal block with terminal block name.

3.3 TESTING

- .1 Send invitation to the City with 5 days advanced notice and submit with it agenda with list of all tests and procedures. If the City declines the invitation then submit test results for their review and approval prior to shipment.
- .2 Testing of the control panels shall be fully completed 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 E-stop system component functionality.
 - .7 Receptacle and lighting functionality.
 - .8 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

- .3 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.
- .4 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 instructors 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 for classroom training at City's site.
- .2 Supply manual for each trainee, describing in detail data included in each 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: At a facility provided by the City.
 - .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 control panel and system operation.

1. Use of the system.

2. Navigation.

3. Alarm system use.

.4 Presentation of the pump starters and system operation.

1.6 MONITORING OF TRAINING

.1 Contract Administrator to monitor training program and may modify schedule and content.

1.7 MEASUREMENT AND PAYMENT

.1 The work described herein will be paid for under the Contract Fixed Fee for "Training". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.

Part 2 Products

2.1 GENERAL

.1 Not Applicable.

Part 3 Execution

3.1 TRAINING

.1 Provide on-site training to City personnel.

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.

.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.

1.3 MEASUREMENT AND PAYMENT

- .1 The work described herein will be paid for under the Contract Lump Sum Price for "Instrumentation (non-standardized)". Said price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this specification, accepted by the Contract Administrator.

Part 2 Products

2.1 NOT APPLICABLE.

.1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE.

.1 Not applicable.

END OF SECTION