PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Refer to Drawings and Specifications for full extent of the scope of the Work.

.2 The scope of the Work includes but is not limited to:

- .1 Architectural
  - .1 Insulating of building walls and roof (currently uninsulated) and finishing with interior gypsum board finish.
  - .2 Removal/protection of rigid foam board insulation.
  - .3 Insulating of existing roof hatch.
  - .4 Sealing of interior floor hatches over the wet well.
- .2 Structural
  - .1 Interior roof repairs, including installing joist hangers, tie-downs and reinforcing roof trusses/rafters, as required.
  - .2 New ladders and platforms in drywell to access and maintain pump shaft bearings.
  - .3 Replacement of guardrails.
- .3 Mechanical
  - .1 Heating and Ventilation system upgrades.
  - .2 Plumbing/piping upgrades.
- .4 Electrical
  - .1 Electrical system upgrades, including new CSTE and Manitoba Hydro service upgrade.
  - .2 Building electrical services upgrades, including new MCCs, VFDs and panels.
  - .3 Building telecommunications upgrades.
  - .4 New PLC Control Panel and automation upgrades.
  - .5 Replacement of all 600V power, 120/240V power, and instrumentation field wiring.
  - .6 New HVAC controls.
  - .7 Refurbishment of existing flood pump motors.

1.2 PERMITS

.1 Contractor shall secure and pay for all permits required for the Work.

1.3 CODES AND STANDARDS

.1 Perform Work in accordance with Manitoba Building Code (MBC) 2011 and all other codes of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.

.2 Meet or exceed requirements of:

- .1 Contract documents.
- .2 Specified standards, codes and references documents.

.3 Workers'/Workmens' Compensation Board and municipal authority.

.4 Requirements of FCC No. 301-Standard for Construction Operations, June 1982, issued by Fire Commissioner of Canada.

.5 Workplace Hazardous Materials Information System (WHMIS).

1.4 PROJECT COORDINATION AND COMMUNICATION

.1 Coordinate progress of the Work, progress schedules, submittals, use of site, temporary utilities, construction facilities and controls.

.2 Maintain at job site, one copy each of the following:

.1 Latest version of all Contract Documents.

.2 Reviewed shop drawings.

.3 Change Orders/Instructions.

.4 Other modifications to Contract.

.5 Field test reports.

.6 Manufacturer's installation and application instructions.

.7 WHMIS documents for all products on-site.

1.5 CUTTING AND PATCHING

.1 Approvals

.1 Submit written request in advance of cutting or alteration which affects:

.1 Structural integrity of any element of Project.

.2 Integrity of weather-exposed or moisture-resistant elements.

.3 Efficiency, maintenance, or safety of any operational element.

.4 Visual qualities of sight-exposed elements.

.5 Work of City or separate contractor.

.2 Inspection

.1 Inspect existing conditions, including elements subject to damage or movement during execution of the Work.

.2 After uncovering, inspect conditions affecting performance of work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.3 Execution

.1 Perform cutting, fitting, and patching to complete the Work.

.2 Remove and replace defective and nonconforming work.

.3 Perform work to avoid damage to other work.

.4 Prepare proper surfaces to receive patching and finishing.

.5 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed, unless expressly permitted by the City.

.6 Restore work with new products in accordance with Contract Documents.

.7 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

1.6 FIELD ENGINEERING

.1 Toxic and Hazardous Substances and Materials

.1 Asbestos discovery: Demolition of asbestos can be hazardous to health. Should material suspected of containing asbestos be encountered in the course of demolition work, stop work and notify Contract Administrator immediately. Do not proceed until written instructions have been received from the Contract Administrator.

1.7 PROJECT MEETINGS

.1 Preconstruction Meeting

.1 A preconstruction meeting will be held with the Contractor and the City. The meeting will be scheduled by the Contract Administrator after Contract Award and prior to commencement of construction.

.2 Construction Meetings

.1 Contract Administrator will schedule and administer project progress meetings throughout progress of work at call of Contract Administrator and the City.

.2 Contract Administrator will distribute written notice of each meeting in advance of meeting date to City and Contractor.

.3 Contract Administrator will record minutes and include significant proceedings and decisions and identify "action by" parties.

.4 Contract Administrator will reproduce and distribute copies of minutes within five days after each meeting and transmit to meeting participants, Contract Administrator and City.

1.8 SUBMITTALS

.1 Administrative

.1 Submit to Contract Administrator submittals listed for review. Submit with reasonable promptness and in an orderly sequence so as to not cause delay in the Work.

.2 Work affected by submittals shall not proceed until review is complete.

.3 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 coordinated with requirements of the Work and Contract Documents.

.4 Verify field measurements and affected adjacent Work are coordinated.

.2 Shop Drawings and Product Data

.1 Where required, Shop Drawings shall carry the stamp of a Professional Engineer licensed to practice in the Province of Manitoba.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connection, explanatory notes and other information necessary for completion of Work.

.3 Adjustments made on shop drawings by Contract Administrator are not intended to change Contract Price.

.4 Make changes in shop drawings as Contract Administrator may require. Contract Administrator will require 10 working days for review of shop drawings.

.5 Submit shop drawings (numbers as indicated below) for review to Contract Administrator for all items requested in the specification and as Contract Administrator may reasonably request where shop drawings will not be prepared due to standardized manufacture of product:

.1 Electronic copy: pdf format

.2 Paper copy: 4 copies

.6 Identify all shop drawings in lower right-hand corner as follows:

.1 Name of Project

.2 City project number (if applicable)

.3 Engineer’s project number

.4 Title of shop drawing

.5 Project series number and name of area (in which item is used)

.6 Specification section number

.7 Option proposed (if applicable)

.8 Date (revised for each submission)

.7 Submissions shall include:

.1 Name and address of:

.1 Subcontractor (if applicable)

.2 Supplier (if applicable)

.3 Manufacturer (if applicable)

.2 Contractor's review stamp, signed by an authorized representative certifying approval of submission, verification of field measurements and compliance with Contract Documents.

.3 Details of appropriate portions of work as applicable indicating:

.1 Fabrication.

.2 Layout; showing dimensions, including identified field dimensions and clearance.

.3 Setting or erection details.

.4 Performance characteristics.

.5 Standards.

.6 Relationship to adjacent work.

.3 Samples (if requested)

.1 Submit for review, samples in duplicate as requested in respective specification Sections.

.2 Deliver samples prepaid to Contract Administrator's business address.

.4 Field Samples and Mock-ups (if requested)

.1 Field samples and Mock-ups: Field erected example of Work complete with specified materials and workmanship.

.2 The City reserves the right to request a field-erected sample or mock-up of the Work prior to accepting installation of any new materials.

.3 Erect field samples and mock-ups at locations as directed by Contract Administrator.

.4 Reviewed and accepted field samples and mock-ups will become standards of workmanship and material against which installed work will be judged.

.5 Operating and Maintenance Manuals

.1 One week prior to the anticipated date of Substantial Performance of the Work, submit to Contract Administrator, 1 copy of operating and maintenance manuals for review. Upon receipt of final comments from Contract Administrator, revise manuals as required and submit copies of manuals to Contract Administrator as follows:

.1 Three (3) hard copies;

.2 One digital file in pdf format.

.2 Manuals to contain warrantee, operational and maintenance information for finished roof installations.

.1 Bind contents in a D-ring, hard covered, plastic-jacketed binder. Organize contents into applicable categories of work, parallel to specifications sections.

1.9 QUALITY CONTROL

.1 Inspection

.1 The City and the Contract Administrator shall have access to the Work at all times. The Contractor shall provide sufficient, safe and proper facilities at all times for the review of the Work by the Contract Administrator and the inspection of the Work by authorized agencies. If parts of the Work are in preparation at locations other than the Place of the Work, the City and the Contract Administrator shall be given access to such work whenever it is in progress.

.2 If work is designated for tests, inspections or approvals in the Contract Documents, by the Contract Administrator’s instructions, or by the laws or ordinances of the Place of the Work, the Contractor shall give the Contract Administrator reasonable notification of when the work will be ready for review and inspection. The Contractor shall arrange for and shall give the Contract Administrator reasonable notification of the date and time of inspections by other authorities.

.3 The Contractor shall furnish promptly to the Contract Administrator two copies of certificates and inspection reports relating to the Work.

.4 If the Contractor covers, or permits to be covered, work that has been designated for special tests, inspections or approvals before such special tests, inspections or approvals are made, given or completed,

the Contractor shall, if so directed, uncover such work, have the inspections or tests satisfactorily completed, and make good covering work at the Contractor's expense.

.5 The Contract Administrator may order any portion or portions of the Work to be examined to confirm that such work is in accordance with the requirements of the Contract Documents. If the work is not in accordance with the requirements of the Contract Documents, the Contractor shall correct the work and pay the cost of examination and correction. If the work is in accordance with the requirements of the Contract Documents, the City shall pay the cost of examination and restoration.

.6 The Contractor shall pay the cost of making any test or inspection, including the cost of samples required for such test or inspection, if such test or inspection is designated in the Contract Documents to be performed by the Contractor or is required by the laws or ordinances applicable to the Place of the Work.

.7 The Contractor shall pay the cost of samples required for any test or inspection to be performed by others if such test or inspection is designated in the Contract Documents.

1.10 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

.1 Installation/Removal

.1 Provide construction facilities and temporary controls in order to execute work expeditiously.

.2 Remove from site all such facilities after use.

.2 Scaffolding

.1 Provide and maintain scaffolding, ramps, ladders, and platforms.

.2 Design and construct scaffolding in accordance with CSA S269.2-M87 (R1998).

.3 Provide mesh hoarding for scaffolding.

.3 Hoisting

.1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment and materials. Make financial arrangements with Subcontractors for use thereof.

.2 Hoists and cranes shall be operated by qualified operator.

.4 Guard Rails and Barricades

.1 Provide as required by governing authorities, secure, rigid guard railings and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.5 Site Storage/Loading

.1 The Contractor shall confine construction machinery and equipment, storage of Products, and operations of employees to limits indicated by laws, ordinances, permits, or the Contract Documents and shall not unreasonably encumber the Work with Products.

.2 The Contractor shall not load or permit to be loaded any part of the Work with a weight or force that will endanger the safety of the Work.

.6 Sanitary Facilities

.1 Provide sufficient sanitary facilities for workers in accordance with local health authorities.

.2 Maintain in clean condition.

.7 Temporary Power

.1 Contractor will pay for temporary power required during construction for temporary lighting and operating of power tools required to perform the Work.

.2 Contractor shall provide connections from designated take-off points, arrange for connection with appropriate utility company (as required) and pay costs for installation, maintenance and removal.

.3 Provide and maintain temporary lighting throughout the project. The level of illumination on all work areas shall be not less than 30-foot candles; walkways shall be not less than 5-foot candles.

.4 Temporary power for electric cranes and other equipment requiring a supply in excess of above shall be the responsibility of the Contractor.

.5 Pay for damage to existing plant if caused by Contractor negligence.

.6 City assumes no responsibility for inconvenience or costs incurred due to loss of power or interruptions

.8 Construction Offices and Safety

.1 If required, provide and maintain in clean condition during progress of Work, adequately lighted, heated and ventilated Contractor's office with space for filing and layout of Contract Documents and Contractor's normal site office staff.

.2 Provide portable fire extinguishers, safety equipment and adequate first aid facilities.

.9 Equipment/Tool/Materials Storage

.1 Provide and maintain, in clean and orderly condition, lock-ups/lockers 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, in location as approved by City.

.3 Use of City supplies, tools, ladders, manlifts and portable equipment is not permitted at any time.

.10 Access to Site

.1 Provide and maintain access routes, pathways, ramps and construction runways, both inside and outside (as effected) of the building, as may be required for access to the Work.

.11 Construction Parking

.1 Contractor parking shall be limited to Site of the work.

.2 Parking of vehicles for delivery of materials and supplies is “temporary only”. Arrange with City or City parking officials for locations of such parking as required.

.12 Project Cleanliness

.1 Contractor shall not be permitted to use City supplies or waist containers for this project.

.2 Maintain the Work in tidy condition, free from accumulation of waste products and debris.

.3 Remove waste material and debris from site and deposit in waste container at end of each working day.

.4 Clean interior areas prior to start of finish work, maintain areas free of dust, fumes, odors, and other contaminants during finishing operations.

1.11 MATERIAL AND EQUIPMENT

.1 Product and Material Quality

.1 Products, materials, equipment and articles (referred to as Products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Defective Products, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Contract Administrator based upon requirements of Contract Documents.

.2 Storage, Handling and Protection

.1 Handle and store Products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact.

.3 Store products subject to damage from weather in weatherproof enclosures.

.3 Protection of Building Finishes and Equipment

.1 Provide protection for finished and partially finished work, along with existing building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, hoardings as required.

.3 Be responsible for damage incurred due to lack of or improper protection.

.4 Manufacturer's Instructions

.1 Unless otherwise indicated in specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify Contract Administrator in writing, of conflicts between specifications and manufacturer's instructions, so that Contract Administrator may establish course of action.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and reinstallation at no increase in Contract Price.

.5 Workmanship

.1 Workmanship shall be best quality, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in their required duties.

.3 Decisions as to quality or fitness of workmanship in cases of dispute rest solely with Contract Administrator, whose decision is final.

1.12 PROJECT CLOSEOUT

.1 Final Cleaning

.1 Remove waste materials and debris from site at regularly scheduled times, minimum daily, or dispose of as directed by City. Do not burn waste materials on site.

.2 Leave work clean before inspection process commences.

.3 Remove dirt and other disfigurations from exterior surfaces.

.2 Documents

.1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers.

.2 Submit material prior to final Application for Payment.

.3 Submit operation and maintenance data, record (as-built) drawings.

.4 Provide warranties and bonds fully executed and notarized.

.5 Execute transition of Performance and Labour and Materials Payment Bond to warranty period requirements.

.6 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining due.

.7 Contract Administrator will issue a final change order reflecting approved adjustments to Contract Price not previously made.

.3 Inspection/Takeover Procedures

.1 Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete, defects are corrected and building is clean and in condition for occupancy. Notify Contract Administrator in writing, of satisfactory completion of the Work and request an inspection.

.2 During Contract Administrator inspection, a list of deficiencies and defects will be tabulated. Correct same.

.3 When Contract Administrator considers deficiencies and defects have been corrected and it appears requirements of Contract have been performed, make application for certificate of Substantial Performance. Refer to requirements of D.20 SUBSTANTIAL PERFORMANCE for specifics to application.

PART 2 PRODUCTS

.1 Not Used

PART 3 EXECUTION

.1 Not Used

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

.1 The work included under this Section includes but is not limited to: Metal Fabrications

1.2 RELATED WORK IN OTHER SECTIONS

.1 The following related sections are included for reference only. It is the Contractor's responsibility to coordinate and include all works described, shown, and referenced in the contract documents.

.1 Section 09 90 00 – Painting

1.3 REFERENCE STANDARDS

.1 ASTM A53-(90b) - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A2 – Standard specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and strip for Pressure Vessels and for General Applications.

.3 CAN/CSA-G40.21-13 (R2018) - Structural Quality Steels.

.4 CAN/CSA-G164-18 - Hot-Dipped Galvanizing of Irregularly Shaped Articles.

.5 CAN/CGSB-1.108-M89 – Bituminous Solvent Type Paint.

.6 CAN/CGSB-1.140 – Oil-Alkyd Type Red Lead, Iron Oxide Primer.

.7 CAN/CSA-S16-19 - Design of Steel Structures.

.8 CSA W59-13 - Welded Steel Construction (Metal Arc Welding).

.9 CSA W59.2-2018 – Welded Aluminum Construction

.10 ASTM 276 - Type 316 or Type 304 Stainless Steel.

.11 CSA W48-18 – Filler Metals and Allied Materials for Metal Arc Welding

.12 ASTM A307-21 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000psi Tensile Strength.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Division 01. Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

1.5 PROTECTION

.1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site. Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Steel W and HSS sections: to CAN/CSA-G40.21, Grade 350W (Class C HSS).

.2 Steel Channels, Angles, Tees, and plates: to CAN/CSA-G40.21, Grade 300W.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A307.

.6 Aluminum shall conform to the following alloy designations of the Aluminum Association:

.1 Extruded Shapes - Structural: 6061-T6
.2 Smooth Plates:5083-H34
.3 Rivets and Bolts: 6061-T6
.4 Checkered or Tread Plate: 6061-T6

.7 All stainless steel: to ASTM A276, Type 304 or Type 316.

.8 Grout: non-shrink, non-metallic, flowable, 40 MPa.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot-dipped galvanizing with zinc coating 610 g/m5 to CAN/CSA-G164.

.2 Shop coat primer: to CAN/CGSB-1.40.

.3 Bituminous paint: to CAN/CGSB-1.108.

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 SHOP PAINTING

.1 Apply one coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.

.3 Clean surfaces to be field welded: do not paint.

2.6 SLAB CORNER GUARDS

.1 Galvanized steel angle as indicated.

2.7 HATCH COVERS

.1 Hatch covers which shall include all of the related hardware.

2.8 MISCELLANEOUS ITEMS

.1 Review all drawings and include all other metal fabrication not included in the above noted list.

PART 3 EXECUTION

3.1 ERECTION

.1 Do welding work in accordance with CSA W59, unless specified otherwise.

.2 Erect metal work square, plumb, straight and true, accurately fitted with tight joints and intersections.

.3 Isolate stainless steel members from direct contact with dissimilar metals.

.4 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, chemically anchored bolts and toggles.

.5 Exposed fastening devices to match finish and be compatible with material through which they pass.

.6 Provide components for building by other sections in accordance with shop drawings and schedule.

.7 Make field connections with bolts to CAN/CSA-S16.1 or weld.

.8 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.9 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.10 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

3.2 FRAMES

.1 The angle frames and border bars shall have mitred corners neatly fitted and welded. Border bars shall be fastened to angle frames by welding.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 00 01 – General Requirements

.2 Section 07 90 00 – Sealants

1.2 REFERENCES

.1 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.2 CAN/ULC-S702-09, Standard for Mineral Fibre Insulation for Buildings.

.3 ASTM C165-07 Recommended Practice for Measuring Compressive Properties of Thermal Insulations.

.4 ASTM C272M-12, Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions.

.5 ASTM C739-17 - Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation.

.6 ASTM D1621-10, Test Method for Compressive Properties of Rigid Cellular Plastics.

.7 ASTM E84-12b Test Method for Surface Burning Characteristics of Building Materials.

.8 ASTM E96M-10 Test Method for Water Vapour Transmission of Materials.

.9 CAN/CGSB-51.34-M86 Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.10 CGSB 71 GP 24M Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.

.11 CSA A101 M1983 Thermal Insulation, Mineral Fibre, for Buildings.

.12 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.

.13 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.14 CAN/ULC S102 -10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

.1 Submit shop drawings/material data sheets in accordance with Section 01 00 01 – General Requirements.

1.4 DELIVER, STORAGE AND HANDLING

.1 Deliver materials to job site in good condition in sealed wrapping with indicated Manufacturer's name, product name and RSI (R) value.

.2 Keep materials protected from elements and other conditions that may cause their damage or degradation.

1.5 QUALITY CONTROL

.1 Perform work of this Section by a specialized insulation applicator having minimum (5) five years of experience on projects of similar size and scope.

PART 2 PRODUCTS

2.1 INSULATION

.1 Type A: Extruded polystyrene board insulation to CAN/ULC-S701, Type 4, rigid, closed cell type, with integral high-density skins, shiplapped edges, and thickness as indicated on the drawings.

- .1 Thermal resistance RSI=0.87 per 25 mm thickness.
- .2 Minimum compressive strength of 210 kPa at 10% deformation or yield.
- .3 Acceptable material: Styrofoam SM by Dow Chemicals, or approved substitute.

.2 Type B: Semi-rigid batt insulation to CSA A101.

- .1 Thicknesses and RSI values as indicated on drawings.
- .2 Acceptable material: Roxul Comfort Batt or approved substitute.

.3 Type C: Two components foamed in place polyurethane.

2.2 VAPOUR BARRIER

.1 Polyethylene film: to CAN/CGSB-51.34, Type 1, 0.15mm (6 mil) thick, unless otherwise indicated.

.2 Acoustic sealant: refer to Section 07 90 00 – Sealants.

2.3 ACCESSORIES

.1 Insulation Baffles.

- .1 Purpose-made cardboard or styrofoam baffles, sized to suit roof truss spacing.

PART 3 EXECUTION

3.1 SCHEDULE

.1 Use Type A insulation for:

.1 Exterior stud wall and roof application. Thickness to fill cavities and provide RSI values indicated.

.2 Use Type B insulation for:

.1 Exterior stud wall and roof application, thicknesses as indicated. Continuous on interior of existing framing, covered by polyethelene vapour barrier.

.3 Use Type C insulation for:

.1 To fill up the spaces at perimeter of exterior window and door frames, penetrations, and other openings. Fill entire cavity and ensure continuity with interior vapour barrier.

3.2 PREPARATION

.1 Ensure that surfaces to receive adhesive or insulation are dry, free of loose material, dirt, grease, surface ridges and sharp projections, ice, frost, or other conditions impairing bond of the adhesive or uniform bedding of the insulation.

.2 Examine substrate and report unacceptable conditions. Commencing work will imply acceptance of substrate conditions.

3.3 INSTALLATION GENERAL

.1 Install materials in accordance with the Manufacturers' printed instructions and as specified.

.2 Ensure the continuity of the thermal and vapour barriers over designated areas. Where insulation is interrupted by construction elements such as hangers, pipe penetrations, etc., neatly fit insulation around such elements and patch spaces around these elements with same insulation. Allow for expansion and contraction and linear movement of these elements.

.3 Where vapour barriers, or insulation are to be provided under other Sections, co-ordinate the work such that thermal and vapour barrier continuity is achieved throughout. At perimeter provide sheet metal or butyl sheet to seal air and vapour barrier to adjacent system.

.4 Do not enclose insulation permanently until installation has been accepted by Consultant. Coordinate installation of insulation with scheduling for enclosing materials.

.5 Provide appropriate protection to maintain integrity of installed insulation until facing materials are in place.

.6 Protect surfaces and in particular the building cladding finishes from being marred or contaminated by the materials. Examine the work of other

Sections where such work is closely associated with the work of this Section and report any damage done to the work of this Section.

.7 Maintain substrate and ambient temperature constantly between 10°C and 38°C during application and curing of adhesive.

3.4 INSTALLATION – INSULATION BAFFLES

.1 Install baffles between trusses along bottom (eave) edge of roof.

.2 Ensure air space between baffles and underside of roof sheathing as shown on drawings.

.3 Secure using roofing nails or staples.

3.5 INSTALLATION – INSULATION

.1 Bevel board edges abutting sloping surfaces.

.2 Fit batt insulation into spaces between studs and bottom cords of roof trusses. Follow Manufacturer's installation instruction.

.3 Where there is a possibility of heat loss through ductwork or conduit which passes through the thermal and air and vapour barrier, extend insulation around the duct or conduit a distance of 300 mm minimum on both sides of the barrier, unless otherwise shown on the Drawings.

.4 Provide appropriate protection to maintain integrity of installed insulation until facing materials are in place.

.5 Pack batt insulation tightly into miscellaneous building cavities as required to ensure continuous thermal barrier.

.6 Apply foamed in place polyurethane insulation using suitable equipment, in accordance with Manufacturer's directions. Fill designated spaces completely, leaving no gaps or voids. Prevent overspray and spills. Trim excess material

3.6 CLEANUP

.1 Clean surfaces marred or otherwise damaged to Consultant's acceptance.

.2 Apply effective and safe method of cleaning accepted by the Consultant.

.3 Pay the cost of replacing finishes or materials that cannot be cleaned.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTONS

.1 Section 01 00 01 – General Requirements

1.2 REFERENCES

.1 Underwriter's Laboratories of Canada (ULC)

.1 CAN-ULC-S101-04, Standard Methods of fire Endurance Tests of Building Construction and Materials.

.2 CAN-ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

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

.1 Material Safety Data Sheets (MSDS).

1.3 PERFORMANCE REQUIREMENTS

.1 Specified materials and application methods shall provide a minimum 1/4 hour (15 minute) fire resistance.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 00 01 – General Requirements.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit [two] copies of WHMIS MSDS - Material Safety Data Sheets.

.3 Samples:

.1 submit duplicate 300 x 300 mm size sample of exposed fireproofing for approval of texture and colour.

.4 Quality assurance submittals:

.1 Test Reports:

.1 Submit product data including certified copies of test reports verifying fireproofing applied to substrate as constructed on project will meet or exceed requirements of Specification.

.2 Submit test results in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

.3 For assemblies not tested and rated, submit proposals based on related designs using accepted fireproofing design criteria.

.2 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.4 Manufacturer's Field Reports:

.1 Submit to manufacturer's written reports within 3 days of review, verifying compliance of Work.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company specializing in sprayed-on fireproofing approved by manufacturer with documented 5 years experience.

.2 Mock-ups:

.1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.

.1 Mock-up will be used to judge workmanship, substrate preparation and application of material.

.2 Apply fireproofing to approximately 5 m2area of surfaces of mock-up-matching surface to be treated.

.3 Allow 24 hours for inspection of mock-up by Contract Administrator before proceeding with fireproofing work.

.4 When accepted, mock-up will demonstrate minimum standard of quality required for this work.

.3 Site Meetings:

.1 Convene pre-installation meeting one week prior to beginning work of on-site installations with Contract Administrator to:

.1 Verify Project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Deliver packaged materials in original unopened containers, marked to indicate brand name, manufacturer and ULC markings.

.2 Storage and Protection:

.1 Store materials indoors in dry location.

.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

.3 Damaged or opened containers will be rejected.

.4 Packaging to indicate shelf-life and materials to be applied prior to expiration of shelf-life.

.5 Provide temporary enclosures to prevent spray from contaminating air beyond application area.

.6 Protect adjacent surfaces and equipment from damage by overspray, fallout, and dusting of fireproofing materials.

1.7 AMBIENT CONDITIONS

.1 At temperatures less than 5 degrees C, ensure that 5 degrees C air and substrate temperature is maintained during and for 24 hours after application. Ensure that natural ventilation to properly dry the fireproofing during and subsequent to its application is provided. In enclosed areas lacking openings for natural ventilation, ensure that interior air is circulated and exhausted to the outside.

.2 Maintain relative humidity within limits recommended fireproofing manufacturer.

.3 Ensure that natural ventilation to properly dry fireproofing during and subsequent to its application is provided.

.4 In enclosed areas lacking openings for natural ventilation, provide minimum of 6 air exchanges per hour by forced air circulation.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Sprayed fireproofing: ULC certified cementitious fireproofing qualified for use in ULC Designs providing the required fire resistance.

.2 Curing compound: type recommended by fireproofing manufacturer, qualified for use in ULC Designs providing the required fire resistance.

.3 Sealer: type recommended by fireproofing manufacturer, qualified for use in ULC Design providing the required fire resistance.

.1 Colour: white.

.2 Ensure spray-applied fireproofing: does not crack, spall or delaminate under downward deflection conditions.

.3 Spray-Applied fireproofing material: not contribute to corrosion of test panels.

.4 Acceptable Product: Carboline Southwest Type 7TB or approved equal to the requirements of B.8.

PART 3 EXECUTION

3.1 EXTENT OF APPLICATION

.1 Fireproofing material, including primers and sealers, to be installed over all exposed rigid insulation located on below-grade and at-grade structure, including but not explicitly limited to:

.1 Walls;
.2 Ceilings;
.3 Columns;
.4 Beams.
.5 Hatches.

.2 Application methods and thicknesses to provide minimum 1/4 hour (15 minute) fire resistance.

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 datasheets.

3.3 PREPARATION

.1 Substrate: free of material which would impair bond.

.2 Verify that painted substrates are compatible and have suitable bonding characteristics to receive fireproofing.

.3 Remove incompatible materials.

.4 Ensure that items required to penetrate fireproofing are placed before installation of fireproofing.

.5 Ensure that new ducts, piping, equipment, or other items which would interfere with application of fireproofing are not positioned until fireproofing work is completed.

.6 Ensure that existing ducts, piping, equipment, or other items in the locations of fireproofing application are protected (masked) to avoid being covered by the application.

3.4 APPLICATION

.1 Apply bonding adhesive or primer to substrate as recommended by manufacturer.

.2 Apply fireproofing to correspond with tested assemblies, and as recommended by manufacturer.

.3 Apply fireproofing over substrate, building up to required thickness to cover substrate with monolithic blanket of uniform density and texture.

.4 Apply fireproofing directly to open web joists without use of expanded lath.

.5 Tamp smooth, surfaces as indicated visible in finished work.

.6 Apply curing compound to surface of cementitious fireproofing as required by manufacturer.

.7 Apply sealer to surface of mineral fibre fireproofing as required by manufacturer where fireproofing is to be painted and as indicated.

3.5 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.6 PATCHING

.1 Patch damage to fireproofing caused by testing or by other trades before fireproofing is concealed, or if exposed, before final inspection.

3.7 CLEANING

.1 Clean surfaces not indicated to receive fireproofing of sprayed material within 24 hours period after application.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 This Section specifies caulking and sealants not specified in other Sections.

.2 Comply with Division 01 – General Requirements, and all documents referred to therein.

1.2 REFERENCES

.1 CAN/CGSB-19.17-M90 One-component Acrylic Emulsion Base Sealing compound.

.2 CAN/CGSB-19.21-M87 Sealing and Bedding Compound Acoustical.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store materials in original wrappings and containers with Manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.4 ENVIRONMENTAL AND SAFETY REQUIREMENTS

.1 Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and provision of material safety data sheets acceptable to Labour Canada.

.2 Conform to Manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use. Sealant and substrate materials to be minimum 5°C.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

.2 Use materials as received from Manufacturers, without additives or alterations. Use one Manufacturer's Product for each kind of Product specified.

.3 Sealant Material:

.1 Type A – Acrylic Latex One Part, Paintable

.1 To Can/CGSB-19.17.

.2 Acceptable material:

.1 Tremco Tremflex 834, or approved substitute.

.2 Type B – Acoustical Sealant

.1 To CAN/CGSB-19.21.

.2 Acceptable material:

.1 Lepage PL Acousti-Seal, or approved substitute.

.4 Accessories.

.1 Joint fillers.

.1 Ensure that back-up materials are compatible with selected sealant and of type recommended by Manufacturer.

.2 Preformed Compressible and Non-Compressible back-up materials:

.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50%.

.2 Neoprene or Butyl Rubber.

.1 Round solid rod, Shore A hardness 70.

.3 High Density Foam.

.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m^3 density, or neoprene foam backer, size as recommended by Manufacturer.

.4 Bond Breaker Tape.

.1 Polyethylene bond breaker tape which will not bond to sealant.

.3 Joint Cleaner.

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant Manufacturer.

.4 Primer: as recommended by Manufacturer.

PART 3 EXECUTION

3.1 PROTECTION

.1 Protect installed work of other trades from staining or contamination.

3.2 PREPARATION OF JOINT SURFACES

.1 Examine joint sizes and conditions to establish correct depth to width relationship or installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter, which may impair work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellant, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant Manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to Manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant Manufacturer's instructions.

3.6 APPLICATION

.1 Sealant:

.1 Apply sealant, primers and joint fillers to Manufacturer's instructions.
.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
.3 Apply sealant in continuous beads.
.4 Apply sealant using gun with proper size nozzle.
.5 Use sufficient pressure to fill voids and joints solid.
.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
.7 Tool exposed surfaces before skinning begins to give slightly concave shape.
.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:

.1 Cure sealants in accordance with sealant Manufacturer's instructions.
.2 Do not cover up sealants until proper curing has taken place.

.3 Cleanup:

.1 Clean adjacent surfaces immediately and leave work neat and clean.
.2 Remove excess sealant and droppings using recommended cleaners as work progresses.
.3 Remove masking after tooling of joints.

.4 Application schedule:

.1 Following sealant location schedule is included for convenience and may not be complete. Examine Contract Drawings and determine

entire extent of Work of this Section. Generally seal following locations:

.2 Sealant Type A:

.1 Joints in gypsum board and plywood, where painting is required.

.3 Sealant Type B:

.1 Sealing of laps and joints in polyethylene vapour barrier.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 00 01 – General Requirements

.2 Section 08 70 00 – Door Hardware

.3 Section 09 90 00 – Painting

1.2 SCOPE

.1 All labour, equipment and materials required to fabricate and supply hollow metal doors and frames, together with ancillary work herein described and required to the full intent of the Drawings and Specifications, including but not limited to the following: hollow metal doors, hollow metal door frames, reinforcing to receive hardware, rubber door bumpers, frame anchors.

1.3 REFERENCES

.1 Canadian Standards Association (CSA).

.1 CSA A101-M1983, Thermal Insulation, Mineral Fibre, for Buildings.

.2 CAN/CSA-G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel.

.3 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-1.181-92, Ready-Mixed Organic Zinc-Rich Coating.

.2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.3 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.4 CAN/ULC-S702-09, Standard for Mineral Fibre Insulation for Buildings.

.5 CGSB 51-GP-21M-78, Thermal Insulation, Urethane and Isocyanurate, Unfaced.

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

.1 ASTM A653/A653M-11, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.

.2 ASTM B29-92, Specification for Pig Lead.

.4 Underwriters' Laboratories of Canada (ULC).

.1 CAN4-S104-10, Standard Method of Fire Tests of Door Assemblies.

.2 CAN4-S105-09, Fire Door Frames.

.5 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).

.1 CSDFMA, Specifications for Commercial Steel Doors and Frames, 2009.

.2 CSDFMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 2009.

.6 National Fire Protection Association (NFPA).

.1 NFPA 80-2013, Fire Doors and Windows.

.2 NFPA 252-2012, Door Assemblies Fire Tests of.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 00 01 – General Requirements.

.2 Indicate each type of frame material, core thickness, reinforcement, location of anchors and exposed fasteners and finishes.

.3 Submit certificate to substantiate design and construction of fire rated assemblies, if requested.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Commercial grade cold rolled sheet steel conforming to ASTM A653 with zinc coating ZF275 (G90 hot dip galvanized).

.2 Door bumpers: black neoprene.

.3 Primer: Conform to CGSB 1-GP-181M.

2.2 FABRICATION GENERAL

.1 Steel member thickness:

Door and Interior Window Frames:	1.6 mm (16ga) minimum
Frame reinforcement:	2.7 mm (12ga) minimum
Anchors:	4.0 mm minimum
T-straps:	1.6 mm (16ga) minimum
Guard Boxes:	0.9 mm (20ga) minimum
Glazing Stops:	1.0 mm minimum
Doors:	1.6 mm (16ga) minimum
Door reinforcement	2.7 mm (12ga) minimum
Reinforcing at double door mullions	3.5 mm (10ga) minimum

.2 Fabricate doors and frames as shown on drawings, sized to suit door openings, in compliance with the Canadian Steel Door and Frame Manufacturer's Association, "Canadian Manufacturing Specifications for Steel Doors and Frames"; except where specified otherwise.

.3 Site confirms opening sizes before fabrication.

.4 Provide fully welded type construction of doors and frames.

.5 Provide hardware reinforcing, blanks and guard boxes for mortise buts and strike, surface mounted hardware and where applicable using templates provided by finish hardware supplier.

.6 Cut mitres and joints accurately and weld continuously on inside of frame profile.

.7 Grind welded corners and joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish.

.8 Touch up doors and frames with primer where galvanized finish damaged during fabrication.

2.3 FABRICATION DOOR FRAMES

.1 Provide concealed jamb and floor anchors: adjustable for non-rated frames, welded for rated frames.

.2 Install (3) three bumpers on strike jamb for each single door.

.3 For frames up to 2250 mm in height secure on each jamb (3) three adjustable anchors for masonry wall, (3) three pre-drilled holes with shallow dimples and with welded spacers behind for concrete wall and structural steel member. Fabricate an additional anchor for each additional 750 mm of height or part thereof.

2.4 FABRICATION DOORS

.1 Fabricate doors 45 mm thick, hollow type, with vertical steel stiffeners.

.2 Door edge seems continuously welded. Provide condensation weep holes at bottom edge of exterior doors.

.3 Provide weather caps for all exterior doors.

.4 Insulate all doors with polyurethane foam insulation completely filling the cavity.

.5 Fasten glazing stops with countersunk screws.

.6 Fire rated doors shall be manufactured and labeled to the ULC requirements.

.7 Acoustic steel doors shall have the Sound Transmission Class (STC) confirmed by test data form a recognized licensed laboratory.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Ensure all doors are installed to be airtight to manufacturer’s standards.

.2 Set frames plumb, square, level and at correct elevation.

.3 Secure anchorage and connections to adjacent construction. Where standard anchors cannot be used, provide special concealed anchors to ensure proper installation.

.4 Brace frame rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.

.5 Exterior frames and frames of acoustic doors are to be insulated with polyurethane foam prior to installation.

.6 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.7 Isolate installed frames from contact with dissimilar material to prevent electrolytic corrosion.

.8 Install doors and hardware in accordance with hardware templates and Manufacturer's instructions.

.9 The door shall remain still when open in any position.

.10 Adjust operable parts for correct function.

.11 Properly clean and touch up doors and frames with primer where galvanized finish damaged during installation.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

.1 Supply door hardware for this project, complete with templates, installation instructions, screws, expansion shields, anchors and other related accessories.

.2 Refer to the schedule shown on drawings and in Part 2 of this section.

1.2 RELATED SECTIONS

.1 Section 01 00 01 – General Requirements

.2 Section 08 11 00 – Steel Doors and Frames

1.3 REFERENCES

.1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (modular construction) prepared by Canadian Steel Door and Frame Manufacturer's Association.

1.4 REQUIREMENTS REGULATORY AGENCIES

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

1.5 SUBMITTALS – HARDWARE LIST

.1 Submit hardware list in accordance with Section 01 00 01 – General Requirements.

.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

1.6 DISCREPANCIES

.1 Report any discrepancies between the Drawings and the Specifications to the Consultant prior to supply of hardware.

.2 Where fire-rated doors are required, and non-conforming hardware is specified herein, Contractor shall provide hardware that satisfies the fire-rating requirements, at no additional cost to the Owner.

1.7 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for door closers, locksets, door holders and fire exit hardware for incorporation into manual specified in Section 01 00 01 – General Requirements.

.2 Brief maintenance staff regarding proper care, cleaning, and general maintenance.

1.8 EXTRA MATERIALS

.1 Supply two sets of wrenches for door closers, locksets, and fire exit hardware.

1.9 DELIVERY AND STORAGE

.1 Store finishing hardware in locked, clean and dry area.

.2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

PART 2 PRODUCTS

2.1 HARDWARE ITEMS

.1 Only door locksets and latchsets listed on CGSB Qualified Products List are acceptable for use on this project.

.2 Use one manufacturer's products only for all similar items.

2.2 DOOR HARDWARE CODES

All locks to be supplied with Schlage cylinders and keyed to Owner’s requirements.

.1 Code 5 (Interior Single Door – Lockable):

Hinges	CB191 (32D)	114 x 101	NRP	32D	Stanley
Lock Set	D50PD	RHO		626	Schlage
Weatherstrip	W13			AL	KN Crowder
Sweep	W13S			AL	KN Crowder

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

.1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Furnish manufacturers' instructions for proper installation of each hardware component.

.3 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.

.4 Where doorstop contacts door pulls, mount stop to strike bottom of pull.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

.1 Provide all labour, materials and equipment for the supply and installation of the gypsum wallboard shown on the drawings and as necessary to complete the project.

1.2 RELATED SECTIONS

.1 Section 07 90 00 – Sealants

1.3 REFERENCE STANDARDS

.1 Do work in accordance with CAN/CSA relevant standards for Gypsum Board Application.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.

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

.1 ASTM C 1280-09, Standard Specification for Application of Gypsum Sheathing.

.2 ASTM A653/A653M-11, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.

.3 ASTM B633 - 11 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

.4 ASTM C1396M-11, Specification for Gypsum Board.

.5 ASTM C 442M-02(2007), S Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.6 ASTM C 475M-02 (2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.7 ASTM C 840-08, Standard Specification for Application and Finishing of Gypsum Board.

.8 ASTM C 954-07, Specification for Steel Drill Screws for the Application of Gypsum Board.

.9 ASTM C 1178-08, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Package finish materials.

.2 Store materials in protected dry areas. Store gypsum boards flat in piles with edges protected.

.3 Ensure that finish metal members are not bent, dented, or otherwise deformed.

.4 Package fire rated materials with accredited testing laboratory labels attached.

1.5 REGULATORY REQUIREMENTS

.1 Provide fire separations and fire protection exactly as specified in test design specification that validates the specified rating. Verify that work specified in other Sections, as a part of the entire assembly, meets applicable validating test design specification.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Maintain temperature minimum 10°C, maximum 21°C for (48) forty-eight hours prior to and during application of Gypsum boards and joint treatment, and for at least (48) forty-eight hours after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

PART 2 PRODUCTS

2.1 GYPSUM BOARD

.1 Plain: Type X, 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges tapered with round edge.

2.2 FASTENINGS AND ADHESIVES

.1 Nails, screws and staples:

.1 Screws:

.1 For wood: casehardened, Phillips head, drywall screws, with corrosion resistant finish.

.1 #6 x 25 mm for single thickness panel fastening;

.2 #7 x 41 mm for double thickness.

.2 For metal studs and furring: same as above, self-drilling, self-tapping.

.2 Laminating compound: Asbestos-free.

.3 Joint Materials:

.1 Joint Reinforcing Tape: 50 mm wide x 0.25 mm thick, perforated paper, with chamfered edges.

.2 Joint Compounds: Asbestos free, latex resin base possessing good adhesion, mixed with fresh, unadulterated water having no detrimental effect on compounds.

2.3 ACCESSORIES

.1 Casing beads, corner beads, metal and channel trims: to CAN/CGSB-7.1-98, ASTM A 366M, 0.5 mm base thickness, commercial grade sheet steel with ZF275 zinc finish to ASTM A591/ASTM B633, perforated flanges; one piece length per location.

.2 Acoustic sealant: to CGSB 19-GP-21M.

.3 Polyethylene: to CAN/CGSB-5, Type 2.

PART 3 EXECUTION

3.1 ERECTION

.1 Do application and finishing of gypsum board in accordance with ASTM C 840 except where specified otherwise.

.2 Do application of gypsum sheathing in accordance with ASTM C 1280.

.3 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C 840 except where specified otherwise.

.4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.5 Install work level to tolerance of 1:1200.

.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles, fans, ducts, HWT exhaust pipe, and stove hood.

.7 Install furring for gypsum board faced vertical bulkheads within and at termination of ceilings.

.8 Install wall furring for gypsum board wall finishes in accordance with ASTM C 840, except where specified otherwise.

.9 Install furring openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

.10 Install furring duct shafts, beams, columns, pipes and exposed services where indicated.

3.2 GYPSUM BOARD APPLICATION

.1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work is approved.

.2 Apply single layer gypsum board to wood furring or framing using screw fasteners. Maximum spacing of screws 200 mm oc.

.3 Apply single layer gypsum board to concrete and concrete block surfaces, where indicated, using laminating adhesive.

.4 Apply water resistant gypsum board where indicated and in wet areas. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

.5 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, fans, stove hoods, grilles, diffusers, and HWT exhaust pipe in partitions where perimeter sealed with acoustic sealant.

3.3 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm oc using contact adhesive for full length.

.2 Install casing beads at all locations where gypsum board edges are exposed, and specifically:

.1 Around perimeter of suspended ceilings, if exposed;

.2 Where gypsum board butts against surfaces having no trim concealing junction;

.3 Along base of walls where no rubber base (or similar) is used to conceal edge;

.4 Seal all exposed joints with sealant.

.3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.4 Install shadow mould at gypsum board/ceiling juncture. Minimize joints; use corner pieces and splicers.

.5 Construct control joints of preformed units two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.

.6 Provide continuous polyethylene dust barrier behind and across control joints.

.7 Locate control joints at changes in substrate construction at approximate 10 m spacing on long corridor runs at approximate 15 m spacing on ceilings.

.8 Install control joints straight and true.

.9 Construct expansion joints, at building expansion and construction joints. Provide continuous dust barrier.

.10 Install expansion joint straight and true.

.11 Install cornice cap where gypsum board partitions do not extend to ceiling.

.12 Fit cornice cap over partition, secure to partition track with two rows of sheet metal screws staggered at 300 mm oc.

.13 Splice corners and intersections together and secure to each member with (3) three screws.

.14 Install access doors to electrical and mechanical fixtures specified in respective Sections.

.15 Rigidly secure frames to furring or framing systems.

.16 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to Manufacturer's directions and feathered out onto panel faces.

.17 Finish corner beads, control joints and trim as required with (2) two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.18 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.19 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.20 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.21 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instruction.

.22 Mix joint compound slightly thinner than for joint taping.

.23 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.

.24 Allow skim coat to dry completely.

.25 Remove ridges by light sanding or wiping with damp cloth.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 00 01 – General Requirements

1.2 REFERENCES

.1 Master Painters institute (MPI):
  .1 Architectural Painting Specifications Manual.

.2 Society for Protective Coatings (SSPC):
  .1 Systems and Specifications Manual, Painting Manual, Volume Two.

1.3 PRODUCT DATA

.1 If requested, submit product data in accordance with Section 01 00 01 – General Requirements.

1.4 QUALITY ASSURANCE

.1 Retain purchase orders, invoices and other documents to prove that all materials utilized in this contract meet requirements of the specifications. Produce documents when requested by Consultant.

.2 Standard of Acceptance:
  .1 Walls: No defects visible from a distance of 1000 mm at 90º to surface.
  .2 Ceilings: No defects visible from floor at 45º to surface when viewed using final lighting source.
  .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.5 DELIVERY STORAGE AND HANDLING

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Indicate on containers or wrappings:
  .1 Manufacturer's name and address.
  .2 Type of paint.
  .3 Compliance with applicable standard.
  .4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened, and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe Manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store materials and equipment in a well-ventilated area with temperature range 7^0C to 30^0C.

.8 Store temperature sensitive products above minimum temperature as recommended by Manufacturer.

.9 Keep areas used for storage, cleaning, and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.

.10 Provide minimum (1) one fire extinguisher adjacent to storage area.

.11 Remove only in quantities required for same day use.

.12 Fire Safety Requirements.

.1 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use, and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.2 Ventilation:

.1 Provide continuous ventilation during and after application of paint. Run ventilation system (24) twenty-four hours per day during installation; provide continuous ventilation for (3) three days after completion of application of paint.

.3 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.4 Substrate and ambient temperature must be within limits prescribed by manufacturer.

.5 Maintain minimum substrate and ambient air temperature of 5^0C for Alkyd and 7^0C for latex paints. Maximum relative humidity 85%. Maintain supplemental heating until paint has cured sufficiently.

.6 Provide temporary heating where permanent facilities are not available to maintain minimum recommended temperatures.

.7 Apply paint finish only in areas where dust is no longer being generated by related.

.8 Construction operations such that airborne particles will not affect the quality of the finished surface.

.9 Apply paint only when surface to be painted is dry, properly cured and adequately prepared.

1.7 SURFACES TO BE PAINTED

.1 Interior walls and ceiling unless made of factory pre-finished panels.

.2 Structural steel and other metal building components, unless shop pre-finished and painted.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Paint materials for each coating formula to be products of a single Manufacturer.

.2 Low odour products: Whenever possible, select products exhibiting low odour characteristics.

2.2 COLOUR

.1 Submit proposed Colour Schedule to Consultant for approval.

2.3 INTERIOR PAINTING SYSTEMS

.1 Steel Doors and Frames:
.1 MPI System INT 5.3A, Latex, Premium Grade, Gloss Level 2 or 3.

.2 Plywood:
.1 MPI System INT 6.4A, Latex, Premium Grade, Gloss Level 2 or 3.

.3 Gypsum Board:
.1 MPI System INT 9.2A, Latex, Premium Grade, Gloss Level 2 or 3.

.4 Cast-In-Place Concrete
.1 MPI System INT 3.1A, Latex, Premium Grade, Gloss Level 2 or 3.

PART 3 EXECUTION

3.1 GENERAL

.1 Apply all paint materials in accordance with Canadian Standards and Paint Manufacturer’s written application instructions.

3.2 PREPARATION

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, door stops, bath accessories and all other surface mounted fittings and fastenings prior to undertaking any painting operations. Store for re-installation after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 As painting operations progress, place "WET PAINT" signs in occupied areas to approval of Consultant.

3.3 PROTECTION

.1 Protect existing building surfaces not to be painted from paint spatters, markings, and other damage. If damaged, clean and restore such surfaces as directed by Consultant.

.2 Cover or mask floors, windows and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.

.3 Protect items that are permanently attached such as Fire Labels on doors and frames.

.4 Protect factory finished products and equipment.

.5 Protect passing pedestrians, building occupants and the general public.

3.4 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant all damage, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Investigate moisture content of surfaces to be painted and report findings to Consultant. Do not proceed with work until conditions fall within acceptable range as recommended by Manufacturer.

3.5 CLEANING

.1 Clean all surfaces to be painted as follows:

.1 Remove all dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths.

.2 Wash surfaces with solution of T.S.P. bleach and clean warm water using a stiff bristle brush to remove dirt, oil, and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.3 Sand existing surfaces with intact, smooth, high gloss coatings to provide adequate surface preparation.

3.6 SURFACE PREPARATION – METAL

.1 Clean interior new metal surfaces to be painted by: removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with the following:

.1 Hand tool cleaning: SSPC-SP-2.

.2 Power tool cleaning: SSPC-SP-3.

.2 Clean exterior new metal surfaces to be painted by: removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with the following:

.1 Commercial blast cleaning: SSPC-SP-6.

.3 Clean existing metal surfaces to be repainted by: removing loose, cracked, brittle or non-adherent paint, rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with following:

.1 Scrape edges of old paint back to sound material where remaining paint is thick and sound, feather exposed edges.

.2 Commercial blast clean rusted and bare metal surfaces where existing paint system has failed.

.3 Solvent cleaning: SSPC-SP-1.

.4 Commercial blast cleaning: SSPC-SP-6.

.4 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes blowing with clean dry compressed air, or vacuum cleaning.

.5 Touch up shop primer to CGSB 85-GP-10M with primer as specified in applicable section. Touch-up to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas.

.6 Prepare galvanized steel and zinc coated steel surfaces to CGSB 85-GP-16M.

.7 Prepare previously painted steel surfaces exposed normally to dry conditions to CGSB 85-GP-15M.

3.7 MIXING PAINT

.1 Mix ingredients in container before and during use and ensure breaking up of lumps, complete dispersion of settled pigment, and uniform composition.

.2 Thin paint for spraying according to Manufacturer's instructions. If directions are not on container, obtain instructions in writing from Manufacturer and provide copy of instructions to Consultant.

3.8 APPLICATION

.1 Method of application to be as approved by Consultant. Apply paint by brush or roller. Conform to Manufacturer's application instructions unless specified otherwise.

.2 Brush application:

.1 Work paint into cracks, crevices, and corners. Paint surfaces not accessible to brushes by spray, daubers, or sheepskins.

.2 Brush out runs and sags.

.3 Remove runs, sags, and brush marks from finished work and repaint.

.3 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Consultant.

.4 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.5 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.6 Sand and dust between each coat to remove visible defects.

.7 Finish top, bottom, edges, and cutouts of doors after fitting as specified for door surfaces.

3.9 MECHANICAL ELECTRICAL EQUIPMENT

.1 In finished areas: paint exposed conduits, piping, hangers, ductwork, and other mechanical and electrical equipment. Colour and texture to match adjacent surfaces or as specified in finish schedule.

.2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by Manufacturer of equipment.

.3 Do not paint over nameplates.

.4 Paint inside of ductwork where visible behind grilles, registers, and diffusers with primer and one coat of matt black paint.

.5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.6 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.10 FIELD QUALITY CONTROL

.1 Perform visual inspection of finishes in presence of Consultant.

.2 Correct deficiencies as requested by Consultant.

3.11 RESTORATION

.1 Clean and re-install all hardware items that were removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashing on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean.

END OF SECTION

PART 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.2 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.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.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 the Engineer 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.

.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 - Testing, Adjusting and Balancing (TAB) for Plumbing.

.5 Approvals:

.1 Submit 1 copy of draft Operation and Maintenance Manual to the Engineer for approval. Submission of individual data will not be accepted.

.2 Make changes as required and re-submit as directed by the Engineer.

.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 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to all mechanical systems, control systems and low voltage control wiring.

.2 Use different colour waterproof ink for each service.

.3 Make available for reference purposes and inspection.

.8 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for Plumbing, 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 the Engineer for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for Plumbing 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.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Furnish spare parts per equipment manufacturer’s recommendations and instructions.

.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.

1.4 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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

NOT APPLICABLE

PART 3 EXECUTION

3.1 EXAMINATION

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

.1 Inform the Engineer of unacceptable conditions immediately upon discovery.

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

3.2 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with applicable specification Section as required.

.2 Prime and touch up marred finished paintwork to match original as required.

.3 Restore to new condition, finishes which have been damaged.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - 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.

3.4 DEMONSTRATION

.1 Contractor will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

3.5 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest edition including addenda's and supplements)

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

.1 NSF/ANSI 14, Plastic Piping System Components and Related Materials.

.2 ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.

.3 ASME B31.9 – Building Services Piping.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM F1970, Standard Specification for Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems.

.2 ASTM D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).

.3 ASTM D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

.4 ASTM D2467, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

.5 ASTM D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride).

.3 Canadian Standards Associations (CSA)

.1 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications.

.2 ASME A112.14/CSA B125.14, Manually Operated Valves for Use in Plumbing Systems.

.4 National Plumbing Code of Canada (NPC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Ensure materials are new, and free of defects.

.3 Avoid contact between dissimilar metals at all times.

PART 2 PRODUCTS

2.1 GENERAL

.1 Installations shall include all devices, attachments, equipment, components and piping necessary to form a complete working system to code requirements.

VALVES

.2 Refer to the Equipment Schedule for valve types and specifications.

.3 All valves of one type (e.g. gate valves) must be of one manufacturer. Ensure that working pressure, size and manufacturer's name are cast or stamped into the body of each valve.

2.2 DIELECTRIC PIPE FITTINGS /UNIONS

.1 Dielectric fittings factory certified to withstand a minimum of 600 volts on a dry line with no flashover. Unions rated at 1.7 MPa conforming to ANSI B16.39. Flanged fittings rated at 1.2 MPa conforming to ANSI B16.24 (bronze) and B16.42 (iron).

2.3 PIPE SLEEVES AND SEALS

.1 Where piping penetrates below grade walls or floors:

.1 Seal: modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening complete with 316 stainless steel fasteners. Seal elements shall be sized and selected per manufacturer’s recommendations and be suitable for the required fire-resistance rating and anticipated environmental conditions. Standard of acceptance: ‘Link-Seal”.

.2 Sleeve: custom-sized molded HDPE sleeves matched to the mechanical seal dimensions complete with reinforcing ribs, end caps, and integrally formed hollow water stop having a minimum outside diameter 100 mm larger than the diameter of the sleeve itself and allowing 13 mm movement between wall forms to resist pour forces. Standard of acceptance: ‘Century-Line’

.2 Elsewhere: Schedule 40 black steel pipe sleeve.

.3 All sleeves and floor penetrations to be water-tight.

PART 3 EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Provide valves and unions to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.3 Route the piping in such a way to have a clear space required for access and service of equipment.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for safe operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

.3 Ensure that none of the pipework and supports obstruct walkways and access ways. Provide not less than 2.1 m clear headroom under piping, piping insulation and supports.

.4 Keep piping clear of manholes and access openings.

3.3 DIELECTRIC COUPLINGS

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

3.4 PIPEWORK INSTALLATION

.1 Install pipework in complete accordance with applicable Codes and by-laws.

.2 Run piping as indicated on the drawings. Check for interferences and make minor adjustments to routing as required to accommodate possible field interferences. If any field interferences require major changes to piping design or routing, contact the Engineer and after obtaining written authorization make the required changes.

.3 Install exposed piping, and similar items approximately as shown on the drawings, parallel or perpendicular to building lines and as close to the structure as possible.

.4 Install all pipe mounted control devices, such as control valves and switches in such manner they can be reached without using a lifting device.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 American National Taper pipe thread must be used for all thread connections. Remove burrs and chips and ream or file the pipe ends out to size of bore.

.7 Leave not more than 2 threads exposed on threaded joints when made up.

.8 Ream pipes, remove scale and other foreign material before assembly.

.9 Arrange piping to permit flushing.

.10 Support piping as required.

3.5 PLUMBING ISOLATION

.1 Install isolation valves as shown on drawings.

3.6 PIPE GUIDES

.1 Provide alignment guides where required for proper operation of the system.

3.7 PIPE ANCHORS

.1 Provide substantial pipe anchors. Anchors shall be suitably attached to the structure and the pipe to prevent movement.

3.8 PIPE SLEEVES AND SEALS

.1 General: Install where pipes pass through masonry structures, concrete structures, and elsewhere as indicated. Be responsible for maintaining the integrity of the building envelope when making penetrations. Enlist the services of qualified trade(s) to make openings in, and/or repairs to, building envelope.

.2 Sleeve Sizes:

.1 Walls: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.2 Floors: 20 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.3 Sleeve Installation:

.1 Concrete walls, masonry walls, and concrete floors on grade: Terminate flush with finished surface.

.2 Other floors:

.1 Terminate 50 mm above finished floor.

.2 Adjust as necessary to accommodate the requirements of through-penetration fire-stopping systems.

.4 Sealing:

.1 Foundation walls and below grade floors: Waterproof, modular mechanical seal.

3.9 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance as specified in relevant sections of Division 22.

.2 Before start-up, clean interior of piping systems in accordance with requirements as specified in relevant sections of Division 22.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise the Engineer and Owner 48-hours minimum prior to performance of pressure tests. All pressure testing to be in accordance with applicable standards and documented on Contractor’s standard testing forms.

.2 Pipework: Test as specified in relevant sections of Division 22, otherwise test to requirements of ASME B31.9.

.3 Test all piping hydraulically to 1½ times the operating pressure but not less than 860 kPa (125 psi).

.4 Prove piping with less than 14 kPa pressure drop and no visible leakages for a period of 24 hours with a hydraulic test.

.5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or test media.

.6 Conduct tests in presence of the Engineer or designate approved by the Engineer.

.7 Pay costs for testing, repairs or replacement, retesting, and making good. The Engineer to determine whether repair or replacement is appropriate.

.8 Insulate or conceal work only after approval and certification of tests by the Engineer.

3.11 EXISTING SYSTEMS

NOT USED.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest edition including addenda's and supplements)

.1 National Building Code of Canada (NBC).

.2 National Plumbing Code of Canada (NPC).

1.2 GENERAL

.1 TAB means to test, adjust and balance in accordance with requirements of Contract Documents and to do other work as specified.

.2 The TAB company must be a firm specializing in such work, equipped with a full range of calibrated instruments, and experienced in adjustment and operation of mechanical systems.

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Names of personnel proposed to perform TAB to be submitted and approved by the Engineer within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

1.4 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

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

1.6 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, final adjustments and re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with affected systems.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 INSTRUMENTS

.1 Prior to TAB, submit to the Engineer list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for applicable system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to the Engineer, prior to start of TAB work on site.

1.8 SUBMITTALS

.1 Submit to the Engineer, prior to commencement of TAB:

.1 A written description of approach to TAB for each system, written specifically for the project, outlining sequence and procedures for the work. Include relevant information including, but not limited to, location of sensors, balancing valves and test ports, approach to optimizing system setpoints, concerns affecting other trades such as penetration sealing, and possible limitations of specified equipment that may affect TAB. Identify deviations from referenced standards and commonly accepted industry practice.

1.9 PRELIMINARY TAB REPORT

.1 Submit for review and approval by the Engineer, prior to submission of formal TAB report:

.1 Details of instruments used.

.2 Details of TAB procedures employed, if different from procedures submitted earlier.

.3 Calculations procedures.

.4 Preliminary measurements.

1.10 TAB REPORT

.1 Format to be in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit six (6) copies of TAB Report to the Engineer for verification and approval, in English, spiral or cerlox bound with covers, complete with index tabs.

1.11 VERIFICATION

.1 Reported results subject to verification by the Engineer.

.2 Provide manpower and instrumentation to verify up to 30 % of reported results.

.3 Number and location of verified results to be at discretion of the Engineer.

.4 Bear costs to repeat TAB as required to satisfaction of the Engineer.

1.12 SETTINGS

.1 After TAB is completed to satisfaction of the Engineer, return systems and equipment to final operation condition. Lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings covered in anyway and shall be permanent and not easily eradicated.

.1 Set memory stop function on calibrated balancing valves.

1.13 COMPLETION OF TAB

.1 TAB to be considered complete when final TAB Report received and reported approved by the Engineer in writing.

1.14 INSTRUMENT TEST PORTS

.1 Coordinate and utilize permanent test ports as required.

1.15 PLUMBING SYSTEMS – DESIGN INTENT

.1 Arrange a meeting with the Engineer to review design intent for all systems prior to the start of TAB. Obtain all information relevant to TAB work prior, including, but not limited to domestic cold water system supply location and flow rate, pressure reducing valve location and set point.

PART 2 PRODUCTS

NOT APPLICABLE

PART 3 EXECUTION

3.1 GENERAL

.1 Investigate all problems and resolve with the contractor's help, to ensure all values are within range. Obtain direction from the Engineer when necessary.

3.2 PRE-TAB REVIEW

.1 Review contract documents and submit documentation specified below in writing to the Engineer prior to the installation of any systems that will require TAB.

.2 Arrange and attend a meeting with the Engineer and appropriate trades to review and discuss adequacy of provision for TAB and other aspects of design and installation pertinent to success of TAB.

.3 Review proposed location of sensors, balancing valves and test ports with other trades to confirm that locations are suitable for TAB equipment and will permit repeatable measurements to permit recalibration on the control’s sensors.

.4 Confirm in writing to the Engineer adequacy of provisions for TAB.

.5 Review specified standards and report to the Engineer in writing all proposed procedures that vary from standard.

3.3 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere.

3.4 OPERATION OF SYSTEMS DURING TAB

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

3.5 START OF TAB

.1 Notify the Engineer 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.1 Construction affecting TAB.

.2 All pressure, leakage, other tests specified.

.3 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of plumbing and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Water treatment systems complete, operational.

3.6 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Balance water systems to within 10% of the quantities shown on the drawings for each component, and to within 5% of design requirements for the overall system.

.2 Check all change orders and clarifications to ensure current information is utilized.

3.7 ACCURACY TOLERANCES

.1 Measured values to be accurate to within 2 % of actual values.

3.8 VERIFICATION OF CONTROLS SYSTEMS

.1 TAB contractor shall assist in verification, demonstration and calibration of the plumbing controls systems, specified under Division 22.

.2 Perform measurements at test ports to confirm calibration of controls sensors, including temperature and pressure, and report on measured versus sensed values.

3.9 PLUMBING SYSTEMS

.1 Do TAB of systems, equipment, components, controls as required to satisfy systems performance.

.2 Quality assurance: Perform TAB under direction of the project supervisor.

.3 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rates, pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, current draw, noise, vibration.

.4 Locations of equipment measurement: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of pressure reducing valves, control valves, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.5 For All Pumps:

.1 Horsepower as determined by voltage and current measurements in all phases.

.2 Pressure difference and flow rate.

.3 Nameplate data.

.4 Verify pump rotation and shut-off head.

.5 Pump curve with operating design and shut-off conditions shown.

.6 For Control Stations and Pressure Reducing Valves:

.1 Set to ensure desired pressure or flow rating.

.7 Flow Meters and Balancing Valves

.1 Nameplate data.

.2 Primary and converted readings for each condition.

.3 Description, including service and location.

3.10 SCHEDULE

.1 Schedule the balancing to suit the progress of the work. Make every attempt to complete the work, or at least the affected local work, prior to occupancy or partial occupancy.

.2 In phased projects, complete the work in each phase, as it is completed. Make final checks and corrections as required to all phases at the completion of the entire project.

3.11 FINAL ADJUSTMENT

.1 Allow for a final adjustment, as directed by the Engineer. Revise the reports accordingly.

3.12 POST-OCCUPANCY TAB

.1 Participate in systems checks twice during Warranty Period – first visit approximately three (3) months after acceptance and second visit within one (1) month of termination of Warranty Period.

.2 Start-up and Commissioning: upon completion and after final cleaning, start-up and commission fans in accordance with manufacturer's printed instructions and Section 01 00 01 General Requirements.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest editions including addenda's and supplements)

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)

.1 NSF/ANSI 14, Plastic Piping System Components and Related Materials.

.2 ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.

.3 ASME B31.9 – Building Services Piping.

.2 American Society for Testing and materials (ASTM)

.1 ASTM F1970, Standard Specification for Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems.

.2 ASTM D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).

.3 ASTM D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

.4 ASTM D2467, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

.5 ASTM D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride).

.3 Canadian Standards Associations (CSA)

.1 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications.

.2 ASME A112.14/CSA B125.14, Manually Operated Valves for Use in Plumbing Systems.

.4 National Plumbing Code of Canada.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 00 01 General Requirements.

PART 2 PRODUCTS

2.1 PIPING

.1 Domestic cold system, within building.

.1 PVC water pipe Schedule 80 per ASTM D1785, CSA B137.3.

2.2 FITTINGS

.1 Fittings shall conform to ASTM D 2467, CSA B137.3.

2.3 JOINTS, UNIONS AND COUPLINGS

.1 For valve threaded joints: ULC certified sealant.

.2 Weld-On joints: solvent cement.

.3 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

.4 Connection between dissimilar material: adapters compatible with materials of both piping systems.

.5 PVC joint unions for solvent weld PVC piping to 1035 kPa (150 PSI).

2.4 BALL VALVES

.1 As specified in Equipment Schedule.

2.5 GATE VALVES

.1 As specified in Equipment Schedule.

2.6 SOLENOID VALVES

.1 As specified in Equipment Schedule.

2.7 HOSE BIBBS

.1 As specified in Equipment Schedule.

PART 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with National Plumbing Code.

.2 Install pipe work in accordance with Section 22 05 02 - Installation of Pipework – Plumbing.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.5 Install wall anchored stainless steel brackets/clamps for PVC piping with spacing as required.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with ball valves.

3.4 PRESSURE TESTS

.1 Conform to requirements of Section 22 05 00 - Common Work Results for Plumbing.

.2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa (125 psi).

3.5 FLUSHING AND CLEANING

.1 Flush entire system. 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.

3.6 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

3.7 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for the Engineer’s approval.

3.8 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.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish water flow and ensure that air is eliminated from the system.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.4 Rectify start-up deficiencies.

END OF SECTION

PART 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.2 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.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.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, the Engineer 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 components.

.5 Description of actions to be taken in event of equipment failure.

.6 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 time required to complete a task.

.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 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit 1 (one) copy of draft Operation and Maintenance Manual to the Engineer for approval. Submission of individual data will not be accepted.

.2 Make changes as required and re-submit as directed by the Engineer upon review.

.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 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Use different colour waterproof ink for each service.

.3 Make available for reference purposes and inspection.

.8 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB) 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 Engineer 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.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Furnish spare parts per equipment manufacturer’s recommendations and instructions.

.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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

NOT APPLICABLE

PART 3 EXECUTION

3.1 EXAMINATION

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

.1 Inform the Engineer of unacceptable conditions immediately upon discovery.

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

3.2 PAINTING REPAIRS AND RESTORATION

.1 Do painting to match existing station coatings.

.2 Prime and touch up marred finished paintwork to match original as required.

.3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

.1 Clean interior and exterior of all systems including strainers.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Section 01 00 01 General Requirements.

.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.

3.5 DEMONSTRATION

.1 The Engineer will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

3.6 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

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

1.2 REFERENCES

(All Codes, Standards and Regulations shall be per latest editions including addenda's and supplements)

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.2 The City of Winnipeg, Water and Waste Department, Identification Standard.

1.3 SUBMITTALS

.1 Product data to include paint colour chips, other products specified in this section.

.2 Samples:

.1 Samples to include nameplates, labels, tags, lists of proposed legends.

.3 Submit fabrication shop drawings as soon as possible, allowing ample time for review, fabrication and installation.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Follow the requirements in Section 01 00 01 General Requirements.

PART 2 PRODUCTS

2.1 PAINT MATERIALS

.1 To match existing across the station as required.

2.2 PIPING SYSTEMS GOVERNED BY CODES

.1 NOT USED

2.3 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.

.3 Provide on each piece of equipment. Include registration plates as required by respective agency and as specified.

.4 Do not apply insulation or paint over plates.

2.4 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

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

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment across the Plant: use size # 9.

2.5 EQUIPMENT IDENTIFICATION FOR PREVENTATIVE MAINTENANCE:

.1 All equipment that requires preventative or scheduled maintenance shall have an identification plate screwed or riveted to it.

.2 For hot equipment, identification plate shall be engraved brass or bronze plate with engraved characters filled with black paint.

.3 For other equipment, identification plate shall be laminated phenolic plastic with black face and white letters engraved.

.4 Minimum letter or character size: 3/8” (10 mm).

.5 The following information shall appear on each identification plate:

.1 Equipment Number and Name

.2 Equipment Code Number.

.6 Prior to fabrication of identification plates, submit list for approval of wording and fabrication details (letter, size, colour, etc.). This list shall include the following for each proposed identification plate:

.1 Proposed Equipment Number and Description.

.2 Permanent Location of the Equipment.

.7 Vibration isolation devices do not require lamacoid identification.

.8 All pumps, tanks, safety and relief valves, and pressure reducing valves, require lamacoid identification.

.9 Confirm permanent building and location codes with the Engineer prior to submittal of lists.

.10 After identification plate installation, insert typewritten directory listing equipment name, description, area(s) served and equipment code number into each Operating and Maintenance manual.

2.6 EXISTING IDENTIFICATION SYSTEMS

.1 NOT USED.

2.7 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, to 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˚C and intermittent temperature of 200˚C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Engineer.

.2 Colours for legends, arrows: to following table:

Background colour:	**Legend, arrows:**
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	**Background colour marking**	**Legend**
Domestic cold water supply	Green	DOM. CWS

2.8 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: black, or coordinated with base colour to ensure strong contrast.

2.9 VALVES, CONTROLLERS

.1 All valves shall be tagged and identified, excluding fixture stop valves located adjacent to fixtures and drain valves that are not piped to drain (either directly or indirectly). All balancing valves are to be tagged.

.2 Provide brass tags with 12 mm stamped identification data filled with black paint identifying each valve. Identification to meet ANSI 13.1 and ANSI 535 standards for labelling equipment and valve tagging.

.3 Add the following information to balancing valve tags, if applicable:

.1 Valve final setting position.

.2 Date of adjustment.

.3 Company and name of individual who made adjustment.

.4 Prepare complete valve directory listing all valve codes and identifying all areas that are served or controlled downstream of each valve (i.e. what each valve shuts off).

.5 Prepare corresponding drawings illustrating each valve location and corresponding valve code. 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, and location.

.6 Provide a copy of the final valve directory and corresponding drawings in each Operations and Maintenance Manual.

2.10 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system data where applicable including point name and ID number, equipment type, setpoint and range, function and (where appropriate) fail-safe position.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

.3 Provide printed cards, laminated with heavy plastic both side, and secure using nylon tags.

2.11 LANGUAGE

.1 Identification in English.

PART 3 EXECUTION

3.1 GENERAL

.1 Before starting work, obtain written approval of identification system from the Engineer.

.2 Provide identification only after all painting specified in Division 09 has been completed.

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

.4 Provide ULC and/or CSA registration plates as required by respective agency.

.5 All identification work shall be 100% complete prior to commissioning.

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 INSTALLATION

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

3.4 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 PVC PIPE

.1 Locations:

.1 To facilitate easy reading and identification from operating floor.

.2 Protection:

.1 Do not paint, insulate or cover.

3.6 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in the pump areas: 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.

3.7 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 the Engineer. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.8 PAINTING AND IDENTIFICATION

.1 Do not paint pre-finished surfaces or brass.

.2 Do not paint non-ferrous and chrome-plated surfaces, stainless steel, aluminum, plastic, glass and pre-finished surfaces, unless directed otherwise by the Engineer.

.3 Prepare all canvas or canvas-like surfaces with one coat (2 mil dry thickness) of a premium quality latex primer-sealer prior to application of two finish coats of paint. In all finished areas, prepare, prime and paint all exposed conduit to match the colour and finish coating of adjacent surfaces (environment) or as directed by the Engineer.

.4 In architecturally unfinished areas, where mechanical lines are normally not painted, colour code lines with minimum 300mm long solid colour band at maximum 6 m intervals, at inlet and outlet points, before and after barriers and equipment, beside all valves and on each line at every access door. Identification markings (fluid service code identification stencil and directional arrow) shall be painted onto every band such that markings are visible and obvious to a viewer.

3.9 NAMEPLATES AND IDENTIFICATION PLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide on hot and/or insulated surfaces.

.3 Protection

.1 Do not paint, insulate or cover in any way.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Testing, Adjusting and Balancing (TAB) means to test, adjust and balance systems to perform in accordance with requirements of Contract Documents and to do all other work as specified in this Section.

1.2 RELATED SECTIONS

.1 Section 01 00 01 General Requirements.

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Prior to TAB, names of all personnel it is proposed to perform TAB to be submitted to and approved by the Engineer.

.2 Provide documentation confirming qualifications, successful experience.

1.4 PURPOSE OF TAB

.1 Test to verify proper and safe operation of equipment and to determine quantitative performance of equipment.

.2 Adjust and regulate the specified flow rates and air patterns at the terminal equipment.

.3 Balance to proportion flows within the distribution systems in accordance with specified design quantities and objectives.

1.5 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes and standards to be to satisfaction of authorities having jurisdiction.

1.6 CO-ORDINATION

.1 Schedule time required for TAB (including allowance for repairs and re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently, and subsequently, where interlocked with other systems, in unison with those systems.

1.7 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to the Engineer adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to the Engineer in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturers unless specified otherwise.

1.9 OPERATION OF SYSTEMS DURING TAB

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

1.10 START OF TAB

.1 Notify the Engineer ten (10) days prior to start of TAB.

.2 Start TAB when building is essentially complete, including:

- .1 Installation of doors, windows and other construction affecting TAB.
- .2 Application of door gaskets, weather stripping, sealing and caulking.
- .3 All pressure and other tests specified elsewhere in Contract Documents.
- .4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB, including but not limited to:

- .1 Proper thermal overload protection in place for electrical equipment.
- .2 Air systems:
  - .1 Filters in place, clean.
  - .2 Duct systems clean.
  - .3 Correct fan rotation.
  - .4 Volume control dampers installed and open.
  - .5 Access doors installed and closed.
  - .6 All outlets installed, volume control dampers open.

1.11 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

- .1 Air handling systems: plus or minus 5%.

1.12 ACCURACY TOLERANCES

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

1.13 INSTRUMENTS

.1 Prior to TAB, submit to the Engineer list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of referenced standards.

.3 Calibrate within three (3) months of TAB. Provide certificate of calibration to the Engineer.

1.14 SUBMITTALS

.1 Submit, prior to commencement of TAB, proposed methodology and procedures for performing TAB, if different from referenced standards.

1.15 PRELIMINARY TAB REPORT

.1 Submit for checking and approval by the Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculation procedures.

.4 Summaries.

1.16 TAB REPORT

.1 Format to be in accordance with referenced standards.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit three (6) copies of TAB Report to the Engineer for verification and approval, in D-ring binders, complete with index tabs.

1.17 VERIFICATION

.1 All reported results subject to verification by the Engineer.

.2 Provide manpower and instrumentation to verify up to 30 percent of reported results.

.3 Number and location of verified results to be at discretion of the Engineer.

.4 Bear costs to repeat TAB as required to satisfaction of the Engineer.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of the Engineer, 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. Markings not to be eradicated or covered in any way.

1.19 COMPLETION OF TAB

.1 TAB to be considered complete only when final TAB Report received and approved by the Engineer.

1.20 AIR SYSTEMS

.1 Standard: TAB to be to standards of AABC or NEBB.

.2 Do TAB of all systems, equipment, components and controls shown on the drawings.

.3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified by AABC or NEBB.

.5 Measurements to include, but not be limited to, following as appropriate for systems, equipment, components and controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage.

.6 Locations of equipment measurements to include, but not be limited to, following as appropriate:

.1 Inlet and outlet of each damper, filter, fan or other equipment causing changes in conditions.

.2 At each controller and controlled device.

.7 Locations of system measurements to include, but not be limited to, following as appropriate: each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).

PART 2 PRODUCTS

NOT APPLICABLE

PART 3 EXECUTION

NOT APPLICABLE

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest edition including addenda's and supplements)

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.2 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.3 ASTM C921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CGSB 51.53, Poly Vinyl Chloride Jacketing Sheet for Insulated Pipes, Vessels and Round Ducts.

.3 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 DEFINITIONS

.1 For purposes of this Section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 Insulation systems - insulation materials, fasteners, jackets and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork.

.2 CRF: Code Rectangular Finish.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Product Data:

.1 Submit manufacturer's shop drawings, instructions, printed product literature and data sheets. Indicate the following:

.1 Manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

.1 Installation instructions to include procedures to be used, installation standards to be achieved.

.2 Material “K” value, temperature rating, density, finish, thickness for each individual service.

1.4 PERFORMANCE CERTIFICATION

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to test codes and standards.

.2 Provide confirmation of testing

1.5 QUALIFICATIONS

.1 Installer to be specialist in performing work of this Section, have at least three (3) years of successful experience in this size and type of project, and be a member, in good standing, of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 00 01 General Requirements and manufacturer's written instructions.

.2 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.

.2 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 TIAC Code C-1: rigid glass fibre board (96 kg/m3 density) to ASTM C612 with foil-scrim-kraft (FSK) factory applied vapour retarder jacket (as scheduled in PART 3 of this Section) to CGSB 51-GP-52Ma having a minimum puncture resistance of 25 Beach Units. On curved surfaces score to suit radius of curve.

.1 Acceptable material: Knauf Insulation Board.

.2 TIAC Code C-2: glass fibre blanket (16 kg/m3 density) to ASTM C553 with foil-scrim-kraft (FSK) factory applied vapour retarder jacket (as scheduled in PART 3 of this Section) to CGSB 51-GP-52Ma having a minimum puncture resistance of 40 Beach Units.

.1 Acceptable material: Knauf Commercial Duct Wrap.

2.3 JACKETS

.1 Canvas (on concealed and exposed duct located in building interior): ULC listed, 220-gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.1 Lagging adhesive: compatible with insulation.

.2 Aluminum (on duct located in building exterior):

.1 To ASTM B209.

.2 Thickness: 0.41-mm sheet.

.3 Finish: smooth.

.4 Jacket mechanical seals: 19-mm wide, 0.5-mm thick, type 304 stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive: water based, fire retardant type, compatible with insulation.

.2 Indoor vapor retarder finish: vinyl emulsion type acrylic, compatible with insulation.

.3 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.

.4 Contact adhesive: quick-setting.

.5 Canvas adhesive: washable.

.6 Fasteners: 4 mm diameter pins with 35 mm square clips, 2 rows each side, length to suit thickness of insulation.

PART 3 EXECUTION

3.1 PREINSTALLATION REQUIREMENTS

.1 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's printed instructions and this specification.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.4 Hangers, supports: apply high-compressive strength insulation where insulation may be compressed by weight of ductwork.

.5 Fasteners: at 300 mm o.c. in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULLATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular outdoor air intake ducts	C-1	Yes	50
Rectangular relief air hoods	C-1	No	50
Rectangular relief air ducts	C-1	Yes	50
Round and rectangular exhaust air ducts	C-2	Yes	50
Round and rectangular heating air supply ducts	C-2	Yes	50
Return air ducts exposed to room air temperature (space being served)	None, unless noted otherwise		

.2 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed	CRF/1	CRD/1
Outdoor	CRF/3	n/a

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials, design, installation, programming and testing for the controls for the building heating and ventilation systems and equipment.

.2 All HVAC controls and systems to be installed by a qualified controls contractor and shall operate as per the sequence of operation identified in this specification. Contractor is required to provide a complete and working system to the satisfaction of the Engineer and Owner.

.3 Contractor to provide as-built control system drawings and complete operational and troubleshooting manuals for the final HVAC system configuration. Commissioning to be completed by the control's contractor.

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature, specifications and data sheets. Include product characteristics, performance criteria and limitations.

.3 Operating and Maintenance Data:

.1 Submit manufacturer's printed operating and maintenance data for incorporation into manual specified in Section 01 00 01 General Requirements.

1.3 STANDARDS

.1 All equipment and devices associated with electrical installation, wiring, communication, detections, alarms, controls, contacts, interlocks, etc. shall be installed per applicable Standards, Codes, Authority Having Jurisdiction including Canadian Electrical Code.

.2 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to specified requirements.

.3 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.4 All equipment electrical enclosures must have NEMA 4X rating.

.5 All wiring shall be installed in rigid conduit as required.

1.4 QUALITY ASSURANCE

.1 Use system suppliers with following qualifications:

.1 Project experience of at least 5 years, staffed by trained personnel capable of providing instruction, routine maintenance, and emergency service on systems.

.1 Provide record of successful installations performed with similar computer-based systems.

.2 Access to local supplies of essential parts and provide 3-year guarantee of availability of spare parts after obsolescence.

1.5 SYSTEM INSTALLATION

.1 Provide and install all devices, control systems, low and line voltage control devices wiring, conduit, transformers, contactors, switches, and hardware required to control the heating and ventilation systems as described on the drawings and the sequence of operation described in this specification, for fully operational HVAC systems.

.2 Supply sufficient programmable controllers of all types to meet project requirements. Quantity and points contents to be approved by the Contract Administrator prior to installation.

.3 Location of HVAC controllers to be approved by the Contract Administrator prior to installation.

1.6 LANGUAGE

.1 Operator to interface to system in English through operator selectable access codes.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 00 01 General Requirements and manufacturer's written instructions.

.2 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.

.2 Store and protect materials from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 GENERAL

.1 The term "provide" means to supply, install, calibrate and wire all items required to make the systems function in the desired manner.

.2 Provide the Controllers for the station HVAC systems and equipment to meet the requirements of the sequence of operation and as shown on drawings.

.3 Provide all devices including but not limited to, thermostats, timers, sensors, alarms, mounting hardware, controllers, actuators, switches, interfacing controls and enclosures required to provide complete and functional systems.

.4 Provide all controllers from one manufacturer.

.5 Mount controllers on the wall in steel cabinets.

.6 Use controllers that are capable of accepting multiple analogs and multiple inputs and that can generate a minimum required programmable discrete and minimum required programmable analog outputs.

.7 Provide for all planning and programming of the controllers via operator interfaces molded as part of the controllers. Provide operator interfaces with minimum 16-character single line LCD display, operator function keys and adjustable display contrast.

.8 Use controllers with an EPROM based system for retention of the program and set points in the event of a power failure.

.9 The HVAC Control panel is supplied by the HVAC controls contractor and shall be interlocked with a station main programmable logic controller (PLC) including communicating alarm signals as required.

.10 Acceptable material: Siemens, Honeywell, Johnson.

2.2 FOR ELECTRIC UNIT HEATERS UH-L65, UH-L75, UH-L76, UH-L77, UH-L78

.1 Controlled by remote line voltage thermostats, NEMA 4X rated.

.2 Unit disconnection switch for local shutoff.

.3 The unit heater controls shall be directly connected to MCC (located on the main floor) without interconnection with HVAC control panel.

2.3 MAIN FLOOR/DRYWELL AND EQUIPMENT SEQUENCE OF OPERATION

.1 Indoor air temperature design conditions:

- Occupied (mode is activated by the room light switch): summer 30°C, winter 20°C. Ventilation (summer and winter): 6 air changes per hour (ACH), corresponding to 100% outdoor air supply (pre-heated in winter).
- Unoccupied: summer 30°C, winter 10°C. Ventilation (summer and winter): 75% of re-circulating air, with 25% outdoor air supply (pre-heated in winter).

.2 A new HVAC control panel shall be installed on the interior wall, controlling:

- the supply air volume, velocity, temperature, statis pressure, filter status;
- the exhaust air volume, velocity, static pressure;
- the re-circulation air volume, velocity, temperature, static pressure;
- air supply and exhaust fans SF-F61, EF-A63 status;
- differential pressure between the main floor and drywell, and wetwell;
- control dampers SD-A68, SD-A70, RD-A71 status;
- exhaust control damper ED-A93 status.
- Alarms.

.3 The space cooling ventilation is provided by: the outdoor air supply through motorized On/Off actuated damper SD-A73 and the exhaust fan EF-A64 per following controls:

- When the space air temperature reaches 30°C (controlled by a wall mounted space temperature sensor with a transmitter), SD-A73 is

energized to fully Open position through Open/Close electric actuator. A time delay shall be applied prior to EF-A64 to start to avoid creating vacuum in the room, which might cause the air supply damper difficult to open.

- After SD-A73 is fully open, exhaust fan EF-A64 starts and continues to run until the room air temperature drops to 27°C.
- When the room air temperature reaches desired setting point utilizing a dual setpoint temperature switch, EF-A64 turns Off, and SD-A73 is closed.
- The space temperature sensor, SD-A73 electric actuator, EF-A64 shall be interconnected through MCC with no connection to HVAC control panel.
- The EF-A64 fan motor shall be connected via 120 VAC to the full voltage non-reversing (FVNR) motor starter.

.4 The space mechanical ventilation is provided by: the outdoor air supply motorized damper SD-A68, supply fan SF-F61, exhaust fan EF-A63, re-circulating damper RD-A71 per following controls.

.1 Unoccupied Mode (the station light switch is turned OFF):

- The outdoor air supply volume control damper SD-A68 is partially open allowing 25% of the outdoor air supply through modulating electric actuator. In winter the outdoor air will be pre-heated by an electric in-duct heater HCE-A66. The duct heater controller shall be incorporated into HVAC control panel and will be automatically controlled based on the desired mode and also, could be adjusted manually, and through a timer switch at the HVAC control panel.
- In case of power outage, SD-A68 is returned to closed position.
- The supply fan SF-F61 is always ON, running continuously providing required air supply at the required rate into the main floor and flood station drywell spaces via a round air supply ductwork.
- The return air damper RD-A71 is open via Open/Close position electric actuator, allowing 75% of the supplied air to be re-circulated back through the system via SF-F61.
- Exhaust fan EF-A63 is ON running on the controlled speed via a dual speed Vari-green drive interconnected with the exhaust control damper ED-A93, relieving 25% of the supplied air to outdoors via the return duct. EF-A63 is equipped with backdraft damper.
- The air supply damper SD-A70 equipped with Open/Close position electric actuator is normally Open (N.O.).
- If the differential pressure transmitter indicates the main floor space air pressure below positive pressure setting point, the supply damper SD-A70 is closed, providing the air supply into the main floor space at the higher rate to pressurize the room as required. When differential pressure switch readings return to the normal desired values, the supply damper SD-A70 fully opens,

and the system returns to normal operation. If differential pressure reading keeps falling below desired settings point, the alarm shall be activated through HVAC control panel indicating the spaces lack of barrier seal.

.2 Occupied Mode (activated by the station light switch):

- The outdoor air supply volume control damper SD-A68 is fully open allowing 100% of the outdoor air supply through modulating electric actuator. In winter the outdoor air will be pre-heated by an electric in-duct heater HCE-A66. The duct heater controller shall be incorporated into HVAC control panel and will be automatically controlled based on the mode and also, could be adjusted manually, and through a timer switch at the HVAC control panel.
- The supply fan SF-F61 is always ON, running continuously providing required air supply at the required rate into the main floor and drywell spaces via a round air supply ductwork.
- The return air damper RD-A71 is closed via Open/Close position electric actuator.
- Exhaust fan EF-A63 is ON running on the controlled speed via a dual speed Vari-green drive interconnected with the exhaust control damper ED-A93, relieving 100% of the supplied air to outdoors via the return duct. EF-A63 is equipped with a backdraft damper.
- The air supply damper SD-A70 equipped with Open/Close position electric actuator is normally Open (N.O.).
- If the differential pressure transmitter indicates the space air pressure below positive pressure setting point, the supply damper SD-A70 is closed, providing the air supply into the main floor space at higher rate to pressurize the room as required. When differential pressure switch readings return to normal desired reading, the supply damper SD-A70 fully opens, and the system returns to normal operation. If differential pressure reading keep falling below desired settings point, the alarm shall be energized through HVAC control panel indicating the spaces lack of barrier seal.

2.4 COMMINUTOR CHAMBER, LIFT STATION SPACES AND EQUIPMENT SEQUENCE OF OPERATION

.1 Indoor air temperature design conditions:

- Occupied (mode is activated by the station light switch): summer – not controlled, winter 10°C. Ventilation (summer and winter): 6 ACH, corresponds to 100% outdoor air supply (pre-heated in winter).
- Unoccupied: summer – not controlled, winter 10°C. Ventilation (summer and winter): 75% of re-circulating air, with 25% outdoor air supply (pre-heated in winter).

.2 A new HVAC control panel shall be installed on the interior wall, controlling:

- the supply air volume, velocity, temperature, statis pressure;

- the exhaust air volume, velocity, static pressure;

- the re-circulation air volume, velocity, temperature, static pressure;

- air supply and exhaust fans SF-F62, EF-A63 status;

- control dampers SD-A69, RD-A72 status;

- exhaust control damper ED-A93 status.

- Alarms.

.3 The spaces mechanical ventilation is provided by: the outdoor air supply motorized damper SD-A69, supply fan SF-F62, exhaust fan EF-A63, re-circulating damper RD-A72 per following controls.

.1 Unoccupied Mode (the comminutor chamber light switch is OFF):

- The outdoor air supply volume control damper SD-A69 is partially open allowing 25% of the outdoor air supply through a modulating electric actuator. In winter the outdoor air will be pre-heated by an electric in-duct heater HCE-A67. The duct heater controller shall be incorporated into HVAC control panel and will be automatically controlled based on the mode and also, could be adjusted manually, and through a timer switch at the HVAC control panel.
- In case of power outage, SD-A69 is returned to closed position.
- The supply fan SF-F62 is always ON, running continuously providing required air supply at the required rate into comminutor chamber, lift station motor room and lift station drywell via a round air supply ductwork.
- The return air damper RD-A72 is open via Open/Close position electric actuator, allowing 75% of the supplied air to be re-circulated back through the system via SF-F62.
- The exhaust fan EF-A63 is ON running on the controlled speed via a dual speed Vari-green drive interconnected with the exhaust damper ED-A93, relieving 25% of the supplied air to outdoors via the return duct. EF-A63 is equipped with backdraft damper.

.2 Occupied Mode (activated by the station light switch):

- The outdoor air supply volume control damper SD-A69 is fully open allowing 100% of the outdoor air supply through a modulating electric actuator. In winter the outdoor air will be pre-heated by an electric in-duct heater HCE-A67. The duct heater controller shall be incorporated into HVAC control panel and will be automatically controlled based on the mode and desired adjustable settings, and also could be adjusted manually, and through a timer switch at the HVAC control panel.
- The supply fan SF-F62 is always ON, running continuously providing required air supply at the required rate into comminutor chamber, lift station motor room and lift station drywell via a round air supply ductwork.
- The return air damper RD-A72 is closed via Open/Close position electric actuator.
- The exhaust fan EF-A63 is ON running on the controlled speed via a dual speed Vari-green drive interconnected with the exhaust

damper ED-A93, relieving 100% of the supplied air to outdoors via the return duct. EF-A63 is equipped with backdraft damper.

2.5 EXHAUST FAN EF-A63 AND EXHAUST CONTROL DAMPER ED-A93

.1 Exhaust fan EF-A63 is always ON running on the low speed/high speed via a dual speed Vari-green drive, and interconnected with the exhaust control damper ED-A93 equipped with modulating electric actuator. The exhaust system controls are per following:

.1 When the control supply damper SD-A68 is fully open (Occupied Mode for flood station), and control supply damper SD-A69 is fully open (Occupied Mode for comm. chamber and lift station): exhaust control damper ED-A93 is fully open, exhaust fan EF-A63 runs at high speed, exhaust rate 929 L/s.

.2 Control supply damper SD-A68 is fully open (Occupied Mode for flood station), and control supply damper SD-A69 is partially open (Unoccupied Mode for comm. chamber and lift station): exhaust control damper ED-A93 is partially open (approx.. 75% open position), exhaust fan EF-A63 runs at high speed, exhaust rate 716 L/s.

.3 Control supply damper SD-A68 is partially open (Unoccupied Mode for flood station), and control supply damper SD-A69 is fully open (Occupied Mode for comm. chamber and lift station): exhaust control damper ED-A93 is fully open, exhaust fan EF-A63 runs at low speed, exhaust rate 445 L/s.

.4 Control supply damper SD-A68 is partially open (Unoccupied Mode for flood station), and control supply damper SD-A69 is partially open (Unoccupied Mode for comm. chamber and lift station): exhaust control damper ED-A93 is partially open (approx. 55% open position), exhaust fan EF-A63 runs at low speed, exhaust rate 232 L/s.

2.6 SENSORS, DETECTORS AND SWITCHES

.1 Thermostat: manual non-programmable line voltage thermostat, with lockable cover, for heating systems. Compatible with unit heaters. Temperature setting and reading in °C and °F. NEMA 4X rated. ULC listed.

.2 Space temperature sensor: automatic programmable low voltage thermostat, for heating and cooling systems. Backlit display with temperature setting and reading in °C and °F. Compatible with HVAC controllers. Accuracy ± 0.5°C. ULC listed.

.3 In-duct temperature sensor: in-duct temperature sensor, able to transmit the temperature data and changes to the HVAC control system. Equipped with a removable, replaceable sensing tip. Measuring range -35°C to 60°C. Temperature element accuracy ±1°C. Power supply 24V. NEMA 4X housing. ULC listed.

.4 Differential pressure transmitter: refer to equipment schedule for specification.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install and wire control devices.

.2 Provide thermal isolation for thermostats mounted on exterior walls.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by equipment installation.

3.4 TRAINING

.1 Allow for a minimum of eight (8) hours of on-site operation and maintenance training as required. Schedule training session with Owner.

3.5 CLEAN-UP, START-UP AND COMMISSIONING

.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 00 01 General Requirements.

.3 Start-up and Commissioning: upon completion and after final cleaning, start-up and commission systems and equipment in accordance with manufacturer's printed instructions and Section 01 00 01 General Requirements.

.1 Verify that all systems, including all component parts, operate as intended and required, and submit a Commissioning Report to the Contract Administrator.

.2 Refer to Section 01 00 01 General Requirements.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 SMACNA Round Industrial Duct Construction Standards.

.3 SMACNA Rectangular Industrial Duct Construction Standards.

.2 American National Standards Institute (ANSI)/National Fire Protection Association (NFPA)

.1 ANSI/NFPA 90A, Installation of Air-Conditioning and Ventilating Systems.

.2 ANSI/NFPA 90B, Installation of Warm Air Heating and Air-Conditioning Systems.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112, Fire Test of Fire Damper Assemblies.

.2 ULC-S505, Fusible Links for Fire Protection Service.

.4 American Society for Testing and Materials (ASTM)

.1 ASTM B209/B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets. Indicate the following:

.1 Sealants.

.2 Tape.

.3 Proprietary joints.

.3 Maintenance Materials, Special Tools and Spare Parts:

.1 Provide the following: six (6) fusible links of each type for fire dampers.

1.3 PERFORMANCE CERTIFICATION

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to test codes and standards.

.2 Provide confirmation of testing.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 00 01 General Requirements.

.2 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.

.2 Store and protect materials from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 ALUMINUM DUCT

.1 Fabricate all ductwork utilizing type 3003-H14 smooth aluminum sheet and type 6061-T6 aluminum angle for flanges and reinforcing.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered a Class A seal.

.1 Acceptable material: Ductmate Canada Ltd., Exanno Nexus.

.4 All transverse joints in ducts 305 mm or more in width, height or diameter to be flanged type.

2.2 SEAL CLASSIFICATION

.1 Classification as follows: SMACNA Seal Class A.

.2 Seal classification definitions:

.1 Class A: Longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with gaskets or sealant and tape.

.2 Class B: Longitudinal seams, transverse joints and connections made airtight with gaskets or sealant and tape.

.3 Class C: Transverse joints and connections made airtight with gaskets or sealant and tape. Longitudinal seams unsealed.

.4 Class D: Unsealed seams and joints.

2.3 SEALANT

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

.2 Acceptable material: Duro Dyne S-2, Foster 30-02.

2.4 TAPE

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

.2 Acceptable material: Duro Dyne FT-2.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: centreline radius: 1.5 times width of duct unless indicated otherwise.

.2 Round: five-piece, centreline radius: 1.5 times diameter of duct unless indicated otherwise.

.3 Mitred elbows, rectangular: with single thickness turning vanes.

.4 Branches:

.1 Rectangular branch: 45° entry on branch.

.2 Round main and branch: conical entry on branch.

.3 Provide volume control damper in branch duct near connection to main duct.

.5 Transitions:

.1 Diverging: 20° maximum included angle.

.2 Converging: 60° maximum included angle.

.6 Offsets: short radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 FIRESTOPPING

.1 Retaining angles all around sleeve, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

2.7 HANGERS AND SUPPORTS

.1 Hanger configurations:

.1 Rectangular duct: trapeze hanger to SMACNA.

.2 Round duct: band hanger to SMACNA, with top and bottom halves and a hanger rod on each side of duct.

.2 Lower hanger attachments:

.1 Rectangular duct: 6061-T6 aluminum angle with 304 stainless steel rods to SMACNA.

.2 Round duct: 6061-T6 aluminum band with 304 stainless steel rods to SMACNA.

.3 Upper hanger attachments: proprietary manufactured galvanized steel strut channel secured to roof truss bottom chords or supplementary wood framing with galvanized steel lag screws.

.1 Acceptable material: Unistrut, Canstrut.

2.8 HOODS

.1 Anchor securely into opening. Make building/hood interface weather tight all around.

2.9 BALANCING DAMPERS

.1 Multi-bladed opposed blade type of aluminum construction, with maximum 100 mm high blades, self-lubricating nylon bearings, shaft extension with locking quadrant, and channel frame complete with angle stop.

2.10 AIR SUPPLY DAMPERS

.1 Thermally insulated extruded aluminum damper with thermally broken frames and blades.

.2 Opposed action blades for volume control, parallel action blades for open/close position.

.3 Stainless steel linkage hardware.

.4 To be installed according to manufacturer's instructions and recommendations.

.5 AMCA certified rating.

.6 Factory installed Belimo electric actuator with NEMA 4X housing.

2.11 RELIEF AND BACKDRAFT DAMPERS

.1 Automatic gravity operated, multi-leaf type, with extruded aluminum drop-in frame with polyurethane sponge sill seal, 26 gauge single-thickness aluminum blades with felt seals, 4.8 mm diameter galvanized steel axles, self-lubricating heavy duty nylon bearings, and mill finish.

PART 3 EXECUTION

3.1 GENERAL

.1 Do work in accordance with SMACNA, ANSI/NFPA 90A and 90B, and as indicated.

.2 Support risers in accordance with SMACNA.

.3 Do not break continuity of insulation vapour barrier with hangers or rods.

.4 Install breakaway joints in ductwork on each side of fire damper.

.5 Fabricate ductwork in lengths to accommodate installation of duct lining where required.

.6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's printed instructions.

3.2 HANGERS

.1 Coordinate with building framing trade for required supplementary wood framing between roof trusses.

.2 Lag screws: holes pre-drilled to 70 percent of screw diameter and counter-bored to screw diameter for non-threaded shank portion of screw.

.3 Rods: complete with 304 stainless steel locking nuts and washers.

.4 Hanger spacing: in accordance with SMACNA.

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for outdoor air intakes.

.2 Form bottom of horizontal duct without longitudinal seams. Solder joints of bottom and side sheets. Seal all other joints with duct sealer.

.3 Slope horizontal duct down towards intake hood.

3.4 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's printed instructions.

.2 Bed tape in sealant and recoat with minimum of one (1) coat of sealant to manufacturer's printed instructions.

3.5 PROTECTION

.1 Protect installed ductwork from damage during construction.

.2 Repair damage to adjacent materials caused by ductwork installation.

3.6 CLEAN-UP, START-UP AND COMMISSIONING

.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 00 01 General Requirements.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, balancing dampers.

1.2 REFERENCES

.1 All Codes, Standards and Regulations shall be of the latest editions including addenda's and supplements.

.1 Air Movement & Control Association International Inc.

.1 AMCA Standard 500-D, Laboratory Methods of Testing Dampers for Rating.

.2 AMCA Standard 511, Certified Ratings Program for Air Control Devices.

.2 Canadian Standards Association (CSA International)

.1 CAN/ULC-S109M, Standard for Flame Tests of Flame-Resistant Fabrics and Films.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

1.4 PERFORMANCE CERTIFICATION

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to test codes and standards.

.2 Provide confirmation of testing.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 00 01 General Requirements and manufacturer's written instructions.

.2 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.

.2 Store and protect materials from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 GENERAL

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

.2 General: construction and air tightness suitable for duct air velocities and pressure class. The following are minimum requirements. Provide additional features where required to suit the Work.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: 75 mm wide galvanized sheet metal frame, 1.6 mm thick, with fabric clenched by means of double locked seams.

.2 Material:

.1 Indoor application: fire-resistant, self-extinguishing, neoprene-coated glass fabric, temperature rated at -40ºC to +90ºC, 0.63 mm thick, and density of 1.02 kg/m^2. Meets the flame-resistance requirements of CAN/ULC-109M.

.2 Outdoor application: fire-resistant, self-extinguishing, DuPont 'Durolon'-coated glass fabric, temperature rated at -40ºC to +120ºC, 0.61 mm thick, and density of 0.81 kg/m^2.

2.3 SINGLE BLADE DAMPERS

.1 Of same material as duct, but at least one sheet metal thickness heavier.

.2 Size and configuration to recommendations of SMACNA,

.3 Round: frame with stiffening beads, continuous shaft for blades over 200 mm diameter.

.4 Locking quadrant with shaft extension to accommodate insulation thickness.

.5 Inside square end bearing and outside spring-loaded round end bearing.

.6 Vibration-free operation.

2.4 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Parallel-blade configuration for On-OFF operation, metal thickness and construction to recommendations of SMACNA. Insulated blades with dura-blade seals.

.3 Maximum blade height: 150 mm.

.4 Maximum blade length: 1200 mm. Use multi-sectional dampers for applications exceeding 1200 mm.

.5 Bearings: pin in bronze bushings or self-lubricating nylon.

.6 Linkage: shaft extension to accommodate insulation thickness with locking quadrant.

.7 Channel frame of same material as adjacent duct, complete with angle stop.

.8 Vibration-free operation.

2.5 ACCESS DOORS IN DUCTS

.1 Uninsulated 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: 2 sash locks.

.2 301 to 450 mm: 4 sash locks.

.3 451 to 1000 mm: piano hinge and minimum 2 sash locks.

2.6 TURNING VANES

.1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA.

2.7 INSTRUMENT TEST PORTS

.1 1.6 mm thick steel, zinc plated and painted after manufacture.

.2 Camlock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

.5 Acceptable manufacturer: Duro Dyne IP1 or IP2.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install air duct accessories in accordance with recommendations of SMACNA HVAC Duct Construction Standards and manufacturer's instructions.

.2 Provide adequate access for service, adjustment, replacement of all accessories.

.3 Flexible Connections:

.1 Install in following locations:

.1 As indicated on drawings and directed by the Engineer.

.2 Length of connection: 150 mm maximum.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.3 Material does not protrude into the duct.

.4 Balancing Dampers:

.1 Install quadrant handles parallel to damper blade(s).

.2 Splitter dampers shall be used only where approved by the Engineer.

.3 Where damper throttling produces excessive noise provide two dampers, duct baffle, volume extractor, or similar device to reduce noise to an acceptable level.

.4 Locations:

.1 Supply, return and ductwork air systems: in each duct.

.2 As directed by the Engineer and TAB contractor.

.5 All dampers to be vibration-free.

.6 Ensure damper operators are observable and accessible.

.5 Access doors:

.1 Size:

.1 300 x 300 mm minimum for viewing.

.2 Up to 1000 x 1000 mm (as duct size permits) for servicing entry.

.6 Location:

.1 At backdraft dampers.

.2 At locations required by code.

.7 Instrument test ports:

.1 General: install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit testing, adjusting and balancing (TAB) and easy manipulation of instruments.

.3 Install insulation port extensions as required.

.8 Turning vanes: install in accordance with recommendations of SMACNA.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest edition including addenda's and supplements)

.1 American National Standards Institute (ANSI)/Air Movement and Control Association (AMCA)

.1 ANSI/AMCA 99, Standards Handbook.

.2 ANSI/AMCA 300, Reverberant Room Method for Sound Testing of Fans.

.3 ANSI/AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.4 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for fans and fan accessories. Include the following:

.1 Fan performance curves showing point of operation, BHP, kW and efficiency.

.2 Sound rating data at point of operation.

.3 Motor, sheave, bearing, shaft, filter, damper and construction details.

.4 Details of vibration isolation.

.3 Operating and Maintenance Data:

.1 Submit manufacturer's printed operating and maintenance data for fans and fan accessories for incorporation into manual specified in Section 01 00 01 General Requirements.

.4 Maintenance Materials, Special Tools and Spare Parts:

.1 Provide six (6) spare sets of filters and one (1) spare set of belts for each in-duct fan.

.2 Furnish list of recommended spare parts for equipment such as bearings and seals, together with list of specialized tools necessary for adjusting, repairing or replacing.

1.3 PERFORMANCE CERTIFICATION

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to test codes and standards.

.2 Provide confirmation of testing.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section - General Requirements and manufacturer's written instructions.

.2 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.

.2 Store and protect fans from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 INLINE DUCT FANS

.1 For product specifications refer to Drawing – Equipment Schedule.

2.2 SUPPLEMENTARY SUSPENSION STEEL

.1 Upper hanger attachments: proprietary manufactured galvanized steel strut channel secured to roof truss bottom chords or supplementary wood framing with galvanized steel lag screws.

.1 Acceptable material: Unistrut, Canstrut.

2.3 FAN DRIVES WITH SPEED CONTROLS

.1 Fan drives as indicated in the drawing – Equipment Schedule.

.2 Dual speed direct driven fans to have Vari-Green motors unless otherwise indicated on the drawings.

2.4 ACCEPTABLE MANUFACTURERS – SUPPLY AND EXHAUST FANS

.1 Greenheck

.2 Twin City

PART 3 EXECUTION

3.1 INSTALLATION

.1 General:

.1 Install with sufficient clearances to permit performance of fan service, maintenance and repair.

.2 Install in accordance with manufacturer's printed installation instructions.

.3 Provide supplementary suspension steel as required. Coordinate with building framing trade for required supplementary wood framing between roof trusses. Pre-drill lag screw holes to 70 percent of screw diameter and counter-bore to screw diameter for non-threaded shank portion of screw.

.2 In-duct Fans:

.1 Install complete with resilient mountings and flexible electrical lead.

.2 Provide sheave and belt required for final air balance.

.3 Access panel to be readily accessible and removable.

3.2 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by fan installation.

3.3 CLEAN-UP, START-UP AND COMMISSIONING

.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 00 01 General Requirements.

.3 Start-up and Commissioning: upon completion and after final cleaning, start-up and commission fans in accordance with manufacturer's printed instructions and Section 01 00 01 General Requirements.

END OF SECTION

PART 1 GENERALPUMPING

1.1 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for grilles, registers and diffusers. Indicate the following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise generation characteristics.

.4 Pressure drop.

.5 Size.

.6 Neck Velocity.

.3 Operating and Maintenance Materials:

.1 Provide keys for volume and air flow pattern adjustment.

1.2 PERFORMANCE CERTIFICATION

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to test codes and standards.

.2 Provide confirmation of testing.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 00 01 General Requirements and manufacturer's written instructions.

.2 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.

.2 Store and protect grilles, registers and diffusers from nicks, scratches and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 GRILLES, REGISTERS AND DIFFUSERS

.1 For product specifications refer to Drawing – Equipment Schedule.

.2 Grilles, registers and diffusers of the same generic type, shall be products of one manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's printed installation instructions.

.2 Install with oval head stainless steel screws in counter-sunk holes where fastenings are visible.

3.2 PROTECTION

.1 Protect installed products and components from damage during construction.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest editions including addenda's and supplements).

.1 ASTM International

.1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect intakes and vents from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 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 HOODS 45/90 DEGREES

.1 Thickness: to SMACNA.

.2 Fabrication: to SMACNA.

.3 Joints: to SMACNA.

.4 Supports: as indicated.

.5 Complete with integral bird screen of 2.7 mm diameter aluminum wire.

.6 Insect screens as indicated on the drawings.

2.3 FIXED LOUVERS

.1 As per Drawing – Equipment Schedule.

.2 Louvers to be finished with fluoropolymer based resin coating, color to match the building exterior.

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 louvres, intakes and vents 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 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest edition including addenda's and supplements)

.1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.2 CAN/CGSB-115.15, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.

.3 CAN/CGSB-115.18, Filter, Air, Extended Area Panel Type, Medium Efficiency.

.3 Underwriters' Laboratories of Canada (ULC)

.1 ULC -S111, Standard Method of Fire Tests for Air Filter Units.

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC filters and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 00 01 General Requirements.

.2 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.

.3 Spare filters: in addition to filters installed immediately prior to acceptance by the Engineer, supply 1 (one) complete set of filters for each.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 00 01 General Requirements.

.2 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 well-ventilated location, and in accordance with manufacturer's recommendations.

.2 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 GENERAL

.1 Media: suitable for air at 100% RH and air temperatures between -40˚C and +50˚C.

.2 Filters shall be provided and installed to allow easy removal. Filter removal shall be from one side of ductwork.

2.2 COTTON PANEL FILTERS

.1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.

.2 Holding frame: slide in channel for side access.

.3 Performance:

.1 The filter media shall have a minimum efficiency of 80% to ANSI/ASHRAE 52.1, and a minimum of MERV 13 per ANSI/ASHRAE 52.2.

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 filter installation in accordance with manufacturer's written instructions.

.1 Inform the Engineer of unacceptable conditions immediately upon discovery.

.2 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.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

(All Codes, Standards and Regulations shall be of the latest edition including addenda's and supplements)

.1 CSA C22.1 No. 46, Electric Air Heaters

.2 Canadian Electrical Code (Section 62)

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 00 01 General Requirements.

.2 Shop Drawings. Indicate the following:

.1 Physical size and mounting methods.

.2 Layout and wiring diagrams of electric heaters including low voltage controls.

.3 Power rating (Kw), voltage, phase.

.4 Required clearances from combustible materials

.5 Heater construction and finish.

PART 2 PRODUCTS

2.1 GENERAL

.1 All product to be supplied suitable to area classifications as indicated on drawings.

2.2 ELECTRIC UNIT HEATERS

.1 Horizontal discharge complete with adjustable louvers finished to match cabinet.

.2 Fan type unit heaters with built-in high heat limit protection. Liquid tight flex connecting the control enclosure to the motor.

.3 Fan motor: Totally enclosed, permanently lubricated ball bearing type with resilient mount. Built in fan motor thermal overload protection.

.4 Wall or ceiling mounting bracket as required.

.5 Controls: Provide NEMA 4X remote thermostat controls for all unit heaters as indicated, from the same manufacturer as the heater. Provide all necessary control relays, transformers, contactors, wiring, etc. that are required for a functional system.

.6 All spaces:

.2 Epoxy coated cabinet

.3 Finned tubular sheath elements

.4 Balanced aluminum fan blade

.5 Acceptable manufacturers: Ouellet, or approved equal.

2.3 IN-DUCT ELECTRIC HEATER

.1 In-line electric heater shall be flanged connected and installed per manufacturer's instructions and recommendations.

.2 Provide ductwork transitions round to square if required to allow in-duct heater installation.

.3 The heater remote controller shall be interconnected with HVAC Control Panel.

.4 Acceptable manufacturers: Thermolec.

2.4 THERMOSTATS

.1 Provide heater control remote thermostats as required.

.2 Remote control thermostats shall wall mounted and rated 120 VAC for line voltage.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Suspended unit heaters shall be installed at the elevation as shown in Equipment Schedule specification.

.2 Install in accordance with manufacturer's instructions and recommendations.

.3 Provide and install power and controls as required.

3.2 FIELD QUALITY CONTROL

.1 Tests:

.1 Perform tests in accordance with Division 26 - Electrical.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Process and control system proposed scope of work is as follows:

.1 Decommissioning and removal of the existing City of Winnipeg RTU Panel and all process field instruments.

.2 Provision of a new PLC based RTU Panel CP-A81.

.3 Provision of all new process field instruments.

.4 Existing City of Winnipeg CSO (Combined Sewer Outfall) Panel and field instruments to remain. All CSO instruments must be continuously monitored on SCADA during all phases of construction.

.5 Communication with the city SCADA system via DNP3 Protocol over cellular and PSTN. All required DNP3 points must be sent to the city SCADA system.

1.3 DESCRIPTION

.1 This section specifies the General Provisions for the supply, delivery, installation, calibration and commissioning of the process control and instrumentation system, including all control and graphic panels, as specified herein and /or detailed on the drawings.

.2 It is the intention of these specifications and drawings, to provide for a complete and fully operating Control and instrumentation system, including communication with the city SCADA system via DNP3 Protocol. All required DNP3 points must be sent to the city SCADA system. Facilities and services must meet the requirements described herein, and in complete accord with applicable codes and ordinances. The specifications do not purport to cover details entering into the design of the system which shall be the responsibility of the Contractor.

.3 The work to be done shall include the provision of all labour, materials, tools and equipment as well as the application of a competent knowledge of construction, whether or not directly specified or shown on the plans, required for the installation testing and placing into service the complete control and instrumentation system, except when it is specifically mentioned that certain materials and/or labour are not part of the contract.

.4 These specifications shall apply to and govern all trades doing control and instrumentation work and shall be read in conjunction with and form a part of the general specifications of the project.

.5 The Control and Instrumentation work includes but is not limited to the following:

.1 Control Panels – Section 25 30 01.

.2 Programmable Logic Controller (PLC) – Section 25 30 03. PLC system to be programmed to provide the functions as required in Sections 25 30 01, 25 30 03, and 25 30 05 and as specifically detailed in the Process Control Narrative. PLC system to be programmed to provide all required interface and interlocks with Vendor supplied PLC's and equipment.

.3 Primary Elements for the measurement of flow, level, pressure, temperature, etc. – Section 25 30 02.

.4 Send and receive DNP3 points to SCADA as per the control narrative and the DNP3 mapping list. In addition to any additional points required by the city during commissioning and testing.

.5 Indicators and annunciators.

.6 Uninterruptible power supplies (UPS).

.7 Control wiring and conduit.

.8 Factory Acceptance testing – Section 25 01 10.

.9 Automation Commissioning – Section 25 01 11.

.10 Spare Parts & Manuals.

1.4 RELATED WORK

.1 General Requirements Division 1.

.2 Finishes Division 9.

.3 Building Mechanical Division 23.

.4 Electrical Division 26.

.5 Communications Division 27.

.6 Appendices:

.1 Appendix B – I/O List.

.2 Appendix C – Instrument List.

.3 Appendix D – Control Narrative.

1.5 EQUIPMENT MANUFACTURERS

.1 All equipment shall be manufactured by experienced manufacturers who can demonstrate in-use records for all equipment offered.

.2 Requests for approval of alternative suppliers shall be submitted to the Engineer. Refer to Division 1 for information on closeout submittals.

.3 The majority of equipment shall be supplied by a single manufacturer, particularly where aesthetics are of concern, such as in panels.

1.6 CODES PERMITS AND FEES

.1 The work shall comply with the requirements of the current edition of the Canadian Electrical Code Part 1, and all local provincial and municipal rules, laws and ordinances pertaining to the work.

.2 Obtain the required construction permits, arrange for inspections and supply the Engineer with approval certificates pertaining thereto including a certificate of final inspection.

1.7 REFERENCE STANDARDS

.1 Unless otherwise specified, equipment shall conform to appropriate standards and recommendations of:

.1 The American Society of Mechanical Engineers hereinafter referred to as ASME Standards.

.2 The Instrument Society of America hereinafter referred to as ISA.

.3 The Canadian Standards Association hereinafter referred to as CSA.

.2 All equipment shall be metric SI Standard.

1.8 MANUALS

.1 Refer to Division 1 for requirements for Operation and Maintenance Manuals and Electrical General Provisions – Section 26 05 01.

.2 Provide operating and maintenance brochures for all equipment and arrange for their insertion into the Operation and Maintenance Manuals. The brochures shall include all applicable, descriptive and technical data, maintenance and operating procedures, wiring diagrams, spare parts lists, service representatives, and suppliers for replacement parts. The brochures shall be neatly and orderly assembled in binders.

.3 Provide training manual specific to the Water Pumphouse facility. Training manual to contain screen captures of all HMI screens along with text describing the system operation and user interface as it relates to each screen.

.4 Requirements for operation and maintenance of process control and instrumentation equipment shall be as specified in various Sections of Division 26.

1.9 SHOP DRAWINGS

.1 Refer to Division 1 and Electrical General Provisions – Section 26 05 01.

.2 Provide layout drawings of instrument and control panels and schematic diagrams, network diagrams as well as detailed loop drawings of all devices listed in the instrumentation data sheets and any equipment connected to the control system.

.3 The Consulting Engineer's review of shop drawings shall be for general arrangement only and shall not relieve the Contractor from responsibility for errors, proper fitting, construction of the work and furnishing of materials.

.4 Control drawings shall be updated as the work progresses and shall be submitted to the Engineer as Drawings of Record when the work is completed.

.5 Submit shop drawings for the following items:

- .1 Control Panels.
- .2 Panel layout drawings.
- .3 Loop drawings for all items connected to the control system -one loop per sheet.
- .4 Field instruments.
- .5 Power supplies.
- .6 PLC and I/O enclosures.
- .7 PLC and I/O modules.
- .8 PLC terminals.
- .9 Operator Work Stations.
- .10 Control System Hierarchy/Network Drawings.
- .11 Interconnection drawings, showing system equipment and field device connections.
- .12 PLC software documentation, which shall include as a minimum:
  - .1 I/O listing entailing a complete list of all system addresses, both used and spare, with a service description for each including mnemonics.
  - .2 Ladder diagram listing, complete with description headings, comments for each rung, and mnemonics for each element.
  - .3 Data table listing, identifying all preset values and their service.
  - .4 Written description of the program(s).

1.10 DRAWINGS OF RECORD

.1 Refer to Division 1 for requirements on Project Record Drawings and General Electrical requirements – Section 26 05 01.

.2 Submit all control drawings and PLC programs for the instrumentation system.

1.11 COORDINATION OF WORK

.1 Cooperate and coordinate with other trades on the project.

.2 Make suitable arrangements with other trades to make provision for the control and instrumentation work and be responsible for the assurance that such provisions are satisfactory for the control and instrumentation work.

.3 Check drawings and specifications of other trades for conflict and coordination with the control and instrumentation trade. If any conflicts are found, obtain a ruling from the Engineer before proceeding.

1.12 AS-BUILT DOCUMENTATION

.1 As work progresses, record on one (1) set of contract drawings, any change to conduit layout as well as any approved changes and deviations from the original contract and/or working drawings. At completion of work, submit to the Engineer. Refer to Electrical General Provisions - Section 26 05 01 for details.

.2 In addition to the as-built contract drawings, submit as-built documentation for inclusion in the Maintenance Manuals as outlined in clause 1.7.

.3 Provide as-built PLC and HMI programming hard copy and back-ups (2 copies) on compatible DVD to the Engineer.

.4 All software development packages and manufacturer's development manuals shall be turned over to the Engineer.

.5 No final contract payment shall be made until all as-built documentation has been accepted by the Engineer.

1.13 WARRANTY

.1 Warranty system assembly, installation, hardware, software, and communications operations for all parts and labour for a period of one year from date of project total performance.

PART 2 PRODUCTS

2.1 MATERIALS

.1 All materials shall be new and the best of their respective kind.

.2 All materials shall bear the approval of the Canadian Standards Association (CSA).

.3 All materials shall be suitable for full operation within environments as specified.

.4 See subsequent clauses for specific equipment and instrument specifications.

2.2 POWER SUPPLY

.1 Provide all necessary power supplies for controls and instruments.

.2 Power wiring to field devices shall be #12 AWG.

.3 Provide power surge protectors and devices to protect instruments, equipment and lines from being functionally impaired or damaged during power surges or environmental conditions such as moisture.

2.3 CONTROL WIRING

.1 Unless specified otherwise, all conductors for control wiring shall be copper with RW90, X-link insulation, 300 volts.

.2 Neutral conductors shall be white, grounding conductors shall be green, DC conductors shall be blue and AC conductors shall be red.

.3 Instrumentation wiring for analog signals shall be individually shielded – multipair cable #16 AWG (7x16) tinned copper.

.4 Control wiring for level and pressure switches shall be #14 THHN Black.

.5 Where dimensional details are required work with the applicable structural and architectural drawings.

.6 The Contractor is responsible for correcting any work completed contrary to the intent of the drawings and specification and shall bear all costs for correcting same.

2.4 CONDUIT, WIRING AND CABLE

.1 Supply and install all conduit, wiring, control and instrumentation cables for the control, instrumentation and low line voltage control for building services.

.2 Conduit and wiring for power, lighting, miscellaneous electrical systems, power supplies to control instrumentation fed from panel boards, and building service panels including other components requiring line voltage power supply shall be supplied and installed as specified in Sections 26 05 33 and 26 05 21.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install and interconnect all process control system equipment and components as indicated.

.2 Install all equipment in accordance with the manufacturer's recommendations and in a manner that will ensure satisfactory operation upon completion.

.3 Provide all labour and all necessary equipment including timbers, scaffolding, tools and rigging materials for installation of the equipment.

.4 Contractor shall be responsible for coordinating all mechanical, electrical and other works for the equipment being installed.

.5 Installation shall meet the minimum standards set forth by Standards and Practices for Instrumentation, Tenth Edition 1989.

.6 Use trained personnel to install systems and controls as per approved shop drawings and in accordance with manufacturer's recommendations.

.7 Follow building lines with all piping and electrical wiring runs. Utilize proper separation and wiring techniques.

.8 The in-line mechanical installation of certain items specified to be supplied in this section are specified to be installed in Division 23 – Mechanical.

3.2 FIELD TESTING

.1 Thoroughly test all control equipment, components, and systems for proper operation, record and report in writing to the satisfaction of the Engineer. Sign and date all test reports (including calibration reports, etc.) during testing, prior to submission to the Engineer.

.2 Tests shall include:

.1 Complete operational test including interlocks, functions, features, options, etc., for all instrumentation, PLC, and computer system control operations.

.2 Operation of alarm initiating devices.

.3 Check the operation of control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.

.4 Calibration of all instruments to manufacturer’s stated accuracy of the instrument.

.3 Supply all necessary test equipment and personnel to completely test the entire instrumentation and process control system.

.4 Contractor to provide written confirmation of the satisfactory completion of the testing of all the system and equipment specified herein prior to scheduling of final start-up and commissioning.

3.3 FAT TEST

.1 Factory Acceptance testing (FAT) shall be in accordance with Section 25 01 10.

3.4 AUTOMATION START-UP AND COMMISSIONING

.1 Automation system start-up and commissioning shall be in accordance with Section 25 01 11.

3.5 SPARE PARTS

.1 The Contractor shall provide the following spare parts:

.1 Two (2) plug-in control relays of each type used complete with base.

.2 Two (2) plug-in time delay relays of each type used complete with base.

.3 Ten (10) fuses of each type used.

.4 Five (5) indicating lights of each type used.

.5 One (1) push button assembly including contact blocks of each type used.

.6 One (1) selector switch assembly including contact blocks of each type used.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the performance and execution of the automation system Factory Acceptance Test (FAT).

1.3 DEFINITIONS

.1 FAT: Factory Acceptance Test.

1.4 DESIGN REQUIREMENTS

.1 Develop a demonstration and test procedure, along with test forms, for the FAT.

1.5 SUBMITTALS

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

.2 Submit the following for review at least fifteen (15) Working Days prior to FAT.

.1 Detailed test procedures 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.

1.6 CLOSEOUT SUBMITTALS

.1 Include all FAT documentation and test forms in the O&M manuals.

1.7 DEMONSTRATION AND TESTING

.1 The purpose of testing is to ensure all status and alarm signals defined in the Functional Requirements Specification (FRS) within the PLC are conveyed to the City's SCADA HMI system via the cellular communication link. This shall be performed in conjunction with the Contract Administrator and/or City of Winnipeg personnel witnessing in person.

.1 All types of DNP3 points need to be tested one by one. This test will include changing digital points states and testing different value for analog points (for example 0%, 25%, 50%, 75% and 100%). Perform functional test for individual points and control/interlock functions whenever it is required.

.2 Verify all DNP3 properties such as DNP3 event time stamping, clock synchronization and deadbands.

.3 Test DNP3 communication on both PSTN and wireless.

.4 Perform a SCADA test during FAT (Test the communication on both PSTN and wireless in addition to selected points).

.2 The location of the FAT shall be in a Contractor supplied facility, within Winnipeg, Manitoba, Canada.

.3 Correct deficiencies at no additional cost and re-test until satisfactory performance is obtained.

.4 Acceptance of tests during the FAT shall not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

1.8 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 DEMONSTRATION SYSTEM

.1 Setup the complete automation system in the Contractor's facility, in a timely manner to allow for the complete and expeditious testing of the system and associated programming.

3.2 PROCEDURES

.1 All tests shall be documented.

.2 Produce test forms to allow for recording the results of the simulations and tests.

.3 All points to the SCADA system shall be tested with the assistance of City personnel.

.4 Advise Contract Administrator of the date of testing. Contract Administrator may, at their discretion, observe factory acceptance testing based on the completeness of the submittal or other factors.

.1 Demonstration tests to include:

.1 Testing of all discrete physical inputs with the use of wire jumpers.

.1 Confirm that the City's SCADA system can see the state transition.

.2 Confirm that the light on the front of the control panel illuminates (where a light is provided).

.3 Confirm that the light on the PLC input card illuminates.

.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.

.2 Confirm that the light on the PLC output card illuminates.

.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 Confirm that the City's SCADA system as able to see each of the 0%, 50%, and 100% of full-scale values as they are tested.

.4 Testing of all analog outputs by forcing the outputs in the PLC software and measuring the value with a multi-meter.

.1 Test the output at 0%, 50%, and 100% of full scale.

.2 Confirm that the City's SCADA system as able to see each of the 0%, 50%, and 100% of full-scale values as they are tested.

.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.

.2 Demonstration tests need not include:

.1 Connection of instruments to the control panel.

.2 Configuration of instruments.

.5 The Contract Administrator may request additional minor tests at the FAT. No additional payment shall be made for additional minor tests.

.6 The Contract Administrator shall review the system and test results. Incorporate comments and feedback from the Contract Administrator into the system design.

3.3 EVALUATION

.1 All evaluations will be pass/fail.

.2 The Contractor is expected to ensure that all required demonstrations are fully operable and meet required specifications, prior to the FAT. Upon failure

of a required demonstration in the FAT, the Contractor shall provide subsequent re-tests to the satisfaction of the Contract Administrator at no additional cost.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the performance and execution of the automation system start-up and commissioning.

1.3 SUBMITTALS

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

.2 Submit commissioning plans and procedures, in writing, at least twenty (20) Working days prior to commissioning.

1.4 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 Section 01 78 00 – Closeout Submittals.

.5 Recommend additional changes and/or modifications deemed advisable to improve performance, environmental conditions or energy consumption.

1.5 COMMISSIONING FORMS

.1 The Contract Administrator shall provide a base set of standard commissioning forms. Additional forms shall be required, and must be prepared by the Contractor. The Contractor will be required to fully complete all test forms and submit to the Contract Administrator.

.2 Supplement the provided forms as required to make a complete commissioning report package. Utilize the Specifications, Drawings, and the Functional Requirements Specification as the basis for preparation of the additional commissioning forms.

1.6 COMMISSIONING

.1 Carry out commissioning under direction of the Contract Administrator and in the presence of representatives of the Contract Administrator and the City of Winnipeg personnel.

.2 Inform, and obtain approval from the Contract Administrator in writing at least fourteen (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 at no additional cost and re-test until satisfactory performance is obtained.

.4 Acceptance of tests shall not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.5 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning shall be considered as satisfactorily completed when the objectives of commissioning have been achieved and reviewed by the Contract Administrator.

PART 2 PRODUCTS

2.1 NOT USED.

PART 3 EXECUTION

3.1 STATUS PRIOR TO COMMISSIONING

.1 Prior to commissioning, ensure that the following is completed:

.1 Installation of all panels and completion of all wiring connections.

.2 Testing wiring for continuity from the field device to the control panel.

.3 Automation panels are cleaned (interior and exterior).

3.2 PROCEDURES

.1 Provide a minimum of one (1) qualified technician to test and commission the control system.

.2 Test each I/O point from the instrument to the City's SCADA HMI.

.1 Tests to be performed in conjunction with the City of Winnipeg personnel to verify alarm and status signals on the City's SCADA HMI.

.2 Test both states of discrete points.

.3 Test, at minimum, two values for analog points.

.3 Test each piece of equipment individually for complete functionality.

.4 Completely test the E-Stop functionality of each piece of equipment, as provided.

.5 Where software logic is provided in the PLC, all modifications to the software program to bypass interlocks or sensors shall be recorded and documented clearly in a separate document, and in the PLC software.

.1 Any software bypasses that remain, prior to leaving site, must be authorized by the Contract Administrator or designated representative.

.6 All deficiencies must be corrected by the Contractor at no additional cost.

.7 Commission each system using procedures prescribed by the Contract Administrator.

.8 Optimize operation and performance of systems by fine-tuning control loops and PID values.

3.3 SYSTEM SOFTWARE

.1 Load PLC system with appropriate program and/or configuration as per the included Functional Requirements Specification, fully tested and approved as part of the software FAT.

.1 Any changes made to the software after the FAT shall be submitted for review and approval of the Contract Administrator.

.2 Any issues identified on site shall be communicated to the Contract Administrator. Approval is required prior to making any modifications.

.3 The Contractor is reminded that this facility is critical to operation of the City's wastewater pumping station.

3.4 CHECKLISTS, FORMS, AND REPORTS

.1 Complete checklists, forms, and reports for each instrument, loop, and control device.

.1 Instrument Loop Checklist.

.2 Discrete Device Checklist

3.5 DEMONSTRATION

.1 Demonstrate to the Contract Administrator and/or the City of Winnipeg personnel 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 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of the PLC / RTU Panel CP-A81

1.3 QUALITY ASSURANCE

.1 Control equipment to CSA C22.2 No. 14-M1987.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 25 00 01 and include schematic, wiring diagrams, and mounting information.

PART 2 PRODUCTS

2.1 GENERAL

.1 Supply the control panels in accordance with the general arrangement and dimensions indicated on the appropriate drawings. Panels must be complete with all instruments, meters, switches, indication lights, relays, etc., as specified herein or as indicated.

.2 Provide removable lamacoid nameplates having letters not smaller than 6 mm to identify equipment.

.3 Provide a sleeve or other mechanism inside each panel door to store flat tabloid (11 x 17 inch) as-built wiring schematics and panel drawings and another for the DVD containing the programming.

2.2 CONSTRUCTION

.1 Minimum panel enclosure ratings to be used are as follows:

.1 EEMAC 12 for ordinary environments.

.2 EEMAC 4X for corrosive environments.

.3 EEMAC 3R for outdoor installations.

.4 EEMAC 7 for hazardous environments.

.2 Unless otherwise specified fabricate floor mounted panels, indicated, of high grade, cold rolled smooth sheet metal steel no thinner than 3 mm thick with

all doors and edges neatly turned and finished smoothly. Visible welding seams will not be accepted.

.3 Construct rigid panels and racks with an angle iron or channel supporting frame, suitably braced and stiffened to prevent any deformation during shipping or installation, and provide a surface free from dents, warping or other deformation. Provide a four-sided channel iron mounting base with front recess.

.4 Provide flush fitting, gasketted doors hung on piano type hinges with three point latches and locking-type handles (CSA Type 12 .construction).

.5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.6 Use rear connected fittings to hold equipment and instrument cases on the panel, but where not possible; any front fixing required shall be only by means of chrome-plated, brass or stainless steel machine screws.

.7 Panel surfaces shall be thoroughly cleaned and degreased before painting. One primer coat shall be covered by two finished paint coats. Refer to Division 9 Finishes.

.8 The surface finish shall be free of runs, drops, ridges, waves and laps. The paints shall be applied in such manner as to provide an even film covering corners and crevices. The exterior finish will be selected after award of the contract.

.9 Panel Accessories: a pocket, 250 mm wide x 150 mm high x 25 mm deep, to hold pertinent drawings and manuals on the lower half of the inside door.

2.3 INTERNAL WORKS

.1 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 volt supply.

.2 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments. Conductors shall be extra flexible stranded copper of gauges sufficient to carry the required currents, and shall in no case be smaller than #16 AWG extra flexible.

.3 Identify all wiring by means of plastic slip-on type or thermally printed heat-shrink type markers. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, and where practical, contained in plastic wiring channels with covers. Provide wire gutter divider to ensure analog signal wiring is kept separate from digital signal or power wiring as appropriate.

.4 Each terminal shall be clearly indelibly marked·with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals. Provide all necessary terminal block accessories such as manufactured jumpers and marking tape.

.5 Mount all internally mounted equipment on DIN rail or mount on a rack and arrange for ease of access and removal when necessary.

.6 Arrange all terminal blocks in the panel in groups such that all low level signals such as 4-20 mA DC are located in one area, followed by contact closure type signals (limit switches, etc.), that do not subsequently energize starters, etc. but are for status indication, and the remainder that contain powered circuits, are to be arranged in such a manner and location so as to prevent interference into the low level signal.

.7 Submit proposed terminal block layout and identification scheme as a shop drawing for review prior to manufacture.

.8 Provide suitable spaces around the terminal blocks for incoming and outgoing conductors or cable assemblies, with a minimum space of 5cm between terminals and wire trough.

.9 Provide plastic cable troughs equal to Panduit complete with snap-on covers for containing the cables. Cables are not to be bunched and tied, but laid in.

2.4 PANEL MANUFACTURER

.1 Panel assembly, subcomponents and all internal components shall be CSA approved. Cabinet construction shall be performed by an established panel manufacturer who shall comply with all building codes, factory, and Department of Labour regulations and has CSA approval as manufacturer for all components of the work including control panels, MCCs, service entrance, etc. Local approvals for panel construction including CSA will not be accepted.

.2 Acceptable panel manufacturer shall be Indus Automation, Manco Control Systems Inc., Celco Controls or approved equal.

2.5 OPERATOR CONTROL STATIONS

.1 Minimum enclosure types for operator control stations to be used are as follows:

.1 EEMAC 12 for ordinary environments.

.2 EEMAC 4X for corrosive environments.

.3 EEMAC 3R for outdoor installations.

.4 EEMAC 7 for hazardous environments.

2.6 SELECTOR SWITCHES

.1 Number of positions as required, labelled as indicated, heavy duty, oiltight, operators as indicated, contact arrangement as indicated, rated 120 V (ac), 10 A.

.2 Size: 22mm Φ.

.3 Acceptable manufacturer shall be Schneider Electric XB4 series.

2.7 PUSHBUTTONS

.1 Heavy duty oiltight, operator flush, black, with 1-NO and 1-NC contacts rated at 10 A. 120 VAC, labels as indicated.

.2 Size: 30mm Φ.

.3 Remote Emergency Stop push-pull / twist to release pushbuttons, heavy duty, oiltight, mushroom head, coloured red, provision for padlocking in depressed position.

.4 Acceptable manufacturer:

.1 Schneider Electric Harmony 9001 K series.

.2 Allen Bradley 800H series.

2.8 CONTROL RELAYS

.1 Number of poles as required, must be double throw type.

.2 Removable relay cube from base.

.3 Acceptable manufacturer shall be Omron, Carlo Gavazzi.

2.9 TERMINALS

.1 Provide Weidmuller "W" series terminals, number indicated plus 20% spare.

.2 Terminals to be rated for connected load.

.3 Double stack terminals will not be permitted unless written approval is obtained from the Engineer.

2.10 DC POWER SUPPLIES

.1 Provide DC power supply DIN rail mounted in interior of panel c/w the following:

.1 Power Rating: As required.

.2 Power Input: 120 VAC.

.3 Power Output: 24 VDC.

.2 Acceptable manufacturer shall be Phoenix Contact UNO Series, Siemens.

2.11 PANEL PROGRAMMING PORT

.1 Provide programming port mounted on face of panel c/w the following:

.1 15A-125 VAC rated, CSA type 5-15R receptacle.

.2 RJ45 CAT 6 bulkhead Ethernet connector.

.3 USB type A F/M connector.

.4 EEMAC 12 rated gasketed housing with hinged cover.

.2 Acceptable manufacturer shall be Phoenix Contact No. CDH CPP.

2.12 INTRINSICALLY SAFE RELAYS

.1 Provide direct non-latching signals from control devices in Class 1, Division 1, Groups A-D hazardous areas.

.2 Power supply: 120VAC.

.3 Output contacts: SPDT, Form “C”, 5A @ 120VAC resistive.

.4 Acceptable manufacturer shall be Warrick Controls, Pepperl & Fuchs, Stahl or approved equal.

2.13 TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS)

.1 Provide TVSS device DIN rail mounted in interior of panel c/w the following:

.1 Power Rating: 1500VA.

.2 Power supply: 120VAC.

.3 Alarm contact: SPDT, Form “C”, 5A @ 120VAC resistive.

.2 Acceptable manufacturer shall be Phoenix Contact No.SFP1-15/120AC, Always-On No. PLC2012015 or approved equal.

2.14 UNINTERRUPTIBLE POWER SUPPLY (UPS)

.1 Provide UPS device in interior of panel c/w the following:

.1 Power Rating: 1500VA.

.2 Power supply: 120VAC.

.3 Alarm contact: SPDT, Form “C”, 5A @ 120VAC resistive.

.2 Acceptable manufacturer shall be Phoenix Contact QUINT Series, Always-On No.GESI52 or approved equal.

2.15 HUMAN MACHINE INTERFACE (HMI)

.1 Provide HMI mounted on face of panels c/w the following:

.1 EEMAC 12 enclosure rating.

.2 Power input: 24 VDC.

.3 12” LED colour touch screen.

.4 EtherNet communication capability.

.2 Acceptable manufacturers:

.1 Schneider Electric Harmony GTO 6310.

2.16 PSTN MODEM

.1 Public switched telephone network (PSTN) modem DIN rail mounted in interior of panel c/w the following:

.1 Power supply: 24 VDC
.2 Serial RS-232 interface.
.3 3-way electrical isolation.

.2 Acceptable manufacturer:

.1 Phoenix Contact No.2313067

2.17 PLC / RTU CONTROL PANEL

.1 Provide one (1) PLC / RTU Control Panel floor mounted in station main floor to contain all items indicated on the drawings including:

.1 Indoor floor mounted cabinet c/w the following:

.1 EEMAC 12 rated enclosure.
.2 12 gauge.
.3 Hinged lockable single door.
.4 Panel finish:
.1 Exterior: ASA 61 light grey enamel.
.2 Interior: White epoxy paint.

.2 Terminal strips (identified) for all wiring.
.3 Lamacoid identification nameplates on all components.
.4 Extra flexible wire to door components.
.5 20A,1P,120 VAC rated panel disconnect switch.
.6 Circuit breakers and/or fuses, as required.
.7 Selector switches as specified in 2.6.
.8 Pushbuttons as specified in 2.7.
.9 120 VAC / 24 VDC power supply as specified in 2.10.
.10 Panel mounted programming port as specified in 2.11.
.11 Transient voltage surge suppressor as specified in 2.13.
.12 UPS as specified in 2.14.
.13 Panel mounted HMI as specified in 2.15.
.14 PSTN modem as specified in 2.16.
.15 Cellular modem as manufactured by Sierra No. RV50X to be supplied by the City of Winnipeg.
.16 PLC as specified in Section 25 30 03.
.17
.18 Panel manufacturer as specified in 2.4.

2.18 REMOTE EMERGENCY STOP PUSHBUTTON STATIONS

.1 Provide eight (8) remote emergency stop pushbutton stations as indicated on the drawings including:

- .1 Two stations for each of the two Flood Station Pumps P-F01 & P-F02 and two Lift Station Pumps P-L01 & P-L02.
- .2 EEMAC 4X rated enclosure.
- .3 Terminal strips (identified) for all wiring.
- .4 Lamacoid identification nameplates on all components.
- .5 Emergency stop pushbuttons as specified in 2.7.
- .6 Panel manufacturer as specified in 2.4.

2.19 INTRINSICALLY SAFE RELAY JUNCTION BOX

.1 Provide one (1) Intrinsically Safe Relay Junction Box wall mounted in station main floor adjacent to the PLC / RTU Control Panel to contain all items indicated on the drawings including:

- .1 Indoor wall mounted cabinet c/w the following:
  - .1 EEMAC 12 rated enclosure.
  - .2 12 gauge.
  - .3 Hinged lockable single door.
  - .4 Panel finish:
    - .1 Exterior: ASA 61 light grey enamel.
    - .2 Interior: White epoxy paint.
- .2 Terminal strips (identified) for all wiring.
- .3 Lamacoid identification nameplates on all components.
- .4 Extra flexible wire to door components.
- .5 Four (4) intrinsically safe relays as specified in 2.12.
- .6 Panel manufacturer as specified in 2.4.

2.20 SPARE PARTS

.1 Provide spare parts as specified in section 25 00 01.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install pushbutton stations, control and relay panels, control devices as indicated and interconnect as indicated.

3.2 TESTS

.1 Perform tests in accordance with Sections 25 00 01 and 26 05 01.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Provide loop check sheet for each I/O point to be submitted to Engineer prior to Start-Up and Commissioning.

.6 Submit one copy of test results to the Engineer.

3.3 START-UP AND COMMISSIONING

.1 Perform all panel start-up and commissioning in accordance with Section 25 00 01 and Division 1.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL CONDITIONS

.1 All sections of Division 1 form a part of this Specification. Read and fully adhere to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

.3 All sections of Divisions 1 to 33 inclusive form part of the Contract Documents. Refer to Section 26 05 01 for General Electrical Requirements related to this work.

1.2 SCOPE

.1 This section specifies the supply installation, field testing, and placing into operation of flow, pressure, temperature, level, turbidity, and other instruments of instrumentation and control.

1.3 RELATED WORK

.1 General Provisions - Section 25 00 01.

.2 Control Panels - Section 25 30 01.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 25 00 01.

PART 2 PRODUCTS

2.1 INSTRUMENTS

.1 Provide each instrument with mechanisms that are corrosion resistant.

.2 Provide each instrument with mechanisms enclosed in a dustproof and a moisture proof case.

.3 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.

.4 Potentiometric signals shall have a "live" zero or positive minimum value in the signal range.

.5 Each component shall be carefully selected and designed for a long lifetime with ample margin to withstand transient and other surge voltages, which may occur in the circuits from any source in the power supply.

.6 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings, e.g., horizontal, vertical or sloped position.

.7 The Contractor shall provide all power supplies. Instruments shall be powered from the same control panel to which the measured signal is being transmitted, unless specifically noted otherwise. The power source to each instrument shall be individually fused, fuse size based on instrument power requirements.

.8 Integrating counters and elapsed time meters shall show the total quantity that has passed through the meter and shall not require the use of a multiplier other than cipher additions. The integrators shall have at least seven figures.

.9 All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.

.10 All materials shall conform to the standards of the Canadian Standards Association (CSA).

.11 For factory calibrated instruments, the factory calibration sheets shall be submitted in the O&M manual.

.12 For Field calibrated instruments, the field calibration sheets shall be submitted in the O&M manual.

.13 All instruments to be installed per Manufacturer's recommended installation guidelines.

.14 Provide Instrument tag fastened to each instrument to match instrument list. Instrument tag to be stainless steel or powder coated aluminum.

2.2 ULTRASONIC LEVEL SENSOR / TRANSMITTER

.1 Ultrasonic level sensing transmitters suitable for potable water and wastewater applications as indicated to monitor water levels in the flood station wet well chamber as indicated.

.2 Instrument identification:

.1 Flood Station Wet Well: F500- LE/LIC.

.3 Transmitter:

.1 Ambient Temperature:

.1 -20°C to +50°C.

.2 Power Supply:

.1 24 VDC.

.3 Measuring points: 1.

.4 Enclosure:

.1 Chemical resistant polyester/polycarbonate alloy surface, panel mounted EEMAC 4X rated enclosure complete with LCD and bar graph display.

.5 Relay Outputs:

.1 Three (3) dry-contacts:

.1 2 SPST for control.

.2 1 SPDT for alarm.

.6 Analog Output:

.1 Qty one (1) 4-20 mA.

.7 Accuracy:

.1 0.25% of maximum range or 6 mm, whichever is greater.

.8 Resolution:

.1 0.1% of program range or 2 mm, whichever is greater.

.9 Range: As indicated in Instrument List.

.10 CSA Approved.

.11 .

.4 Transducer:

.1 Ambient Temperature: -20°C to +65°C.

.2 Degree of Protection: IP65/IP68.

.3 Range: 0.3 to 8 m.

.4 Beam Angle: 10°.

.5 Frequency: 44 kHz.

.6 Built-in temperature compensation.

.7 Submersible transducer shield.

.5 Transducer Cable:

.1 Type:

.1 1 PR, 18 AWG, Shielded Twisted Pair.

.2 Electrical Characteristics:

.1 62.3 pF/m @ 1 kHz between conductors.

.2 108.3 pF/m @ 1 kHz between conductor and shield.

.3 Length: 30 metres.

.6 Acceptable manufacturer:

.1 Siemens Sitrans MultiRanger 100 c/w XRS-5 transducer.

.2 The supply of ultrasonic level transmitters for the City of Winnipeg has been standardized under 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 discount pricing that the City has negotiated with the Vendor.

.2 Contact: Trans-West Company, 126 Bannister Road, Winnipeg, MB, R2R 0S3.

.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 HYDROSTATIC PRESSURE LEVEL

.1 Provide submersible hydrostatic pressure level sensor suitable for wastewater applications to monitor wastewater level in the lift station wet well chamber as indicated.

.2 Instrument identification:

.1 Lift Station Wet Well: L500-LE/LIC.

.3 Sensor Requirements:

.1 Type: Hydrostatic level sensing.

.2 Piezo-resistive sensor with ceramic diaphragm.

.3 Stainless steel housing (30mm Ø).

.4 Mechanical protection: IP68

.5 CSA rated Class 1 Zone 1 suitable for installation in sewage wet well hazardous location.

.6 24 VDC loop power supply.

.7 4-20 maDC analog input signal to station PLC panel.

.8 Signal cable c/w desiccant (mounted inside panel).

.9 Mount sensor near bottom of lift station wet wet well. Run sensor signal cable in 50mm PVC sleeve secured to side of wet well.

.10 Acceptable manufacturer:

.1 Sitrans LH300 or approved equal.

2.4 FLOAT SWITCHES

.1 Provide float switches as indicated, teardrop shaped submersible, weighted and encapsulated in an enclosure suitable for immersion in potable water and wastewater.

.2 Float switches shall be individually suspended by means of a submersible cable affixed to a galvanized steel float bracket as indicated on the drawings. Provide float rings to prevent cable entanglement.

.3 Acceptable manufacturer:

.1 SJE Rhombus MegaMaster.

.2 Flygt ENM-10

.3 Approved equal.

2.5 BUILDING FLOOD SWITCHES

.1 Building Flood Switch shall be ultrasonic gap type.

.2 Enclosure rating shall be Category 2 suitable for corrosive environments.

.3 Acceptable manufacturer shall be Siemens Sitrans LVL200.

2.6 SMOKE DETECTOR

.1 Provide smoke detectors as indicated.

.2 Dual-Ionization Technology.

.3 Power supply: 100-130VAC 60Hz.

.4 Auxiliary Alarm relay contacts: 10A @ 120VAC/28VDC Form C (N.O./N.C.).

.5 Operating Temperature: 4°C to 38°C.

.6 Alarm Level: 85dB @ 3 m (10 ft.).

.7 Indicator Lights:

.1 Green LED remains on when unit is powered.

.2 Red LED flashes when unit is in alarm.

.8 Acceptable Manufacturer:

.1 Edwards ESA5011KA Smoke Detector.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Coordinate the work of this Section with the installation of the equipment specified in the relevant Sections of Divisions 15, 26 and 26 and shown on the Mechanical and Electrical drawings.

.2 Perform all work in compliance with the relevant sections of this Division.

3.2 FIELD INSTRUMENT MOUNTING

.1 "Mounting" shall mean the positioning and fastening with proper brackets in the position required.

.2 All equipment shall be mounted in accordance with manufacturer's recommendations.

.3 Locations of all field instruments are subject to modification by the Engineer who reserves the right to move any item up to 3 meters from the position shown, without change to the contract price, provided notice is given before the related work has commenced.

.4 Exact locations of all field instruments shall be site determined by the Contractor to the satisfaction of the Engineer to ensure proper operation of the device.

.5 Employ any and all means of trade, skill, and workmanship to install all field instruments to the satisfaction of the Engineer.

3.3 COMMISSIONING

.1 Instrument manufacturer's qualified service representative shall be on site as required or as otherwise specified, whatever is more stringent, to perform instrument calibration, testing and commissioning and to instruct Owner's representative in all aspects of instrument operation and maintenance.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of the new PLC / RTU Panel CP-A81 programmable logic controller (PLC).

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section 25 00 01 and include details on all CPU functions, programming, flow charts, operator menus, control sequences, schematics, component dimensions, data storage quantity, data storage speed, data storage back-ups, and program storage back-ups.

PART 2 PRODUCTS

2.1 PLC

.1 The PLC mounted in the new PLC / RTU Panel as specified in Section 25 30 01 as shown on the drawings shall include:

- .1 Central processing unit (CPU) including power supply.
- .2 I/O modules: discrete input, discrete output, analog input and analog output.
- .3 Remote monitoring hardware.
- .4 All necessary supporting hardware, e.g. PLC backplane, terminal strips, etc.
- .5 PLC programming.

.2 Environmental Conditions

- .1 Temperature ratings:
  - .1 Storage temperature: -40 to 85°C.
  - .2 Operating temperature: 0 to 60°C.
- .2 Humidity: 0 to 93% non-condensing.
- .3 Altitude: 2000 metres full operation.
- .4 Vibration and shock:
  - .1 Shock (half sine wave): 15g peak, 11 msec, 3 pulses/axis
  - .2 Vibration: 10 to 57 Hz@ 0.075 mm d.a 57 to 150 Hz@ 1 G.

.3 Free fall: 1m.RFI and EMF Protection:

.4 RFI/EMF susceptibility: 27 to 500 Mhz: 10 V/m.

.5 Electrostatic discharge: 8 kV/ 4 kV contact.

.6 Surge withstand: IEC 801-5 2000 V, shield to ground.

.3 Central processing unit (CPU):

.1 General:

.1 The CPU shall consist of non-rack mounted sub-assemblies (modules) which solve application logic, store the application program, store numerical values related to the logic, and interface to the I/O modules.

.2 The CPU shall provide local diagnostic information via front mounted LED display on CPU.

.3 A dry contact shall provide for remote PLC failure alarm indication. The CPU shall come complete with all necessary software to provide for this alarm function.

.4 Memory back-up for program to be provided with capacitor to allow PLC to store program to non-volatile memory prior to shutdown on power loss.

.5 On board Ethernet ports or Ethernet communication module to be included in system and have a minimum of 2 Ethernet ports on completely separate subnets.

.2 Program Storage:

.1 1 Megabyte program memory minimum.

.2 PLC program storage medium shall be solid state, the use of battery backed memory will not be acceptable.

.3 50msec maximum scan time.

.4 Time-of-day clock.

.5 Watchdog timer.

.3 Programming Language:

.1 Programming language shall be FBD (Function block diagram).in accordance with IEC 61131-3.

.2 Acceptable programming language:

.1 Schneider Electric Unity Pro.

.4 Input/Output (I/O) Modules:

.1 General:

.1 All I/O modules shall be of the non-rack mounted plug-in type modular design.

.2 LED indicators adjacent to each I/O point.

.3 All user wiring to the I/O modules shall be through a heavy duty terminal strip. Removable, push-in type terminal strip

shall allow for module replacement without disturbing field wiring. Pressure type screw terminals shall be used to provide fast, secure wire connections.

.4 Malfunction of an I/O module shall not affect the operation of the remaining I/O modules or the CPU.

.5 CPU shall retain status of all I/O points of a failed I/O module.

.6 Isolation shall be provided between all internal logic and external power circuits. Isolation shall meet minimum specification of 1000V RMS.

.2 Discrete Inputs:

.1 No. of modules: As required.

.2 Description: Isolated Input Module.

.3 Number of points: As required plus 20% or minimum 6 spare points, of each type of input card used, whichever is greater.

.4 Operating voltage: 120VAC and/or 24VDC as indicated.

.5 Points per group: Isolated.

.6 Acceptable manufacturer:

.1 Schneider Electric No. BMX DDI 1602.

.3 Discrete Outputs:

.1 No. of modules: As required.

.2 Description: Relay (NO) Output Module.

.3 Number of points: As required plus 20% or minimum 4 spare points, whichever is greater.

.4 Points per group: Isolated.

.5 Max. current/pt.: 1 Amp, Resistive.

.6 Acceptable manufacturer:

.1 Schneider Electric No. BMX DDO 1602.

.4 Analog Input:

.1 No. of modules: As required.

.2 Description: Analog Input Module (Uni-Polar).

.3 No. of channels: As required plus 20% or minimum 4 spare points, whichever is greater.

.4 Operating current: 4 to 20 maDC.

.5 Isolation: 1000 VAC Channel to Bus.

.6 Accuracy: 0.05% of full scale current.

.7 Acceptable manufacturer:

.1 Schneider Electric No. BMX AMI 0810.

.5 Analog Output:

.1 No. of modules: As required.

.2 Description: Analog Output Module (Uni-Polar).

.3 No. of channels: As required plus 20% or minimum 2 spare points, whichever is greater.

.4 Operating current: 4 to 20 maDC.

.5 Isolation: 2500 VDC Channel to Bus.

.6 Accuracy: 0.2% of full scale current.

.7 Acceptable manufacturer:

.1 Schneider Electric No. BMX AMO 0810.

.5 Remote Communication:

.1 System shall contain two (2) Ethernet / Serial RTU modules dedicated to DNP3 SCADA communication.

.2 Program modules to fully communicate with SCADA via DNP3 protocol on both PSTN and cellular.

.3 Acceptable manufacturer:

.1 Schneider Electric BMX NOR0200H.

.6 Accessories:

.1 For systems requiring a backplane, backplane shall be supplied to house the CPU, AC power supply, communication module, discrete input, discrete output, analog input, and analog output modules as required. Backplane shall include at minimum 2 spare slots.

.7 Acceptable Manufacturer:

.1 Schneider Electric Modicon M580.

.8 Purchase or Quotation

.1 The supply of all PLC equipment and associated accessories for the City of Winnipeg has been standardized under RFP 756-2013. No alternates or substitutes will be accepted.

.2 All requests for purchase or quotation shall reference RFP 756-2013 to receive discount pricing that the City has negotiated with the vendor.

.3 Contact Schneider Electric Canada, 21 Omands Creek Blvd, Winnipeg MB, R2R 2V2.

.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.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Mount and install PLC and associated equipment in the PLC control panel CP-A81as indicated on the drawings and as specified in Sections 25 30 01.

.2 All PLC programming shall be configured and implemented accordance with these specifications and as further specified in Section 25 91 01.

.3 Complete PLC and control system installation, testing, start-up and commissioning shall be as described in Sections 25 00 01 and 26 05 01.

3.2 TRAINING

.1 Installation, testing, start-up and commissioning of SCADA system as described in Section 25 00 01.

.2 PLC supplier shall allow for, as a minimum, the following site trips:

.1 Pre-start-up meeting (1 day).

.2 Initial system start-up and commissioning (10 days) (2 weeks).

.3 On-site training of City of Winnipeg system operator to consist of one half day training session during second trip noted specified above.

.4 2 future 3-day site trips during first six months of plant operation after substantial completion for follow-up training and trouble shooting.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 EXAMINATION OF DRAWINGS

.1 The electrical drawings do not show all architectural, mechanical and structural details. All electrical schematics are shown diagrammatically unless otherwise noted. The Contractor shall review the mechanical and structural drawings to obtain building dimensions and details. Verify dimensions accurately by measurements.

.2 To change the location of electrical equipment, submit a request in writing to the Engineer for approval. If approved, such changes are to be made at no additional cost to the Owner.

.3 No extra will be allowed for any additional labour or materials required for relocation of equipment due to interference with equipment of other trades, beams, joists, walls, etc., unless the conflict has been submitted to the Engineer in writing before closing of tenders.

1.3 APPROVED DESIGN AND INSTALLATION

.1 Equipment and material to be of approved design and manufactured in accordance with all governing regulations such as "Canadian Standards Association", "Canadian Electrical Code", "Provincial Department of Labour", "Underwriters Laboratory", etc. Equipment and material must bear applicable acceptance labels of all associations and governing bodies recognized by the municipal, provincial and federal authorities.

.2 Install equipment in strict accordance with manufacturer's recommendations and governing rules, regulations and codes.

.3 Where requirement conflict occurs, install all materials in accordance with the most severe requirements.

.4 Material installed under this Division to be new and of uniform construction.

.5 All installations to ensure maximum headroom, minimum interference with free use of surrounding areas, and best access to equipment.

.6 To deviate major service runs from the location shown on the drawings, submit to the Engineer suitable drawings showing such deviations together with reasons for deviations and obtain approval from the Engineer before proceeding with the installation.

1.4 CODES AND STANDARDS

.1 Install all equipment in accordance with current editions of CSA 22.1 and 22.2, including all local amendments unless otherwise specified.

.2 Perform all work in accordance with drawings, specifications, applicable municipal and provincial regulations, and any pertinent inspection bulletins issued by the electrical inspection authority having jurisdiction over the installation. In no instance shall the standard established by the drawings and specifications be reduced.

.3 Provide a copy of all standards referred to in this Section for use on site.

1.5 PERMITS INSPECTIONS AND FEES

.1 Deliver to the Engineer all necessary interim and final certificates of inspection and approval which may be required by all Inspection Authorities having jurisdiction over the work, as evidence that the work installed conforms with the laws and regulations of all governing authorities.

.2 Submit copies of all plans and specifications to the authority having jurisdiction for inspections as may be required prior to commencement of work to comply with the above.

.3 Notify the Inspection Authorities in sufficient time for them to arrange to inspect work.

.4 Pay all associated fees.

1.6 ABBREVIATIONS

.1 Abbreviations for electrical terms shall be to CSA 285-1983.

.2 Names used throughout these specifications are:

EEMAC	Electrical & Electronic Manufacturers Association of Canada (formerly CEMA)
CSA	Canadian Standards Association
FM	Factory Mutual
NEMA	National Electrical Manufacturers Association (U.S.)
JIC	Joint Industry Conference
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
CEC	Canadian Electrical Code
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
NBC	National Building Code
NSI	American National Standards Institute

1.7 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Division 1.

.2 Submit shop drawings for all equipment as indicated with the exception of conduit, standard conduit fittings and low voltage wiring.

.3 Indicate on shop drawings details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.4 Where applicable, include wiring, single line and schematic diagrams.

.5 Wiring drawings showing interconnection with work or other divisions are required.

.6 Indicate the number or letter used as an identification symbol on product data for panel boards, lighting fixtures and other equipment.

1.8 OPERATION AND MAINTENANCE MANUALS

.1 Include in the manuals information based on following requirements:

.1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data to be in form of approved shop drawings, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists.

.3 Advertising or sales literature is not acceptable.

.4 Provide wiring and schematic diagrams and performance curves.

.5 Include names and addresses of local suppliers for all items included in the operation and maintenance manuals.

.2 Submit six (6) complete copies of manuals and "as-built" drawings to the Engineer for review. Revise initial manual as required by the Engineer prior to final submission.

.3 All other requirements as laid out in Division 1.

1.9 RECORD DRAWINGS

.1 Submit record drawings in accordance with Division 1.

.2 The Contractor shall record all changes made during construction and provide record drawings to the Owner upon completion of the work.

.3 Include with the record drawings a list for each motor indicating motor or equipment number and name, nameplate voltage, horsepower and current, the size of overload and breaker or fuse protection provided.

1.10 DEFINITIONS

.1 The following are definitions of terms and expressions used in the specification:

.1 “Inspection Authority" means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site.

.2 "Supply Authority" means electrical power company or commission responsible for delivery of electrical power to project.

.3 "Electrical Code" means Canadian Electrical Code C22.1 or code in force at project location.

.4 "Indicated" means as shown on contract drawings or noted in contract documents.

.2 Refer to CSA C22.2 No.0 for "Definitions and General Requirements".

1.11 COOPERATION AND COORDINATION

.1 Schedule expediting of all materials and execution of work with associated work specified in other Divisions.

.2 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 galvanized steel pipe, sized for free passage of conduit, and protruding 50 mm (2").

.3 Cables, conduits and fittings to be embedded or plastered over neatly and close to building structure so furring can be kept to a minimum.

.4 Arrange for holes through exterior walls and roof to be flashed and made weatherproof.

1.12 SOURCE QUALITY CONTROL

.1 Arrange for a plant inspection by Engineer where specified.

.2 Inform Engineer of manufacturing progress and arrange inspections at appropriate times.

.3 Action required by factory inspection shall not be construed as final acceptance.

.4 Obtain a Certificate of Acceptance from the inspection authority on completion of work and hand it to the Engineer.

.5 The Engineer may carry out inspections and prepare deficiency lists for action by the Contractor, during and on completion of project.

1.13 GUARANTEE

.1 Guarantee work described in this Section of the specification against all defects in labour and materials.

1.14 CARE, OPERATION AND START-UP

.1 Instruct the Owner's operating personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of manufacturer's factory service representative to supervise start-up of installation, check, test, adjust, balance ·and calibrate components.

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

1.15 APPROVAL OF ALTERNATE MATERIALS

.1 Tenders shall be based on the materials, products, and manufacturers specified.

.2 Alternates to materials, products, and manufacturers specified shall be in accordance with Division 1.

PART 2 PRODUCTS

2.1 GENERAL

.1 All materials shall be fully approved by the Canadian Standards Association (CSA) for use as installed and meet the requirements of this specification in all respects.

.2 Where there is no alternative to supplying equipment which does not have CSA approval, submit such equipment to Provincial Hydro Inspection Authorities for special inspection and obtain approval. Pay all associated fees.

.3 Materials and equipment shall be of Canadian manufacture except where specified otherwise or where Canadian made materials or equipment do not exist.

.4 Where two or more units of the same class or type of equipment are required, the units shall be the product of a single manufacturer, although components of equipment need not be products of the same manufacturer.

.5 Use material and equipment available from regular production of manufacturer.

.6 Control panels and component assemblies to be shop manufactured.

2.2 FINISH

.1 Finish metal enclosure surfaces by removing rust and scale, cleaning, and applying rust resistant primer inside and outside with at least two coats of finish enamel.

.2 Paint all outdoor electrical equipment "equipment green" finish to EEMAC-Y1.

.3 Paint all indoor switchgear and distribution enclosure "light grey" to ASA 61 grey.

.4 Clean, prime and paint exposed hangers, racks, fastenings, etc., to prevent rusting.

2.3 VOLTAGE RATINGS

.1 Operating voltages to be within those defined in CSA Standard C235-1969.

.2 All motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment must be able to operate in extreme operating conditions established in above standard without damage to equipment.

2.4 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring must be suitable for copper conductors.

2.5 ENCLOSURES

.1 Minimum enclosure types to be used are as follows:

.1 EEMAC 12 for ordinary environments;
.2 EEMAC 4X for corrosive environments;
.3 EEMAC 3R for outdoor installations;
.4 EEMAC 7 for hazardous environments.

2.6 MANUFACTURERS AND CSA LABELS

.1 Manufacturer's nameplates and CSA labels are to be visible and legible after equipment is installed.

2.7 WARNING SIGNS

.1 Provide warning signs with suitable background colour and lettering as required to meet requirements of inspection authorities and Engineer. Use decal signs, minimum size 178 mm x 250 mm.

2.8 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: 432mm x 279mm minimum size.

.2 Drawings:

.1 *****-E0003 - Single Line Diagram

2.9 PLYWOOD MOUNTING BOARDS

.1 Surface wall mounted panelboards and other electrical equipment shall be installed on plywood mounting boards. Boards shall be provided under this section of the specifications, sized to suit equipment indicated and/or implied.

.2 Plywood mounting boards shall consist of 20 mm fir plywood fastened securely to wall.

.3 Plywood mounting boards, strapping and trim shall be treated with wood preservative prior to installation and painted with one coat of primer and two coats of grey enamel ASA61. Painting shall be completed before any electrical equipment is mounted on the plywood.

.4 Service entrance equipment shall be spaced from the plywood mounting boards to the satisfaction of the inspection authorities.

PART 3 EXECUTION

3.1 WORKMANSHIP

.1 Where sheet metal enclosures are not provided with knockouts, Greenlee punches shall be used in all cases. Cutting torches shall not be used for making holes.

3.2 INSTALLATION

.1 Determine manufacturers' recommendations regarding storage and installation of equipment and adhere to these recommendations.

.2 Check all factory joints and tighten where necessary to ensure continuity.

3.3 MOUNTING HEIGHTS

.1 Mounting height of equipment is given from finished floor to top of equipment.

.2 Exact mounting height of unnoted equipment must be verified with Engineer before proceeding with installation.

.3 Install electrical equipment at heights listed below unless otherwise indicated. (All heights in millimetres from finished floor unless indicated):

.1	Local Switches:	1420
.2	Wall Receptacles:	450
.3	Lighting Panels:	1800
.4	Cabinets:	1800
.5	Emergency Lights:	2400 (minimum)

.4 All dimensions indicated are to the top above finished floor elevation.

3.4 SPECIAL PROTECTION

.1 Accept the responsibility to protect those working on the project from any physical danger due to exposed electrically energized equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts "LIVE-600 VOLTS" or with the appropriate voltage.

.2 Arrange for the installation of temporary doors, barriers, etc., for all electrical equipment. Keep these doors locked at all times except when under direct supervision.

3.5 FIREPROOFING

.1 Where sleeves or openings are installed in walls, floors, roof or partitions to accommodate raceways, cables or bus duct, provide all necessary seals, fittings, barriers and fire-resistant materials to restore the installation to its original fire rating to the satisfaction of the Engineer and the Owner's insurance underwriters.

3.6 EQUIPMENT IDENTIFICATION

.1 Supply and install identification nameplates on all equipment such as motor starters, safety switches, panelboards, pushbutton stations, etc. and any equipment not so supplied. All nameplates shall be securely fastened to equipment with galvanized steel screws.

.2 All identification nameplates, except for motors, shall be laminated phenolic with minimum 6 mm (1/4 inch) black letters on white background, the wording of which shall be identical to that on the single line diagrams and the title of the equipment controlled. Motor nameplates to be of non-corroding metal stamped or engraved with black lettering on light background.

.3 Warning nameplates snail be laminated phenolic with minimum 6 mm (1/4 inch) white letters on red background, the wording to be reviewed by the Engineer. All warning nameplates to be screwed to equipment.

.4 Warning nameplates required by Inspection Authorities shall be provided for all electrical switchgear and equipment and on access doors to electrical rooms, vaults, switchyards, etc. in accordance with the applicable Code regulations. Obtain all necessary details from the Inspection Authorities.

.5 Where wording not specified on the drawings, obtain exact wording from the Engineer.

.6 Identify pull boxes, terminal cabinets and junction boxes enclosing cables or connections with nameplates indicating voltage, box number and circuit number.

.7 Provide junction boxes, relay panels and miscellaneous equipment energized from two or more sources with a warning nameplate prominently displayed, noting number and location of sources and their voltage.

.8 Provide a typewritten circuit directory with a clear plastic cover for each panel board in a suitable holder on the inside of each panel door. Unless otherwise noted, the directory shall indicate breaker or switch circuit number, rating, load description and associated load data.

.9 Manufacturer's nameplates and CSA labels to be visible and legible after equipment is installed.

3.7 WIRING IDENTIFICATION

.1 Provide permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and

branch circuit wiring. Maintain phase sequence and identification throughout system, i.e. panelboards, starters, terminal blocks, disconnect switches.

.2 Maintain identification system at all junction boxes, splitters, cabinets and outlet boxes.

.3 Use colour coded wires in communication cables, matched throughout system. All colour coding must adhere to CSA C22.1.

3.8 TOUCH-UP PAINTING

.1 Be responsible for field touch-up painting of all shop painted electrical equipment installed in this Contract.

.2 All surfaces to be painted shall be dry, clean, free from dust, dirt, grease, frost, rust, loose crystals or extraneous matter, tool and machine marks. Feather out edges of scratch marks to make patch inconspicuous.

.3 Apply one or more coats of paint until the damaged surface has been restored to original finish condition. Do not apply succeeding coats until preceding coat is dry and hard. Sand lightly between coats with No. 00 sandpaper.

.4 Be responsible for obtaining the necessary touch-up paint of the original type and quality from the equipment manufacturer.

.5 Supervise priming and finish painting of all electrical equipment and material not shop painted.

3.9 SLEEVES AND OPENINGS

.1 Provide sleeves and openings for exposed conduits, busways, and wireways, where they pass through walls or floors conforming to relevant fire codes where applicable.

.2 Sleeves for individual conduits shall be galvanized steel in ordinary areas or stainless steel in corrosive environments.

.3 Pack or fill sleeves and openings after the completed work is in place. Filling shall provide a waterproof seal to prevent leakage of water or other liquids through the sleeve or opening.

.4 Sleeves and openings shall not displace reinforcing steel, and shall receive approval of the Engineer prior to placement.

3.10 CUTTING AND PATCHING

.1 Do all drilling, cutting, fitting and patching necessary for the running and securing of conduits, wireways, and other electrical equipment.

.2 Provide supports necessary for same.

.3 Provide bracing and anchorage of work subject to Engineer's approval.

.4 No cutting of the structural members or of the fireproofing shall be done without the written consent of the Engineer.

.5 Caulk and flash all conduits passing through walls, roofs or other surfaces exposed to weather or as indicated on the drawings to prevent the passage of water and/or sewer gases.

3.11 HANGERS AND SUPPORTS

.1 Provide hangers; angles, channels, and other supports necessitated by field conditions to install all items of electrical equipment. Design of supports and methods of fastening to building structures shall be subject to the Engineer's approval.

.2 All local motor control devices are to be grouped and mounted on a free-standing frame of stainless steel construction easily accessible and as close to the motor as possible.

.3 Provide weight-distribution facilities, where required, so as not to exceed the load-bearing capacities of floors or walls that bear the weight of, or support, electrical items.

.4 Paint all exposed parts of hangers and supports with an anti-rust inhibiting primer.

.5 Equipment shall not be held in place by its own weight. Provide base anchor fasteners in each case.

3.12 PROTECTION OF EQUIPMENT

.1 Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps.

.2 Fixtures, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced by the Contractor.

3.13 TESTING OF ELECTRICAL SYSTEMS

GENERAL

.1 Prior to the Engineer's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Engineer to ensure that the operation of the system and components satisfy the requirements of the Specifications.

.2 Ensure that the system and its components are ready prior to the inspection and test for acceptance.

.3 All testing shall be conducted by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Engineer. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the Owner. Submit six copies of the test certificates to the Engineer.

Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

.4 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

.5 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.

.6 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Owner.

.7 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.

.8 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

.9 Supply all instruments, meters and personnel required for the tests.

3.14 CABLE AND WIRE 1000 VOLT AND BELOW

.1 Tests on cables in this voltage range shall be limited to insulation resistance measurements using a 500V megger for systems up to 350V and a 1000V megger for 351-600V systems.

.2 Record all test results in a log book and submit to the Engineer for reference. Replace or repair all circuits, which do not meet minimum requirements specified in the CEC, Table 24. Insulation resistance of the following circuits shall be measured:

.1 Power, lighting and motor feeders (with equipment disconnected): phase-to-phase, phase-to-neutral and phase-to-ground.

.2 Control circuits: measure to ground only.

.3 Do not perform megger tests on control circuits containing transistorized or solid-state components.

.4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

3.15 GROUNDING SYSTEM

.1 Test the grounding system efficacy for compliance with CSA Standard C22.1 and Supply Authority requirements. Verify that the ohmic resistance values specified therein are not exceeded.

.2 Notify Inspection and Supply Authorities that they may be present to witness Contractor testing and provide any assistance required by these Authorities for their own testing procedures.

3.16 TRAINING

.1 Provide for the training of the Owner's representatives in the operation, maintenance and testing of all systems and equipment including the provision of qualified manufacturer's technical representatives for specialized systems.

.2 Provide these services for such period, and for as many visits as necessary to put installation in working order, and to ensure that operating personnel are conversant with all aspects of its care and operation.

3.17 DELIVERY AND STORAGE

.1 Ship and store floor mounted equipment in upright position.

.2 Ship channel bases and anchor stencils in advance of equipment.

.3 Keep equipment doors locked. Protect equipment from damage and dust.

.4 Block moving parts when necessary to prevent damage during movement and shipment of equipment. Instructions to remove blocking before putting equipment in service to be clearly and conspicuously displayed.

.5 Store all electrical equipment indoors. Temperature sensitive equipment to be stored in heated spaces.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

.2 This section covers the supply and installation of all wire and box connectors.

1.2 QUALITY ASSURANCE

.1 Solder lugs to CSA C22.2 No. 19-1935 (R1981).

.2 Wire connectors to CSA C22.2 No. 65-M1988.

.3 Connectors shall be copper or copper alloy.

.4 Bushing stud connectors to EEMAC 1Y-2-1961 and shall be suited for conductor type.

.5 Clamps or connectors for cable to CSA-C22.2 No. 18, 1972.

PART 2 PRODUCTS

.1 MATERIALS

.2 All lugs, terminals and screws used for termination of wiring must be suitable for copper conductors.

.3 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.

.4 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper 10 AWG or less.

.5 Clamps or connectors for flexible conduit, as required.

.6 All cable terminations shall be with compression type connectors.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65-M1988.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install crimp type connectors to the satisfaction of the Engineer.

.5 Install box connectors to CSA requirements.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install the complete wiring systems specified herein including, but not limited to:

.1 Low voltage wire and cables

.2 Instrumentation wiring

.3 Modbus RS485 cable

.4 Thermostat (low voltage) wiring

.2 Include in the wiring system all wiring, terminations, wire markers, cable tags, cable ties, splice fittings, insulation tapes, connectors and miscellaneous materials necessary to complete the wiring system.

PART 2 PRODUCTS

2.1 LOW VOLTAGE WIRE AND CABLE (1000V AND BELOW)

.1 Conductors: stranded Copper conductors, with minimum power conductor size: No. 12 AWG, minimum control conductor size: No. 14 AWG.

.2 Power conductors: size as indicated, with cross linked polyethylene (XLPE) insulation rated 1000 V – RW90 or RWU90, as indicated.

.3 Control conductors: XLPE insulation rated 600 V – RW90.

.4 Control panel wiring: copper with thermoplastic insulation type TEW rated at 600 V.

.5 Provide multi-conductor cables wrapped with interstitial fillers and an overall PVC (minus 40°C) flame retardant, low acid gas evolution jacket.

.6 Insulated ground conductors forming part of a multi-conductor cable assembly shall have green colour coding.

.7 Colour coding of insulated conductors:

.1 1-conductor cable-Black

.2 2-conductor cable-Black, White

.3 3-conductor cable-Red, Black, Blue

.4 4-conductor cable-Red, Black, Blue, White

.5 Multi-conductor cables-Number code

.6 Intrinsically safe field wiring: Yellow

.8 Teck90 Cable requirements:

.1 Conductors: Class B compressed stranded Copper conductors, size as indicated, with cross linked polyethylene (XLPE) insulation rated 1000V – RW90.

.2 Inner jacket: Black PVC flame-retardant, moisture resistant

.3 Armour: flexible interlocking aluminum armour.

.4 Overall jacket: PVC flame-retardant, moisture and sunlight resistant, with fully printed label of cable description on jacket.

.5 Compliances: cable rated for wet and dry installation, and hazardous locations. Compliant with CSA C22.2 Nos. 131 and 174, including CSA FT1 and FT4.

.6 Armoured/Teck90 Cable connectors:

.1 Watertight connectors for non-hazardous areas.

.2 Class 1, Zone 1, Group II B rated connectors c/w sealing compound for hazardous areas.

2.2 INSTRUMENTATION SIGNAL WIRING

.1 Multi-conductor type with individually colour or number coding.

.2 Twisted pairs or triplets (triads) as required. Provide grouped cables with multiple pairs or triplets as required.

.3 Each pair or triplet to be wrapped in an aluminium / mylar shield with an overall bare stranded copper drain wire

.4 Ratings: 600VAC, insulated, 90°C.

.5 Minimum conductor size: #16AWG, stranded conductors, tinned-copper.

.6 Non-armour cable: overall aluminium sheath and an outer FR-PVC jacket.

.7 Armour cable (as indicated on drawings): overall interlocking aluminium flexible armour and an outer FR-PVC jacket.

.8 Multiple pairs/triplets to incorporate an overall aluminium/mylar shield with a copper drain wire.

.9 Armour cable connectors:

.1 Watertight connectors for non-hazardous areas.

.2 Class 1, Zone 1, Group II B rated connectors c/w sealing compound for hazardous areas.

2.3 THERMOSTAT (LOW VOLTAGE) CABLE

.1 Low energy 300 V control cables: stranded anneal copper conductors, twisted pairs/triplets, multi-conductors as required, with PVC insulation rated 80°C, and a UV rated overall PVC jacket covering.

.2 Minimum size: #18AWG.

2.4 WIRING ACCESSORIES

.1 Wire markers: computer printed, black letters on white background, self-laminating – vinyl markers, number of markers as required.

.2 Cable markers for cables or conductors greater than 13 mm diameter: strap-on type, rigid PVC, black letters on white background, with PVC covered aluminium straps.

.3 Terminal blocks: minimum 600 V rated, modular, sized to accommodate conductor size used.

.4 Where screw-type terminals are provided on equipment field wiring: terminate with pressure-type insulated copper fork tongue terminals.

.5 Splice connectors for wire sizes Nos. 12-10 AWG inclusive: compression spring type.

.6 Splice connectors for wire sizes No. 8 AWG and larger: split-bolt type, sized to suit number and size of conductors, c/w flame retardant foot-type insulator.

.7 Cable ties shall be nylon, one-piece, self-locking type.

.8 Connectors for Teck armoured cables installed in hazardous locations: design approved for the application.

.9 Connectors for Teck armoured cables installed in wet areas or outdoors: watertight design.

.10 Cable pulling lubricant: compatible with cable covering and will not cause damage and corrosion to conduits or ducts.

PART 3 EXECUTION

3.1 INSTALLATION – GENERAL

.1 Install all wire and cable according to the drawings, with a minimum power conductor size of No. 12 AWG and minimum control conductor size of No. 14 AWG.

.2 Pull cable into ducts and conduits in accordance with the cable manufacturer’s recommendations, using patented cable grips suitable for the type of cable or using pulling eyes to be installed directly onto the cable conductors.

.3 Limit pulling tensions to those recommended by the manufacturer to avoid overstressing cable.

.4 Utilize adequate lubricant when pulling cables through ducts and conduits to minimize wear on cable jackets.

.5 Install all through wiring in junction and pull boxes having no connection within the box with a minimum of 150 mm of slack left inside the box.

.6 Install instrument and thermocouple extension wiring separate from power and control wiring.

.7 Make connections to equipment “pig-tails” with mechanical, insulated, screw-on connectors for wire sizes Nos. 12-10 AWG. For wire sizes No. 8 AWG and larger utilize split-bolt connectors, taped with three layers minimum of insulating tape.

.8 No splices shall be permitted in cable or wiring runs, and shall only be permitted in junction boxes.

.9 Unless otherwise specified, make all wiring tapes, splices and terminations with identified compression screw type terminal blocks, securely fastened to avoid loosening under vibration or normal strain. Make connections for interior and exterior lighting circuits and 120 V, 15 amp convenience receptacle circuits using screw-on or split-bolt connectors and insulating tape.

.10 Identify each conductor by plastic slip-on markers at each termination indicating the circuit designation or wire number.

.11 Identify each cable by attaching a suitable marker, stamped or indelibly marked with the cable number, at each end of the cable and in all intermediate manholes, junction boxes and pull boxes.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of all firestop systems equipment and material for conduit and cable tray wall penetrations.

1.3 REFERENCE STANDARDS

.1 Test Requirements:

.1 ULC-S115-M or CAN4- S115-M, “Standard Method of Fire Tests of Through Penetration Fire Stops”.

.2 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Material.

.3 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 01.

.2 Submit material safety data sheets (MSDS) provided with product.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver material undamaged in manufacturer’s clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.

.2 Coordinate delivery of materials with scheduled installation date to allow minimum on-site storage time.

.3 Store materials under cover and protect from weather and damage in compliance with manufacturer’s requirements, including temperature limitations.

.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

.5 Do not use damaged or expired materials.

PART 2 PRODUCTS

2.1 MANUFACTURES

.1 Unless otherwise approved by the Engineer, or specified herein, provide firestop material of one (1) manufacture throughout.

.2 Catalogue numbers specified are for the purpose of illustrating features and to establish the grade of quality of the firestop material. Products from other manufacturers which have identical features and characteristics are acceptable with prior approval.

.3 Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with performance requirements. Use only components specified by manufacturer and approved by the qualifying testing and inspecting agency for firestop system.

.4 Typical products for large penetrations made to accommodate conduit and cable tray systems include:

- .1 Hilti:
  - .1 CFS-BL Fire Block
  - .2 CP 620 Fire Foam
  - .3 CP 675 Firestop Board
  - .4 CP 618 Putty Stick
- .2 Roxtec

PART 3 EXECUTION

3.1 PREPARATION

.1 Verification of Conditions:

- .1 Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- .2 Verify penetrations are properly sized and in suitable condition for application of materials.
- .3 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellants and any other substances that may affect proper adhesion.
- .4 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- .5 Comply with manufacturer’s recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- .6 Prepare firewall penetration for conduit sleeve and/or cable trayas per manufacturer’s installation instructions. Install fire wall sleeve with the required firestop pillows and putty per manufacturer’s instructions.

3.2 INSTALLATION

.1 Install firestop materials in accordance with ULC Fire resistance Directory or UL Products Certified for Canada (cUL) Directory.

.2 Comply with manufacturer's instructions for installation of through-penetration materials.

.3 Installation of fire blocks:

.1 Install wire mesh on one side of the penetration to support the fire block installation.

.2 Build up the fire blocks within the penetration firmly seated. Cut the fire blocks with a knife to suit the places penetrations.

.3 Finish building up the fire blocks until the entire opening is filled.

.4 Completely fill cable spaces and gaps between blocks and joints with firestop sealant.

.5 Fasten identification nameplate in place.

3.3 FIELD QUALITY CONTROL

.1 Perform inspection of firestopping penetration in accordance with ASTM E 2174, "On-Site Inspection of Installed Fire Stops".

.2 Where deficiencies are found or penetration firestopping is damaged or removed because of testing and/or repair replace penetration firestopping to comply with all specified requirements.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Furnish all labour, materials, equipment and services specified, indicated or requested to install a complete grounding system. The grounding system shall include ground rods, all wiring, ground bus, thermit welds, mechanical fittings, connectors, links and miscellaneous materials necessary to complete a grounding system acceptable to the Inspection Authorities.

1.3 QUALITY ASSURANCE

.1 Grounding equipment to CSA C22.2 No. 41-M1987.

.2 Copper grounding conductors to ASA A7.1 1964.

PART 2 PRODUCTS

2.1 GROUND AND BONDING CONDUCTORS

.1 Conductors shall be concentric stranded, soft drawn copper. Insulated conductors, where required by Inspection Authorities or specified, shall be type TW, 600-volt rating, green colour, and shall meet the same flame-spread requirements of all wiring in the area and conditions where they are installed.

.2 Conductors shall be sized at least per the requirements of the latest version of the Canadian Electrical Code and of the local Authority, or as indicated, whichever is the greater size.

.3 Where direct buried bare ground conductor comes into contact with corrosive material, the conductor shall be tinned.

2.2 GROUND CLAMPS

.1 Ground clamps for connecting ground conductors to metal water piping not suitable for thermit weld connections shall be sized to accommodate the system ground conductor and the water pipe, as manufactured by T & B, Burndy.

2.3 COMPRESSION CONNECTIONS

.1 Compression connectors shall be manufactured from pure wrought copper. Conductivity of this material shall be no less than 99%.

.2 Each connector shall be factory filled with oxide-inhibiting compound.

.3 Connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

.4 Connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.

.5 Terminal lug for communication system grounding shall be compression type and conform to the following:

.1 Material: Tin Plated Copper (aluminum not permitted).

.2 Wire Size: to match conductor

.3 Number of Stud Holes: 2

.4 Stud Hole Size: 3/8”

.5 Bolt Hole Spacing: per ANSI Joint Standard J-STD-607-A

.6 Tongue Angle: Straight

2.4 BUS/BUSBAR

.1 Material: Copper (aluminum not permitted).

.2 Size:

.1 1/4" (6mm) X 4" (100mm) X 20” (508mm).

.3 Busbars:

.1 Number of holes:

.1 34 places - 7/16” (11mm) stud hole size;

.2 34 places – 1/4” (6mm) stud hole size.

.3

.2 Be pre-drilled to accommodate two-hole lugs.

.3 Hole spacing per ANSI J-STD-607-A.

.4 Incorporate insulators and stand-off brackets that electrically isolate busbar

from mounting surface.

.4 Acceptable manufacturer:

.1 Burndy No. BBB14420J or approved equal.

2.5 MECHANICAL CONNECTIONS

.1 Mechanical connectors shall be of bronze, copper or brass construction with stainless steel hardware selected and sized specifically for the particular application and shall meet latest IEEE standard.

2.6 GROUND RODS

.1 Ground rods shall be 19 mm (3/4") diameter, 3m (10 feet) long, copper clad steel construction with the copper exterior coating permanently bonded to the steel core.

2.7 GROUND WELL

.1 Ground well shall be made of 14 gauge Hot Dip Galvanized steel with 10 inch. diameter and 12 inch depth. The cover must be mechanical attached to the box.

PART 3 EXECUTION

3.1 GENERAL

.1 Install products in accordance with manufacturer's instructions.

.2 Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

.3 Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

.4 Attach grounds permanently before permanent building service is energized.

.5 Terminate each grounding conductor on its own terminal lug. Sharing a single lug by multiple conductors is not allowed.

.6 All grounding electrode conductors and individual grounding conductors shall be installed in PVC conduit, in exposed locations.

.7 Installation of the compression connectors shall be made with a compression tool and die system, as recommended by the manufacturer of the connectors, and shall be irreversible.

.8 Pre-crimping of the ground rod is required for all irreversible compression connections to a ground rod.

.9 Install ground rod networks as indicated. Verify that final backfill and compaction has been completed before driving rod electrodes.

.10 Install main ground bus as indicated.

.11 Install the ground rod lead to the building in a ground well (electrode box) as a ground rod access point. The ground well cover shall be flush with the final grade to prevent burial.

.12 All ground rods shall be driven to the full length of 10 feet into the ground until the top of the rod is 6" below grade.

.13 Make connections between the ground conductor and the grounding rod grid using IEEE 837 certified compression connectors.

.14 Make all other buried or encased conductor joints, splices and connections with compression type connection.

.15 Make bonding connections to building steel or flat metallic surfaces with compression type connection. Locate connections where they will not be

subject to mechanical damage and, where possible, be accessible for inspection.

.16 Make bonding and ground electrode conductor connections to the main ground bus as indicated.

.17 All other joints, splices and connections: as indicated.

.18 Where compression type hardware is used, install using the hydraulic tools and methods, as specified the hardware manufacturer.

.19 Protect grounding and bonding conductors or bus subject to mechanical damage by rigid steel conduit or steel guards which shall be effectively grounded at both ends to the ground conductor they are protecting, regardless of their length.

.20 Securely bond metal enclosures, motor frames, steel supports for starters, panels, switches, etc., which are not rigidly secured to and in contact with grounded structural steel of a building or conduit system, or which are subject to excessive vibration, to building steel or conduit system with stranded copper conductors.

.21 Install ground conductors passing through masonry walls, floors, foundations, etc. in 25mm (1") rigid PVC conduit sleeves. Where sleeves are installed in walls or floors below grade, seal the sleeves watertight after installation of ground conductor.

.22 Provide and install a main ground bus in the Electrical Room and other locations, as indicated.

3.2 LESS THAN 600 VOLT-ELECTRICAL SYSTEM GROUNDING

.1 Provide code sized copper grounding electrode conductor from electrical room ground bus to secondary switchboard ground bus, each separately derived system neutral, building steel, ground rod, and all concrete encased electrodes.

.2 Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

.3 Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steelwork, distribution panels, outdoor lighting, telephone backboard.

3.4 TESTS

.1 Perform tests in accordance with Section 26 05 01.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Owner and inspection authority having jurisdiction.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of all fastenings and supports for equipment mounted under the electrical contract.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Expansive screw anchors, shields, or other fastening items containing lead or other material that might loosen or melt under fire conditions shall not be used. All fastenings located in the corrosive plant environment shall be corrosion resistant stainless steel.

.2 Power-actuated fasteners and devices shall not be used.

.3 Support channels, length as required, U shaped, size as required, of stainless steel.

.4 Support equipment, conduit or cable clips, spring loaded bolts, cable clamps, etc., to be purpose-built accessories to basic channel members.

.5 Two-hole PVC straps to secure surface conduits 50 mm and smaller.

.6 Beam clamps to secure conduit to exposed steel work.

.7 Support individual cable or conduit runs with 6.0 mm diameter stainless steel threaded rods and spring clips.

.8 Support two or more cables or conduits on channels supported by 6.0 mm diameter stainless steel threaded rod hangers where direct fastening to building construction is impractical.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install fastenings and supports as required for each type of equipment, cables and conduit to manufacturer's installation recommendations.

.2 Provide metal brackets, frames, hangers, clamps and related support structures where indicated or as required to support conduit and 'cable runs.

.3 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.4 Provide adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.5 Do not use supports of other equipment installed for conduit or cable support except, with permission and approval of the Engineer.

.6 Any aluminum support bracket or channel that is in direct contact with concrete is required to have inert spacers to reduce chemical reaction between support and concrete.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Furnish all labour, materials, supervision, equipment and services specified indicated or requested to install all electrical boxes specified herein and on the drawings.

PART 2 PRODUCTS

2.1 ENCLOSURE RATINGS FOR ALL EQUIPMENT LISTED HEREIN

.1 Indoor and dry locations: NEMA/EEMAC 12, unless otherwise noted on drawings.

.2 Below grade, damp or outdoor locations: NEMA/EEMAC 4X, unless otherwise noted on drawings.

.3 Hazardous or classified areas: suitable for Class 1, Zone 1, Group II B areas.

2.2 JUNCTION AND PULL BOXES

.1 Reference: CAN CSA C22.2 No. 40-M1989.

.2 Welded galvanized steel construction with screw-on flat covers for surface mounting and captive non-corroding chain.

.3 Covers with neoprene gasket and 25 mm minimum extension all around, for flush mounted pull and junction boxes.

.4 Piano-type hinges on boxes larger than 300 x 300 mm.

2.3 GENERAL OUTLET AND CONDUIT BOXES

.1 Reference: CAN CSA C22.2 No. 18-M1987.

.2 Size boxes in accordance with CSA C22.1.

.3 102 mm square or larger outlet boxes as required for special devices.

.4 Boxes in hazardous areas: suitable for Class 1 Zone 1, Group II B areas.

.5 Gang boxes where wiring devices are grouped.

.6 Blank cover plates for boxes without wiring devices.

.7 Combination boxes with barriers where outlets for more than one system are grouped.

2.4 SHEET STEEL OUTLET BOXES

.1 Electro galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.5 MASONRY BOXES

.1 Electro galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls, c/w preformed knock-outs.

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 boxes with factory threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.8 FITTINGS – GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.9 MANUFACTURERS

.1 Acceptable manufacturers: Appleton, Crouse-Hinds, W.C. Pursley, BEL, Stelpro, Pyle National, Taylor, and C.E.B.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

.3 Install pull boxes in inconspicuous but accessible locations.

.4 Mount cabinets with top not higher than 2 m above finished floor.

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

.6 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

.7 Provide access panels in ceilings where junction and pull boxes are located in spaces not otherwise accessible.

.8 Make cut-outs for outlet boxes recessed in walls neatly and of the minimum practical size.

.9 Install boxes to clear all building and mechanical services equipment. Where two or more devices are shown at one location, utilize multi-gang boxes. Supply all outlet boxes with covers or plaster rings as required.

.10 Size all boxes to accommodate the number of conduits, conductors and terminal blocks. Provide junction boxes with 20% spare terminal blocks.

.11 Securely fasten surface-mounted boxes to the building or mounting structure and support independently of the conduits entering the box.

.12 Install junction and pull boxes mounted on brick, concrete or block walls with 3 mm thick lead or nylon washers between box and wall face.

.13 Provide all boxes sized to the Manitoba Electrical Safety Code requirements, in all conduit raceway systems to limit length of straight conduit runs to 60 m. Reduce this length by 15 m for each 90° bend or 8 m for each 45° bend or offset.

.14 Mark location and size of all pull boxes on the record drawings.

.15 Install boxes in hazardous locations as required and shown on the drawings. Provide conduit seals for all conduits entering enclosure.

.16 Support boxes independently of connecting conduits.

.17 Fill outlet and conduit boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.18 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.19 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Supply and install all conduits, fittings, supports, hangers and miscellaneous support materials and hardware required for the complete systems in accordance with the applicable codes and regulations and as specified herein and on the drawings.

1.3 LOCATION OF CONDUIT

.1 Drawings do not indicate all conduit and supporting runs. Those indicated are in diagrammatic form only.

PART 2 PRODUCTS

2.1 CONDUITS

.1 Minimum conduit size: 21mm (3/4”).

.2 Rigid PVC conduit, manufactured to schedule 40 wall thickness. Solvent weld compound for all PVC joints. Complies with CSA C22.2 No. 211.2-06.

.3 Rigid steel metal threaded conduit, hot dip galvanized inside and outside with a coated layer to inhibit rust. Complies with CSA C22.2 No. 45-M1981 (R2003).

.4 Epoxy coated conduit: with zinc coating and corrosion resistant epoxy finish inside and outside.

.5 Flexible steel conduit and liquid tight flexible metal conduit, spirally wound interlocked aluminum armour construction with overall PVC jacket. Complies with CSA C22.2 No.56-04.

.6 Flexible conduit (coupling) for hazardous areas: suitable for Class 1, Zone 1, Group II B areas. Length to suit installation

.7 Electrical Metallic Tubing (EMT) conduit: size as indicated and complies with CSA C22.2 No.83-M1985 (R2003).

2.2 CONDUIT FASTENINGS AND SUPPORTS

.1 One-hole and two-hole hot dip galvanized steel straps.

.2 Hot dipped galvanized steel beam clamps.

.3 Hot dipped galvanized steel channel type supports, U-shape, size 41x41 mm, 2.5 mm thick.

.4 6 mm diameter threaded galvanized steel rods to support suspended channels. Provide all necessary galvanized steel spring-loaded bolts, nuts, washers and lockwashers.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit. Fittings to incorporate nylon insulated throat or bushing.

.2 Factory “ells” where 90° bends are required for 25 mm and larger conduits.

.3 Pressure type terminals for all rigid steel conduit grounding wire connections.

.4 Rigid steel conduit hub type connectors in wet or outdoor areas: nylon insulated with recessed neoprene ‘O’ ring.

.5 Liquid tight flexible conduit fittings to incorporate a threaded grounding core, nylon compression ring and gland. Insulated throat, male thread and locknut or bushing with an integral ‘O’ ring seal.

.6 Locknuts bonding type with sharp edges for digging into metal wall of enclosure

.7 Thinwall (EMT) conduit fittings: die cast zinc, insulated compression type connectors (set screw type not acceptable).

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.2 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 CONDUIT SEAL FITTINGS, DRAINS AND BREATHERS

.1 Suitable for Class 1, Zone 1, Group II B, hazardous areas.

.2 Sealing compound: Chico A, restricts passage of gases, vapours, or flames between conductors and fitting.

.3 Include drain to automatically remove condensation in each seal fitting.

2.6 FISH CORD

.1 6 mm stranded nylon cord, tensile strength 5 kN.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Use EMT OR rigid galvanized steel conduit for any exposed “life-safety” circuit wiring in non-hazardous areas.

.2 Use rigid PVC conduit for all non-hazardous areas, indoor and outdoor wiring.

.3 Use epoxy coated rigid galvanized steel threaded conduit in all hazardous rated areas.

.4 Install ground conductor in all types of conduits.

.5 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.6 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures.

.7 Use liquid tight flexible metal conduit for connection to all motors or vibrating equipment.

.8 Use hazardous area (Class 1, Zone 1, Group II B) flexible coupling for connection to explosion proof motors.

.9 Install conduit sealing fittings in hazardous areas. Fill with compound.

.10 Install breathers on conduit system and control panels in Hazardous areas.

.11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.12 Mechanically bend steel conduit over 19 mm diameter.

.13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.14 Install fish cord in empty conduits.

.15 For recessed panelboards, run two 25 mm spare conduits up to ceiling space and two 25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.

.16 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.17 Dry conduits out before installing wire.

.18 Support equipment using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.19 Install expansion sleeves wherever conduits cross a structural expansion joint.

3.2 SURFACE CONDUITS

.1 Use metal conduit (with separate ground wire) for all life safety devices such as emergency lighting and exit signage and as defined in Section 46 of the Canadian Electrical Code.

.2 Run parallel or perpendicular to building lines.

.3 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.4 Run conduits in flanged portion of structural steel.

.5 Group conduits wherever possible on surface mounted channels.

.6 Do not pass conduits through structural members except as indicated.

.7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

.8 Do not use ‘C’-type clamps or perforated metal straps.

.9 The maximum length of straight conduit run shall be 60 m between pull boxes or other terminations. Reduce this length by 15 m for each 90º bend or 7 m for each 45º bend or offset. Conduit runs to include not more than the equivalent of two 90º bends between pull boxes except where indicated otherwise on the drawings.

.10 Make no holes in building structural members for supporting conduits without the permission of the Engineer.

.11 Touch up and repair coated conduits and fittings on which the epoxy or PVC finish has been damaged; paint with a compound material supplied by the original conduit manufacturer.

.12 Fasten exposed conduit to building construction or support system using straps.

- .1 One-hole galvanized steel straps to secure surface conduits 50 mm and smaller.
- .2 Two-hole galvanized steel straps for conduits larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.13 Suspended support systems.

- .1 Support individual conduit runs with 6 mm diameter threaded rods and spring clips.

.2 Support two or more conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.14 For surface mounting of two or more conduits use channels at 1.5 m o.c. spacing.

.15 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit runs.

3.3 CONCEALED CONDUITS

.1 Do not install horizontal runs in masonry walls.

.2 Do not install conduits in terrazzo or concrete toppings.

.3 Run concealed conduits in ceiling spaces in straight lines with large radius bends where applicable.

.4 Install conduits in cores of concrete masonry walls as the walls are being erected.

.5 Do not cut into the wall after the walls are in place, unless otherwise authorized by Engineer.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel. Install in middle third of concrete slab or wall.

.2 Fix conduit to reinforcing bars (or provide chairs) to prevent conduit from moving during concrete placement.

.3 Protect conduits from damage where they stub out of concrete. Terminate stub-ups 100 mm above finished floor and seal with threaded cap.

.4 Install sleeves where conduits pass through slab or wall.

.5 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.

.6 Do not place conduits in slabs in which slab thickness is less than 4 times conduit outer diameter.

.7 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.8 Organize conduits in slab to minimize crossovers.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

.2 Protect conduits from damage where they stub out of concrete. Terminate stub-ups 100 mm above finished floor and seal with threaded cap.

.3 Install sleeves where conduits pass through slab or wall.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Furnishing of all labor, material, supports and services to install a complete cable tray system as shown and or indicated on the drawings. The cable tray system is defined to include, but not be limited to, straight sections of cable tray, bends, tees, elbows, drop-outs, supports and all other related accessories necessary for a complete installation.

1.3 RELATED SECTIONS

.1 Section 26 05 26 – Grounding and Bonding.

1.4 REFERENCE STANDARDS

.1 Canadian Electrical Code – latest edition

.2 Manitoba Electrical Code – latest edition

.3 NEMA VE 1 – Metal Cable Tray Systems

.4 NEMA VE 2 – Metal Cable Tray Installation Guidelines

1.5 STANDARDS AND TESTS

.1 All cable tray shall meet or exceed the requirements of CSA Standard C22.2, No. 126-M91, for Class D1 tray outdoors and Class C1 tray indoors.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 01, including:

.1 Indicate tray type, dimensions, support points, and finishes.

.2 Product Data: Provide data for tray sections, connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps, hold-down plates, support hardware, and accessories.

.3 Detailed sketch of proposed method(s) of installation.

PART 2 PRODUCTS

.1 Trays shall be CSA or CUL listed aluminum cable trays.

.2 Trays to be welded construction, components shall be accurately rolled, formed or extruded to close tolerances and all edges rounded. Side rail top and bottom flanges to have full rounded smooth edges.

.3 Cable supporting cross rungs shall be provided with slotted holes for acceptance of standard channel fittings. Top cable bearing surface shall be flat, all edges to be rounded, the cross section of the rung to extend the full width of the tray. Rung spacing shall be 300 mm. Channel tray to be provided with vented bottoms.

.4 Support rods shall be SS316, threaded and 13 mm diameter.

.5 All straight tray sections, angles, offset, corners, cable dropouts, reducers, splice plates, coupling connectors, covers including tray fittings and hardware shall be from the same manufacturer.

.6 Warning labels:

.1 Engraved or printed nameplates shall include the following or similar language:

.1 WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install metallic cable tray in accordance with NEMA VE-1 and VE-2.

.3 Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps as required.

.4 Conduit connections to the tray shall be made with an CUL approved clamps, manufactured specifically for the purpose.

.5 Do not make field risers or bends. All risers and bends to be manufactured.

3.2 COORDINATION

.1 Contractor shall coordinate the installation of the cable tray with plumbing and HVAC Contractors so that clearance is maintained between the cable tray and other trade’s work. Clearance shall be a minimum of 300 mm on both sides of cable tray (one side if wall mounted) and 200 mm on top of cable tray. Tray shall not restrict removal of ceiling panels nor lighting assemblies. If these conditions cannot be met, Contractor shall notify Owner for clarification and direction before proceeding with installation.

.2 Do not install cable tray below re-heat coils, traps or drains. In those areas that have no option furnish and install a manufacturer approved cover extending 300 mm on either side.

3.3 CLEARANCES

.1 To reduce or eliminate EMI, the following minimum separation distances shall be adhered to:

.1 One meter from transformers and motors.

.2 Balanced twisted-pair cabling installed in cable tray shall be separated from LED drivers, fluorescent lamps and associated fixtures by a minimum of 125 mm.

.3 Zero pathway separation distance is permitted when electrically conductive telecommunications cables, the power conductors or both are enclosed in metallic pathways that meet the following conditions:

.1 Metallic pathway(s) completely enclose the power conductors and are continuous;

.2 Metallic pathway(s) are properly bonded and grounded per ANSI/TIA-607-B;

.3 Walls of pathway(s) have a minimum thickness 1 mm (0.04 in) nominal if made of steel;

.4 No separation is required between power and telecommunications cables crossing at right angles.

3.4 SUPPORT

.1 No conduit shall be attached to the cable tray except for the conduits that terminate at the cable tray. Cable tray supports can be used to support conduit. Do not use more than 1/2 of the cable tray support for conduit support.

.2 Provide supports at each connection point, at end of each run, and at other points to maintain spacing between supports of 2.5 m maximum.

.3 Bolts and nuts shall be installed in all holes of cable tray splice plates per manufacturer’s instructions.

.4 Tray support shall be installed in a trapeze or wall angle configuration and approved by Owner.

.5 Supports shall be formed shape channel trapeze members, or formed mounting assemblies that are part of the manufacturer’s integrated cable tray system, complete with nuts, bolts, washers, lock washers and tray clamps as required for a complete and finished installation.

.6 Submit complete detailed sketch(es) for approval of the actual proposed method(s) of installation.

.7 Maximum allowable deviation of the tray, from level horizontal plane measured across width of tray, is 10 mm with tray loaded to capacity.

.8 Approval of installation method does not relieve Contractor from meeting above deviation requirement. If additional support is needed, as determined by Owner, Contractor shall furnish and install the additional support at no additional cost.

3.5 FITTINGS AND HARDWARE

.1 Use manufactured expansion fittings where required at the building expansion joints and as required by the manufacturer.

.2 Nuts, bolts, washers, rod shall be SS316.

.3 Provide End-of Run Drop-out (100 mm radius; minimum) at terminus of cable tray at equipment room(s) and wherever tray is discontinuous and there is a change in height.

.4 Provide threaded rod protector sleeves over all threaded rod supporting tray. Protectors shall extend above tray a minimum of 200 mm.

.5 Provide covers in dusty areas, outdoors, for trays passing under walkways or where there is risk of falling debris.

3.6 GROUNDING AND BONDING

.1 Ground and bond cable tray under provisions of Section 26 05 26 – Grounding and Bonding for Electrical Systems.

.2 Provide electric continuity between tray components. Provide manufacturer’s grounding clamps as required. Use antioxidant compound to prepare aluminum contact surfaces before assembly if required by the manufacturer. Assembled tray shall be CUL. classified as an equipment grounding conductor.

.3 Provide #4 AWG bare stranded copper equipment grounding conductor through entire length of tray. Bond equipment ground conductor to each component, each tray section, and connect to main building equipment grounding conductor.

.4 Equipment grounding conductor connections to the tray shall be made using a CUL listed mechanical connection. Sheet metal or TEK screws shall not be used for grounding.

3.7 PENETRATIONS

.1 Rated Penetrations:

.1 Where cable tray is to penetrate a fire rated wall or floor, the following installation method shall be used:

.1 Stop tray at penetration and fasten tray end to wall/floor.

.2 Provide manufactured re-enterable system (ie Roxtec or approved equivalent) that features built-in fire and smoke sealing system that allows cables to be added or removed without need to remove or reinstall fire stopping materials. Capacity (for cabling) of the system shall match that of cable tray.

.3 Install re-enterable system per manufacturer's instructions.

.4 Bond each re-enterable system to equipment grounding conductor with minimum #6 stranded copper wire.

.2 Non-rated Penetrations:

.1 Where cable tray is to penetrate a non-rated wall or floor, the following installation method shall be used:

.1 Stop tray at penetration and fasten tray end to wall/floor.

.2 For every 150 mm of tray width, furnish and install 100 mm PVC sleeve or rigid galvanized nipple (threaded at both ends) through penetration extending 100 mm beyond both sides and adequately supported.

.3 Provide fiber or plastic bushing on both ends of PVC sleeve, or for rigid galvanized nipple, provide fiber or plastic bushing on one end and ground bushing on other end.

.4 Bond each grounding bushing to equipment grounding conductor using minimum #6 stranded copper wire.

.5 Completely seal annular space between wall and conduit sleeve with urethane caulk.

.6 Plug conduits with material to prevent sound or odor transmission.

.3 Warning Signs

.1 Provide warning signs at 5 metre intervals along cable tray. Adjust labeling interval to ensure signs are visible.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to provide all trenching and backfilling as necessary for the installation of all underground cables, etc., as indicated.

PART 2 PRODUCTS

2.1 TRENCHING AND BACKFILLING

.1 Trenching shall be approximately 1000mm in depth, width to suit proper installation.

.2 Backfill for trenches for all direct buried cables, ducts, conduits, etc., shall consist of fine sand (minimum 100 mm below and above cables, etc.) and firmly compacted. Backfill finishing material shall be as indicated in Division 03.

.3 All direct buried cables, ducts, etc., crossing over each other or over/under other types of underground service shall be encased in wood planks treated with pentachlorophenol.

.4 Frozen earth, large lumps or boulders shall not be used for backfill material.

.5 Provide treated wood planks meeting approved wood treatment materials over all buried cables, etc., under existing or future roads and sidewalks.

.6 Provide sleeves under all parking, concrete and traffic areas for cables.

.7 Where cables enter building provide a vertical 100 X 250 mm white sign with black wording ELECTRICAL CABLES securely fastened to the building wall approximately 300 mm above finished grade.

2.2 CABLE PROTECTION

.1 Provide identification tape labelled as indicated showing location of direct buried cables.

PART 3 EXECUTION

3.1 DIRECT BURIAL OF CABLES

.1 After specified sand bed is in place, lay cables in trench, maintaining a 75 mm minimum clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 M run, maintaining mir1Imum cable separation and bending radius requirements.

.3 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Maintain 75 mm minimum separation between cables of different circuits. Maintain 300 mm horizontal separation between low and high voltage cables. When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position. At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables. Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables with fire alarm and control cables in upper position. Install treated planks on lower cables 0.6 m in each direction at crossings.

.6 After sand protective, cover is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks as indicated to cover length of run.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 General Electrical Provisions.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:

.1 After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

.7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

.8 Contractor responsible for making all necessary repairs to installation resulting from improper backfilling, compaction, etc.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of all dry type transformers.

1.3 QUALITY ASSURANCE

.1 To CSA C22.2 No. 47-1961 and C9-1966

.2 Energy efficiency rating in accordance with NRCan 2019 – ON Reg. 404/12.

.3 To C.E.C. Section 26-260 "Marking of Transformers"

1.4 SUBMITTALS

.1 Shop drawings in accordance with Section 26 05 01.

.1 Voltage ranges and taps

.2 KVA rating

.3 Mounting configurations

.4 Weight

.5 Cable terminal sizes

.2 Nameplate data.

PART 2 PRODUCTS

2.1 TRANSFORMERS

.1 Equipment ID: XFMR-A73.

.2 Transformers to have the following characteristics:

.1 Type: ANN

.2 Enclosure: Sprinkler-proof.

.3 Three phase transformer voltage ratings:

.1 600V delta connected primary, 120/208V wye connected secondary.

.4 Single phase transformer voltage ratings:

.1 600V connected primary, 120/240V centre-tap connected secondary.

.5 kVA rating as indicated on drawings.

.6 Operating frequency of 60 Hz.

.7 Winding insulation of 1000 V class, 150° degree temperature rise.

.8 Maximum impedance of 5%.

.9 Sound rating standard.

.10 Basic Impulse Level (BIL) is standard.

.11 Hipot is standard.

.12 Taps 4-2 1/2 percent FCAN, FCBN.

.13 Air ventilated via louvres.

.14 Termination at bottom of transformer.

.15 Finish shall be ASA 61 grey.

.16 All transformer motor windings to be copper.

2.2 MANUFACTURERS

.1 Acceptable manufacturer:

.1 Schneider Electric Square "D".
.2 Hammond.
.3 Bemag.
.4 Approved equal.

PART 3 EXECUTION

3.1 MOUNTING

.1 Installation to C.E.C. Section 26-248.

.2 Units shall be floor or wall mounted as indicated on drawings.

.3 Mount transformers in level upright position.

.4 Units shall be clear of air obstructions on five sides by minimum of 75 mm to ensure adequate ventilation.

.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.

3.2 CONNECTIONS

.1 Make primary and secondary connections.

.2 Energize transformers immediately after installation is completed, where practicable.

3.3 TESTING

.1 Testing of transformers is accordance with Section 26 05 01.

3.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of all distribution and power panelboards, including mounting hardware and breakers or fuses.

1.3 QUALITY ASSURANCE

.1 All equipment to CSA Standard C22.2 No. 29-M1989.

.2 Fault current ratings to be indicated on nameplates.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 01.

PART 2 PRODUCTS

2.1 PANELBOARDS

.1 Equipment ID: PNL-A73.

.2 120/240 V, 1 phase, 3 wire distribution panelboard bus and breakers to be rated 10,000 amps interrupting capacity.

.3 Panelboard mains, number of circuits, and number and size of branch circuit breakers shall be as indicated on the drawings.

.4 The main bus bars shall be copper and shall be equipped with solderless lugs for incoming cables. Neutral to be of same ampere rating as mains.

.5 Distribution section to accommodate circuit breakers. Breakers shall be the interchangeable trip type.

.6 Doors shall have spring hatches and cylinder locks, and all locks shall be keyed alike with two keys per panelboard.

.7 All panelboards shall be supplied complete with a built-in surge protection device as specified in section 26 43 13 and sized in accordance with specific panelboard electrical characteristics.

.8 EEMAC 4X enclosure in corrosive environments, EEMAC 12 enclosure in ordinary areas.

.9 Acceptable manufacturer:

.1 Schneider Electric Square “D” NQ series.

.2 Cutler-Hammer Pow-R-Line Series.

.3 Siemens type NDP.

.4 Approved equal.

2.2 CIRCUIT BREAKERS

.1 Refer to Section 26 28 21 for breaker specification.

.2 Breakers shall be numbered with odd numbers on left and even numbers on right sides of the panel.

.3 Breakers shall be the bolt-on type and shall provide instantaneous trip on over-currents and time-delay trip on overloads.

.4 Breakers shall be compatible with fault current rating of the panel.

.5 Breakers shall be of the thermal magnetic tripping type.

.6 Main breaker shall be separately mounted on top or bottom of panel to suit cable entry as required. When mounted vertically, down position should open breaker.

PART 3 EXECUTION

3.1 PLANT ASSEMBLY

.1 Install circuit breakers in panelboards before shipment.

3.2 INSTALLATION

.1 Locate panelboards as indicated on the drawings and mount securely, plumb true and square.

.2 Install each panelboard 1980 mm above finished floor measured to the top of the enclosure.

.3 Install panelboards mounted on brick, concrete or block walls on plywood backboards or use 3 mm thick lead washers between enclosure and wall face. Where practical, group panels on common backboard.

.4 Make all field wiring connections and terminations. Connect loads to circuits as indicated and connect neutral conductors to common neutral bus with respective neutral identified.

3.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01.

.2 Provide nameplate for each panelboard engraved as directed.

.3 Provide complete circuit directory with typewritten legend showing location and load of each circuit.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section describes the supply and installation of the following two (2) new Motor Control Centres (MCC's) as indicated on the drawings and specified herein:

.1 MCC-A71: Flood Pumping Station MCC.
.2 MCC-A72: Lift Station MCC.

1.3 RELATED WORK

.1 Section 26 28 21 - Circuit Breakers.

.2 Section 26 29 10 - Motor Starters.

.3 Section 25 30 01 – Control Panels

1.4 QUALITY ASSURANCE

.1 Conduct equipment inspection at manufacturer's plant.

.2 Provide manufacturer's type test certificates.

.3 The Engineer reserves the right to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

.4 Submit written test results to the Engineer.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 01. Indicate:

.1 Outline dimensions.
.2 Configuration of identified compartments.
.3 Floor anchoring method and dimensioned foundation template.
.4 Cable entry and exit locations.
.5 Dimensioned position and size of busbars and details of provision for future extension.
.6 Schematic and wiring diagrams.

1.6 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor control centre for incorporation into the Operation and Maintenance Manual as specified in Section 26 05 01.

.2 Include data for each type and style of starter.

1.7 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 26 05 01.

.2 Provide listed spare parts for each different size and type of starter:

.1 2 sets of contacts, stationary
.2 2 sets of contacts, movable
.3 1 contact, auxiliary
.4 1 control transformer for each VA rating
.5 1 operating coil for each starter size supplied
.6 2 fuses of each rating
.7 4 indicating lamps for each type provided
.8 2 relays for each type provided

1.8 CODES AND STANDARDS

.1 Materials and workmanship shall comply with codes and standards of the Province in which the work is located and local codes, regulation and standards.

.2 In addition, the work shall conform to the latest editions and amendments of the applicable Codes and Standards of the following agencies:

.1 EEMAC Standard ICS2-322.
.2 CSA Standard C22.2 No. 14-M1987, "Industrial Control Equipment".
.3 CSA Standard C22.1, Canadian Electrical Code, Part I plus Provincial supplements.
.4 Applicable sections of ANSI (American National Standards Institute) Standards.
.5 All equipment to be CSA approved.

1.9 GUARANTEE

.1 The performance of the motor control centre equipment shall be guaranteed throughout to perform the duty stated herein in accordance with General Conditions

PART 2 PRODUCTS

2.1 SUPPLY CHARACTERISTICS

.1 Motor control centres shall be rated 347/600V, 60Hz, 3 phase, 4 wire, amperage as indicated. Motor control centre shall be "Intelligent" type

equipped with Ethernet communication modules for all starter overloads, reduced voltage starters, VFD's, and power monitor modules.

.2 Motor control centre components shall be capable of communicating directly to the main plant PLC using the AB/TCP communication protocol without the need for protocol conversion.

.3 All equipment controlling loads shall have Hand-Off-Auto switches on MCC bucket door. Auto Status shall be connected to the Intelligent component input for remote monitoring by main PLC control system.

.4 Intelligent Overloads for Starters to contain monitoring of current, overload status, Auto Switch status and provide for remote start/stop control and fault reset.

.5 Intelligent reduced voltage starters to contain monitoring of current, overload status, fault status, Auto Switch status and provide for remote start/stop control and fault reset.

.6 Intelligent VFD's to contain monitoring of current, fault status. Auto Switch status, running status, speed feedback and provide for remote start/stop control, speed control and fault reset.

.7 MCC buckets to contain Ethernet Tap devices to permit the connection of the network in a daisy-chain fashion. Standard of acceptance shall be Allen-Bradley 1783-ETAP.

2.2 MOTOR CONTROL CENTRE GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Accommodating incoming cable to enter at top as indicated.

.4 Class 2, Type B.

.5 Motor circuit protector combination starters.

.6 Enclosure ratings:

.1	MCC-1:	Sprinkler proof EEMAC 1A.
.2	MCC-2:	Sprinkler proof EEMAC 1A.

.7 IC Rating: 42kA.

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, minimum 305 mm high.

.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 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 Provision for outgoing cables to exit via top and bottom.

.8 Removable lift means.

.9 Provision for future extension of one end of motor control centre including busbars without need for further drilling, cutting or preparation in the field.

.10 Divide assembly for shipment to site, as indicated complete with hardware and instructions for re-assembly. Shipping splits shall be coordinated such that each section can be shipped via air freight in horizontal position. Provide all necessary internal bracing for shipping in horizontal position. Coordinate maximum dimensions and weight with general contractor and air carrier.

2.4 SILLS

.1 Continuous 100 mm 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 tin plated copper busbars in separate compartment insulated self-cooled, extending entire width and height of motor control centre, supported on insulators.

.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 MCC short circuit rating shall be 42 kA rms symmetrical.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.6 GROUND BUS

.1 Tin plated copper bus size 50mm x 6mm extending entire width of motor control centre, located at top. Ground motor control centre main bus as specified in Section 26 05 28.

2.7 STARTER UNIT COMPARTMENTS

.1 Units EEMAC size 4 arid smaller, circuit breaker units 225 A 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 silver 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 Devices and components by one manufacturer to facilitate maintenance.

.7 All starters and contactors to have one N.O. and one N.C. spare contact wired to terminal block.

2.8 WIRING AND TERMINAL BLOCKS

.1 The shop installed wiring arrangement shall be as indicated. For Type B wiring, all control connections to be brought to terminal blocks within each starter compartment. Provide a minimum of 5 spare terminal blocks for #12 AWG incoming control wiring.

.2 Incoming and outgoing power cables and conduits shall enter the MCC's from the bottom as indicated.

.3 Provide internal power wiring from the line side of each starter to the bus stabs with a minimum of #12 AWG wire rated for 600 volt duty. Size wiring to accommodate the largest horsepower that the line starter Is capable of switching.

.4 Control wiring shall be as 600 V rated, XLPE insulated, minimum #14 AWG size. Install wiring to panel doors utilizing extra flexible 49-strand conductors.

.5 All internal wiring shall employ stranded copper conductors.

.6 Identify all wiring by means of heat shrink or sleeve type wire markers as manufactured by Critchley, Brady Datab, fixed to each conductor at both ends.

.7 Wires shall be colour coded as follows:

.1 Control circuits Red

.2 Power circuits Black

.8 Terminal blocks shall be of the compression type and shall be of modular pull-apart construction enabling unit wiring to be easily separated from the field wiring. Identify any terminal blocks with numbers identical to the wire numbers.

.9 No more than two wires shall be placed under each terminal screw.

2.9 INCOMING LINE TERMINATION

.1 Provide pressure type cable lugs and bus adapters or extensions suitable for terminating the main incoming cable conductors. The lugs shall accommodate the number and size of cables as indicated. Cable entry shall be from the top of the MCC as indicated.

2.10 SPACE FOR FUTURE UNITS

.1 Provide spaces for starters or switching units in the MCC's for equipment designated "Future". Fully equip these spaces with horizontal and vertical bus bars and an fittings necessary to accommodate the future equipment with a minimum of field alterations and additions. Provide bolted-on blank covers.

2.11 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 21.

2.12 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01.

.2 Motor control centre main nameplate as indicated.

.3 Individual compartment nameplates engraved as indicated.

2.13 MCC-A71 LAYOUT

.1 Section #1:

.1 1 - 600A,3P, service entrance rated main breaker CB-A71 as specified in Section 26 28 21.

.2 One power meter Schneider Electric PM 5000 Series, Provide all necessary cable for connection to SCADA system Ethernet switch.

.3 1 - 30A,3P circuit breaker c/w Surge Protection Device (SPD) CB-TVSS as specified in Section 26 43 13.

.4 1 – 200A,3P circuit breaker CB-A71-T to subfeed MCC-A72. Breaker shall be Kirk-Key interlocked with breaker CB-A72 in MCC-A72.

.5 1 – 12” Empty Space.

.2 Section #2:

.1 1 – Electronic Soft Starter for Flood Pump P-F01, 125 HP, 3Φ, 600V.

.3 Section #3:

.1 1 – Electronic Soft Starter for Flood Pump P-F02, 100 HP, 3Φ, 600V.

.4 Section #4:

.1 1 - 30A,3P circuit breaker CB-L65 for 20 kW Unit Heater UH-L65.
.2 1 - 15A,3P circuit breaker CB-L75 for 10 kW Unit Heater UH-L75.
.3 1 - 15A,3P circuit breaker CB-L76 for 5 kW Unit Heater UH-L76.
.4 1 - 15A,3P circuit breaker CB-L77 for 5 kW Unit Heater UH-L77.
.5 1 - 15A,3P circuit breaker CB-L86 for 5 kW Unit Heater UH-L78.
.6 1 – 12” Empty Space.

.5 Section #5:

.1 1 – FVNR for Exhaust Fan EF-A64, 3 ¾ HP, 3Φ, 600V.
.2 1 – 50,3P circuit breaker CB-A66 for 36 kW Duct Heater HCE-A66.
.3 1 – 20,3P circuit breaker CB-A67 for 13 kW Duct Heater HCE-A67.
.4 2 – 18” Empty Spaces

2.14 MCC-A72 LAYOUT

.1 Section #1:

.1 1 – 200A,3P circuit breaker CB-A72. Breaker shall be Kirk-Key interlocked with breaker CB-A71-T in MCC-A71.
.2 1 - 40A,2P circuit breaker CB-A73 for 15 KVA, 1 phase Transformer XFMR-A73.
.3 1 – 600V Power Failure Relay ESL-A721.
.4 1 – 18” Empty Space.

.2 Section #2:

.1 1 - 50A,3P circuit breaker CB-L01 for Lift Pump P-L01 20 HP VFD.
.2 1 - 50A,3P circuit breaker CB-L02 for Lift Pump P-L02 20 HP VFD.
.3 1 – Spare slot for future Lift Pump P-L03 VFD.
.4 3 – 12” Empty Spaces.

2.15 FINISHES

.1 Apply finishes in accordance with Section 26 05 01.

.2 Paint motor control centre exterior ASA 49 light grey enamel and interiors white.

2.16 MANUFACTURERS

.1 Acceptable MCC manufacturer/model shall be Schneider Electric Model 6.

.2 This product was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.

2.17 PURCHASE OR QUOTATION

.1 All requests for purchase or quotation shall reference RFP 756-2013 to receive discount pricing that the City has negotiated with the vendor.

.2 Contact Schneider Electric Canada, 21 Omands Creek Blvd, Winnipeg MB, R2R 2V2.

PART 3 EXECUTION

3.1 SHOP ASSEMBLY

.1 Shop assembly shall be maximized, to minimize the on-site erection work. Equipment should thus be shipped in as few subassemblies as is practical and in accordance with overall erection schedule.

.2 Containers and components clearly identified for transportation and field assembly.

3.2 PACKAGING AND SHIPPING

.1 Each item shall be packed, crated or otherwise protected so that it is not damaged in transit and arrives in serviceable condition at the site. In particular, measures shall be taken to prevent accumulation of water in equipment.

.2 Crates, boxes and cartons shall be clearly marked to indicate the purchase order number and the name of the equipment.

.3 Shipping invoice shall show the crate, box or carton number.

.4 All finished rubbing ·surfaces which are not assembled in the shop shall be adequately protected during shipment by wrapping with burlap or canvas or other means which shall be secured by wooden batts securely wired together.

3.3 INSTALLATION AND TESTING

.1 Install embedded floor channels where applicable.

.2 Set and secure MCC's in place, rigid, plumb and square, on channel bases.

.3 Interconnect MCC cubicles with bus bar and wiring connectors supplied by manufacturer.

.4 Check factory-made connections for mechanical security, electrical continuity, and current phasing.

.5 Make grounding connections between equipment ground busses and building grounding system.

.6 After finishing work, remove foreign material, including dust, before energizing equipment.

.7 Perform all tests in accordance with Section 26 05 01 and 25 00 01.

.8 Make all power and control field wiring connections.

.9 Check overload trip unit settings against drawings and motor nameplate data.

.10 Ensure moving and working parts are lubricated where required.

.11 Operate starters in sequence to provide satisfactory performance of motor control centre during 8 hour period.

3.4 COMMISSIONING

.1 The motor control manufacturer shall include for the testing and commissioning of the complete systems and instruct the Owner's personnel in the operation of the systems. Two additional site visits shall also be included during the warranty period.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated, or requested to install the wiring and control devices specified herein and on the drawings.

PART 2 PRODUCTS

2.1 GENERAL AC SWITCHES

.1 Single pole, double pole, 3-way, 4-way switches, as indicated, 20 Amp, 120 VAC, CSA approved.

.2 Non-hazardous areas (Electrical Room): manually operated, industrial-grade AC switches. Colour to be advised by Engineer.

.3 Hazardous classified areas (Wet Well Room): manually-operated c/w enclosure suitable for Class 1, Zone 2, areas.

.4 Switches of one manufacturer throughout project.

.5 Acceptable manufacturers:

.1 Non-hazardous: Arrow Hart, Pass & Seymour, Hubbell and Leviton.

.2 Hazardous: Crouse-Hinds and Appleton

2.2 GENERAL AC RECEPTACLES

.1 Non-hazardous areas: industrial grade, 15A-125V AC rated, CSA type 5-15R configuration, U ground, CSA approved, single or duplex receptacle as indicated on drawings. Colour to be advised by Engineer.

.2 Hazardous or classified areas: suitable for Class 1, Zone 1, Group II B areas, 15A-125V AC rated, CSA type 5-15R configuration, delayed action – circuit breaking receptacle with plug adapter. Single or two gang assemblies as indicated on drawings.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable manufacturers:

.1 Non-hazardous: Arrow Hart, Pass & Seymour, Hubbell and Leviton.

.2 Hazardous: Crouse-Hinds and Appleton

2.3 GROUND FAULT INTERRUPTING RECEPTACLES

.1 Receptacle: Duplex CSA 5-15R configuration, 125V, 15A, Class A type interrupter.

.2 Integral solid state ground sensing device.

.3 Integral “test” and “reset” pushbuttons.

.4 Acceptable manufacturers: Leviton, Hubbell and Bryant.

2.4 COVER PLATES

.1 Cover plates from one manufacturer throughout project.

.2 Stainless steel utility box cover for wiring devices installed in surface mounted utility boxes.

.3 Stainless steel cover plates (1 mm thick) for wiring devices mounted in surface mounted FS or FD type conduit boxes.

.4 Weatherproof (WP) double lift spring loaded cast aluminium cover plates complete with gaskets for duplex receptacles as indicated.

.5 Weatherproof spring loaded cast aluminium cover plates complete with gaskets for single receptacles or switches.

PART 3 EXECUTION

3.1 GENERAL SWITCH INSTALLATION

.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 specified in Section 26 05 01 – Electrical General Requirements or as indicated.

3.2 GENERAL RECEPTACLE INSTALLATION

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height specified in Section 26 05 01 – Electrical General Requirements or as indicated.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Provide a separate grounding wire from power source (panel board) to each receptacle, light switch, control panel, junction box, etc.

3.3 COVER PLATE INSTALLATION

.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.

3.4 ISOLATED GROUND RECEPTACLE

.1 Provide a separate insulated ground wire from power source (panel board) to each Isolated Ground receptacle.

.2 Provide a separate bonding wire from power source (panel board) to each receptacle box. Bonding wire to be in addition to the insulated ground wire for Isolated Ground receptacles.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of all magnetic and thermal magnetic circuit breakers.

.2 Specific circuit breaker voltage, phase, ampacity, pole numbers, interrupting capacity, breaker type and setting are indicated elsewhere in the specifications or on the drawings.

1.3 QUALITY ASSURANCE

.1 All equipment to CSA Standard 22.2, No. 5-M1986.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 01, including:

.1 Component function, make and model no.

.2 Breaker voltage and amperage.

.3 Breaker phase, number of poles & number of wires.

.4 Indication of solid neutral if required.

.2 Submit time-current characteristic curves for breakers with ampacity of 15A and over or with interrupting capacity of 22,000A symmetrical (rms) and over at system voltage.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-trip breakers with single handle for multiple applications.

.3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

2.2 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping.

2.3 MAGNETIC BREAKERS

.1 Magnetic circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection (motor starters).

2.4 ENCLOSURES

.1 All breakers shall be housed in an EEMAC 12 rated panelboards, motor panels or MCC. Wall mounted breakers to be housed in enclosures rated for the specific environment as specified in section 26 05 01.

2.5 MAIN BREAKER

.1 New main breaker to be installed in MCC-A71 as specified in Section 26 24 19 and as indicated herein:

.1 Breaker ID Tag: CB-A71
.2 Service entrance rated.
.3 LSI.
.4 600A, 3P.
.5 347V / 600V, 3 phase, 4W service.

2.6 SUB BREAKERS

.1 Flood Pump Breakers to be installed in MCC-A71 as specified in Section 26 24 19 and as indicated herein:

.1 Breaker ID Tags:
  .1 Flood Pump P-F01: CB-F01;
  .2 Flood Pump P-F02: CB-F02.
.2 LI.
.3 Breaker Rating:
  .1 CB-F01; 250A, 3P;
  .2 CB-F01; 250A, 3P.
.4 600V, 3 phase, 3W service.

.2 MCC-A72 Feeder Breaker to be installed in MCC-A71 as specified in Section 26 24 19 and as indicated herein:

.1 Breaker ID Tag: CB-A71-T.
.2 LSI.
.3 Breaker Rating: 200A, 3P.
.4 347V / 600V, 3 phase, 4W service.

.3 MCC-A72 Temporary Generator Breaker to be installed in MCC-A72 as specified in Section 26 24 19 and as indicated herein:

.1 Breaker ID Tag: CB-A72.

.2 LSI.

.3 Breaker Rating: 200A, 3P.

.4 347V / 600V, 3 phase, 4W service

2.7 MANUFACTURERS

.1 For circuit breakers protecting fans, heating elements, transformers and panel boards, acceptable manufacturer is Schneider Electric QOB series

.2 For circuit breakers protecting electric motors, acceptable manufacturer is Schneider Electric Mag-Guard MCP.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers in panelboards and on wall as indicated.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of all motor and equipment disconnect switches.

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Division 01 including the following information:

.1 Scale drawing of switch and enclosure.

.2 Switch voltage rating.

PART 2 PRODUCTS

2.1 UNFUSED DISCONNECT SWITCHES

.1 Provide unfused disconnect switches as indicated, voltage and amperage rated to suit loads.

.2 Disconnect shall be front-operational, heavy duty, industrial grade, quick-make, quick-break type.

.3 Make provision for padlocking in the "OFF" position.

.4 Mechanically interlocked door to prevent opening when handle in "ON" position.

.5 "ON/OFF" switch position indication on switch enclosure cover.

.6 Disconnect enclosures shall be EEMAC 4X in corrosive environments, EEMAC12 in ordinary areas, or EEMAC 7 in hazardous environments, unless otherwise indicated.

2.2 MANUFACTURERS

.1 EEMAC 12 and 4X rated equipment disconnects shall be as manufactured byCooper Crouse-Hinds GHG series, Arrow Hart AH series, Cutler-Hammer HD series, Schneider Canada Square "D" CHU series.

.2 EEMAC 7 rated equipment disconnects shall be as manufactured by Cooper Crouse-Hinds GHG series.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches as per manufacturer's recommendations.

.2 Mount switches at 1400mm above finished floor to the underside of the switch enclosure.

3.2 IDENTIFICATION

.1 Provide lamacoid nameplate on front face of switch identifying equipment.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of the motor starters.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 26 05 01. Include:

.1 Mounting method and dimensions

.2 Starter size and type

.3 Layout of identified internal and front panel components

.4 Enclosure types

.5 Wiring diagram for each type of starter

.6 Interconnection diagrams

1.4 STANDARDS

.1 IEC Standards are acceptable for magnetic starter and contactors if application size doubled.

.2 EEMAC North American Standards to apply.

.3 Open wound starters or relay coils not allowed.

.4 All coils to be epoxy potted.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data as specified in Section 26 05 01.

.2 Include operation and maintenance data for each type and style of starter.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with the Section 26 05 01.

.2 Provide listed spare parts for each different size and type of starter:

.1 2 sets of contacts, stationary.

.2 2 sets of contacts, movable.

.3 1 set of contacts, auxiliary.

.4 1 control transformer for each VA rating supplied.

.5 1 operating coil for each starter size supplied.

.6 2 fuses of each rating.

.7 4 indicating lamps, for each type supplied.

.8 1 communication module of each type supplied

.9 List local suppliers all above parts.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Starters shall be EEMAC E140-1.

.2 Half size starters not acceptable.

.3 Smallest size starter to be size 1.

2.2 MANUAL MOTOR STARTERS

.1 Single or three phase manual motor starters of size, type and rating, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or, three overload heaters, manual reset, trip indicating handle as required.

.3 Enclosures as specified in 26 05 01.

.2 Accessories:

.1 Toggle switch: standard heavy duty oil tight labelled as indicated.

.2 Indicating light: heavy duty oil tight type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

.3 Acceptable manufacturer shall be Schneider Electric FG1 series.

2.3 FULL VOLTAGE NON-ERVERSING (FVNR) MAGNETIC STARTERS

.1 Magnetic starters through NEMA Size 9 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter shall have one (1) NO auxiliary contact.

.2 Coils shall be permanently marked with voltage, frequency and part number.

.3 Solid-State Overload Relay

.1 Where indicated on the drawings, provide a definite-purpose, microprocessor-based Overload Relay (OLR) in each starter and/or where indicated on the drawings for protection, control and monitoring of the motors. The OLR shall meet UL 1053, CUL and CSA standards

.2 The relay shall not require external current transformers for applications up to 150 amperes for motors rated less than 600 Vac. Where larger motors are involved, external current transformers shall be used. The relay shall include terminals for remote trip and remote reset.

.3 The OLR shall have the following motor control functions:

.1 1 - Fault relay, Form C, NO/NC contact with a rating code of B300 per UL 508.

.2 1 - Ground fault relay, Form A, NO contact with a rating code of B300 per UL 508.

.3 1 - External remote reset terminal.

.4 1 - Trip status indicator.

.4 The OLR shall be capable of accommodating external current transformers with ranges from 150:5, 300:5, and 600:5 amperes. Provide three (3) current transformers sized per manufacturer's recommendations based on motor full-load amperes and service factor.

.5 The OLR shall draw its power from the line-voltage input for the motor. The OLR shall be suitable for either 50 Hz or 60 Hz

.6 The OLR shall have selectable trip classes 5-30.

.7 The OLR shall be equipped with an operator-interface (OI)/ display interface panel. The OI shall have a seven-segment display for programming, monitoring, and alarming functions.

.8 The OLR shall annunciate the following conditions:

.1 Motor Protection consisting of:

.1 Thermal overload
.2 Jam protection
.3 Current unbalance
.4 Current phase loss
.5 Ground fault
.6 Phase reversal

.2 Load protection consisting of:

.1 Under-current
.2 Low power (kW)
.3 High power (kW)

.3 Line Protection consisting of:

.1 Over-voltage
.2 Under-voltage
.3 Voltage unbalance
.4 Voltage phase unbalance

.9 The OLR shall have the following monitoring capabilities:

.1 Current—Average and Phase RMS
.2 Voltage—Average and Phase RMS
.3 Power—Motor kW
.4 Power Factor
.5 Frequency
.6 Thermal capacity
.7 Run hours
.8 Ground fault current
.9 Current unbalance %
.10 Voltage unbalance %

.10 The OLR shall have Type 12 remote-mounted display/operator-interface option for use with enclosed control or motor control centers.

.11 The OLR shall be equipped with the following optional communication module:

.1 Modbus
.2 Ethernet IP with I/O

.4 NEMA Size 00 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any arrangement normally open or normally closed. Size 3 through 8 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any arrangement normally open or normally closed.

.5 Motor starters shall be Schneider Electric Square “D” Class 8536, Type S.

2.4 SOFT STARTER

.1 Design requirements:

.1 The Short Circuit Current Rating (SSCR) of the assembly must equal or exceed 18 kA.
.2 Ventilation system designed for ambient temperature range of 5°C to 35°C. Enclosure temperature not to exceed 45°C.

.2 Soft Starter Modules:

.1 Continuous rating: as indicated on the Drawings.
.2 Rated operation voltage: 600 VAC, 60 Hz.
.3 Control circuit voltage: 120 VAC, 60 Hz.
.4 Operating temperature range, without de-rating: -10°C to +40°C.
.5 Logic inputs: Qty 4, 24 VDC, programmable.
.6 Logic outputs: Qty 2, 24 VDC (open collector), programmable.
.7 Relay outputs: Qty 3, Form-A (Normally Open).
.8 Analog outputs: Qty 1, 0-20 mA / 4-20 mA, programmable.
.9 Vibration resistance:
.1 1.5 mm peak from 2 to 13 Hz.

.2 1 gn from 13 to 200 Hz.

.10 Shock resistance: 16 g, 11 ms.

.11 Acceptable products:

.1 Schneider Electric ATS48 Series.

.2 No alternates will be accepted.

.3 Isolation Contactors:

.1 NEMA rated, size as indicated on the Drawings.

.2 120 VAC, 60 Hz coil.

.4 Bypass Contactors:

.1 NEMA rated, size as indicated on the Drawings.

.2 120 VAC, 60 Hz coil.

.5 Control Transformers:

.1 Single phase, dry-type, with 600V primary and 120V secondary, complete with primary and secondary fusing, installed in enclosure with soft starter, as indicated.

.2 Calculate required size of the control transformer. The size shown on the drawings is the minimum size. Provide size as required for appropriate operation of the starter, plus 20% spare capacity.

.6 Interval Timing Relays:

.1 Interval timing relay automatically switches state when energized and switches back to steady state after timing period lapses.

.2 Relay contact shall switch back to steady state while coil remains energized indefinitely.

.3 120 VAC, 60 Hz coil.

.4 Din rail mountable.

.5 Pins: 8.

.6 Power supply start.

.7 Time delay setting:

.1 Adjustable: 0.1 - 60 seconds.

.2 Rotary analog.

.8 Relay Outputs:

.1 Form-B contacts: Quantity 2.

.2 Rated for 120 VAC, 60 Hz.

.9 Modes:

.1 E (Interval).

.10 Acceptable products:

.1 Omron H3CR-A8 complete with Omron PF085A.

.7 Current Transducers:

.1 Power Supply: 120 VAC, 60 Hz.

.2 Input: 0 - 5A, 60 Hz.

.3 Output: 4 - 20 mA.

.8 Current Meters:

.1 Type: Analog

.2 Input: 0 - 5 A, 60 Hz.

.3 Display Range: 0 - 200 A.

.9 Cooling:

.1 Provide cooling system as required to maintain an acceptable enclosure.

.2 Intake fan located at bottom of enclosure.

.3 Exhaust vent located at top of enclosure.

.10 Door-mounted soft starter Human Interface Module (HIM).

.11 Pilot Devices:

.1 Push buttons and selector switches: Heavy-duty, oil tight, NEMA rated, 30 mm, labelled as indicated on the Drawings.

.2 Indicating lights: Heavy-duty, oil tight, NEMA rated, 30 mm, LED bulb, type and color as indicated on the Drawings.

.3 Start push buttons to utilize a green cap, and stop pushbuttons to utilize a red cap.

.4 Pilot devices are to be labelled with text along with label locations as indicated on the Drawings.

.12 Documentation:

.1 Provide door pocket with complete set of drawings for each starter.

2.5 CONTROL TRANSFORMERS

.1 Single phase, dry type, control transformer with 600 volt primary voltage and 120V secondary, complete with secondary fuse, in-stalled in with starter as indicated.

.2 Size control transformer for control circuit load required plus 100% spare capacity.

2.6 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 01.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01.

.2 Magnetic starter designation label, engraved as indicated in the motor equipment description column on the electrical motor schedule.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install starters, connect power and control circuits as indicated.

.2 Install auxiliary contacts and connect wiring.

.3 Ensure correct MCP settings and overload devices elements installed.

.4 Manual motor starters shall be mounted 1500mm above finished floor level to top of starter enclosure.

3.2 TESTS

.1 Perform tests in accordance with Section 26 05 01 and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section provides specification requirements for adjustable frequency drives, variable speed drives or herein identified as AC Drives for use with NEMA B design AC motors.

.2 Any exceptions/deviations to this specification shall be indicated in writing and submitted with the quotation.

1.3 REFERENCES

.1 CSA C22.2 No. 14-M91-Industrial Control Equipment.

.2 IEC 529-Degrees of Protection Provided by Enclosure.

.3 NEMA ICS7-Industrial Control and Systems Adjustable Speed Drives.

.4 NEMA ICS 7.1-safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives.

.5 UL 508-UL Standard for Safety Industrial Control Equipment.

.6 UL 508C-UL Standard for Safety Power Conversion Equipment.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 01. Submittal to include standard catalogue sheets showing voltage, horsepower, maximum current ratings and recommended replacement parts with part numbers shall be furnished for each different Horsepower rated AC Drive provided.

1.5 WARRANTY

.1 1-year parts warranty shall be provided on materials and workmanship from the date of start-up or 18 months from the date of shipment.

1.6 QUALITY ASSURANCE

.1 The AC Drive and all associated optional equipment shall be CSA certified. As verification, a CSA label shall be attached on the side of the drive controller.

.2 The AC Drive shall be designed, constructed and tested in accordance with NEMA, NEC, IEC standards and CSA certified.

PART 2 PRODUCTS

2.1 GENERAL DESCRIPTION

.1 The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage as defined in the following sections.

.2 The input power section shall contain external 5% line reactor. The line reactor should provide a minimum of 5% impedance based on the drive operating at its continuous output current rating.

.3 The input power section shall-utilize a full wave bridge design incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage. This power section shall be insensitive to phase rotation of the AC line. The DC voltage shall be filtered.

.4 The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBTs) or intelligent power modules (IPMs) as required by the current rating of the motor.

.5 The AC Drive's output shall be connected to output 3% load reactor for distances shorter than 30 m or dv/dt filter for distances longer than 30 m. Load reactors and/or dv/dt filters to be Transcoil KDR or V1k series, or approved equal.

2.2 MOTOR DATA

.1 The AC Drive shall be sized to operate the following AC motor:

.1 Motor Horsepower: as indicated on drawings.

.2 Motor RPM: 1800; 60Hz.

.3 Motor voltage: 575 VAC.

.4 Motor service factor: 1.15.

2.3 APPLICATION DATA

.1 The AC Drive shall be· sized to operate a constant torque load.

.2 The motor speed range shall be from a minimum speed of 1.0 Hertz to a maximum speed of 60 Hertz.

.3 The AC drive shall have, as a minimum, a 5:1 turndown ratio.

.4 The AC drive shall be capable of running in reverse.

2.4 ENVIRONMENTAL RATINGS

.1 The AC Drive shall be of construction that allows operation in a pollution Degree 2 environment.

.2 The AC Drive shall be designed to operate in an ambient temperature from 0° to + 40°C.

.3 The storage temperature range shall be -40° to + 70° C.

.4 The maximum relative humidity shall be 95% at 40°C, non-condensing.

.5 The AC Drive shall be rated to operate at altitudes less than or equal to 3,300 ft. (1000m). For altitudes above 3,300 ft., derate the AC Drive by 1% for every 300 ft. (100 m).

2.5 ENCLOSURE

.1 Stand-alone, floor mounted cabinet.

.2 EEMAC 1A gasketted, suitable for location in a rugged industrial environment.

2.6 RATINGS

.1 The AC Drive shall be designed to operate from an input voltage of 500 to 600VAC +/- 10%.

.2 The AC Drive shall operate from an input voltage frequency range from 47 to 63 Hz.

.3 The displacement power factor shall not be less than .96 lagging under any speed or load condition.

.4 The efficiency of the AC Drive at 100% speed and load shall not be less than 97%.

.5 The constant torque rated AC Drive overcurrent capacity shall be not less than 150% for 1 minute.

.6 The output carrier frequency of the AC Drive shall be selectable from 1.0 to 6 KHZ depending on Drive rating. For low noise operation, derating may be required.

.7 The output frequency shall be from 0.1 to 320 Hertz.

.8 The.AC drive will incorporate Sensorless Flux Vector control technology for increased starting torque and better dynamic speed control performance.

2.7 PROTECTION

.1 Upon power-up the AC Drive shall automatically test for valid operation of memory, dynamic brake failure, power and the pre-charge circuit.

.2 The Power Converter shall be protected against short circuits between, output phases, output phases and ground. The AC Drive shall safely shut down without damaging any power circuit devices.

.3 For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function should provide up to 10 programmable restart attempts with Lock-out after the last attempt. The programmable time delay before restart attempts will range from 1 to 60 seconds. This feature can be defeated if not required.

.4 The rotating motor auto start on power-up function could be enabled/disabled if required.

.5 The AC Drive shall be capable of running without a motor connected for setup and testing.

.6 The deceleration mode of the AC drive shall be programmable for normal and fault conditions. The stop modes shall include free-wheel stop, emergency stop and DC injection braking.

.7 Upon a loss of the analog process follower reference signal, the AC drive shall fault and/or operate at a user defined speed set between software programmed low speed and high speed settings.

.8 The AC drive shall have solid state I^2t protection that is UL listed and meets UL 508 as a Class 10 overload protection and meets IEC 947. The minimum adjustment range shall be from 50 to 110% of the current output of the AC Drive.

.9 There shall be a minimum of 2 skip frequency ranges that can each be programmed with a programmable bandwidth from 0 to 10Hz. The skip frequencies shall be programmed independently, back to back or overlapping.

.10 The AC Drive shall have an internal over temperature protection.

2.8 ADJUSTMENTS AND CONFIGURATIONS

.1 If required, a password should be available to allow the terminal keypad to be locked out from unauthorized personnel.

.2 The acceleration and deceleration ramp times shall be adjustable from [0.1 to 3000.0 seconds].

.3 The memory shall retain and record run status, operating time, fault type of the past 10 faults.

.4 Slip compensation shall be a software enabled function.

.5 The AC drive. shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator continuously, at start and/or at stop. The level of current will be adjustable between 15-150% of rated current.

.6 The AC drive shall be fully programmed to match motor nameplate data as installed on site.

.7 The AC drive shall be programmed, commissioned and tuned to site process conditions and per process requirements.

.8 As a minimum, the following parameters shall be accessible:

.1 Maximum speed

.2 Minimum speed

.3 Current limit

.4 Thermal overload

.5 Restart limit

.6 Skip frequency and bandwidth

.7 Preset speed

2.9 OPERATOR INTERFACE

.1 The operator interface terminal should feature and alphanumeric display with seven indicators for speed controller status (Run, direction, ready stop, alarm, fault) and three indicators for control (1/0 terminal, keypad, bus/communication). There are also three LEDs indicators green/green/red for Ready, Run, Fault. The terminal should allow the modification of AC drive adjustments via a keypad. All electrical values, configuration parameters, application and activity function access, faults, local control, adjustment storage will be in plain English.

.2 The display will be a high resolution, LCD backlighted screen capable of displaying two lines of alphanumeric characters. The use of coded or abbreviated displays shall not be acceptable.

.3 The following monitoring values shall be accessible and available when in the operating mode:

.1 Frequency (Hz) and/or motor speed (RPM)

.2 Motor current (A), motor voltage (V), motor torque (%), motor power (%)

.3 Drive temperature (°C)

.4 Motor temperature (%)

.5 Values or status of analog I/O, digital I/O

.4 The operator terminal shall allow the user to display up to three user selectable monitoring values on the same screen at a time.

.5 The operator terminal shall offer a general menu consisting of parameter setting, fault history, and drive configuration. A software lock with password will limit access to the main menu or parameters.

.6 There will be function keys that allowing the ability to scroll through menus and screens, select or activate functions or increase the value of a selected parameter.

.7 A data entry key will allow the user to confirm a selected menu or numeric value.

.8 The following control functions shall be available on the keypad:

.1 Start

.2 Stop

.3 Select

.4 Reset

.5 Direction control

.9 A RESET key will allow a parameter to return the existing value if adjustment is not required and the value is displayed.

.10 The AC drive shall have a LED on the keypad to indicate RUN status of the drive.

2.10 CONTROL

.1 External pilot devices shall be able to be connected to a terminal strip for starting/stopping the AC Drive, speed control and displaying operating status. All outputs will be software assignable.

.2 The control power for the digital inputs and outputs shall be 24 VDC.

.3 There will be two (2) analog inputs. The analog inputs will be hardware selectable and consist of the following configurations: 0(4)-20 mA, 0-10V, or +/- 10V.

.4 There will be six (6) digital inputs that shall be individually user assignable to perform the various control functions available.

.5 There will be one (1) software assignable analog output that can be selected and assigned in the software. The analog output assignments shall be programmable 0(4)-20 mA or 0-10V.

.6 Two form "C" configurable relay output contacts and an open collector output (24 VDC) to power a relay or pilot light, shall be provided. Each shall be programmable to indicate one of the following:

.1 Run

.2 Fault

.3 Ready

.4 At speed

.5 Current limit

.6 Follower present

.7 Auto Speed mode

.8 Reverse indicator

.9 PID control active

.10 Over-temperature alarm

.7 There shall be available additional hardware input l output cards for incorporating alternate control signals including AC voltage logic inputs, PTC thermistor inputs and encoder feedback inputs.

2.11 COMMUNICATIONS

.1 The AC Drive shall be equipped with AB-TCP Ethernet/IP communication card and shall be capable of communicating directly with the Modicon PLC without the need for an external protocol converter.

2.12 MANUFACTURERS

.1 The AC Drive shall be Schneider Electric Altivar 71.

.2 This product was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted.

2.13 PURCHASE OR QUOTATION

.1 All requests for purchase or quotation shall reference RFP 756-2013 to receive discount pricing that the City has negotiated with the vendor.

.2 Contact Schneider Electric Canada, 21 Omands Creek Blvd, Winnipeg MB, R2R 2V2.

PART 3 EXECUTION

3.1 INSPECTION

.1 Verify that the location is ready to receive work and the dimensions are as indicated.

.2 Do not install AC Drive until the building environment can be maintained with the service conditions required by the manufacturer.

.3 The supplier of AC Drive shall have a factory trained service representative in domestic residence within 1000 km (average) of the job site. The factory representative shall be trained in the maintenance and troubleshooting of the equipment as specified herein.

3.2 PROTECTION

.1 Before and during the installation, the AC Drive equipment shall be protected from site contaminants.

3.3 INSTALLATION

.1 AC drives shall be installed in the motor control centre as indicated. Installation shall be in compliance with manufacturer's instructions, drawings and recommendations.

3.4 TRAINING

.1 An on-site training course of 1 day shall be provided by a representative of the AC Drive supplier to plant and / or maintenance personnel.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 This section covers the supply and installation of all transient voltage surge suppressors.

1.3 RELATED SECTIONS

.1 Section 25 30 01 – Control Panels.

.2 Section 26 24 17 – Panelboards.

.3 Section 26 24 16 – Motor Control Centres.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with General Electrical Requirements Section 01 33 00 including:

.1 Unit dimensions, mass, installation instruction details and wiring configuration.

.2 Clamping voltage test data, in a graph form, for a Category B3 ringwave and a Category B3 combination wave, as defined by ANSI/IEEE C62.41 and tested in accordance with ANSI/IEEE C62.45.

.2 A nameplate showing the electrical ratings, including UL 1449 surge suppression ratings and the UL and CSA monograms, shalt be permanently affixed to the unit.

PART 2 PRODUCTS

2.1 GENERAL PRODUCT

.1 The transient voltage surge suppressors (TVSS) or surge protection devices (SPD) described by this specification are to be installed in the various panels as indicated.

.2 All TVSS devices shalt be listed under UL 1449 and certified by CSA.

.3 TVSS device enclosure shall be rated EEMAC 12.

2.2 SPECIFIC PRODUCT REQUIREMENTS

.1 TVSS device installed on the MCC shall be suitable for a Category C3 environment in accordance with ANSI/IEEE C62.41.

.2 TVSS device shall be wired in parallel into the electrical system.

.3 TVSS device shall feature full-cycle tracking clamping profiles that follow the AC sine wave contour for uniform transient voltage surge suppression regardless of phase angle.

.4 TVSS device circuit shall be a MOV-based, hybrid design; surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform shall be rated and internally fused to a minimum of 100kA in relation to available interrupting capacity (AIC) per phase and provide equal impedance paths to each matched. MOV bank. TVSS device design shall not be based on components such as gas tubes, which may crowbar the system.

.5 The maximum continuous operating voltage (MCOV) shall be greater than 115% of the nominal system operating voltage.

.6 TVSS devices shall protect against surges between phase and neutral (L-N) and neutral and ground (N-G) in wye configured systems (four-mode TVSS device). TVSS devices for branch panels shall protect against surges between phase and neutral (L-N), phase and ground (L-G) and neutral and ground (N-G) in wye configured systems (seven-mode TVSS device). All delta configured systems shall be protected between phases (L-L) and phase to ground (L-G).

.7 TVSS devices shall be capable of sustaining a single pulse transient current (based on a single pulse 8 x 20µs waveform specified in IEEE C62.45) of 150kA in the L-N mode for wye configured systems, or L-L and L-G for delta configured systems, and 50kA in the N-G mode. TVSS devices for branch panels shall be capable of sustaining a single pulse transient current (based on a single pulse 8 x 20µs waveform specified in IEEE C62.45) of 90 kA in the L-N and L-G modes, or L-L and L-G for delta configured systems, and 50kA in the N-G mode.

.8 Maximum let through voltage shall not exceed the following UL 1449 Classification, for Category B3 ring and combination waves:

Max. Let Through Voltage per Mode	L-N, N-G; L-G (when present)	L-L
120/240 VAC, 1φ	500	-
120Y/208 VAC	500	-
220 VAC Delta	-	500
220Y/380 VAC	800	-
240 VAC Delta	-	800
277Y/480 VAC	1000	-
347Y/600 VAC	1200	-
480 VAC Delta	-	1500
600 VAC Delta	-	2000

.9 TVSS device endurance shall meet the UL Category C3 as an adjunct to its TVSS UL listing, consisting in the application of 1000 surges at 30-second intervals with 20 kV full peak voltage values for IEEE Category C3.

2.3 SAFETY AND DIAGNOSTIC MONITORING

.1 TVSS device shall have visual indicators and an audible alarm to advise that the system is active and functioning properly or that TVSS protection has been lost or damaged and that device maintenance or replacement is necessary.

.2 TVSS device shall include a set of 1 N.O. and 1 N.C. contacts for remote monitoring of device status and be capable of incorporating an optically-coupled sensing circuit option, which will permit monitoring of the TVSS device from a remote site.

.3 TVSS device shall include a test and diagnostic circuit to ensure proper functioning of the monitoring circuit.

2.4 ACCEPTABLE MANUFACTURER

.1 All TVSS devices shall be from the same manufacturer

.2 TVSS device manufacturer shall provide a full 5 year warranty from the date of installation against any part failure when installed in compliance with the manufacturer's instructions and all applicable national and local electrical codes.

.3 Acceptable manufacturer shall be Schneider Electric Square D SurgeLogic.

PART 3 EXECUTION

3.1 WIRING REQUIREMENTS

.1 All TVSS devices shall be installed in accordance with the applicable sections of the C.E.C. Part I and following the manufacturer's recommended practice. Conductor lead lengths to the TVSS device shall be kept as short as possible, without unnecessary bends. Conductors shall be twisted and tightly bound together. Refer to manufacturer's instructions for required size of conductors.

3.2 EXTERNALLY MOUNTED TVSS

.1 Provide a breaker sized in accordance with TVSS device manufacturer's instructions for connection of TVSS device into panel.

.2 Maximum conductor lead length between breaker and TVSS device shall not exceed 500mm (18").

3.3 INTEGRATED DISTRIBUTION PANEL INSTALLATION

.1 TVSS devices shall be factory installed into the distribution panelboards as specified in Section 26 24 17.

3.4 CONTROL PANEL INSTALLATION

.1 TVSS's to be supplied as stand-alone units for installation in control panels as specified in Section 25 30 01.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections form part of the Contract Documents.

1.2 SCOPE

.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install the lighting equipment specified herein and on the drawings.

1.3 SUBMITTALS

.1 Submit shop drawing in accordance with Division 01.

.2 Submit shop drawings for all luminaries and accessories, as specified herein and on the contract drawings.

PART 2 PRODUCTS

2.1 LIGHTING – LUMINAIRE SCHEDULE

.1 Refer to Contract Drawings for all lighting products (i.e., luminaries, exit signs, emergency lighting units, etc.).

.2 Provide all necessary mounting brackets, hangers, etc., as required for installation.

2.2 PHOTOCELLS

.1 Photo-electric cell: cadmium sulphide, epoxy coated.

.2 Construction: weather tight die cast housing, completely self-contained, not affected by moisture, vibration or temperature changes. Includes fixed base and bracket for conduit mounting.

.3 Controls: on-off adjustment, with manual light level selector for 1-5fc turn-On and 3-15fc turn-Off adjustments. Includes adjustable delay for false switching.

.4 Ballast rating: 120VAC, 2000W/1800VA, SPST contact.

.5 Operating temperature range: -40°C to + 60°C

.6 Acceptable manufacturer: Tork 2101 Series.

2.3 LED LUMINAIRE ASSEMBLIES

.1 Driver

.1 The LED driver shall be securely mounted inside the fitter, for optimized performance and longevity.

.2 The LED driver shall be supplied with a quick-disconnect electrical connector on the power supply, providing easy power connections and fixture installation.

.3 The driver shall be UL Listed or Recognized, have a power factor not less than 90%, and a THD no greater than 20% at full load.

.4 The driver shall have overload as well as short circuit protection.

.5 The drive current for pole mounted luminaries shall be 450ma, constant current design.

.6 The drive current for wall mounted luminaries shall be 700ma, constant current design.

.7 The driver shall be a DC voltage output, 60 Hz.

.8 The driver shall have a minimum efficiency of 90%.

.2 Light Sources

.1 The luminaire shall use high output, high brightness LEDs.

.2 The LEDs shall be attached to the printed circuit board with not less than 90% pure silver to insure optimal electrical and thermal conductivity.

.3 The LEDs and printed circuit boards shall be protected from moisture and corrosion by a conformal coating of 1 to 3 mm.

.4 The LEDs and printed circuit board construction shall be environmentally friendly and 100% recyclable. They shall not contain lead, mercury or any other hazardous substances and shall be RoHS compliant.

.5 The LED life rating data shall be determined in accordance with IESNA LM-80-08. Testing must be done with a complete assembled luminaire.

.3 Optics

.1 The luminaire shall be provided with individual acrylic, refractor type optics applied to each LED.

.2 The luminaire shall provide light distribution per IESNA classifications. Testing shall be done in accordance with IESNA LM-79-08.

.4 Performance

.1 The LED arrays are built in series-parallel circuits which maintain overall light output in the event of single LED failures.

.2 The LED and LED driver shall operate over -40°C to +50°C ambient air temperature range.

.3 The high performance white LEDs will have a minimum 70,000 hour L70 value rated at 25°C.

.4 The high brightness, high output LEDs shall be a maximum 5000K colour temperature with a minimum 75 CRI (+/- 5%).

.5 The pole mounted luminaire fixture output shall be IES Type III distribution.

.6 The wall mounted luminaire fixture output shall be IES Type IV distribution.

.5 Warranty

.1 The luminaire shall be free from all defects in materials and workmanship for a minimum period of five (5) years from the date of manufacture.

.2 The luminaire manufacturer shall warrant the LED boards/system, during the stated warranty period, against failure defined as more than three (3) simultaneous non-operating LEDs.

.3 The driver shall be warranted for a minimum of five (5) years.

.6 Shop Drawings

.1 All shop drawings must be submitted with the following tests:

.1 IESNA LM-79-08

.2 IESNA LM-80-08, test must be done for the complete assembled luminaire.

.7 Alternates

.1 Luminaires not meeting the minimum requirements of this specification will not be considered.

2.4 EXIT SIGNS

.1 Complies with Minimum Energy Performance standards as dictated by Natural Resource Council of Canada (NRCC) and most recent CSA Standards (CAN/CSA C860-01).

.2 Maximum power consumption: 5 Watts per face.

PART 3 EXECUTION

3.1 LIGHTING LUMINAIRES

.1 Install lighting luminaires as shown on the drawings and in accordance with the manufacturer’s installation recommendations.

.2 Replace any new luminaires showing marks or scratches due to handling or tool marks at no cost to the Owner.

.3 Install all luminaries accurately in line and level. Align luminaries shown in continuous rows and in straight lines.

.4 Provide and install any additional support brackets, clamps, channels, hangers, etc., necessary to install the luminaries where shown. Do not support luminaries from ducts, piping or equipment. Ensure that all installed luminaries are freely accessible.

.5 Check area for interference from piping, ductwork and equipment, and obtain written authorization from the Engineer before proceeding with fixture installation.

.6 Cooperate with the ceiling materials contractor. Ensure installation of luminaires is in correct location in relation to ceiling, and luminaires are suitable for the ceiling installed. Ensure no obstructions exist over ceiling, which will interfere with the installation of the luminaires.

.7 Coordinate work with all other divisions. If interferences are discovered advise the engineer immediately and do not proceed until adjustments are approved.

.8 All interior luminaires to be installed directly to ceiling structure or as noted on drawings

3.2 WIRING

.1 Install wiring for all lighting luminaires in accordance with Section 26 05 01.

3.3 FIELD QUALITY CONTROL

.1 After installation perform potential and continuity tests and ensure that all ground connections are properly made and made good any equipment or material which fails the tests before energizing the system.

3.4 VERIFICATION

.1 Ensure emergency lighting system complies with Section 3.2.7.3 of the Manitoba Building Code, latest edition and bulletins.

.2 Provide (as a separate price item) manufacturer’s on-site field certification/testing of the emergency lighting system.

END OF SECTION