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PROJECT MANUAL
Issued for Construction

Swift Current Research and Development
Centre
Booster Pump & Backflow Prevention
Upgrade

Swift Current Sask.

2020-10-09

Contract No. 465-1-16-C45

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END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 The addition of a domestic water booster pump for the facility. Work of this Contract comprises of the following works at the Swift Current Research and Development Centre (SCRDC) located in Swift Current, SK:
- .2 The addition of Domestic water booster pump for the facility.
- .3 Piping work to eliminate cross connections in the domestic water system.
- .4 The addition of backflow preventors.

1.2 WORK SEQUENCE

- .1 Construct Work in phases to accommodate use of premises, during construction.
- .2 Continuous operation of the facility, with minimal shut down and impact to operations, is required.
 - .1 In the event the work will require a temporary shutdown of the domestic water system it must be done at an agreed schedule with AAFC and if possible after hours.
- .3 Develop Construction Progress Schedule, taking into account continuous operation, and occupancy during construction.
- .4 Maintain fire access/control.

1.3 DEPARTMENTAL REPRESENTATIVE-FURNISHED ITEMS

- .1 Departmental Representative's Responsibilities:
 - .1 Inspect deliveries jointly with Contractor.
 - .2 Contractor's Responsibilities:
 - .1 Designate submittals and delivery date for each project in progress schedule.
 - .2 Review shop drawings, product data, samples, and other submittals. Submit to Departmental Representative notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
 - .3 Receive and unload products at site.
 - .4 Inspect deliveries jointly with Departmental Representative; record shortages, and damaged or defective items.
 - .5 Handle products at site, including uncrating and storage.
 - .6 Protect products from damage, and from exposure to elements.
 - .7 Assemble, install, connect, adjust, test, and finish products.
 - .8 Provide installation inspections required by public authorities.
-

- .9 Repair or replace items damaged by Contractor or subcontractor on site (under its control).

1.4 FIRE SAFETY REQUIREMENTS

- .1 Comply with both the National Building Code of Canada 2010 and the National Fire Code of Canada 2010 for safety of persons in buildings in the event of a fire and the protection of buildings from the effects of fire, as follows;
 - .1 The National Building Code (NBC): for fire safety and fire protection features that are required to be incorporated in a building during construction.
 - .2 The National Fire Code (NFC):
 - .1 The on-going maintenance and use of the fire safety and fire protection features incorporated in buildings.
 - .2 The conduct of activities that might cause fire hazards in and around buildings.
 - .3 Limitations on hazardous contents in and around buildings.
 - .4 The establishment of fire safety plans.
 - .5 Fire safety at construction and demolition sites.
 - .2 Welding and cutting:
 - .1 At least one week prior to commencing cutting, welding or soldering procedure, provide to Departmental Representative:
 - .1 Notice of intent, indicating devices affected, time and duration of isolation or bypass.
 - .2 Completed welding permit as defined in NFC.
 - .3 Return welding permit to Departmental Representative immediately upon completion of procedures for which permit was issued.
 - .2 “Fire Watchers” as described in NFC shall be assigned when welding or cutting operations are carried out in areas where combustible materials within 15m may be ignited by conduction or radiation.
 - .3 Where work requires interruption or cause activation of fire alarms or fire suppression, extinguishing or protection systems:
 - .1 Provide “Watchman Service” as described in NFC; In general, watchman service is defined as an individual conversant with “Fire Emergency Procedures”, performing fire picket duty within an unprotected and unoccupied (no workers) area once per hour.
 - .2 Retain services of manufacturer for fire protection systems on daily basis or as approved by Departmental Representative, to isolate and protect all devices relating to:
 - .1 modification of fire alarms, fire suppression, extinguishing or protection systems; and/or
 - .2 cutting, welding, soldering or other construction activities that might activate fire protection systems.
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- .3 Immediately upon completion of work, restore fire protection systems to normal operation and verify that all devices are fully operational.
- .4 Inform fire alarm system monitoring agency and local Fire Department immediately prior to isolation and immediately upon restoration of normal operation.

1.5 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

1.6 FIELD QUALITY CONTROL

- .1 Carry out Work using qualified licensed workers or apprentices in accordance with Provincial Act respecting manpower vocational training and qualification.
- .2 Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licensed workers.
- .3 Determine permitted activities and tasks by apprentices, based on level of training attended and demonstration of ability to perform specific duties.
- .4 Provide Health and Safety requirements as per Saskatchewan Employment Act.

END OF SECTION

Part 1 General

1.1 CONTRACTOR USE OF PREMISES

- .1 Refer to Section 01 52 00 – Construction Facilities, article “Access and Egress”.
- .2 Limit use of premises for Work, for storage, and for access to allow:
 - .1 Departmental Representative occupancy of adjacent areas.
 - .2 Work by other contractors.
- .3 Co-ordinate use of premises under direction of Departmental Representative.
- .4 Repair or replace portions of existing work which have been altered during construction.
- .5 Closures: protect work temporarily until permanent enclosures are completed.
- .6 Maintain life safety routes, and fire access/control.
- .7 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic, noise, and security regulations.
- .8 Schedule delivery of materials during regular business hours, but outside of peak traffic times, unless otherwise approved by Departmental Representative.

1.2 BUILDING OCCUPANCY

- .1 Refer to Drawings for phasing/work sequencing.
 - .2 Areas adjacent to the Work will remain occupied and in use as research laboratories during entire construction period for execution of normal operations.
 - .3 Disruption to building occupants in adjacent areas of the premises may impact on research in progress.
 - .4 Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises.
 - .5 Co-operate with Departmental Representative in scheduling operations to minimize conflict, to ensure research is not disturbed, and to facilitate continued Departmental Representative usage and operation.
 - .6 Protect infrastructure and services running through the area of the Work that supports occupied operational spaces.
 - .7 Work in Occupied Areas:
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WORK RESTRICTIONS

- .1 Place sticky mat in area directly outside construction work zones in occupied areas, to trap dust from equipment and shoes of personnel leaving construction zone. Vacuum mat daily and when visibly soiled.
- .2 Personnel shall wear clean coveralls, and booties over construction footwear. Personnel shall remove coveralls, and vacuum themselves with HEPA-filtered vacuum to remove dust from their clothing before leaving construction zone.
- .3 Clean work area with HEPA-filtered vacuum at end of each work day.
- .4 Cover and protect equipment and furnishings with clean tarpaulins.
- .5 Seal doors, vents, and other sources of potential air leak between construction zone and adjacent occupied areas.
- .6 Enclose supplies, equipment and waste in covered containers when transporting to and from occupied areas.

1.3 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services. Obtain required permission 10 Working days in advance of interruption.
- .2 Where Work involves interruption of services to occupied adjacent areas, breaking into or connecting to existing services, give Departmental Representative minimum two Working Days' notice for necessary interruption throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by Department Representative, or governing authorities with minimum disturbance to facility operations.
- .3 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .4 Submit schedule to and obtain approval from Departmental Representative for shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .5 Provide temporary services to maintain critical building systems, as directed by Departmental Representative.
- .6 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .8 Record locations of maintained, re-routed and abandoned service lines.

1.4 BUILDING SMOKING POLICY

- .1 Comply with smoking restrictions. Smoking is not allowed.
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1.5 CONTROL OF NOISE, VIBRATION AND NOXIOUS FUMES AND SMOKE

- .1 Be aware of locations of existing mechanical air intakes and vents. Prevent noxious fumes and smoke associated with the Work from entering surrounding occupied buildings.
- .2 Minimize noise, vibration and dust-generating activities from affecting occupied areas. Provide 72 hours' notice to Departmental Representative prior to work causing noise, vibration, and dust generation. Schedule dust-generating work after normal work hours in and near occupied areas where it is not possible to isolate and contain the work.
- .3 Be prepared to stop and reschedule Work upon verbal notice from Departmental Representative that the Work is causing detrimental effect on the operation of occupied areas. Such notice will only be made when specific procedures undertaken in occupied areas require it.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Action Submittals: Written and graphic information and physical samples that require Departmental Representative's responsive action. Unless specifically noted otherwise in individual sections, the following shall be considered Action Submittals:
 - .1 Product Data.
 - .2 Shop Drawings.
 - .3 Samples
 - .4 Construction Schedule.
- .2 Informational Submittals: Written and graphic information and physical samples that do not require Departmental Representative's responsive action. Submittals may be rejected for not complying with requirements. Unless noted otherwise in individual sections, the following shall be considered Informational Submittals:
 - .1 Certificates.
 - .2 Maintenance Data.
 - .3 Test and Inspection Reports.
 - .4 Delegated Design Calculations.
 - .5 Closeout Submittals.
 - .6 Sample warranties.
 - .7 Sustainable design or LEED submittals.
 - .8 Manufacturer's installation instructions.
- .3 Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.2 ADMINISTRATIVE

- .1 Process submittals using electronic media. Provide submittals in electronic format, unless otherwise agreed to by Contractor and Departmental Representative.
 - .2 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
 - .3 Do not proceed with Work affected by submittal until review is complete.
 - .4 Present shop drawings, product data, in SI Metric units.
 - .5 Where items or information is not produced in SI Metric units converted values are acceptable.
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SUBMITTAL PROCEDURES

- .6 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .7 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .8 Verify field measurements and affected adjacent Work are co-ordinated.
- .9 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittals.
- .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .11 Keep one reviewed copy of each submission on site.

1.3 ELECTRONIC SUBMISSIONS

- .1 Provide electronic submittals (excluding samples) for information and review in electronic format using the following guidelines:
 - .1 Provide in Portable Document Format (*.pdf) with selectable text and graphics that are readable. Generally, merge documents into one bookmarked document up to 10 mb. Use hierarchical bookmarks to form a table of contents and provide hyperlinks to the subject topic.
 - .2 Break down information into documents of "like" or related materials or systems. Include final ratings, parameters, specifications, options, and other pertinent information. In the case where Departmental Representative returns submittal "Approved As Noted" and includes mark-ups or comments that change originally submitted ratings, parameters, specifications, options, and other pertinent information, the Sub-Contractor shall correct the documents in the original electronic document prior to submitting the final electronic documents.
 - .3 Highlight specific rating, parameter, specification, option, and other pertinent information when original document includes multiple alternatives. For instance when a range of performance parameters are given, or various sizes are shown, or various options are listed, the applicable item shall be indicated by highlight, circle, or pointer.
 - .4 Do not include generalized direction from the Departmental Representative that does not relate to ordering and purchasing the equipment. For instance, notes like, "Coordinate with xxx for final motor horsepower" are not to be transferred to the electronic submittal. In that example only the final coordinated sizes would be indicated.
 - .5 References within this specification that indicate sheet size will refer to electronic sheet (printing) size.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures, product data, and other data which the Contractor provides to illustrate details of a portion of the Work.
 - .2 When requested for delegated-design, submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in the Province of Saskatchewan.
 - .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
 - .4 Departmental Representative will endeavour to review each submission within 10 Working Days.
 - .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
 - .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested. Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
 - .7 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of Subcontractor, Supplier, and Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
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SUBMITTAL PROCEDURES

- .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
 - .11 Seal and signature of professional engineer if specified.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .10 Submit electronic copy of product data sheets or brochures for requirements requested in specification Sections where shop drawings will not be prepared due to standardized manufacture of product.
- .11 Delete information not applicable to project.
- .12 Supplement standard information to provide details applicable to project. If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copy will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .13 Review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
- .1 Review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.5 CONSTRUCTION SCHEDULE

- .1 Deliver Bar Chart (Gantt chart): graphic display of schedule related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date placed horizontal bars. Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

- .2 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration. Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.
- .3 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.
- .4 Clearly show sequence and interdependence of construction activities and indicate:
 - .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
 - .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
 - .3 Time for submittals, resubmittals and review.
 - .4 Time for fabrication and delivery of manufactured products for Work.

1.6 INFORMATIONAL SUBMITTALS

- .1 Submit electronic copy of certificates for requirements requested in specification Sections.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .2 Submit electronic copy of manufacturers' instructions for requirements requested in specification Sections.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .3 Submit electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections.
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with the National Building Code of Canada (NBCC), the National Fire Code of Canada (NFC) and other codes of provincial or local application provided that in case of conflict or discrepancy, the most applicable requirements apply in accordance with the Authority Having Jurisdiction.

- .2 Meet or exceed requirements of:
 - .1 National Building Code of Canada 2010
 - .2 National Fire Code of Canada 2010
 - .3 National Plumbing Code of Canada 2010.
 - .4 The Canadian Electrical Code.
 - .5 Specified standards, codes and referenced documents.
 - .6 CAN/CSA, Z462-08, Workplace Electrical Safety Standard
 - .7 Saskatchewan Employment Act for Health and Safety Requirements.

- .3 Electrical components and equipment which are not CSA approved shall be approved by the Authority Having Jurisdiction prior to connection to the electrical service. Pay for costs associated with obtaining necessary approval.

1.2 PERMITS AND BY-LAWS

- .1 Submit applications, documents and obtain and pay for permits and certificates required in respect to the execution of the Work.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Province of Saskatchewan
 - .1 The Occupational Health and Safety Act, 1993 (including amendments effective November 7, 2012)
 - .2 The Occupational Health and Safety Regulations, 1996

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Informational Submittal: Submit design drawings, signed and sealed by qualified professional engineer licensed in the province of Saskatchewan, for scaffolds and work platforms, in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Additions or modifications to scaffolding must be approved by professional engineer in writing.

1.3 ACCESS AND EGRESS

- .1 Maintain existing services to building and provide for personnel and vehicle access.
- .2 Limit access to and egress from the construction site by way of access gate designated by Departmental Representative.
- .3 In the event temporary openings are required in exterior walls, ensure openings are weathertight, and vermin proof. Reinststate exterior walls to condition that existed prior to construction.
- .4 Maintain safe occupant access, egress and internal circulation for occupied areas of the buildings, and for construction workers in the area of the Work.
 - .1 Ensure Authorities Having Jurisdiction review and approve egress routes. Do not alter egress routes without prior approval from Authorities Having Jurisdiction.
 - .2 Post egress routes as part of emergency procedures.

1.4 SCAFFOLDING

- .1 Scaffolding: in accordance with Province of Saskatchewan, The Occupational Health and Safety Act, 1993, and The Occupational Health and Safety Regulations.
 - .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, and temporary stairs.
 - .3 Erect without damage to building or finishes scheduled to remain.
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1.5 HOISTING

- .1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists and cranes: operated by qualified operator.
- .3 Locate hoists and cranes in location approved by Departmental Representative.

1.6 USE OF SITE AND FACILITIES AND SITE STORAGE

- .1 Construction staging area will be assigned to the Contractor for storage of construction materials. Maintain in neat condition.
- .2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .3 Do not load or permit to load any part of Work with weight or force that will endanger Work.
- .4 Move stored products or equipment that interfere with operations of Departmental Representative or other contractors.
- .5 Obtain and pay for use of additional storage or work areas needed for operations.

1.7 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.8 CONSTRUCTION PARKING

- .1 Limited parking may be permitted on site within designated staging area at the discretion of the Departmental Representative.
- .2 Limited parking for construction personnel vehicles may be available in adjacent parking areas at prevailing rates. Make own arrangements for parking.
- .3 Provide and maintain adequate access to project site.

1.9 SECURITY

- .1 Contractor must have all employees on site to be Security Cleared. Through a Government of Canada process. Copies of valid security clearances to be provided to Departmental Representative.
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1.10 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.11 CLEAN-UP

- .1 Refer to section 1.74.11

END OF SECTION

Part 1 General

1.1 GENERAL PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Departmental Representative or other contractors.
- .2 Remove waste materials from site minimum once daily at regularly scheduled times.. Remove waste materials more frequently as directed by Departmental Representative. Do not burn waste materials on site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Dispose of waste materials and debris off site. Do not wash waste materials down sewers or into waterways.
- .5 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .6 Do not damage or soil existing waste handling and housekeeping rooms. Do not plug or obstruct hoppers, toilets, sinks or drains.
- .7 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .8 Schedule cleaning operations so that resulting dust and other contaminants will not fall on wet, newly painted surfaces, infiltrate into occupied areas, or trigger fire alarm smoke or dust detectors.

1.2 PROGRESSIVE CLEANING

- .1 Remove liquid spills promptly.
 - .2 Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - .3 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
 - .4 Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - .5 Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - .6 Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Performance.
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- .7 In occupied areas, clean-up work area each day, before leaving area. Vacuum area with HEPA vacuum and leave ready for use.
- .8 During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Performance.
- .9 Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- .10 Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

1.3 FINAL CLEANING

- .1 In preparation for Substantial Performance or occupancy, conduct inspection of sight-exposed surfaces.
- .2 Remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .4 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .5 Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from sight-exposed interior and exterior finished surfaces.
- .6 Vacuum clean and dust building interiors, behind grilles, louvres and screens in area of Work. Vacuum exterior surfaces of exposed ductwork.
- .7 Remove dirt and other disfiguration from exterior surfaces.

1.4 SITE RESTORATION

- .1 Upon completion of project, reinstate surfaces and building or site finishes affected by Work to condition which existed prior to commencement of Work, unless directed otherwise.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Departmental Representative's Inspection.
 - .2 Departmental Representative's Interim Completion Inspection:
 - .1 Departmental Representative, and Contractor will perform inspection of Work to identify defects or deficiencies.
 - .2 Contractor shall correct Work as directed. Coordinate with Departmental Representative to establish a date for completion of deficiencies.
 - .3 Completion Tasks: submit written certificates in English that the following tasks have been performed:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted, and balanced, and fully operational.
 - .4 Certificates required by authorities having jurisdiction: submitted.
 - .5 Operation of systems: demonstrated to facility personnel.
 - .2 Prior to Interim Completion of the Work, or start of operation and instruction period, whichever is earlier, provide:
 - .1 Draft Operation and Maintenance Manuals for mechanical systems, electrical systems, and laboratory equipment prior to start up for reference purposes.
 - .2 Record and "as-built" drawings.
 - .3 Keys for equipment and building as specified, including related keying information and keying charts.
 - .4 Test reports for mechanical and electrical systems, as specified in Divisions, , 22 26.
 - .5 Equipment and systems operating instructions and orientation for facility personnel.
 - .6 Spare parts.
 - .7 Warranty and Bond Certificates.
 - .8 Commissioning and Commissioning Reports.
 - .3 Final Inspection:
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CLOSEOUT PROCEDURES

- .1 When completion tasks and deficiencies are completed, request final inspection of Work by Departmental Representative.
- .2 If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.
- .4 Declaration of Interim Completion: when Departmental Representative advises Contractor that deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Interim Completion.
- .5 Commencement of Warranty Periods: date of Departmental Representative's acceptance of submitted declaration of Interim Completion shall be date for commencement for warranty period.
- .6 Final Payment:
 - .1 When Departmental Representative considers final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment.
 - .2 If Work is deemed incomplete by Departmental Representative, complete outstanding items and request reinspection.

1.2 FINAL CLEANING

- .1 In accordance with Section 01 74 11 – Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 SP-66-04, ACI Detailing Manual 2004.
 - .1 ACI 315-99, Details and Detailing of Concrete Reinforcement.
 - .2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
 - .2 ASTM International (ASTM)
 - .1 ASTM A1064/A1064M-13, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - .3 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-A23.3-04, Design of Concrete Structures.
 - .3 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement
 - .4 CSA W186-M1990(R2002), Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .5 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles
 - .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315.
- .3 Submit shop drawings including placing of reinforcement and indicate:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Consultant, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Sizes of chairs, spacers and hangers
- .4 Detail lap lengths and bar development lengths to CSA-A23.3.

1.3 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 - Quality Control
 - .1 Upon request submit in writing to Consultant proposed source of reinforcement material to be supplied.

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 off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Consultant.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18.
- .3 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .4 Cold-drawn annealed steel wire ties to CSA G30.3
- .5 Mechanical splices: subject to approval of Consultant.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Consultant's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

- .2 Upon request, inform Consultant of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
- .2 Do not displace reinforcing to accommodate sleeves, inserts except where indicated or authorized by Consultant.
- .3 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.
- .1 Confirm schedule by giving Consultant 48 hour notice of completion of reinforcing steel placing.
- .2 Allow after completion of placing reinforcing steel 4 hours for site review of reinforcing steel and formwork.
- .4 Ensure cover to reinforcement is maintained during concrete pour.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

- .1 Manitoba Building Code of Canada 2011.
- .2 ASTM International (ASTM)
 - .1 ASTM C42-13, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - .2 ASTM C191-13, Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
 - .3 ASTM C260-01, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .4 ASTM C348-14, Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
 - .5 ASTM C494/C494M-05, Standard Specification for Chemical Admixtures for Concrete.
 - .6 ASTM C666-15, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
 - .7 ASTM C920 - 11 Standard Specification for Elastomeric Joint Sealants
 - .8 ASTM C928-13, Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.
 - .9 ASTM D1751-04(2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- .3 Canadian Standards Association (CSA)
 - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-A3000-13, Cementitious Materials Compendium
- .4 International Concrete Repair Institute (ICRI)
 - .1 ICRI No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.3 DEFINITIONS

- .1 Unacceptable Concrete: Concrete exhibiting surface defects that may impair adhesion of overlays including honeycomb, fins, “snots,” tie holes, “bug holes,” sharp offsets, rutted cracks, ragged corners, deviations in the surface plane, and other similar concrete defects, along with spalling and delamination of the concrete surface.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Designate cleaning area for tools to limit water use and runoff.
- .2 Carefully coordinate specified concrete work with weather conditions.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams.
 - .1 Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal.
 - .2 Dispose of waste in accordance with applicable local, provincial and national regulations.
- .5 Choose least harmful, appropriate cleaning method which will perform adequately.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Consultant.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

Part 2 Products

2.1 MATERIALS

- .1 Portland cement to CSA-A3001.
- .2 Cementitious hydraulic slag: to CAN/CSA A3000.
- .3 Water: to CAN/CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density, except as otherwise specified.
- .5 Air entraining admixture: to ASTM C260.
- .6 Chemical admixtures: to ASTM C494. Obtain Consultant's approval before using accelerating or set retarding admixtures during cold and hot weather placing.
 - .1 Maximum VOC Content: 350g/L (less water)

- .7 Grout: Portland Cement based non-shrink, non-metallic composition, meeting following requirements:
 - .1 Not exhibit bleeding or segregation at pumpable consistency.
 - .2 Compressive Strength: 25 MPa at 1 day.
 - .3 Bond Strength (ASTM C882) 13 MPa @ 28 days.
 - .4 Positive expansion confirmed by ASTM C827.
 - .5 Not produce a vapour barrier.
- .8 Cure and sealing compound: To ASTM C 1315, Type I, Class B:
 - .1 Maximum VOC Content: 200 g/L (less water)
 - .2 Standard of Acceptance: CC 1315WB, by Master Builders Solutions.
 - .3 Bituminous impregnated fiber board: to ASTM D1751.
- .9 Polyethylene film: 0.125 mm thickness to CAN/CGSB-51.34.

2.2 MIXES

- .1 For General Concrete:
 - .1 Hydraulic Cement Type: GU General Use.
 - .2 Strength: 32 MPa @ 28 days.
 - .3 Slump: 90 +/-30 mm.
 - .4 Exposure Class: C-1.
 - .5 Aggregate Size: 20 mm
 - .6 Water Cement Ratio: 0.45
 - .7 Air (%): 5-8.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Consultant's written approval before placing concrete.
 - .1 Provide 72 hours minimum notice prior to placing of concrete.
- .2 Power wash all chipped down surfaces to ensure proper binding of new concrete.
- .3 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .4 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .5 Pumping of concrete is permitted only after approval of equipment and mix.
- .6 Do not disturb reinforcement and inserts during concrete placement.

- .7 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .8 Protect previous Work from staining.
- .9 Clean and remove stains prior to application of concrete finishes.
- .10 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .11 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
 - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .12 Do not place load upon new concrete until authorized by Consultant.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2
 - .1 Except as noted below, concrete curing and protection to be in accordance with CAN/CSA-A23.1.
 - .2 Before concrete is placed, completely remove ice, snow and frost from formwork; reinforcing and other surfaces shall be raised above 10°C for 24 hours minimum prior to concreting.
 - .3 Concrete aggregates and water: heat to maximum 80°C.
 - .4 Concrete temperature: 30°C when deposited.
 - .5 Concrete when placed during freezing weather, or if freezing is anticipated during curing period, shall be fully enclosed and the temperature of same maintained at 18°C for the first three days and 10°C for the next three days.

3.3 FINISHING HORIZONTAL SURFACES

- .1 Following consolidation and screeding, immediately bull-float surface to close and smooth the surface.
- .2 Under adverse conditions only, excess bleed water may be removed from surface using procedures acceptable to Consultant and those noted in CSA-A23.1.
 - .1 Ensure surface is not damaged.
- .3 It is imperative that finishing be completed before surface of concrete dries, otherwise extensive cracking will result. Follow CPCA and CSA-A23.1 procedures and recommendations.
- .4 Ensure uniform, level surface is obtained.
- .5 Immediately after final finishing, apply additional coat of evaporation reducer to prevent drying shrinkage.
 - .1 Apply at manufacturer's recommended coverage.

- .2 Do not apply evaporation reducer during any finishing operation.
- .3 Do not work into surface.
- .6 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- .7 Finish classifications:
 - .1 Specified finish: Class A as defined by CSA-A23.1, and meeting following requirements:
 - .1 FF = 20
 - .2 Surface texture:
 - .1 Exposed Surfaces: Brooming after steel trowel finish as per CSA-A23.1 Section 7.6.6.
 - .2 Concrete Repair Mortar: Nonslip finish to CSA-A23.1, Section 7.6.6.
 - .2 Conform to standard of acceptance reviewed by Consultant.

3.4 CURING

- .1 Cure and protect concrete in accordance with requirements of Section 7.7 of CSA A23.1.
- .2 Concrete surfaces to be cured at a minimum temperature of 10°C, or greater in accordance with manufacturer's written recommendation, for the entire curing period.
- .3 Upon final finishing of concrete, and once concrete has hardened sufficiently to prevent surface damage, curing shall commence.
 - .1 Apply specified cure and sealing compound where Type 1 curing regime specified.
- .4 Workers shall not be allowed on concrete for 12 hours after placement.
- .5 Ensure that curing method does not interfere with concrete placing operations, or damage surface of freshly placed concrete.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by inspection/testing agency in accordance with CAN/CSA-A23.2, designated by Contractor, approved by Consultant and paid for by Owner.
- .2 Inspection and testing of concrete and concrete materials by Testing Laboratory designated by Contractor, approved by Consultant and paid for by Owner.
 - .1 Perform additional testing when test results are low, inaccurate or otherwise questionable.
 - .2 Costs for additional testing paid for by Contractor at no cost to Contract.
- .3 Inspection or testing does not augment or replace Contractor quality control nor relieve Contractor's contractual responsibility.

- .1 Testing agency will report in writing all results of testing found to be outside specified amounts to Contractor and Consultant.
- .4 Take three test cylinders from each 5 cubic metres of each class of concrete placed or for each day of concrete placement if the latter is less than 5 cubic metres.
 - .1 Test as follows:
 - .1 One 7 day laboratory cured test.
 - .2 Two 28 day laboratory cured tests.
- .5 Make at least one slump test for each set of test cylinders taken.
- .6 Cure concrete test cylinders in location designated by testing agency for a minimum of 48 hours prior to transporting to laboratory.
- .7 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2M.
- .8 Number of trial mixes employed: sufficient to satisfy Consultant that specified air dry density will be met or exceeded.
- .9 Test each type aggregate for gradation, other properties to CAN/CSA-A23.2.
 - .1 Minimum 22.68 kg samples.

END OF SECTION

Part 1 General

1.1 SELECTIONS

- .1 Any product is accepted for installation in the work, provided the product chosen meets with the required design characteristics as particularly noted in the specifications and equipment schedules, and matches the design features of the item where a particular trade name and model is given, and suits the installation. Conform to space limitations on products that are equal in design characteristics.

1.2 CHANGES DUE TO USE OF DIFFERENT MANUFACTURERS

- .1 Where the Contractor proposes to use an item of equipment other than that detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or of any other part of the mechanical, electrical or architectural layout, all such redesign and all new Drawings and details required shall, with the acceptance of the Departmental Representative, be prepared by the Contractor at his own expense.
- .2 Where deviations are accepted requiring a different quantity or arrangement of ductwork, piping, wiring, conduit and equipment from that indicated on the Drawings, this Division is responsible to furnish and install all such ductwork piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, without additional compensation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems.
 - .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.
 - .5 Approvals:
 - .1 Submit one electronic copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .3 Submit one hard copy of the O&M manual once the draft has been approved.
 - .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 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.

- Include changes to existing mechanical systems, control systems and low voltage control wiring.
- .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
- .3 Use different colour waterproof ink for each service.
- .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 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).
 - .2 Submit to Departmental Representative for approval and make corrections as directed.
 - .3 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
- .3 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.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and 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

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

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

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

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

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: conduct all Startup procedures in accordance with manufacturers recommendations. Provide startup report to departmental representative upon completion.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 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 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Division 1.
 - .2 Waste Management and Disposal:
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
-

- .4 Unused sealant, adhesive materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .5 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 MATERIALS

- .1 Materials and resources in accordance with Division 1.

2.2 DOMESTIC WATER PRESSURE BOOSTER SYSTEM

- .1 General requirements:
 - .1 Skid mounted packaged variable speed triplex system, factory assembled, tested and adjusted, ready for external field piping and electrical connections.
 - .2 Pumps: stainless steel, close-coupled, horizontal end-suction design with mechanical seal suitable for potable water applications.
 - .3 Pipe headers: Stainless steel pipe
 - .1 Rated for 860 kPa (125 psig).
 - .2 Connection to match connecting piping shown on drawings.
 - .3 Pressure transmitter mounted on discharge header and wired to controller to indicate process variable.
 - .4 Valves:
 - .1 NPS 2 and under: Ball valve, stainless steel body, ball and stem.
 - .2 NPS 2-1/2 and greater: Butterfly valve, epoxy coated ductile iron, stainless steel disc and stem, EPDM seat liner.
 - .3 Isolation valves on suction and discharge of each pump.
 - .4 Check valve on discharge of each pump.
 - .5 Supports: install complete package on factory fabricated structural steelwork
 - .6 Control panel: solid-state in NEMA 1 enclosure, with the following features or functions:
 - .1 Designed for mounting on package frame.
 - .2 CUL listed, CE marked.
 - .3 Single point power connection with manually operated fused door interlock disconnect switch.
 - .4 Local-Off-Remote switch.
 - .5 Adjustable frequency drive (AFD) with line and load reactors for each pump with HOA selector switch. NEMA 3-R enclosure.
 - .6 Motor overload protection.
 - .7 Microprocessor-based pump logic controller with the following features:
 - .1 Loss of suction protection.
 - .2 Lack of NPSHa.

- .3 Dead-head protection.
- .4 Low flow, over pressure and pressure sensor error shut-down.
- .5 Dry contacts for remote monitoring of common alarm output.
- .8 Pressure and suction gauges, 90 mm nominal diameter, with range suitable to the application.
- .9 Sensors and transmitters:
 - .1 Pressure transmitter mounted in discharge header.
 - .2 Flow sensor.
- .2 Features and performance:
 - .1 As scheduled. Scheduled characteristics govern where the conflict with the general requirements specified herein.
- .3 Operation:
 - .1 System will operate under own controls.
 - .2 Each transmitter/sensor to send 4-20mA signal to controller for process control.
 - .3 Lead pump shall operate to meet the pressure set point and continue to operate at constant speed to meet demand.
 - .4 Lag pumps shall start automatically to meet demand.
 - .5 Lag pump shall shut down when demand is satisfied, subject to time delay or other strategy to avoid short cycling of pumps.
 - .6 Lead pump to operate during demand.
 - .7 When system is satisfied, lead pump shall be shut-down for low flow/no flow condition.
 - .8 Failure of single pump, VFD or sensor shall not cause the system to shut down.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls.
 - .2 Install shut-off valves on discharge and inlet. Install strainer on inlet.
 - .3 Maintain clearances as recommended by manufacturer for service and as required by code.
 - .4 Ensure pump and motor assembly do not support piping.
-

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Check power supply.
 - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

3.4 START-UP

- .1 General:
 - .1 Procedures:
 - .1 Check power supply.
 - .2 Start pumps, check impeller rotation.
 - .3 Check for safe and proper operation.
 - .4 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
 - .5 Test operation of hands-on-auto switch.
 - .6 Test operation of alternator.
 - .7 Run-in pumps for 12 continuous hours.
 - .8 Adjust alignment of piping and conduit to ensure full flexibility.
 - .9 Eliminate causes of cavitation, flashing, air entrainment.
 - .10 Measure pressure drop across strainer when clean and with flow rates as finally set.

3.5 REPORTS

- .1 In accordance with Section 01 33 00 – Submittals.
- .2 Product Information report forms.
- .3 Pump performance curves (family of curves) with final point of actual performance.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-13, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-11, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 American Society for Testing and Materials (ASTM) International Inc.
 - .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B88M-13 Standard Specification for Seamless Copper Water Tube (Metric).
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-02, Butterfly Valves.
 - .2 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
- .7 National Research Council (NRC)/Institute for Research in Construction
 - .1 NRCC 38728, National Plumbing Code of Canada (NPC) 2010.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 - Submittals.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, and packaging materials.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn temper, Type L: to ASTM B88M.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1 1/2 and smaller: wrought copper to ANSI/ASME B16.22, cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

- .1 Flanged: ASME B16.21, nonmetallic, flat, asbestos-free, full-face type for Class 150 and 300 cast copper alloy flanges. 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - .2 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
 - .3 Teflon tape: for threaded joints.
 - .4 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
-

.5 Solder:

- .1 NPS 2 ½ and under: Alloy Sn95 (95% tin, 5% silver) to ASTM B32.
- .2 NPS 3 and over: Silver solder, 15% silver, 80% copper (Sil-Fos).

.6 Grooved couplings:

- .1 Allowed for NPS 2 and over: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.

.7 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

2.4 BALL VALVES

.1 NPS 2 and under, screwed:

- .1 To MSS-SP-110, Class 150, bronze body, stainless steel ball and stem, PTFE adjustable packing, PTFE seat, steel lever handle.

2.5 BUTTERFLY VALVES

.1 NPS 2-1/2 and over, grooved ends:

- .1 Class 300, bubble tight shut-off, bronze body EPDM coated ductile iron disc with integrally cast stem.
- .2 Lever operated, NPS 8 and over: gear operated.

2.6 GLOBE VALVES

.1 NPS 2 and under, screwed:

- .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc.
- .2 Lockshield handles: as indicated.

2.7 STRAINERS

.1 NPS 2-1/2 to 8:

- .1 Equal to Spirax-Sarco 'BF-150' or Toyo 381A for pressures up to 125 psi (861 kPa), bronze body Y pattern, flanged ends, perforated stainless steel screen.

.2 Screen Perforation Sizes:

- .1 Strainers NPS 2-1/2 to NPS 8: 0.8mm (1/32"), or 1.6mm (1/16") as directed by Consultant.

.3 Provide valve for strainer blowdown on all strainers 38mm and larger, on all pump strainers (all sizes), and where indicated. Strainer blowdown valves to be piped to funnel drain for all pump installations and wherever else indicated. Otherwise, provide nipple and end cap. Blowdown valve to be minimum NPS 3/4 on NPS 1-1/2 strainer, minimum NPS 1 on strainers NPS 2 to NPS 4, and minimum NPS 2 on strainers over NPS 4.

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 Provincial Plumbing Code and local authority having jurisdiction.
- .2 General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install components having pressure rating equal to or greater than system operating pressure.
- .5 Install piping free of sags, bends, and kinks.
- .6 Install fittings for changes in direction and branch connections in hard drawn copper tube.
- .7 Install domestic cold water piping below and away from any heat source, domestic hot water, and other hot piping so as to maintain temperature of cold water as low as possible.
- .8 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .9 Install drains at low points and in trapped sections, to ensure entire system can be drained.
- .10 Install drain valves with hose thread outlet complete with cap and chain at water meter, hot water tanks and in mains where shown and/or necessary for complete drainage.
- .11 Install shut off valves at all connections to major pieces of equipment.
- .12 'Dead-legs' or 'dead' pipe stubs are not permitted on domestic water supply systems.

3.3 PIPING JOINT CONSTRUCTION

- .1 Join pipe and fittings as follows:
 - .1 Ream ends of pipe and tube and remove burrs to restore full inside diameter.
-

- .2 Remove scale, slag, dirt, and debris from inside and outside of pipe, tube, and fittings before assembly.
- .3 Soldered Joints: Construct joints according to ASTM B 828.
- .4 Threaded Joints: Construct in accordance with industry standard practices and manufacturer's recommendations.
- .5 Mechanical Joints: Grooved copper tube and grooved-tube fitting joints shall be assembled with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's standard written procedure. Grooved ends on copper and copper alloy tube shall be roll-formed only using the appropriate roll-groove tool to construct a groove meeting the coupling and fitting manufacturer's written specifications. Cut grooving methods shall not be used on copper and copper alloy tube.

3.4 PIPING CONNECTIONS

- .1 Make piping connections as specified below:
 - .1 Install solder-joint to male-thread adapters, or solder-joint to male-thread unions meeting the requirements of ASME B16.18 or ASME B16.22, adjacent to each threaded valve and threaded equipment connection in a copper tube system.

3.5 VALVES

- .1 Isolate equipment, fixtures and branches with ball or butterfly valves as follows, unless otherwise indicated:
 - .1 NPS 2 and under: ball valves.
 - .2 NPS 2 ½ and over: butterfly valves.
- .2 Refer to drawings for application of other valve types.

3.6 PRESSURE TESTS

- .1 Conform to requirements of Section 22 05 00 - Common Work Results - Plumbing.
- .2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.

3.7 PRESTART-UP INSPECTIONS

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

3.8 DISINFECTION

- .1 Flush out, disinfect and rinse system to approval of Departmental Representative.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.9 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 circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.10 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterilize domestic water systems for Legionella control.
 - .4 Verify compliance with safety and health requirements.
 - .5 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

3.11 OPERATION REQUIREMENTS

- .1 Operational requirements in accordance with Division 1 include:
 - .1 Cleaning materials and schedules.
 - .2 Repair and maintenance materials and instructions.
-

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-13, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-10, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C547-12, Mineral Fiber Pipe Insulation.
 - .5 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-0, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-09, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
 - .2 TIAC ss:
 - .1 CPF: Code Piping Finish.
-

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's electronic product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit an electronic copy of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
-

- .2 Protect against damage.
- .3 Store at temperatures and conditions required by manufacturer.

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 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to ASTM C547.
 - .2 Maximum "k" factor: to ASTM C547.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to ASTM C547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: 0.034 W/mK at 24C to ASTM C547.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: 0.033 W/mK at 24C to ASTM C547
 - .4 Jacket: to CGSB 51-GP-52Ma.
 - .5 Maximum "k" factor: to ASTM C1427.
 - .6 Certified by manufacturer: free of known potential stress corrosion cracking corrodants.
- .6 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: to ASTM C533
 - .2 Maximum "k" factor: 0.053 W/mK at 24C to ASTM C533.
 - .3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

- .2 Contact adhesive: quick setting.
 - .1 Maximum VOC Content: 80 g/L (less water)
- .3 Canvas adhesive: washable.
 - .1 Maximum VOC Content: 50 g/L (less water)
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.
 - .1 Maximum VOC Content: 70 g/L (less water)

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Canvas:
 - .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: compatible with insulation. Maximum VOC Content: 70 g/l (less water)

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 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at valves greater than 75mm diameter.
- .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.5 INSULATION OF VALVES AND FITTINGS

- .1 Valves, fittings, unions, flanges:
 - .1 NPS 2 and under: continue insulation over fittings and valves.
 - .2 NPS 2-1/2 and larger: Use preformed sections of insulation, one or more pipe sizes larger at unions, valves, etc. Butt to adjacent sections or overlap by 25mm wherever possible. Seal exposed edges.
 - .2 Insulate elbows piping elbows as follows:
 - .1 NPS 2 and under: mitre corners of preformed insulation and butt together tightly. Apply tape at seam.
 - .2 NPS 2-1/2 and greater: tightly wrap elbows with flexible insulation to same thickness as adjacent insulation. Cover with canvas wrap.
-

3.6 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.7 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)			
			Run out	to 1	1 1/4 to 2	2 1/2 to 4
Domestic HWS		A-1	25	25	25	38
Domestic CWS		A-3	25	25	25	25

- .5 Finishes:
 - .1 Exposed indoors: canvas.
 - .2 Exposed in mechanical rooms: PVC.
 - .3 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM) International Inc.
 - .1 ASTM D2564-12, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
 - .2 ASTM E84-14/UL 723-08 - Standard Test Method for Surface Burning Characteristics of Building Materials
- .2 Canadian Standards Association (CSA) International
 - .1 CSA-B181.2-11, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
- .3 Health Canada/workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS)
- .4 Underwriter's Laboratories of Canada (ULC).
 - .1 CAN/ULC-S115-05, Standard Method of Fire Tests of Firestop Systems.
- .5 Warnock Hersey International (WHI).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Store at temperatures and conditions recommended by manufacturer.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates and packaging materials.

Part 2 Products

2.1 PIPING AND FITTINGS

- .1 Above grade DWV piping to:
-

-
- .1 PVC pipe to CAN/CSA-B181.2.
 - .2 Pipe and fittings must be supplied by the same manufacturer.
 - .3 Pipe and fittings must be listed to CAN/ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25, smoke developed not exceeding 50.
 - .4 Joints: solvent weld for PVC: to ASTM D2564.
 - .1 Maximum VOC Content: 510 g/L (less water)

2.2 FIRESTOPPING DEVICES

- .1 Certified to CAN/ULC-S115 and tested with a 50 Pa pressure differential.

Part 3 Execution

3.1 GENERAL

- .1 Minimum pipe grade:
 - .1 For sizes smaller than 100 mm, minimum grade to be 2%.
 - .2 Sizes 100mm and larger, minimum grade to be 1%.

3.2 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Specific requirements:
 - .1 Sanitary drainage (all areas except laboratory; drawing label: 'SAN'): PVC-DWV.

3.3 INSTALLATION

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's requirements.
- .3 Do not install in vertical shafts unless otherwise approved.

3.4 FIRESTOPPING

- .1 Provide certified firestopping devices at all penetrations of fire separations.
- .2 Install in accordance with the appropriate WHI listings supplied by the firestopping device manufacturer.

3.5 TESTING

- .1 Hydraulically test to verify grades and freedom from obstructions.
-

3.6 PERFORMANCE VERIFICATION

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

3.7 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

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

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.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
 - .2 Lettering and numbers raised or recessed.
 - .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.
-

2.2 SYSTEM NAMEPLATES

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

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20
 - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
- .5 Extent of background colour marking:

- .1 To full circumference of pipe or insulation.
- .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

- .1 Where not listed, obtain direction from Departmental Representative.
- .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 hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT

2.4 VALVES, CONTROLLERS

- .1 General:
 - .1 Full knowledge of the location, operation and function of valves in the facility is highly important. As such, proper and thorough identification of valves is considered an essential part of the scope of work.
 - .2 All valves shall be tagged and identified, excluding heating convector or fixture stop valve located adjacent to heating convector or fixture, and excluding all drain valves which are not piped to drain (either directly or indirectly). All balancing valves to be tagged.

2.5 LANGUAGE

- .1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Protection:
 - .1 Do not paint, insulate or cover.

3.4 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping 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.

3.5 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, 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 Departmental Representative.
- .3 Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .4 Use same numbering scheme as existing facility. Number valves in each system consecutively.

END OF SECTION

Part 1 General

1.1 COORDINATION

- .1 Where existing services or systems, such as electrical power, sump pumps, etc. are required to be disrupted and/or shut-down, coordinate the shut-downs with the Departmental Representative and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruptions and/or shutdowns and ensure the duration of same is kept to the absolute minimum. Refer to Section 01 14 00 – Work Restrictions.
- .2 Should any temporary connections be required to maintain services or systems during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing equipment or system be damaged, make full repairs without extra cost, and to the satisfaction of the Departmental Representative.
- .3 Comply with instructions regarding working hours necessary to maintain the building in operation.

Part 2 Products

2.1 MATERIALS

- .1 Provide all materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.
- .2 Add modules, switches, etc., in existing control panels, as required, to extend existing systems to the new or renovated areas only. Confirm existing on site.
- .3 It is the intent of these specifications to not re-use any existing wiring.

Part 3 Execution

3.1 INSTALLATION

- .1 Install boxes, conduit and wiring through existing areas as required for the new installation.
- .2 Test and confirm all existing grounding systems are effective and in good condition. Include work and materials required to change wiring and make good existing.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2 No. 65 Wire Connectors.
- .2 CSA C22.2 No. 18 Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .3 CSA C22.2 No. 0.3 Test Methods for Electrical Wires and Cables.

Part 2 Products

2.1 WIRE CONNECTORS

- .1 Copper long barrel compression connectors sized for conductors. Use two-hole long barrel compression connectors for feeder conductors.
- .2 Solderless, self-insulated connectors for hand twist wire joints for lighting, small power, and associated control devices, with nylon insulator. Solderless, self-insulated connectors for hand twist wire joints for solid to stranded connections, nylon insulator.

2.2 CABLE CONNECTORS

- .1 Provide rain-tight connector fittings, complete with O-rings, for use on surface mounted weatherproof or sprinkler-proof enclosures. Side entrances to enclosures are preferred however when top entries are necessary rain-tight connectors must be used for all panels, contactors, etc.

2.3 RAIN-TITE COUPLINGS

- .1 Rain-tight couplings shall be used for surface mounted conduits exposed to moisture or sprinkler heads.

Part 3 Execution

3.1 CABLE INSTALLATION

- .1 Install cables for feeders or branch circuits in raceways.
- .2 Support on channels where cables are grouped and not run in tray.
- .3 Run cables parallel to the lines of the building.
- .4 Bends to be concentric.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2 No. 0.3 Test Methods for Electrical Wires and cables.
- .2 CAN/CSA-C22.2 No. 131.

Part 2 Products

2.1 CABLE IDENTIFICATION

- .1 Cables to be identified with wire markers.
- .2 Machine printed self laminating label type.
- .3 Thermal transfer type with printable area and translucent vinyl film.

2.2 BUILDING WIRES

- .1 Conductors in conduit:
 - .1 Type: RW90, RWU90
 - .2 Conductors for panel and branch circuits:
 - .1 Solid copper #10 AWG and smaller
 - .2 Stranded copper #8 AWG and larger.
 - .3 Sized as required (minimum #12 AWG).
 - .3 Insulation:
 - .1 Cross link polyethylene (XLPE), 90°C.
 - .4 Configuration:
 - .1 Single conductor.
 - .5 Voltage Rating: 600V.
 - .6 Certification:
 - .1 CSA C22.22 No. 38.

2.3 CONNECTORS

- .1 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs, as required.
 - .2 Refer to Section 26 05 20 Wire and Box Connectors and 26 05 22 Connectors and Terminations.
-

Part 3 Execution

3.1 CABLE INSTALLATION & WORKMANSHIP

- .1 Install cables for feeders or branch circuits in raceways.
- .2 Prevent over-heating by induction in accordance with rule 12-3022(7) and 4-010 and Appendix B Canadian Electric Code, Part 1 where single conductor cables connect to boxes and cabinets.
- .3 Run cables parallel to the lines of the building.
- .4 Bends to be concentric.

3.2 PHASE BALANCING

- .1 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting for optimum balancing.
- .2 Record all changes on "as-built" drawings.

3.3 MINIMUM CABLE SIZE

- .1 Minimum wire size to be #12 gauge throughout except where indicated otherwise.
- .2 Be responsible for providing the minimum wire size to meet the code where the wire size shown on the drawing is inadequate to serve the load.
- .3 Minimum size of panelboard and motor feeders is to be in accordance with CEC.

3.4 VOLTAGE DROP

- .1 Size wiring for branch circuits to achieve a maximum 3% voltage drop.
- .2 Base on distance from overcurrent device to furthest wiring device/load.
- .3 Provide cable size for entire length of circuit.
- .4 Submit voltage drop calculations when requested.

3.5 NEUTRAL CONDUCTORS

- .1 Reduced neutrals not permitted.
- .2 Provide separate neutrals for all dimmers, laser printers or as otherwise indicated.

3.6 GROUND CONDUCTORS

- .1 Provide a green insulated ground conductor equal in size to current carrying conductors within all raceways.
-

3.7 INSTALLATION OF BUILDING WIRES

- .1 Install wiring in conduit system in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Ensure conduits are dry and free of debris before pulling cables.
- .3 Provide colour coding and identification as per this Section.
- .4 Wires in outlet, junction and switch boxes, not having a connection within the box shall not be spliced, but shall continue unbroken through the box.

3.8 INSTALLATION IN EQUIPMENT

- .1 Group and lace-in neatly, wire and cable installed in switchboards, panel boards, cabinets, wireways and other such enclosures.

3.9 TERMINATIONS

- .1 Terminate wires and cables with appropriate connectors in an approved manner.

3.10 MOTOR CONNECTIONS

- .1 Flexible connections to motors shall not exceed 2m unless authorized in writing by Departmental Representative.

3.11 IDENTIFICATION

- .1 Provide cable identification on all cables.
- .2 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, colour coded as listed below.
- .3 Colour code wire in conduit and single conductor cables as follows unless otherwise shown on the drawings:

Three Phase Systems:	Single Phase Systems:
Phase A - red	Phase A - red
Phase B - black	Phase B - black
Phase C - blue	Neutral - white
Neutral - white	Ground - green
Ground - green	

- .4 Maintain phase sequence and colour coding throughout project.
- .5 Use colour-coded wires in communication cables, matched throughout the system.
- .6 Identification text to include panel name, wire number and wire type (A, B, C, N or G). Identification to be independent of circuit numbers to allow phase balancing.

- .7 Provide identification on cables at:
 - .1 Inside distributions/panelboards.
 - .2 Inside device boxes or at terminations.
 - .3 Wide junction boxes where joints are made.

- .8 Distribution feeders to be identified as follows:
 - .1 Color code of feeder phase shall appear on every cable in two locations at any distribution; once inside the distribution enclosure near the cable termination and once outside the distribution enclosure, in a visible location near the enclosure.

- .9 Color code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc., by means of colored insulation or markers. Use markers of a type not subject to aging or deterioration through heating, drying or easy erasure. Color code in accordance with Rule 4-036 of the CEC. Phasing to be ABC, left, centre, right respectively.

- .10 Demonstrate to the Departmental Representative that each wire has been clearly identified with wire markers where requested.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.41-M1987(R1999), Grounding and Bonding Equipment.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper, long barrel or short barrel compression connectors as required, sized for conductors.
- .2 Provide compression lugs for feeder cables. Set screw connectors not allowed.

Part 3 Execution

3.1 INSTALLATION

- .1 Install terminations and splices in accordance with component installation specifications and instructions.
- .2 Bond and ground as required.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association:
 - .1 CAN/CSA C22.2 No. 41 Grounding and Bonding Equipment.

Part 2 Products

2.1 EQUIPMENT

- .1 Ground equipment: to CAN/CSA C22.2 No. 41
- .2 Clamps for grounding of conductor: size as required to electrically bond to underground water piping.
- .3 Grounding conductors: bare stranded copper, tinned, soft annealed, minimum size #3/0.
- .4 Ground bus: copper; minimum 300mm long, 25mm high and 6mm thick with pre drilled holes, complete with 2700V insulated supports, fastenings, connectors.

2.2 ACCESSORIES

- .1 Non-corroding, necessary for complete grounding system, type, size, material as required, including:
 - .1 Grounding and bonding bushings
 - .2 Protective type clamps
 - .3 Bolted type conductor connectors
 - .4 Thermit welded type conductor connectors
 - .5 Bonding jumpers, straps
 - .6 Pressure wire connectors
- .2 Copper alloy castings with silicon bronze bolts, nuts and washers for connecting pipe, tube, cable, flat bar and special bus shapes.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Ensure that all components make good contact at connections to form a continuous metallic ground through the system. Torque bolts in accordance with equipment installation recommendations.
-

- .2 Ensure that contact surfaces are free of grease, oil, paint, primer and similar surface coverings. Clean all conductor contact surfaces thoroughly before installation by scratch brushing until bright and shiny.
- .3 Install complete permanent, continuous system and circuit grounding systems including electrodes, conductors, connectors and accessories to conform to code. Where EMT is used, run ground wire in conduit.
- .4 Install connectors in accordance with equipment installation recommendations.
- .5 Protect exposed grounding conductors from mechanical injury.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end as necessary and run separate ground conductor.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Where not specified otherwise, size of bonding and grounding conductors to be in accordance with Table 16 of the Canadian Electrical Code.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to the following: frames of motors, starters, control panels, distribution panels.

3.4 FIELD QUALITY CONTROL

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative. Record readings and place copy in maintenance manual.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

- .1 Not used.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, galvanized steel, size 41mm x 41 mm, 2.5mm thick, surface mounted, suspended or set in poured concrete walls and ceilings as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
 - .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
 - .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
 - .4 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 32mm and smaller.
 - .2 Beam clamps to secure conduit to exposed steel work.
 - .5 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6mm diameter threaded rods and spring clips.
 - .2 Support two or more cables or conduits on channels supported by 10mm diameter threaded rod hangers where direct fastening to building construction is impractical.
 - .6 For surface mounting of two or more conduits use U-channels at 1500mm on centre spacing.
 - .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
 - .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
 - .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
-

- .10 Do not use supports or equipment installed for other equipment for conduit or cable support except with permission of Departmental Representative.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with equipment installation recommendations.
- .12 Install continuous vertical channel supports for conduits in utility service rooms and mechanical room.
- .13 Where conduit and cable runs are installed on support systems, they shall run so as to be as inconspicuous as possible. Coordinate support system with equipment of other trades to ensure proper installation of equipment. Run support system paths perpendicular or parallel to building lines.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CAN/CSA C22.2 No. 40 Cutout, Junction and Pull Boxes.
- .2 CAN/CSA C22.2 No. 75 Splitters.

Part 2 Products

2.1 SPLITTERS, JUNCTION BOXES, PULL BOXES AND CABINETS - GENERAL

- .1 ANSI 61 grey polyester powder coat finish inside and out over phosphatized steel.
- .2 Gasketed and waterproof for wet and damp locations.
- .3 Locate splitters, junction and pull boxes as needed for each system.

2.2 JUNCTION AND PULL BOXES

- .1 Code gauge sheet steel, welded construction.
- .2 Screw-on hinged flat covers.
- .3 For flush mounting, covers to overlap box by 25mm minimum all round with flush head cover retaining screws.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Supply all pull boxes and junction boxes shown on the drawings and as required for the installation.
 - .2 Install in inconspicuous but accessible locations, above removable ceiling or in electrical rooms, utility rooms, or storage areas. Advise Departmental Representative of locations prior to installation.
 - .3 Size in accordance with Rule 12-3036, Canadian Electrical Code, as a minimum. Sizes shown on the drawings may be adjusted to suit available space. Review with Departmental Representative where necessary.
 - .4 Install terminal block as Type T cabinets.
 - .5 Where junction and pull boxes are not indicated, install pull boxes so as not to exceed 30m of conduit run between pull boxes.
-

- .6 Install junction and pull boxes clear of all mechanical duct work and piping.

3.2 IDENTIFICATION

- .1 Install size 2 identification labels indicating system name and system voltage (where voltage is applicable).

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CAN/CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CAN/CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CAN/CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .5 CAN/CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

1.2 LOCATION OF CONDUIT

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.
- .2 Contractor shall produce layout sketches of conduit runs through mechanical and electrical service areas to avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

Part 2 Products

2.1 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 32mm and smaller. Two hole steel straps for conduits larger than 32mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 U-channel type supports for two or more conduits at no more than 2M O/C spaced as per code and equipment installation recommendations, whichever is closer.
- .4 Threaded rods, 6mm diameter, to support suspended channels.
- .5 Perforated metal and field fabricated hangers and supports not acceptable.

2.2 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
 - .2 Factory "ells" where 90° bends are required for 27mm and larger conduits.
 - .3 Steel set screw connectors and couplings. Insulated throat liners on connectors.
-

- .4 Raintight connector fittings complete with O-rings for use on weatherproof or sprinkler proof enclosures. Raintight couplings to be used for surface conduit installations exposed to moisture. Raintight connectors shall be used for all top entries to panels, contactors, motor control starters and centres, transformers, etc.

2.3 CONDUIT - GENERAL

- .1 Minimum conduit size shall be 21mm unless otherwise indicated.

2.4 ELECTRICAL METALLIC TUBING (EMT)

- .1 Conduit: electrical metallic tubing with wall thickness less than rigid conduit, hot dipped galvanized with corrosion resistant and friction reducing coating on inside, to CAN/CSA C22.2 No. 83.
- .2 Connectors and fittings: in dry locations, steel or malleable iron wet concrete tight, set-screw fasteners with insulated throats complete with expansion joints as required. Die cast connectors are not permitted.

Part 3 Execution

3.1 CONDUIT INSTALLATION

- .1 Provide a separate raceway for each electrical system.
 - .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
 - .4 Do not surface mount conduits in other areas unless specifically indicated.
 - .5 Use flexible metal conduit in dry locations for connection to motors.
 - .6 The length of any conduit run shall not exceed 30m and no conduit run shall have more than four 90° bends before a pull box is required. Pull boxes to be installed in accessible ceiling space. Conduits shall be supported within 300mm of entering any junction box, pull box, cabinet or panel board.
 - .7 Conduit to be sized as per Canadian Electrical Code. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit at no extra cost.
 - .8 Install conduit sealing fittings in hazardous areas. Fill with compound.
-

- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Radius of bend shall be not less than 600mm.
- .10 Mechanically bend steel conduit over 21mm diameter.
- .11 Install fish cord in empty conduits.
- .12 Install expansion joints where conduits cross building expansion joints.
- .13 Ream conduit ends to remove all burrs.
- .14 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .15 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits within 300mm of flues, steam or hot water lines.
- .7 When a conduit can be run surface, it shall be primed and painted with two coats of paint to satisfaction of Departmental Representative.

3.3 GROUNDING

- .1 Where current carrying conductors are installed in raceway, provide ground wire of equal size.
- .2 Ensure raceways are large enough to accommodate additional (ground) wire.

3.4 INSTALLATION OF EMT CONDUIT

- .1 Use EMT strictly in accordance with Rules 12-1400 to 12-1410 inclusive of CEC.

3.5 WORKMANSHIP

- .1 Take extreme care and ream the ends of all conduits to ensure a smooth interior finish that will not damage the insulation of the wires. Ensure electrical continuity in all conduit systems.
-

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Suitably identify with lamacoid nameplates all pieces of electrical equipment such as disconnect switches, contactors, motor starters, control devices, pull boxes and all equipment connected direct to the power supply.

1.2 NAMEPLATES AND PANEL DIRECTORIES

- .1 Laminated phenolic nameplates with engraved white letters on:
 - .1 Black for normal power.
 - .2 Red for emergency power.
- .2 Unless specifically indicated otherwise lettering size to be as follows:
 - .1 Lamacoid nameplates: 3mm thick plastic engraving sheet, black or red faced, white core, mechanically attached with shelf-tapping screws or split rivets, unless otherwise specified. Sizes as follows:

NAMEPLATE SIZES

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

- .3 Prior to nameplate fabrication, submit to the Departmental Representative for approval a copy of all panel directories with a list stating exact wording and fabrication details for all nameplates.
 - .1 Submit one complete package, including details for all equipment and devices connected to or part of the electrical distribution.
 - .2 Submission to be received by Departmental Representative a minimum of 7 weeks prior to schedule completion of the work.
 - .4 Submit panel directories in electronic format to accommodate future revisions.
 - .1 Submit copies of all 'as-built' panel directories for all new panel boards worked on.
 - .5 Use Departmental Representative's building and location codes to provide permanent equipment identification. Confirm permanent building and location codes with Departmental Representative prior to making name plates and directories.
 - .6 In each maintenance/operating manual, include a copy of all panel directories and nameplate listings which were reviewed by Departmental Representative, including any
-

changes or corrections prior to lamacoid fabrication. Nameplate listing schedule shall have exact description of what appears on installed lamacoid, for all lamacoids (excluding receptacle lamacoids) installed by Division 26.

- .7 Co-ordinate names of equipment and systems with mechanical to ensure consistency.
- .8 All nameplates and panel directories to be installed and 100% complete prior to commissioning.

1.3 PANELBOARD AND DISTRIBUTION CENTRE IDENTIFICATION

- .1 Provide a typewritten data card enclosed in a clear plastic pouch attached inside the door of each panel board or distribution centre. Information listed on the data card shall include the following:
 - .1 Panel board or distribution centre title and code number.
 - .2 Supply feeder panel board or distribution centre title and code number, slot number and location (Departmental Representative's building and location code).
- .2 Panelboard directories to match formatting of existing directories located within the facility.

1.4 OTHER EQUIPMENT IDENTIFIED BY NAMEPLATE

- .1 Splitters and pullboxes: Indicate their function and characteristics (equipment description and location where fed from and what it feeds). 401-D/38

1.5 CONDUIT AND CABLE IDENTIFICATION

- .1 Junction boxes with power wiring, all circuits inside the box shall be identified on the inside of the cover plate with permanent marker.
- .2 Provide self-sticking vinyl stick-on conduit markers for the following systems. Markers to be:
 - .1 28.6 mm x 114.3 mm for 25 mm conduit and larger.
 - .2 12.7 mm x 57.2 mm for conduit under 25 mm.
- .3 Space markers 10 metres on centres maximum for exposed conduits and conduits in accessible ceiling spaces and, in addition, attach markers before and after all barriers, where conduits pass through closets, cupboards, stairwells, etc., and adjacent to all panels, cabinets, pullboxes and access fittings. Markers to be laminated mylar with orange background and black letters. Identify systems as follows:

NORMAL POWER
EMERGENCY POWER

- .4 All stick-on conduit markers must be installed during installation of related conduit systems, not after installation of complete conduit systems.
-

- .5 Do not apply stick-on conduit markers onto exposed raceways.

Part 2 Products

- .1 Not used.

Part 3 Execution

- .1 Not used.

END OF SECTION

Part 1 General

- .1 Not used.

Part 2 Products

2.1 NAMEPLATES

- .1 Lamacoid:
 - .1 Black with white lettering for normal power
 - .2 Red with white lettering for emergency power

Part 3 Execution

3.1 MOTOR SURVEY

- .1 Make a complete survey of all electrical motors. Number every motor, both single phase and three phase. Label every motor to show the motor number, the motor name and location of the starter. Example: 'Motor #41 Exhaust Fan #3, Starter in MCC#1'. Label every starter to show motor it controls and, where motor is not in same area, give location of motor. Identify voltage and panel being fed from.
- .2 For every motor and starter, fill in the form illustrated herein. List each motor on a separate 200 x 300 mm page. Provide three typed copies of this list in each maintenance manual prior to substantial completion. Where motors are controlled by more than one control device, prepare an accurate elementary diagram of the controls on a 200 x 300 mm sheet. Forms and diagrams are to be neatly typed and drafted.

3.2 NAMEPLATES

- .1 Securely screw to equipment, so as to be clearly visible.
-

SURVEY OF MOTORS

Motor Name and Number: _____

HP: _____ Amps: _____ Volts: _____ Phase: _____

Service Factor: _____

OPERATING CONDITIONS

No Load Amps: _____ Phase A: _____ Phase B: _____ Phase C: _____

Operating Voltage: _____ A to B: _____ B to C: _____ C to A: _____

Overload Size: _____

Wire Size: _____

Special Controls and Remarks (Thermistor and Relay Type, Capacitors, etc.)

PREPARED BY: _____ DATE: _____

END OF SECTION

Part 1 General

- .1 Not used.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible disconnect switch in NEMA 2 enclosure for interior sprinkler proof application, unless otherwise indicated.
- .2 Provision for padlocking in on-off position.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as required.
- .5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.
- .8 Cover viewing window to allow visual verification of “On-Off” status.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification.
- .2 Indicate name of load controlled on size 4 nameplates.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses only where specifically indicated.
- .2 Install circuit disconnect switches where indicated or where required by code.

END OF SECTION
