

## **PART 1 GENERAL**

### **1.1 LOCATION OF WORK**

The Mission Flood Pumping Station (FPS) is located at 91 Archibald St. Winnipeg.

### **1.2 MOBILIZATION AND DEMOBILIZATION**

.1 The Contractor is responsible for all costs of mobilization and demobilization.

.1 Mobilization and Demobilization includes all associated travel costs.

### **1.3 INSURANCE, BONDS AND PERMITS**

.1 The Contractor is responsible for all costs associated with applying and obtaining insurance, bonds and permits.

.1 The cost includes all associated travel costs.

### **1.4 BEHAVIOUR**

.1 Contractor and his forces shall maintain an appropriate and cooperative manner on the Site at all times.

.2 City of Winnipeg maintains the right to remove any individual from the Site for inappropriate behavior.

### **1.5 WORK HOURS**

.1 The Contractor and his workforce will be allowed to work as per the City of Winnipeg By-Laws.

.1 The successful Contractor will present his anticipated work schedule upon award of the Contract.

### **1.6 MINIMUM STANDARDS**

.1 Execute work to meet or exceed the latest edition:

.1 National Building Code of Canada unless more stringent requirements of Manitoba Building Code apply, including all amendments up to project date.

.2 Rules and regulations of authorities having jurisdiction.

.3 Fire Commissioner of Canada, No. 301, Standard for Construction.

.4 Occupational Health and Safety Act.

.5 Canadian Construction Safety Code.

.6 Contract documents.

.7 Manitoba Plumbing Code.

- .8 Workplace Health and Safety.
- .9 National Fire Code of Canada
- .10 Canadian Electrical Code.
- .11 Rules and regulations of authorities having jurisdiction.
- .12 Energy Act;
- .13 ULC Standards;

### **1.7 EXISTING SERVICES**

- .1 Before commencing work, contact the City of Winnipeg representatives to establish utilities location and extent of existing services and notify the Contract Administrator of findings.
- .2 Whenever it is necessary to cut, interfere with, or connect to existing services of facility to do so at hours and times recommended by governing authorities and approved by the Contract Administrator; and with minimum disturbance to occupants, pedestrian and vehicular traffic and public and private property.
- .3 Utility Supports may need to be implemented to protect existing services.
- .4 Submit schedule to and obtain approval from the Contract Administrator for each proposed shutdown of active service or facility.
  - .1 Adhere to approved schedule and provide notice to affected parties.
- .5 If unknown services are encountered, immediately notify the Contract Administrator and confirm findings in writing and/or on Drawings.
  - .1 Obtain the Contract Administrator's written direction if such services require cutting, capping or relocation to do work.
- .6 Should access or services be affected by the work, the notification of emergency agencies and/or affected homeCity of Winnipegs shall be the responsibility of the Contractor.

### **1.8 STORAGE OF EQUIPMENT AND MATERIALS**

- .1 The Contractor will provide his own storage facilities to be located near the work site.
- .2 The location shall be approved by the City of Winnipeg.
- .3 The Contractor is to fence his storage area and provide 24-hour security.
- .4 The Contractor will note the requirements for temporary facilities specified under the appropriate sections.

### **1.9 INVENTORY OF SALVAGED MATERIAL**

- .1 Throughout the Contract, the Contractor is to review all salvaged material, spare parts and miscellaneous equipment produced or encountered in the Work with the City of Winnipeg prior to removing from the community.

- .2 All material requested by the City of Winnipeg is to be placed into inventory at a location directed by the City of Winnipeg or Contract Administrator.
- .3 The Contractor shall ensure that all material accepted be signed off by an authorized representative of the City of Winnipeg as the material is delivered and entered into the inventory.

#### **1.10 FEES, PERMITS AND CERTIFICATES**

- .1 Provide authorities having jurisdiction with information requested.
- .2 Pay fees and obtain all certificates and permits required.
- .3 Furnish certificates and permits when requested.
- .4 Pay customs bonds as required when transporting through the United States.

#### **1.11 DOCUMENTS**

- .1 Keep one copy of contract documents and shop drawings on the site.
- .2 The Contract Administrator will provide two additional sets of full-size white prints for record drawing purposes.
- .3 At the onset of construction, the Contract Administrator will provide the Contractor with up to Three (3) sets of Contract Drawings and Specifications free of charge.
  - .1 Additional sets will be provided upon payment of \$250.00 to the Contract Administrator for each set.

#### **1.12 AS-BUILT RECORD DRAWINGS**

- .1 As work progresses and as required, record significant deviations from the Contract drawings.
- .2 Obtain and record all pipe invert elevations and locations.
- .3 Contractor responsible for preparing marked up As-Built drawings.
- .4 Electronic Record Documents:
  - .1 Contract Administrator will prepare electronic record documents based on as-built information received from the Contractor.
  - .2 Contractor shall employ the services of the Contract Administrator to transfer as-built information and changes on the record documents to the computer generated drawings and documents.
- .5 Prior to Preliminary Acceptance, submit one copy of As-Built drawings to Contract Administrator.
  - .1 Holdback will not be released until drawings are furnished.

- .6 Final payment on the Contract will not be made until correct record documents are received

### **1.13 ADDITIONAL DRAWINGS**

- .1 Contract Administrator may furnish additional drawings to clarify work.
- .2 Such drawings become part of Contract documents.

### **1.14 MATERIAL AND EQUIPMENT**

- .1 Use new products unless otherwise specified.
- .2 Deliver and store material and equipment to manufacturer's instructions with manufacturer's labels and seals intact.

### **1.15 CONCEALMENT**

- .1 Conceal pipes, ducts, conduit and wiring in finished areas unless otherwise specified.

### **1.16 CUTTING AND REMEDIAL WORK**

- .1 Coordinate work to keep cutting and remedial work to a minimum.
- .2 Execute cutting and remedial work required.
  - .1 Obtain Contract Administrator's approval before cutting, boring or sleeving structural members.
- .3 Use specialists in affected material to execute cutting and remedial work.
- .4 Match work to adjoining construction and finishes.
- .5 Fit components tight to adjoining surfaces.

### **1.17 CONSTRUCTION TIME AND SCHEDULING**

- .1 On award of contract, submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion.
  - .1 When schedule has been approved by the Contract Administrator, take necessary measures to complete work within scheduled time.
  - .2 Do not change schedule without Contract Administrator's approval.
- .2 In conjunction with and in form acceptable to Contract Administrator provide within 10 working days after contract award, schedule showing dates for:
  - .1 Submission of shop drawings, material tests and samples.
  - .2 Delivery of equipment and materials.

- .3 Commencement and completion of work of each major component of the work.
- .4 Total completion date within time period required by contract documents.
- .3 Interim review of work progress based on schedule submitted will be conducted as decided by Contract Administrator. The schedule shall be updated by Contractor in conjunction with and to approval of Contract Administrator.
- .4 Contract Administrator will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.

### **1.18 ENERGY CONSERVATION**

- .1 The Contractor is encouraged to employ all reasonable means at his disposal to carry out an effective energy and natural resources conservation program and use energy saving construction techniques throughout the entire construction period.
- .2 With due regard for necessary protection of the property, the safety of workmen and public, and overriding By-laws and Regulations, Contractor shall conserve energy and non-renewable natural resources, in such ways as:
  - .1 Switching off unnecessary lighting, particularly during inactive period.
  - .2 Utilizing efficient methods, controls, equipment and enclosures to conserve temporary heating.
  - .3 Any other construction activities which may result in saving of energy and natural resources.

### **1.19 SUPERVISION**

- .1 Provide the necessary supervision and qualified tradesmen to ensure the flow of materials and on-site installation compatible with the overall project schedule and progress.
- .2 No separate payment will be made under this item and the Contractor shall include this cost in the cost of the work being supervised.

### **1.20 ACCEPTANCE OF WORK**

- .1 The Contract Administrator and required technical disciplines will attend inspection of the Project Works prior to the substantial certificate of completion as part of the commissioning and inspection process.
  - .1 Additional commissioning inspections requiring technical engineering disciplines will be provided on a time and expense basis and invoiced to the Contractor.
  - .2 Final inspections requiring technical engineering disciplines beyond the Project Total Completion date will be provided on a time and expense basis and invoiced to the Contractor.

### **1.21 PAYMENT ITEMS**

- .1 Payment shall be based upon the lump sum as listed in the Bid Form, using actual as-constructed quantities as determined by the Contract Administrator.
- .2 In the event of any conflict between the Bid Prices and Specifications, the order of precedence shall be the Contract, Specifications and Drawings.
- .3 In addition to the requirements of Terms of Payment, Contractor shall provide a set of pictures illustrating work completed to each progress payment claim. **Progress Claim will not be processed without pictures substantiating progress claim.** A photograph shall be taken of all work prior to being covered. The photos shall be presented as follows:
  - Colour photos, 4 pictures per page on 8 ½ x 11 inch letter size paper;
  - Each picture to be identified with caption;
  - Presented in PDF format;
  - Digital copy of all pictures to be provided to Contract Administrator upon project completion.

### **1.22 DUST CONTROL & CLEAN-UP DURING CONSTRUCTION**

- .1 All dust control and clean-up of mud tracking on existing roads shall be deemed to be included in the Bid Price.

### **1.23 ENVIRONMENTAL CONSIDERATIONS**

- .1 The Contractor shall carefully review all aspects of the related specified Sections and Appendices and familiarize himself with all environmental considerations associated with the Work.
- .2 The Contractor is responsible for both adhering to these environmental considerations and for implementing any and all mitigation measures described within these Contract Documents.

### **1.24 CONTRACTOR'S USE OF PREMISES**

- .1 The Contractor must ensure approval from City of Winnipeg for easements for construction, storage and access as required.
- .2 Make arrangements with proper owners if additional areas are required.
  - .1 Obtain written agreements and submit copies to Contract Administrator.
- .3 Confine operations within easements for construction, storage and access as shown on Contract Drawings.

- .4 Do not enter upon or occupy with workers, tools or materials any lands other than public streets, roadways, rights-of-way or easements shown on Contract Drawings except after written consent has been received from property owner.

### **1.25 QUALITY CONTROL**

- .1 Adhere to manufacturer's recommendations with respect to handling, preparation, installation, testing, operation or protection of any product or material to be incorporated in work.
- .2 Ensure that all materials supplied are compatible with each other unless specific adjacent materials have been specified.
  - .1 Correct any defective work caused by non-compatibility of materials.
- .3 Where practical or desirable, tests will be conducted by Contract Administrator on materials and equipment to be incorporated into permanent works before delivery to site.
- .4 Submit to Contract Administrator full information on materials, equipment and related arrangements to be furnished.
- .5 Submit information in a form approved by Contract Administrator.
- .6 Submit sufficient information to enable Contract Administrator to determine whether proposed materials, equipment and arrangements meet contract requirements.

### **1.26 PROJECT COORDINATION**

- .1 Other Contracts may be awarded by City of Winnipeg for work to be done adjacent to and/or within limits of construction as shown on Contract Drawings.
  - .1 Limits of work included in any such contracts are identified on Contract Drawings or elsewhere in Contract Documents.
- .2 Do not undertake any part of work without permission of Contract Administrator.
- .3 Cooperate and make suitable working arrangements with other Contractor(s) to ensure satisfactory completion of work.
- .4 Obtain approval in writing from Contract Administrator for all arrangements made with other Contractor(s).
- .5 Contract Administrator will determine coordination and execution of work in the event that Contractors are unable to reach satisfactory working agreement.

### **1.27 PUBLIC RELATIONS AND NOTICES**

- .1 Appoint competent representative to receive and deal with any complaints from public in regard to safety, protection of traffic, condition of road surfaces along line of work, or nuisances on account of work.

- .2 Inform Contract Administrator, City of Winnipeg and local police of name, address and telephone number of public relations representative within two (2) weeks after date of order to commence work.
- .3 Deal promptly with all complaints received and carry out remedial actions to prevent further complaints.
- .4 Give adequate notice of schedule (timing and location) of movement of materials, construction activities, maintenance and repairs to affected land owners and occupants of properties adjacent to work areas.
- .5 Notify Contract Administrator immediately of any complaints of damage to property or personal injury.

### **1.28 PROJECT MEETINGS**

- .1 Project meeting will be held at times and locations approved by the Contract Administrator and City of Winnipeg.
- .2 Pre-construction meeting will be arranged with the City of Winnipeg, Contract Administrator, subcontractors, to discuss scope, schedule and construction of the project.
- .3 Biweekly progress meetings will be held at the site.
- .4 Progress inspections will be carried out as required.
- .5 There will be one substantial completion and one total completion meeting at the site.
- .6 Contractor shall be responsible for the costs of additional trips to site if the construction is not completed by the date of Total Performance.
- .7 Contract Administrator will record and distribute minutes, progress reports including any deficiency items to City of Winnipeg and contractor, within seven days of meeting.

### **1.29 COORDINATION OF SUBTRADES**

- .1 Neither the organization of the specifications into divisions, sections, and parts nor the arrangement of drawings shall control the Contractor in dividing the Work or be interpreted as a mechanism by which the responsibility of the Work is to be delineated, among subcontractors and suppliers or in establishing the extent of the work to be performed by a trade.
  - .1 Changes in the Work resulting from such delineation shall not be eligible for claims as Extra Work to the project.

### **1.30 REQUEST FOR ALTERNATIVES**

- .1 No substitutions will be permitted without prior written approval of Contract Administrator.



- .2 Proposals for substitution must be submitted in accordance with B.7.
- .3 Proposals will be considered by Contract Administrator if:
  - .1 Materials selected by tenderer from those specified, are not available.
  - .2 Delivery date of materials selected from those materials specified would unduly delay completion of contract.
  - .3 Alternative material to those specified, which are brought to the attention of and considered by the Contract Administrator as equivalent to the material specified and will result in a credit to the contract amount.
  - .4 Should proposed substitution be accepted either in whole or in part, assume full responsibility and cost when substitution affects other work on project. Pay for design or drawing changes required as a result of substitution.
- .4 In addition to the data required by the preceding clauses of this section, for Requests for Equal in accordance with B.7, provide the following:
  - .1 Section and clause no(s) of the item(s) being made reference to.
  - .2 Name, model no., construction and/or other features of the specified product.
  - .3 Name, model no., construction and/or other features of the proposed product.
  - .4 Certification of compliance with specification.
  - .5 Special conditions and price adjustments (if any).
  - .6 Written explanation as to the reason for the requested substitution.

### **1.31 MEASUREMENT FOR PAYMENT**

- .1 Unless specifically referenced in the Bid Form, there shall be no measurement for payment of Division 1 items.
- .2 Division 1 work items shall be incidental to the contract and included in other pay items.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**PART 1      GENERAL**

**1.1            DOCUMENTS**

1. The General Conditions of the Contract and the other General Requirements of Division 1 attached hereto shall apply to and be part of this Section.

**1.2            SUBMISSION OF QUOTATION FOR CONTEMPLATED CHANGE NOTICES**

1. If the Contract Administrator determines that the cost of the work will be affected due to a contemplated change, the Contractor shall submit a quotation to the Contract Administrator in accordance with the instructions specified herein.
2. Quotations for Contemplated Change Notices must include a detailed breakdown of all labour, material, plant and equipment costs incurred by the Contractor. Quotations from subcontractors involved in the change must also be supported by similarly detailed breakdowns for the subcontractors' costs.
3. It is the responsibility of the Contractor to ensure that all subcontractors' quotations included in the Contractor's quotation to the Contract Administrator are fair and reasonable in view of the terms expressed herein.
4. The labour hours required for the contemplated change shall be based on the estimated number of hours to perform the work.
5. Time spent by a working foreman may be included in the number of labour hours, at a rate agreed to in writing by the Contractor and the Contract Administrator.
6. Time attributable to material handling, productivity factors and approved rest periods is to be included in the number of hours required by the contemplated change and will not be paid as a separate item under hourly rates.
7. Mark-ups referred to in Parts 4 and 5 of this section are not to be included in the hourly labour rates.
8. Credit for work deleted will only be for the work directly associated with the changes stipulated in the particular Contemplated Change Notice.
9. When a change deletes work which has not yet been performed, the Contract Administrator is entitled to an adjustment in the Contract Amount equal to the cost the Contractor would have incurred had the work not been deleted.
10. Mark-ups referred to in Clauses 1.4 and 1.5 of this Section shall not be applied to any credit amounts for deleted work.
11. In those cases where the change involved additions and deletions to the work, the percentage mark-ups referred to in Clause 1.5 and 1.6 below shall apply only when the cost of the additions minus the cost of the deletions would result in an increase

in the Contract Amount. The percentage allowance shall only be applied to that portion of the costs of the additions that is in excess of the cost of the deletions.

12. If the contemplated change in the work necessitates a change in the contract completion date, or has an impact on the work, the Contractor shall identify and include the resulting cost in the breakdown of its quotation to the Contract Administrator.
13. Upon acceptance of the Contractor's quotation by the Contract Administrator, the Contract Administrator shall prepare and issue the Formal Change Order.

### **1.3 HOURLY LABOUR RATES**

1. The hourly labour rates listed in the Contractor's quotation shall be determined in accordance with the collective agreements that are applicable at the site of the work and shall include:
  1. The base rate of pay.
  2. Vacation pay
  3. Benefits which include:
    1. Welfare contributions
    2. Pension contributions
    3. Union dues
    4. Training and industry funds contributions
    5. Other applicable benefits, if any, which can be substantiated by the Contractor.
  4. Statutory and legislated requirements, assessed and payable under statutory authority, which include:
    1. Employment Insurance contributions
    2. Canada Pension Plan or Quebec Pension Plan contributions
    3. Worker's Compensation Board or Commission de la santé et de la sécurité du travail premiums.
    4. Public Liability and Property Damage insurance premiums.
    5. Health tax premiums.
2. In the case of non-union labour, all rates claimed shall be in accordance with the terms of the Labour Conditions forming part of this contract and the Contractor must provide satisfactory proof of the rates actually paid.

### **1.4 MATERIAL, PLANT AND EQUIPMENT COSTS**

1. The costs of all purchases and rentals must be based on the actual amount paid to the suppliers by the Contractor or subcontractor and said costs are to include all applicable discounts.

### **1.5 ALLOWANCE TO THE CONTRACTOR OR SUBCONTRACTOR ON WORK BY OWN FORCES**

1. A mark-up, equal to 10% of the cost of all labour, material, plant and equipment furnished or supplied by the Contractor or subcontractor's that is required by the contemplated change, shall be added to the Contractor's or subcontractor's

quotation as full compensation for:

1. All supervision, coordination, administration, overhead, margin and the risk of undertaking the work within the stipulated amount.
2. Miscellaneous additional costs related to:
  1. The purchase or rental of material, plant and equipment.
  2. The purchase of small tools and supplies.
  3. Safety and protection measures.
  4. Permits, bonds, insurance, Contract Administrating, as-built drawings, commissioning and site office.

**1.6 ALLOWANCE TO CONTRACTOR ON WORK PERFORMED BY IT'S SUBCONTRACTORS**

1. A mark-up, equal to 10% of the total of all quotations received from subcontractors, shall be added to the Contractor's quotation as full compensation for:
  1. All supervision, coordination, administration, overhead, margin and the risk of undertaking the work within the stipulated amount.
  2. Miscellaneous costs related to:
    1. Safety and protection measures.
    2. Permits, bonds, insurance, Contract Administrating, as-build drawings, commissioning and site office.

**PART 2 PRODUCT**

Not Used

**PART 3 EXECUTION**

Not Used

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Schedules, form, content, submission.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.3 CONSTRUCTION PROGRESS SCHEDULING**

- .1 Submit initial schedule in duplicate within ten (10) days after issuance of the Notice to Proceed or Letter of Intent.
- .2 Submit revised schedules with each Application for Payment, identifying changes since previous version.
- .3 Submit MS Project based Gantt Chart with separate line for each major portion of Work or operation, identifying first work day of each week.
- .4 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- .5 Indicate estimated percentage of completion for each item of Work at each submission.
- .6 Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.
- .7 Include dates for commencement and completion of each major element of Work.
- .8 Indicate projected percentage of completion of each item as of first day of month.
- .9 Indicate progress of each activity to date of submission schedule.
- .10 Indicate changes occurring since previous submission of schedule:
  - .1 Major changes in scope.
  - .2 Activities modified since previous submission.
  - .3 Revised projections of progress and completion.
  - .4 Other identifiable changes.

**END OF SECTION**

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**PART 1      GENERAL**

**1.1          ADMINISTRATIVE**

- .1      Submit to Contract Administrator, 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.
- .2      Do not proceed with Work affected by submittal until review is complete.
- .3      Present shop drawings, product data, and samples in SI Metric units.
- .4      Where items or information is not produced in SI Metric units converted values are acceptable.
- .5      Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6      Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7      Verify field measurements and affected adjacent Work are co-ordinated.
- .8      Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- .9      Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
- .10     Keep one reviewed copy of each submission on site.

**1.2          SHOP DRAWINGS AND PRODUCT DATA**

- .1      The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2      Contract Administrator will retain three (3) copies of reviewed shop drawings.
  - .1      Provide sufficient copies of shop drawings for Contract Administrator's review to ensure adequate distribution.
- .3      Submit drawings stamped and signed by professional engineers registered or licensed in Province of Manitoba, where required.

- .4 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.
- .5 Contract Administrator will endeavour to review each submission within 14 working days.
- .6 Adjustments made on shop drawings by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
- .7 Make changes in shop drawings as Contract Administrator may require, consistent with Contract Documents. When resubmitting, notify Contract Administrator in writing of revisions other than those requested.
- .8 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.
- .9 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 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.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.

- .8 Wiring diagrams.
- .9 Single line and schematic diagrams.
- .10 Relationship to adjacent work.
- .10 After Contract Administrator's review, distribute copies.
- .11 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Contract Administrator may reasonably request.
- .12 All electronic submissions must be provided in searchable PDF format.
- .13 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Contract Administrator where shop drawings will not be prepared due to standardized manufacture of product.
- .14 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Contract Administrator.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
- .15 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Contract Administrator.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of contract, complete with project name.
- .16 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Contract Administrator.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .17 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Contract Administrator.
- .18 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .19 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Contract Administrator.
- .20 Delete information not applicable to project.
- .21 Supplement standard information to provide details applicable to project.



- .22 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copies 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.
- .23 The review of shop drawings is for sole purpose of ascertaining conformance with general concept.
  - .1 Review shall not mean Contract Administrator 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.

### **1.3 REQUIRED SHOP DRAWINGS**

- .1 Shop drawings to be submitted are to include, but not necessarily be limited to the following.
  - .1 Reinforcing Steel:
    - .1 Locations
    - .2 Sizes
    - .3 Bar list
    - .4 Mill reports
  - .2 Portland Cement Concrete:
    - .1 Design mix
    - .2 Method of placement
    - .3 Sealants
    - .4 Formwork
    - .5 Plasticizer
  - .3 Site Work:
    - .1 Culverts
    - .2 Geotextile
    - .3 Aggregate Gradations
    - .4 Valves
    - .5 Piping and Fittings

- .6 Manholes
- .4 Mechanical:
  - .1 Process Piping
  - .2 Dimensioned Mechanical Layout
  - .3 Pumps including Pump Curves
  - .4 Valves c/w pertinent actuators
  - .5 Flowmeters
  - .6 Chemical feed systems
  - .7 Monitoring equipment
  - .8 Water and Wastewater Treatment Process System Miscellaneous Items
  - .9 Plumbing System Piping and Fittings
  - .10 Tankage and Coatings
  - .11 Link Seals for floor and wall penetrations
  - .12 Pressure Tanks
  - .13 Pressure Gauges and other instrumentation units
  - .14 Couplings
  - .15 Pipe Hangers and Supports
  - .16 Heating and Ventilation Equipment
- .5 Miscellaneous Metals and Structural Steel:
  - .1 Flashing
  - .2 Lintels
  - .3 Grating and Supports
  - .4 Bearing Pads
  - .5 Vent Pipes
  - .6 Hatches
  - .7 Railing
  - .8 Catwalks
  - .9 Fall arrest systems
- .6 Building/Structural:
  - .1 Wood or Metal Frame Materials w/ Location and Sizing
  - .2 Doors
  - .3 Door Hardware
  - .4 Air/Vapour Barrier

- .5 Exterior Block Sample (Where Applicable)
- .6 Block Lintels (Where Applicable)
- .7 Roofing Materials
- .8 Colour Charts
- .9 Prefinished Metal Siding Details (Profiles, Colours, etc.)
- .7 Electrical:
  - .1 Conduit Layout Plans
  - .2 Service Panels
  - .3 Control Panels
  - .4 Wire and Cables
  - .5 Light Fixtures
  - .6 Sub Panels
  - .7 Breakers
  - .8 Breaker Boxes
  - .9 Also See Division 26
- .8 Miscellaneous:
  - .1 Floor Drains
  - .2 Sump Pit
  - .3 Plumbing Fixtures
  - .4 Shelves
  - .5 Cabinets and other furnishings
  - .6 Fire Safety equipment
- .2 Contractor is to notify Contract Administrator of anticipated deviances from Contract Drawings and Specifications, as additional shop drawings may be requested.

#### **1.4 SAMPLES**

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
  - .1 Deliver samples prepaid to Contract Administrator's business address.
  - .2 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of Contract Documents.
  - .3 Adjustments made on samples by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
  - .4 Make changes in samples which Contract Administrator may require, consistent with Contract Documents.

- .5 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

**1.5 CERTIFICATES AND TRANSCRIPTS**

- .1 Submit all certificates as required by the Contract and Workers' Compensation Board status immediately after award of Contract.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

**1.2 REFERENCES**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Manitoba
  - .1 The Workers Compensation Act RSM 1987 - Updated 2006.
  - .2 The Workplace Safety and Health Act (the "WSH Act").
- .4 City of Winnipeg Workplace Safety & Health Program for Contractors

**1.3 SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed or Letter of Intent and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit copies of Contractor's authorized representative's work site health and safety inspection reports to Contract Administrator and authority having jurisdiction, as requested.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit copies of Workplace Hazardous Materials Information System (WHMIS) and Material Safety Data Sheets (MSDA) acceptable to Contract Administrator, Labour Canada, and Health and Welfare Canada.
- .7 Contract Administrator will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within seven (7) working days after receipt of plan. Revise plan as appropriate and resubmit plan to Contract Administrator within five (5) working days after receipt of comments from Contract Administrator.

.8 Contract Administrator's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Contract Administrator.

#### **1.4 WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)**

.1 Obtain Material Safety Data Sheets relating to specified products or other regulated products and materials that will be used on the work site, including those materials not specified herein.

.2 Take precautions as may be required or reasonable in this circumstance to protect own employees and employees and facilities of Contract Administrator, during the handling, storage and applications of these products.

#### **1.5 FILING OF NOTICE**

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

#### **1.6 SAFETY ASSESSMENT**

.1 Perform site specific material and safety hazard assessment related to project.

#### **1.7 MEETINGS**

.1 Schedule and administer Health and Safety meeting with Contract Administrator prior to commencement of Work.

#### **1.8 REGULATORY REQUIREMENTS**

.1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

#### **1.9 GENERAL REQUIREMENTS**

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Contract Administrator may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

#### **1.10 RESPONSIBILITY**

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

#### **1.11 COMPLIANCE REQUIREMENTS**

- .1 Comply with The Workers Compensation Act, Workplace Safety Regulation, Manitoba Reg. RSM 1987 – Updated 2006.
- .2 Comply with the Workplace Safety and Health Act (the “WSH Act”).
- .3 City of Winnipeg Workplace Safety & Health Program for Contractors

#### **1.12 UNFORSEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Contract Administrator verbally and in writing.

#### **1.13 HEALTH AND SAFETY CO-ORDINATOR**

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
  - .1 Have minimum two (2) years' site-related working experience specific to activities associated with Work of this Contract.
  - .2 Have working knowledge of occupational safety and health regulations.
  - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.
- .2 Contractor must notify the Contract Administrator of the individual, including all qualifications and experience for approval prior to commencing the Work.

#### **1.14 POSTING OF DOCUMENTS**

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

#### **1.15 CORRECTION OF NON-COMPLIANCE**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Contract Administrator.
- .2 Provide Contract Administrator with written report of action taken to correct non-compliance of health and safety issues identified.

- .3 Contract Administrator may stop Work if non-compliance of health and safety regulations is not corrected.

#### **1.16 BLASTING**

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Contract Administrator.

#### **1.17 POWDER ACTUATED DEVICES**

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

#### **1.18 WORK STOPPAGE**

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

#### **1.19 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

#### **1.20 CONFINED SPACES**

- .1 Every worker who enters a confined space must be qualified and adequately trained in safe work practices. Workers must be equipped with all required PPE and be trained to recognize the hazards associated with working in confined spaces.
- .2 The Contractor must maintain up to date records of training for each employee who will be working in confined spaces.

#### **1.21 WORKING AT HEIGHTS**

- .1 Every worker who will be working at heights must receive proper training and be sufficiently qualified to do so. The training requirement is for all workers who will be using any of the following:
  - .1 Travel restraint systems;
  - .2 Fall restricting systems;
  - .3 Fall arrest systems;
  - .4 Safety nets; and
  - .5 Work belts or safety belts.

#### **1.22 PAINTING**

- .1 All workers who will be completing painting of any components of the Work must be equipped with all of the necessary PPE, as regulated in all appropriate codes and standards and as recommended by the Manufacturer.



**1.23 MACHINE GUARDING**

- .1 Machine guarding must be performed on all hazardous areas of machines to prevent contact with body parts or to control hazards (noise, chips, etc.) from exiting the machine.
- .2 The Contractor must include provisions for machine guarding in their Safe Work Plan (SWP).

**1.24 ELECTRICAL EQUIPMENT**

- .1 The Contractor personnel working on electrical equipment and lines must be trained and certified to work on those equipment.
- .2 The workers must take all safety precautions and wear required PPE.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 01 74 19 – Waste Management and Disposal.

**1.2 REFERENCES**

- .1 Definitions:
  - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
  - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.
  - .3 Erosion: deterioration, displacement, or transportation of land surface by wind or water, intensified by land-clearing practices related to construction activities.
  - .4 Sediment: particulate matter transported and deposited as a layer of solid particles within a body of water.
- .2 Reference Standards:
  - .1 Canadian Construction Documents Committee (CCDC)
    - .1 CCDC 2-2008 Stipulated Price Contract.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review by Contract Administrator.
- .2 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction, including any remedial work that may be required.
- .3 Address topics at level of detail commensurate with environmental issue and required construction tasks.

- .4 Include in Environmental Protection Plan:
  - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.

#### **1.4 ENVIRONMENTAL PROTECTION**

- .1 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .2 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .3 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .4 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .5 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as clean-up water or dewatering of ground water.

#### **1.5 SITE CLEARING AND PLANT PROTECTION**

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Contract Administrator.

#### **1.6 WORK ADJACENT TO WATERWAYS**

- .1 Waterways to be free of excavated fill, waste material and debris.
- .2 Design and construct temporary crossings to minimize erosion to waterways.

#### **1.7 POLLUTION CONTROL**

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.

- .3 Prevent extraneous materials from contaminating air and waterways beyond application area.
  - .1 Provide temporary enclosures where indicated directed by Contract Administrator.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

**1.8 FIRES**

- .1 Fires and burning of rubbish on site not permitted.

**1.9 NOTIFICATION**

- .1 Contract Administrator will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Contract Administrator of proposed corrective action and take such action for approval by Contract Administrator.
  - .1 Do not take action until after receipt of written approval by Contract Administrator.
- .3 Contract Administrator will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

**PART 2 PRODUCTS**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 CLEANING**

- .1 Clean in accordance with Section 01 74 11 – Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 CODES AND STANDARDS**

- .1 Perform Work in accordance with latest edition of the National building code and Manitoba Building Code including Supplements up to tender closing date, and all Codes as well as Standards specified within the text of this specification, provided that in case of conflict or discrepancy, more stringent requirements apply. Drawings and specifications do not create any release from compliance with governing Codes and Standards.
- .2 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.
- .3 Electrical components and equipment which are not CSA approved shall be approved by the Manitoba Department of Labour prior to connection to the electrical service. Pay for all costs associated with obtaining the necessary approval.

**1.2 SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions.

**1.3 PERMITS**

- .1 Apply and obtain all permits required to start and complete the construction of the project. Pay for all costs associated with obtaining the necessary approval.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 INSPECTION**

- .1 Allow Contract Administrator access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Contract Administrator instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Contract Administrator will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

**1.2 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies may be engaged by Contract Administrator for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Contractor.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Contract Administrator. Contractor to Pay costs for retesting and re-inspection.

**1.3 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants. Co-operate to provide reasonable facilities for such access.

**1.4 PROCEDURES**

- .1 Notify appropriate agency and Contract Administrator in advance of requirement for tests, in order that attendance arrangements can be made.

- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

#### **1.5 REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Contract Administrator as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Contract Administrator, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Contract Administrator will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Contract Administrator.

#### **1.6 REPORTS**

- .1 Submit 4 copies of inspection and test reports to Contract Administrator.
- .2 Provide copies to subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.
- .3 Reports to be provided in searchable PDF format.

#### **1.7 TESTS AND MIX DESIGNS**

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Contract Administrator and may be authorized as recoverable.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 ACCESS**

- .1 Provide and maintain adequate access to project site.
- .2 Build and maintain temporary road where directed and provide snow removal during period of work (as applicable).
- .3 If authorized to use existing roads for access to project site, maintain such roads for duration of contract and make good damage resulting from Contractor's use of roads.

**1.2 STORAGE SHEDS**

- .1 Provide adequate weather tight sheds with raised floors, for storage of materials, tools and equipment which are subject to damage by weather.

**1.3 SANITARY FACILITIES**

- .1 Provide sanitary facilities for work force and Contract Administrator's staff in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

**1.4 POWER**

- .1 Arrange, pay for and maintain temporary electrical power supply in accordance with governing regulations and ordinances.
- .2 Install temporary facilities for power such as pole lines and underground cables to approval of local power supply authority.
- .3 Electrical power and lighting systems installed under this contract may be used for construction requirements without prior approval of Contract Administrator provided that guarantees are not affected. Make good damage. Replace lamps which have been used over period of the duration of the contract.

**1.5 HEATING AND VENTILATING**

- .1 Pay for costs of temporary heat and ventilation used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment. Use of direct-fired heaters discharging waste products into work areas will not be permitted unless prior approval is given by Contract Administrator.
- .2 Provide temporary heat and ventilation in enclosed areas as required to:
  - .1 Facilitate progress of work.



- .2 Protect work and products against dampness and cold.
- .3 Prevent moisture condensation on surfaces.
- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .3 Maintain minimum temperature of 10 degrees C or higher where specified as soon as finishing work is commenced and maintain until acceptance of structure by Contract Administrator.
- .4 Ventilating:
  - .1 Prevent hazardous accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
  - .4 Ventilate storage spaces containing hazardous or volatile materials.
  - .5 Ventilate temporary sanitary facilities.
  - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful elements.
- .5 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform to applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services
  - .4 Prevent damage to finishes
  - .5 Vent direct-fired combustion units to outside.
- .6 Activate radiation system under direction of Contract Administrator to provide temporary heat, after building is closed in.
- .7 Replace filters at time of final acceptance of work.

## **1.6 SITE SIGNS AND NOTICES**

- .1 Only Project Identification and Contract Administrator/Contractor signboards and notices for safety or instruction are permitted on site.
- .2 Format, location and quantity of site signs and notices to be approved by Contract Administrator.

- .3 Signs and notices for safety or instruction to be in English language, or commonly understood graphic symbols.
- .4 Maintain signboards, signs and notices for duration of project. Remove and dispose of signs off site on completion of project.

**1.7 SCAFFOLDING**

- .1 Construct and maintain scaffolding in rigid, secure and safe manner.
- .2 Erect scaffolding independent of walls. Remove promptly when no longer required.

**1.8 REMOVAL OF TEMPORARY FACILITIES**

- .1 Remove temporary facilities from site when directed by Contract Administrator.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 INSTALLATION AND REMOVAL**

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

**1.2 DEWATERING**

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

**1.3 WATER SUPPLY**

- .1 Provide continuous supply of potable water for construction use.

**1.4 TEMPORARY POWER AND LIGHT**

- .1 Temporary power for equipment is responsibility of Contractor. Pay for temporary power during construction for temporary lighting and operating of power tools.
- .2 Pay costs for installation, maintenance and removal of temporary power.

**1.5 TEMPORARY COMMUNICATION FACILITIES**

- .1 Provide and pay for temporary telephone, fax, data hook up, lines, equipment necessary for own use and use of the Contract Administrator.

**1.6 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

**PART 2 PRODUCTS**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff to catch basins or airborne dust to adjacent properties and walkways, in accordance with Section 01 35 43 – Environmental Procedures, and according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until pavements, roadways completed and permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore areas disturbed during removal.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-S269.2-M1987 (R2003), Access Scaffolding for Construction Purposes.
  - .2 CAN/CSA-Z321-96 (R2001), Signs and Symbols for the Occupational Environment.

**1.2 SUBMITTALS**

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

**1.3 INSTALLATION AND REMOVAL**

- .1 Prepare site plan indicating proposed location and dimensions of areas to be used by Contractor, number of trailers to be used, staging area, and avenues of ingress/egress to areas.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Provide construction facilities in order to execute work expeditiously.
- .4 Remove from site all such work after use.

**1.4 SCAFFOLDING**

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, and platforms.

**1.5 HOISTING**

- .1 Provide, operate and maintain hoists, cranes required for moving of materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists, cranes to be operated by qualified operator.

**1.6 SITE STORAGE/LOADING**

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

### **1.7 CONTRACTOR FUEL REQUIREMENTS**

- .1 The Contractor must supply fuel containment and storage for the duration of the project.
- .2 Fuel containment and storage includes transfer containers and storage containers, complete with spill kits and containments as required.
- .3 Lay down area plans must be submitted a minimum of 21 days prior to Construction and approved by Contract Administrator prior to any work taking place.

### **1.8 CONSTRUCTION PARKING**

- .1 Parking will be permitted on site where designated by Contract Administrator, provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

### **1.9 SECURITY**

- .1 Ensure adequate security provided to guard site and contents of site after working hours and during holidays.

### **1.10 OFFICES**

- .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide a desk and chair in the office for the Contractor Administrator use.
- .3 Provide marked and fully stocked first-aid case in a readily available location.
- .4 Subcontractors to provide their own offices as necessary. Direct location of these offices.

### **1.11 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.

### **1.12 CONSTRUCTION SIGNAGE**

- .1 No signs or advertisements, other than warning signs, are permitted on site.
- .2 Signs and notices for safety and instruction in project location official languages. Graphic symbols to CAN/CSA-Z321.

- .3 Maintain approved signs and notices in good condition for duration of project and dispose of off site on completion of project or earlier if directed by Contract Administrator.

**1.13 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Provide access as necessary to maintain traffic and parking at building site.
- .2 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .3 Protect travelling public from damage to person and property.
- .4 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .5 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .6 Dust control: adequate to ensure safe operation at all times.

**1.14 CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Stack stored new material not in construction facilities.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 CONSTRUCTION SAFETY MEASURES**

- .1 Observe and enforce construction safety measures required by National Building Code 1985 Part 8, Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Manitoba, Worker's Compensation Board and municipal statutes and authorities.
- .2 In event of conflict between any provisions of above authorities the most stringent provision governs.
- .3 Where applicable, the Contractor shall be designated the "Constructor" as defined by Provincial Acts.

**1.2 FIRE SAFETY REQUIREMENTS**

- .1 Comply with requirements of standard for Building Construction Operations FCC No. 301-1982, issued by Fire Commissioner for Canada.
- .2 This standard may be obtained from:  

Fire Commissioner for Canada  
Sir Charles Tupper Building  
Riverside Drive  
Ottawa, Ontario K1A 0M2

**1.3 OVERLOADING**

- .1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

**1.4 EXCAVATIONS**

- .1 The General Contractor shall be responsible for adequate fencing of all excavations overnight and on holidays and shall provide adequate lights and barricades as may be required in the opinion of the Authorities having Jurisdiction and accepted by the Contract Administrator.

**PART 2 PRODUCTS – NOT USED**

**PART 3 EXECUTION – NOT USED**

**END OF SECTION**



**PART 1 GENERAL**

**1.1 FIRES**

- .1 Fires and burning of rubbish on site is not be permitted.

**1.2 DRAINAGE AND EROSION CONTROL**

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .2 Do not pump water containing suspended materials into waterways or sewer systems.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- .4 Prior to commencing excavation or site grading operations, erect siltation control fence to prevent erosional run off from carrying suspended materials from disturbed areas of stockpiles leaving the site and entering waterways.
  - .1 Acceptable product Terrafence with prepositional posts or approved equal in accordance with B.7.
- .5 Removal of vegetation from sloped approaches to watercourses to be kept to a minimum. Excavate and stabilize temporary channel beds prior to any diversion of flow.

**1.3 PLANT PROTECTION:**

- .1 Protect all trees and plants that are designated to remain.
  - .1 Do not stockpile material within drip line.
  - .2 Do not allow traffic, vehicles or equipment to compact soil within drip line. To accomplish this, erect temporary snow fence around affected areas.
  - .3 Prune interfering branches.
  - .4 Do not cut tree roots.
- .2 Damaged Trees:
  - .1 Replace all trees that are to remain that have been damaged beyond saving.
  - .2 Replace trees with similar size and species or as approved by Contract Administrator.

## **1.4 POLLUTION CONTROL**

- .1 Refuelling Areas
  - .1 Review in detail proposed route of construction to plan access routes and fuelling areas.
  - .2 Establish suitable fuelling and maintenance areas and obtain approval from Contract Administrator.
  - .3 Do not fuel or maintain equipment within thirty (30) meters of any watercourse unless non-spill facilities are used.
  - .4 Provide Contract Administrator with refueling plan and spill response plan a minimum of fourteen (14) days prior to start of work for review and approval.
- .2 Cleaning Equipment
  - .1 Do not clean equipment in watercourses.
  - .2 Clean construction equipment prior to entering roadways.
  - .3 Do not clean equipment in locations where debris can gain access to sewers or watercourses.
  - .4 All equipment is to be free of external fluid leaks.
- .3 Spills
  - .1 Submit procedures for interception, rapid clean up and disposal of spillage that may occur, for Contract Administrator's review, prior to commencing work.
  - .2 Be prepared at all times to intercept, clean up and dispose of any spillage that may occur whether on land or water.
  - .3 Keep all materials required for clean up of spillages readily accessible on site.
  - .4 Report immediately any spills causing damage to environment to Spills Action Centre of Manitoba Conservation.
- .4 Disposal
  - .1 Do not empty fuel, lubricants or pesticides into sewers or watercourses.
  - .2 Dispose of all construction debris in an approved location.

## **1.5 NOISE CONTROL**

- .1 Establish and maintain site procedures such that noise levels from construction areas are minimized.
- .2 Use vehicles and equipment equipped with efficient muffling devices.
- .3 Provide and use devices that will minimize noise level in construction area.

**1.6 DUST CONTROL**

- .1 Prevent dust nuisance resulting from construction operations at all locations on site.
- .2 Use water, brine or calcium chloride to control dust.
  - .1 Minimize use of calcium and brine, particularly in close proximity to watercourses or agricultural lands.
  - .2 Transport dusty materials in covered haulage vehicles.
  - .3 Public roadways shall be kept clean and free of mud.
- .3 Payment for water Calcium Chloride or brine to be included with the applicable item for which dust control is required.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 INSTALLATION AND REMOVAL**

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

**1.2 HOARDING SITE ENCLOSURE**

- .1 Provide temporary site enclosure using 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at maximum 2.4 m on centre with lockable gates for access by workers and vehicles. Maintain fence in good condition.
- .2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

**1.3 GUARD RAILS AND BARRICADES**

- .1 Provide secure, rigid guard rails and barricades around deep excavations.
- .2 Provide as required by governing authorities.

**1.4 WEATHER ENCLOSURES**

- .1 Provide temporary weather tight closures to enclose building exterior, interior work for temporary heat. Design enclosures to withstand local wind pressure and snow loading.

**1.5 ACCESS TO SITE**

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

**1.6 PUBLIC TRAFFIC FLOW**

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

**1.7 FIRE ROUTES**

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

**1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

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

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 REFERENCES**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Contract Administrator reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Contract Administrator in event of conformance with Contract Documents or by Contractor in event of non-conformance.

**1.2 QUALITY**

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Contract Administrator based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

**1.3 AVAILABILITY**

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Contract Administrator at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Contract Administrator reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

#### **1.4 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementation products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber, on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.
- .9 Touch-up damaged factory finished surfaces to Contract Administrator's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.5 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.

#### **1.6 MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Contract Administrator in writing, of conflicts between specifications and manufacturer's instructions, so that Contract Administrator will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.

#### **1.7 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required Work is such as to make it impractical to produce required results.

- .2 Do not employ anyone unskilled in their required duties. Contract Administrator reserve right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Contract Administrator, whose decision is final.

#### **1.8 CO-ORDINATION**

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Coordinate with the other contractor (if any) working on or around the project site.
- .3 Coordinate with all governing authorities.

#### **1.9 CONCEALMENT**

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform the Contract Administrator if there is interference. Install as directed by Contract Administrator.

#### **1.10 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

#### **1.11 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Contract Administrator.

#### **1.12 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, building occupants, and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 REFERENCES**

- .1 Contract Administrator's identification of existing survey control points and property limits.

**1.2 SURVEY REFERENCE POINTS**

- .1 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .2 Make no changes or relocations without prior written notice to Contract Administrator.
- .3 Report to Contract Administrator when reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
- .4 Replace control points in accordance with original survey control.

**1.3 SURVEY REQUIREMENTS**

- .1 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2 Establish lines and levels, locate and lay out, by instrumentation.
- .3 Stake for grading, fill, paving, topsoil placement and landscaping features.
- .4 Stake slopes and berms.
- .5 Establish pipe invert elevations.
- .6 Establish foundation, column locations, and floor elevations.

**1.4 EXISTING SERVICES**

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Contract Administrator of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Contract Administrator.
- .3 Remove existing services and facilities as indicated on Decommissioning Drawing.

**1.5 LOCATION OF EQUIPMENT AND FIXTURES**

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.



- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Contract Administrator of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment to Contract Administrators approval.

**1.6 RECORDS**

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of service installations, prepare record drawing showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

**1.7 SUBMITTALS**

- .1 On request of Contract Administrator, submit documentation to verify accuracy of field Contract Administrating work.
- .2 Submit record drawing certified by Contractor and noting those elevations and locations of completed Work that conform and do not conform to Contract Documents.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RECORD DRAWINGS**

- .1 As work progresses, neatly record significant deviations from the contract drawings using fine, red marker on full size white prints.
  - .1 Neatly print lettering and numbers in size to match original.
  - .2 Lines may be drawn free-hand but shall be neat and accurate.
  - .3 Add at each drawing title block note: **"AS BUILT RECORD"**.
  - .4 Also circle on List of Drawings each title and number of drawings marked with "as-built" records.
- .2 Record following significant deviations:
  - .1 Depths of various elements of foundation.
  - .2 Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvement and geodetic elevation.
  - .3 Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
  - .4 Field changes of dimensions.
  - .5 Other significant deviations which are concealed in construction and cannot be identified by visual inspection.
- .3 Turn one set of As-built Record Drawings over to Contract Administrator on completion of work, signed by Contractor.
- .4 If project is completed without significant deviations from contract drawings, declare this in writing and submit to Contract Administrator in lieu of As-Built Record Drawings.

**PART 2 PRODUCTS – NOT USED**

**PART 3 EXECUTION – NOT USED**

**END OF SECTION**

## **PART 1      MAINTENANCE MANUAL**

1. This section outlines the requirements of operational and maintenance data to be provided for this project.
2. On completion of this project, Contractor shall submit to Contract Administrator six (6) final hard copies of Operating and Maintenance Data in English made up as follows:
  1. Bind in 6 white vinyl hard covered, 3-D ring loose leaf binders for 215x280, sized paper. Binders to have clear plastic pocket on front face and spine and vinyl pouches on inside front and back covers.
  2. Enclose title sheet, labelled "Operating and Maintenance Data Manual", project name, date and list of contents.
  3. Organize contents into applicable sections of work to parallel project specification breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
  4. The contractor shall provide 2 draft copies of the "Operating and Maintenance Manual" 2 weeks prior to the commencement of construction. Construction may not be permitted until the Operating and Maintenance Manual is deemed to be at least 90% complete.
3. Include the following information plus data specified:
  1. Maintenance instruction for finished surface and materials
  2. Copy of hardware and paint schedules
  3. Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity and serial number.
  4. Names, addresses and phone number of subcontractor and suppliers
  5. Guarantees, warranties and bonds showing:
    1. Name and address of project
    2. Guarantee commencement date (Date of Final Certificate of Completion)
    3. Duration of guarantee
    4. Clear indication of what is being guaranteed and what remedial action will be taken, under guarantee.
    5. Signature and seal of approval of appropriate Sub-contractor.
  6. Additional material used in project listed under various sections showing name of product

4. Neatly type all lists and notes. Use clear drawings, diagrams or manufacturer's literature.
5. Include one complete set of reviewed shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
6. Include a list of all manufacturer's recommended spare parts, lubricants and operation and maintenance equipment, neatly typed and organized by section with a detailed table of contents.
7. On completion of project, Contractor shall submit to Contract Administrator three (3) CD ROM copies of all Operating and Maintenance Data presented in the hard copy binders:
  1. O & M data to be presented in Portable Document Format (PDF) and shall be exact copy of that contained in the binders (no generic pdf specs).
  2. Each individual O & M specific document is to be presented as an independent "PDF" file (i.e. whole binder I not to be one single PDF file).
  3. Information presented on CD ROM is to be categorized and organized into folders/subfolders that correlate to the information delineation and categorization applied to the bound O & M Manual Binders.

## **PART 2 MAINTENANCE MATERIALS**

1. Where supply of maintenance materials are specified, deliver to site as follows:
  1. Use unbroken cartons, or if not supplied in cartons, they shall be strongly packaged.
  2. Clearly mark as to content
  3. If applicable, give area where material used.
  4. Materials to be supplied for 3 months after preliminary acceptance.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SCOPE**

- .1 This section outlines measures to be taken to ensure that existing flows and functionality are maintained while operating the Manto Sipi Cree Nation water and wastewater systems until the new water and wastewater treatment systems are put "on line".
  - .1 "Existing Flows" refers to those systems and equipment components observed to be operational in delivering treated water supplies and collecting and treating wastewater at the time that the construction contract is signed.
    - .1 It is the Contractor's responsibility to accurately assess and document these "existing" operational conditions.
      - .1 Submit assessment report to the Contract Administrator and the City prior to commencing alteration activities demanded by this contract.
- .2 The existing treated water supply/distribution system and wastewater collection/treatment system may have to be taken out of service sequentially as new modifications are completed and energized for upgraded operating service.
- .3 During the period that work is underway on the new facilities, treated water flow through the existing water system and wastewater flow and treatment through the existing wastewater system must be maintained in a manner similar to its present form.
  - .1 Not only shall the same degree of flow and water quality, and same quality of wastewater treatment be provided, but it shall be automatically controlled in a manner identical to the system presently in place.
- .4 The Contractor must set up a temporary pumping/piping/control arrangement to ensure that water and wastewater flow in its present form and method of control is provided until the Start-Up Period on the new water and wastewater treatment facilities has been successfully completed.
- .5 Provide measures necessary to ensure that the temporary pump/piping/control system is protected from vandalism and freezing.
  - .1 Depending on the timing of work, it may be necessary to insulate and heat trace the pump/piping systems installed.
- .6 Prior to commencing work, submit the proposed temporary pump/piping system to Contract Administrator for review along with:
  - .1 Proposed schedule including information regarding temporary measures to ensure undisturbed flows.
  - .2 Temporary piping size, layout and arrangement.
  - .3 Wiring schematics indicating how power and control wiring will be modified.
- .7 The Contractor shall co-ordinate this work with the Contract Administrator and the First Nation.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 GENERAL**

- .1 Carry out cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- .2 Store volatile wastes in covered metal containers and remove from premises daily.
- .3 Prevent accumulation of wastes which create hazardous conditions.
- .4 Provide adequate ventilation during use of volatile or noxious substances.

**1.2 MATERIALS**

- .1 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .2 Ensure WMHIS data sheets are on site.

**1.3 CLEANING DURING CONSTRUCTION**

- .1 Maintain project site free from accumulations of waste materials and rubbish.
- .2 Provide on-site containers for collection of waste materials and rubbish.
- .3 Remove waste materials and rubbish from site.
- .4 Vacuum clean interior building areas when ready to receive finish painting.
- .5 Schedule cleaning operations so that resulting dust and other contaminants will not fall on wet, newly painted surfaces.

**1.4 FINAL CLEANING**

- .1 In preparation for substantial completion or occupancy, conduct inspection of sight-exposed interior and exterior surfaces.
- .2 Remove grease, dust, dirt, stains, fingerprints and other foreign materials from sight-exposed interior and exterior finished surfaces including glass and other polished surfaces.
- .3 Broom clean paved surfaces; rake clean other surfaces of grounds.
- .4 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .5 Remove snow and ice from access to building.
- .6 Replace heating and ventilation filters if units were operated during construction.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 DEFINITIONS**

- .1 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .2 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .3 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .4 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before deconstruction stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .5 Salvage: removal of structural and non-structural construction materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .6 Separate Condition: refers to waste sorted into individual types.
- .7 Source Separation: acts of keeping different types of waste materials separate, beginning from first time they became waste.

### **1.2 WASTE REDUCTION WORKPLAN (WRW)**

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
  - .1 Destination of materials listed.
  - .2 Deconstruction/disassembly techniques and sequencing.
  - .3 Schedule for deconstruction/disassembly.
  - .4 Location.
  - .5 Security.
  - .6 Protection.
  - .7 Clear labelling of storage areas.
  - .8 Details on materials handling and removal procedures.
  - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

- .4 Describe management of waste.
- .5 Post WRW or summary where workers at site are able to review content.
- .6 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .7 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

**1.3 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)**

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations and facility operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
  - .1 Transport to approved and authorized recycling facility.

**1.4 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Contract Administrator.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of structures is endangered, cease operations and immediately notify Contract Administrator.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate, store materials produced during dismantling of structures in designated areas.



- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

- .1 On-site source separation is recommended.

## **1.5 DISPOSAL OF WASTES**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste volatile materials, mineral spirits, oil, paint thinner, into waterways, storm, or sanitary sewers.
- .3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

## **1.6 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility.

## **1.7 SCHEDULING**

- .1 Co-ordinate Work with other activities at site to ensure timely, orderly progress of Work.

## **PART 2 PRODUCTS**

- .1 Not Used.

## **PART 3 EXECUTION**

### **3.1 APPLICATION**

- .1 Do Work in compliance with Waste Reduction Workplan (WRW).
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

### **3.2 CLEANING**

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

**END OF SECTION**

**PART 1 GENERAL**

**1.1 ADMINISTRATIVE REQUIREMENTS**

- .1 Acceptance of Work Procedures:
  - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
    - .1 Notify Contract Administrator in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
    - .2 Request Contract Administrator's inspection.
  - .2 Contract Administrator's Inspection:
    - .1 Contract Administrator and Contractor to inspect Work and identify defects and deficiencies.
    - .2 Contractor to correct Work as directed.
  - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
    - .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 Utility companies: submitted.
    - .5 All required electrical permits must be obtained.
    - .6 Operation of systems: demonstrated to City of Winnipeg's personnel.
    - .7 Commissioning Report submitted to Contract Administrator.
    - .8 Work: complete and ready for final inspection.
  - .4 Final Inspection:
    - .1 When completion tasks are done, request final inspection of Work by Contract Administrator, and Contractor.
    - .2 When Work incomplete according to Contract Administrator, complete outstanding items and request re-inspection.
  - .5 Declaration of Substantial Performance: when Contract Administrator considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
  - .6 Commencement of Lien and Warranty Periods: date of City of Winnipeg's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.

- .7 Final Payment:
  - .1 When Contract Administrator considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
  - .2 When Work deemed incomplete by Contract Administrator, complete outstanding items and request re-inspection.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

**1.2 FINAL CLEANING**

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

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-warranty Meeting:
  - .1 Convene meeting one week prior to contract completion with contractor's representative and Contract Administrator to:
    - .1 Verify Project requirements.
    - .2 Review manufacturer's installation instructions and warranty requirements.
  - .2 Contract Administrator to establish communication procedures for:
    - .1 Notifying construction warranty defects.
    - .2 Determine priorities for type of defects.
    - .3 Determine reasonable response time.
  - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
  - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, four final copies of operating and maintenance manuals in English.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

**1.3 FORMAT**

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
  - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dxf format on CD.

#### **1.4 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties.
  - .3 Schedule of products and systems indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

#### **1.5 AS -BUILT DOCUMENTS AND SAMPLES**

- .1 Maintain, in addition to requirements in General Conditions, at site for Contract Administrator, City of Winnipeg, one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Change Orders and other modifications to Contract.
  - .5 Reviewed shop drawings, product data, and samples.
  - .6 Field test records.
  - .7 Inspection certificates.
  - .8 Manufacturer's certificates.

- .2 Store record documents and samples in field office apart from documents used for construction.
  - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
  - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
  - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Contract Administrator.

## **1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Contract Administrator.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
  - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimension and detail.
  - .5 Changes made by change orders.
  - .6 Details not on original Contract Drawings.
  - .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 As part of Work, submit to Contract Administrator upon Substantial Performance of Work, before occupancy, one set of marked up as-built drawings which reflect as-built information.

- .8 Electronic Record Documents:
  - .1 Contract Administrator will prepare electronic record documents based on as-built information received from the Contractor.
  - .2 Contractor shall employ the services of the Contract Administrator to transfer as-built information and changes on the record documents to the computer-generated drawings and documents.
  - .3 Cost for preparation of electronic record documents shall be covered in the respective line items in the Fee Form. No separate payment will be made.
- .9 Final payment on the Contract will not be made until correct record documents are received.
- .10 Provide digital photos for site records.

**END OF SECTION**

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**Part 1          General**

**1.1      DESCRIPTION**

- .1      Demonstrate scheduled operation and maintenance of equipment and systems to City of Winnipeg's personnel no less than two weeks prior to date of final inspection.
- .2      Dates for training to be submitted and approved by City of Winnipeg and City of Winnipeg at least two weeks prior to the commencement of training.
- .3      Training sessions are to be developed with input from the City of Winnipeg and shall be approved by the City of Winnipeg and the City of Winnipeg. Contractor shall submit the course contents to Contract Administrator's review minimum of 6 weeks prior to the first training session. The contractor shall incorporate all comments from the City of Winnipeg and submit the finalized course content at least two weeks prior to first training session. Major areas to be covered includes, but not limited to, the following:
  - .1      Electrical and Control
  - .2      HVAC
  - .3      Plumbing
- .4      Training will be conducted by the Contractor to City of Winnipeg operations staff.
- .5      City of Winnipeg will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed-upon times.

**1.2      QUALITY CONTROL**

- .1      When specified in individual Sections require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct City of Winnipeg's personnel, and provide written report that demonstration and instructions have been completed.

**1.3      SUBMITTALS**

- .1      Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Contract Administrator's approval. Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3      Give time and date of each demonstration, with list of persons present. Ensure persons present sign an attendance form.

**1.4      CONDITIONS FOR DEMONSTRATIONS**

- .1      Equipment has been inspected and put into operation.
- .2      Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.



## **1.5 PREPARATION**

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated personnel are present.

## **1.6 DEMONSTRATION AND INSTRUCTIONS**

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.
- .5 Provide all shop drawings and operation and maintenance manuals for all installed components of the Works to the Contract Administrator, to assist in the preparation of the Commissioning and Training Document.

## **1.7 TIME ALLOCATED FOR INSTRUCTIONS**

- .1 For each training session, allow two (2) half days (4 hours each) for instruction and on the job hands on training for facility operators.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**Part 1            General**

**1.1    SUMMARY**

- .1    Acronyms:
  - .1    Cx - Commissioning.
  - .2    O&M - Operation and Maintenance.
  - .3    PI - Product Information.
  - .4    PV - Performance Verification.
  - .5    TAB - Testing, Adjusting and Balancing.

**1.2    PRE-COMMISSIONING**

- .1    The Contractor is responsible to complete Pre-Commissioning activities prior to Commissioning.
- .2    The purpose of Pre-Commissioning is the inspection and testing of all equipment, system components, and controls by the Contractor's own forces or by Supplier and Manufacturer's representatives, prior to the Commissioning, to ensure that unexpected operational problems are not identified during Commissioning.
- .3    All components that will be tested in Commissioning should be tested in Pre-Commissioning.
- .4    Start Cx only after elements of the facility affecting start-up and performance verification of systems have been completed.

**1.3    COMMISSIONING PLAN**

- .1    A comprehensive Commissioning Plan shall be provided by Contractor for the review of Contract Administrator minimum of two weeks prior to commissioning. The commissioning plan shall detail list of actions to be carried out on each day of commissioning period. The commissioning plan shall include a schedule that would indicate the dates of commissioning. It shall also include commissioning forms to be filled out by the contractor to record and document the results of commissioning procedures. (Commissioning forms are to be developed by Contractor with input from Suppliers, Manufacturers and Contract Administrator as appropriate.)
- .2    Minimum of two separate site visits by the involved trades shall be allocated to commissioning.
- .3    The Contractor will provide training to staff on the operation and maintenance of all newly installed equipment. Refer Section 01 79 00 Demonstration and Training.
- .4    Contractor shall schedule a meeting with Contract Administrator to review the commissioning plan. Contract Administrator's requirements shall be incorporated into the commissioning plan.

**1.4    GENERAL**

- .1    Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

Objectives:

- .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
- .2 Supplement training of O&M staff. Commissioning is not considered a formal training session.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactive with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Substantial Performance will not be granted until the "start-up" period outlined herein has been completed to the satisfaction of the Contract Administrator.
- .4 The works will not be turned over to the City of Winnipeg for operation until the start-up period has been completed to the satisfaction of the Contract Administrator.

**1.5 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the non-functional system, including related systems as deemed required by Contract Administrator, to ensure effective performance.
- .2 Costs for corrective work, additional tests, and site visits to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.
- .3 Costs associated with subsequent site visits by Contract Administrator and City of Winnipeg personnel that are, in the opinion of the Contract Administrator, due to the Contractor being unprepared for Commissioning, shall be borne by the Contractor.
- .4 Commissioning must be carried out by personnel who meet the following criteria:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Able to interpret test results accurately.
  - .3 Able to report results in clear, concise, logical manner.

**1.6 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

- .2 Visual inspection of quality of installation.
- .2 Start-up: follow accepted start-up procedures.
- .3 Operational testing: document equipment performance.
- .4 System PV: include repetition of tests after correcting deficiencies.
- .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Contract Administrator after distinct phases have been completed and before commencing next phase.
- .4 Document required tests on approved PV forms.
- .5 Provide the services of a manufacturer's technician to certify that equipment is operating as intended. Manufacturer's technician shall instruct the Operators in the operation and maintenance of the equipment provided.
  - .1 Other sections of this document outline commissioning requirements for various pieces of equipment. Included in these other sections will be the number of days and time that the supplier is to include in the quoted price for commissioning of the respective line items.
    - .1 The Contractor is required to coordinate and pay for the commissioning services of those listed and shall take these quoted prices into account and shall "cover" the difference to obtain the minimum commissioning, start-up and warranty periods described.
- .6 The following equipment is to be commissioned by a manufacturer's representative:
  - .1 Electrical and Controls
  - .2 HVAC and Plumbing
  - .3 Plumbing
  - .4 Communication

## **1.7 PAYMENT**

- .1 The Contractor shall note that payment for manufacturers' representative, sub-Contract Administrators and traders during the commissioning, start-up or warranty periods shall be included under the applicable supply and installation items.

## **1.8 START-UP DOCUMENTATION**

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

## **1.9 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

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

## **1.10 TEST RESULTS**

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

## **1.11 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under accepted simulated operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.

## **1.12 WITNESSING COMMISSIONING**

- .1 Contract Administrator representative to witness activities and verify results.

## **1.13 AUTHORITIES HAVING JURISDICTION**

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

## **1.14 DEFICIENCIES, FAULTS, DEFECTS**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Contract Administrator.

- .2 Report problems, faults or defects affecting Cx to Contract Administrator in writing. Stop Cx until problems are rectified. Proceed with written approval from Contract Administrator.

#### **1.15 COMPLETION OF COMMISSIONING**

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

#### **1.16 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

#### **1.17 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

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

#### **1.18 OCCUPANCY**

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

#### **1.19 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Contract Administrator.

#### **1.20 PERFORMANCE VERIFICATION TOLERANCES**

- .1 Application tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. If tolerance is not otherwise specified, to be within +/- 2% of specified values.
- .2 Instrument accuracy tolerances:
  - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
  - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

**1.21 CONTRACT ADMINISTRATOR'S PERFORMANCE TESTING**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED WORK**

- .1 Section 03 10 00 – Concrete Forming and Accessories
- .2 Section 03 20 10 – Concrete Reinforcing
- .3 Applicable Sections of Division 1

**1.2 REFERENCE STANDARDS**

- .1 Do Concrete Materials and Methods of Concrete Construction in accordance with CAN/CSA - A23.1.
- .2 Do testing of concrete in accordance with CAN/CSA A23.2, Methods of Test for Concrete.
- .3 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete, ACI 211.1.

**1.3 CERTIFICATES**

- .1 Submit certificates in accordance with Section 01 33 00 - Submittal Procedures
- .2 A Minimum 4 weeks prior to starting concrete work, submit to Contract Administrator manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
  - .1 Portland cement.
  - .2 Blended hydraulic cement.
  - .3 Supplementary cementing materials.
  - .4 Grout.
  - .5 Admixtures.
  - .6 Aggregates.
  - .7 Water.
  - .8 Waterstops.
  - .9 Waterstop joints.
- .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1 or latest.



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**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Portland cement: to CAN/CSA-A5.
- .2 Supplementary cementing materials: to CAN/CSA-A23.5.
- .3 Water: to CAN/CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be high density.
- .5 Air entraining admixture: to CAN3-A266.1.
- .6 Chemical admixtures: to CAN3-A266.2. Contract Administrator to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete retarders: to ASTM C494 or latest water based, low VOC, solvent free. Do not allow moisture of any kind to come in contact with the retarder film.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
  - .1 Compressive strength: 50 MPa at 28 days.
- .9 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 50 MPa at 28 days.
- .10 Curing compound: to CAN/CSA A23.1, white, and to ASTM C309, Type 1 chlorinated rubber.
- .11 Premoulded joint fillers:
  - .1 Bituminous impregnated fiber board: to ASTM D1751.
- .12 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.
- .13 Ribbed waterstops: extruded PVC of sizes indicated:
  - .1 Tensile strength: to ASTM D412 or latest, method A, Die "C", minimum 11.4 MPa.
  - .2 Elongation: to ASTM D412 or latest, method A, Die "C", minimum 275%.
  - .3 Tear resistance: to ASTM D624 or latest, method A, Die "B", minimum 48 kN/m.

## **2.2 MIXES**

- .1 Cement: Refer to drawings.
- .2 Minimum compressive strength at 28 days: as indicated on drawings.
- .3 Nominal size of coarse aggregate: Refer to drawings.
- .4 Slump at time and point of discharge: At the discretion of the concrete supplier provided the mix meets the mix guidelines on the drawings and is suitable for the type of application.
- .5 Air content: Refer to drawings.
- .6 Chemical admixtures: following admixtures in accordance with ASTM C494, type, quantity, water reducing strength increasing, air entraining, super plasticizers.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- .1 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .2 Prior to placing concrete, obtain Contract Administrator 's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .3 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with shrinkage compensating grout or epoxy grout to anchor and hold dowels in positions as indicated.
- .4 Do not place load upon new concrete until authorized by Contract Administrator.

### **3.2 CONCRETE PLACEMENT**

- .1 Place concrete in accordance with lines and levels indicated on drawings and in accordance with CAN/CSA-A23.1.
- .2 Notify the Contract Administrator minimum 48 hours prior to commencement of concreting operations to allow for inspection.
- .3 Notify all trades sufficiently in advance to ensure provision is made for openings, inserts and fasteners.
- .4 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken. Provide Contract Administrator with this information upon request.

- .5 Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.
- .6 Ensure all anchors, seats, plates and all other items to be cast into concrete are placed, held securely, and will not cause undue hard-ship in placing concrete. Rectify same and proceed with Work.
- .7 No water may be added after the initial introduction of mixing water for the batch.
- .8 Maintain concrete cover around reinforcing as indicated on the drawings.
- .9 Conveying equipment shall not impart harmful shock or vibration to fresh concrete, or cause misalignment of forms. All conveying and placing equipment shall be kept clean of hardened concrete and foreign materials at all times. Carts, wheelbarrows, etc., shall not be run directly over reinforcing.
- .10 Concrete shall be placed in its final position as soon as possible after mixing and must be in place within 1.5 hours after the water has been added to the dry materials. Any concrete sitting more than 1.5 hours since mixing cement and water, or having a partial set before placing, shall not be used.
- .11 Any concrete that splashes or otherwise coats reinforcing, which is not to be cast within 2 hours shall be cleaned off.
- .12 Pour concrete continuously between predetermined construction and control joints. Do not "break" or interrupt successive pours such that "cold" joints occur.
- .13 The vertical height of free fall of concrete shall not exceed 1500mm (5ft). For greater falls, concrete shall be deposited by chute or spout to prevent segregation of material.
- .14 The use of high-frequency internal vibrators is mandatory for all concrete Work on this job and the use of such shall strictly conform to CAN/CSA-A23.1, Section 19.
- .15 Provide concrete for placement by Division 4 in masonry lintels, bond beams, columns, and at steel beam bearings. Refer to drawings.
- .16 Conform to the requirements of CAN/CSA-A23.1 when concreting during cold or hot weather.
- .17 A competent mechanic shall correct and replace reinforcement and other embedded members, which may become displaced before and during pouring.
- .18 Remove and replace defective concrete, including excessive honeycombing or embedded debris, as directed by the Contract Administrator.
- .19 Finishing.
  - .1 Finish concrete in accordance with CAN/CSA-A23.1.

- .2 Use procedures acceptable to Contract Administrator and those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
- .3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that any compounds used are compatible.
- .4 Concrete floors and reservoir base slabs to have a smooth trowelled finish.
- .5 Provide swirl-trowelled finish where floor tile is to be applied.
- .6 Provide light broom finish for exterior slab surfaces, unless otherwise noted.
- .7 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges, unless otherwise noted.

### **3.3 COLD WEATHER CONCRETING**

- .1 The following items are minimum requirements for protecting concrete during and after placement in freezing weather. Except as follows, concrete curing and protection to be in accordance with CAN/CSA-A23.1, Section 21.
- .2 Before any concrete is placed, all ice, snow, and frost shall be completely removed from all formwork and other surfaces against which concrete shall be placed, and temperature of such surfaces shall be raised to and maintained, at 5°C minimum, prior to and during concreting. Where concrete Work is to come in contact with earth, the surfaces of the earth shall be completely free of frost when the concrete is placed thereon.
- .3 Concrete aggregates and water shall be heated to not over 80°C. Concrete shall not be less than 20°C nor more than 30°C in temperature when deposited. 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 no less than 20°C for three (3) days and not less than 5°C for an additional four (4) days.
- .4 All protecting coverings shall be kept clear of the concrete and form surfaces to permit full circulation of air and shall be maintained intact for at least 24 hours after the artificial heat is discontinued.
- .5 Heating enclosures shall be strong and windproof, but well ventilated, and heating units so located as to prevent local overheating, drying of the concrete, or damage from combustion gasses. Units must be vented outside the building. No direct-fired units will be acceptable.

### **3.4 SUMMER CONCRETING**

- .1 The contractor must prepare the curing procedures to suit the environmental conditions.

- .2 Shrinkage cracks are caused by rapid drying of the concrete and by thermal effects which include heat during curing, ambient conditions and shape considerations.
- .3 The following requirements are designed to minimize those effects and thereby minimize the cracking of the concrete.
  - .1 The maximum temperature of the concrete must be maintained at or below 24°C.
  - .2 The maximum water/cement ratio is .45 and shall not exceed this value.
  - .3 The concrete shall be air entrained.
  - .4 The surface of slabs against which new concrete is poured shall be cooled using intermittent wetting techniques and the temperature shall not be more than 5°C greater than the new concrete at the time of pouring.
  - .5 During periods of hot weather, the slabs and walls of structures shall be continuously cooled using wetted burlap or fog spraying with polyethylene sheets if the structure cannot be shaded.
    - .1 Windbreaks are to be erected when the above measures do not reduce the rate of allowable evaporation.
  - .6 The concrete shall be "wet cured" for at least 10 days during hot weather above 30°C and 4 days for weather between 18°C and 30°C.
  - .7 The use of curing compounds will be considered for conditions where the concrete will be shaded or otherwise protected from the sun and where the surface of the concrete will not be in contact with potable water under service conditions.
    - .1 The curing compound shall conform to the requirements of CGSB 90 GP1a, "Liquid Membrane-Forming Compounds for Curing Concrete".

### **3.5 SITE TOLERANCE**

- .1 Concrete tolerance in accordance with CAN/CSA-A23.1 straight edge method.

### **3.6 FIELD QUALITY CONTROL**

- .1 Concrete sampling and testing is to be performed by a CSA approved firm, acceptable to the Contract Administrator, and paid for by this Section. Testing shall be performed in accordance with CAN/CSA-A23.2.
- .2 Provide free access to all portions of Work and cooperate with the inspection agency.
- .3 Three (3) concrete test cylinders shall be taken for every seventy-five (75) or less cubic meters (m<sup>3</sup>) of concrete placed, per day, and tested as follows:
  - .1 One (1) 7-day laboratory cured test
  - .2 Two (2) 28-day laboratory cured tests

- .4 One (1) slump test and one (1) air test will be taken for each set of test cylinders taken.
- .5 The inspection agency shall, at its discretion, reject trucks with unacceptable concrete.
- .6 Provide inspection agency with accurate description and location of area, or area of items from which samples are taken, and these shall be clearly recorded on test reports.
- .7 During cold weather, take an additional test cylinder, to be field cured in same conditions as concrete it represents, and tested at 28 days.
- .8 Inspection or testing by Contract Administrator will not augment or replace Contractor quality control nor relieve the Contractor's contractual responsibility.

### **3.7 FILLETS AND CHAMBERS**

- .1 The edges and re-entrant angles of all concrete exposed to view shall be bevelled to a 20 mm x 20 mm fillet or chamfer unless large fillets or chamfers are indicated on the drawings.

### **3.8 BUILD IN**

- .1 Wherever practicable, fittings and pipework to be built-in shall be installed at the time of pouring of the concrete structure and boxing out will be done only with sanction and to the satisfaction of the Contract Administrator.
  - .1 Forms shall be neatly fitted around the items built-in so as to prevent any leakage of mortar.
  - .2 All pipes passing through floors or through concrete walls retaining liquids shall have puddle flanges cast in situ.

### **3.9 ANCHOR BOLTS**

- .1 Wherever practical and approved, anchor bolts and securing bolts shall be built into the concrete as the work proceeds but when this is impracticable or undesirable, suitable pockets shall be left to receive the bolts which shall be securely grouted in after installation.
- .2 In hardened concrete, core and grout anchors with 40 MPa non-shrink grout. Authorization to be obtained from the Contract Administrator prior to using mechanical anchors cored into hardened concrete.
  - .1 Torque all nuts on anchor bolts to manufacturer's recommendations.
  - .2 When requested by Contract Administrator torque nuts using a torque wrench in presence of Contract Administrator.

### **3.10 CONSTRUCTION JOINTS**

- .1 Provide construction joints where specified or shown on the drawings.
  - .1 Locate and make other joints so as not to impair the strength, water tightness and appearance of the structure.
  - .2 Joints are subject to the approval of the Contract Administrator.
- .2 Before placing new concrete, remove all dirt, loose aggregate and laitance from face of existing concrete.
  - .1 This shall be accomplished by sandblasting, power washing or other method acceptable to the Contract Administrator.
- .3 Allow adequate curing time to the satisfaction of the Contract Administrator between placing adjacent sections separated by construction joints.
  - .1 Place concrete in alternate sections if necessary and place closing sections after alternate sections have cured.
- .4 Curing compound not to be used on construction joints.

### **3.11 PLACING AND COMPACTING**

- .1 Mixing and placing equipment shall be such that when concreting has started, the depositing of concrete shall be carried on as a continuous operation until the placing of the panel or section is completed.
  - .1 Concreting shall be carried out at such a rate that the concrete is at all times sufficiently plastic to ensure proper bonding of the successive layers.
  - .2 Sufficient equipment shall be assigned to the job for a specific pour to ensure that the time interval between batches being placed does not exceed 20 minutes.
- .2 In walls or deep sections, when the Contract Administrator permits the use of removable separators or spreaders, they shall not be removed until the concrete has reached their level.
  - .1 Suitable tools shall be provided for their removal and recovery.
- .3 Do not place concrete in water.
- .4 Before placing new concrete against existing concrete which is at a lower temperature than the new concrete, the area must be enclosed and heated until the concrete temperature rises to within 5°C of the temperature of the new concrete.
  - .1 However, at no time shall concrete be poured against frozen surfaces or any surface which is colder than 5°C.
- .5 Before placing floor slabs on subgrade which is below 3°C enclose and heat the surrounding space until the subgrade is at least 10°C.

- .6 Before depositing new concrete on concrete that has set, the form ties shall be tightened, the surface of the set concrete suitably roughened, thoroughly cleaned of foreign matter and laitance, and saturated with water in advance of concreting.
  - .1 The first 15 cm layer of new concrete placed on hardened concrete should contain an excess of mortar to ensure bond.
  - .2 This may be obtained by first placing concrete of the quality specified for the work but from which 30 to 50 percent of the course aggregate has been omitted.

### **3.12 VIBRATORS**

- .1 The use of mechanical vibrators is required as applicable to the forming operations employed.
- .2 Vibrators shall be sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3500 impulses per minute.
- .3 A sufficient number of vibrators shall be employed so that at the required rate of placement vibration throughout the entire volume of each layer of concrete and complete compaction are secured.
  - .1 At least one extra gasoline powered vibrator shall be on hand for emergency use.
- .4 Vibration shall not be continued in any one spot to the extent that pools of grout are formed.
  - .1 Care shall be taken to avoid any but slight disturbance to concrete which has become too stiff to regain plasticity when vibrated.
  - .2 Vibration shall not be applied directly to steel which extends into partially hardened concrete.

### **3.13 REPAIRING CONCRETE SURFACES**

- .1 As soon as face forms are removed, the surfaces shall be thoroughly washed with clean water under pressure, and all fins, projections and off-sets smoothed off.
  - .1 Metal ties shall be cut and any defective areas, permitted by the Contract Administrator to be patched shall be repaired at once before the concrete is thoroughly dry.
- .2 At the discretion of the Contract Administrator, defective areas shall be chipped away to a minimum depth of 25 mm or to solid concrete, whichever is greater, with edges perpendicular to the surface.
  - .1 The area to be patched and a 150 mm wide band around it shall be thoroughly wetted.



- .2 A grout of equal parts cement and sand shall then be brushed into the surface followed by a mortar of the same mix as the unit being repaired except for the absence of coarse aggregate.
- .3 The patch shall be left slightly higher than the surrounding area and allowed to reach initial shrinkage before the final screening.
- .4 Patches shall be cured continuously for a period of 10 days.
  - .1 Bonding of patch work to parent concrete and the curing of the completed repair work will require special attention.
  - .2 Filling shall be free from shrinkage cracks or dummy areas after the fillings have been cured and dried
  - .3 The concrete constituents shall be mixed so as to avoid colour variations in surface finishes.
- .5 Any visible cracks caused as the result of the Contractor's failure to comply with these specifications shall be repaired at the Contractor's expense using a method/materials approved by the Contract Administrator.

### **3.14 FINISHES FOR FORMED CONCRETE**

- .1 Type 1 - Unexposed or buried surfaces
  - .1 Such surfaces require no treatment after form removal other than such repair of defective concrete, tie holes and associated specified curing.
  - .2 Undressed lumber may be used for forming.
- .2 Type 2 - Exposed surfaces
  - .1 This finish applies to all permanently exposed formed surfaces.
  - .2 After the surface has been repaired and is sufficiently hard, it shall be ground with carborundum stone and water until even and smooth.
  - .3 After curing of all patches, their surfaces shall be finished as follows:
    - .1 A sack-rubbed finish is to be used to give a uniform colour and appearance to a smooth surface.
    - .2 After defects have been repaired, the surface shall be saturated thoroughly with water and kept wet at least 1 hour before finishing operations begin.
    - .3 A grout of 1 part cement, 1-1/2 to 2 parts of fine sand passing a 630 µm sieve, and sufficient water for a thick, creamy consistency should be applied.
    - .4 It should be preshrunk by mixing at least 1 hour before it is used and then remixed without the addition of water and applied uniformly by brush, plasterer's trowel, or rubbed float to completely fill air bubbles and holes.
    - .5 The surface should be vigorously floated with a wood, sponge-rubber, or cork float immediately after applying the grout to fill any

- small air holes (bugholes) that are left and to remove some excess grout.
- .6 The remaining excess grout should be scraped off with a sponge-rubber float.
  - .7 If the float pulls grout from holes, a sawing motion of the tool should correct the difficulty.
  - .8 The grout remaining on the surface should be allowed to stand undisturbed until it loses some of its plasticity but not its damp appearance.
  - .9 Then the surface should be rubbed with clean, dry burlap to remove all excess grout.
  - .10 All air holes should remain filled, but no visible film of grout should remain after the rubbing.
- .4 Any section being cleaned with grout must be completed in one day, since grout remaining on the surface overnight is too difficult to remove.
- .5 If possible, work should be done in the shade and preferably during cool, damper weather.
- .1 During hot or dry weather, the concrete can be kept moist with a fine fog spray.
- .6 The completed surface should be moist-cured by keeping the area wet for 36 hours following the clean down.
- .1 When completely dry, the surface should have a uniform colour and texture.

### **3.15 FINISHES FOR UNFORMED CONCRETE**

- .1 Screeding: This finish shall apply to all surfaces to be covered by concrete or fill material. It is also the first step in other finishes and shall include sufficient levelling and screening to produce even, uniform surfaces at the
- .2 Floated: This finish shall apply to unformed surfaces not permanently concealed by fill material or concrete where a trowelled or special finish is not indicated. It is also the second step where further finishing is specified.
  - .1 Floating may be performed by the use of hand or power-driven equipment, and shall be started as soon as the screened surface has stiffened sufficiently to permit floating without drawing water or excess fines to the surface.
- .3 Trowelled: Where surfaces are to be finished without a topping or are to receive paint, tile or similar applications, they shall be finished by trowelling as follows:
  - .1 Slabs: Concrete shall be screened, tamped and floated to the correct elevation and compacted with a rotary discing machine. After the concrete has hardened sufficiently (not less than 30 minutes after placing), the surface shall be power trowelled to a hard, smooth surface and then protected from damage.

- .1 Slabs exposed to the weather (where hardening is not specified) shall be screened, floated and spin-trowelled using a finishing machine to produce a smooth, dense, non-slip surface.
- .2 Top of Walls: The tops of walls and other locations unsuited for machine trowelling, shall be given a smooth steel trowel finish applied by hand.
  - .1 The concrete shall be screened and wood floated by hand to straight, level and even lines and then allowed to stand until all weather sheen has disappeared before trowelling.
  - .2 Final trowelling shall be done manually, employing a steel trowel (in a circular motion) after the concrete has hardened to the point that no mortar accumulates on the trowel and a ringing sound is produced as the trowel is drawn over the surface.
    - .1 On thin walls, a stainless steel finishing tool to leave 10 mm radius on the edge shall be used.
- .3 Roof Slabs: Roof slabs on buildings shall be carefully screeded and wood floated followed by a light spin trowelling (or Pinch Finish) sufficient to produce a smooth, dense finish. Trowelling as in a) above or steel trowelling by hand as in b) shall not be allowed.

### **3.16 DEFECTIVE WORK**

- .1 Concrete is defective when:
  - .1 Failing to meet all requirements of this specification.
  - .2 Concrete contains excessive honeycombing or embedded debris.
  - .3 28 day average strength in any defined area is less than 95% of specified minimum strength.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED WORK**

- .1 Section 03 20 10 – Concrete Reinforcing
- .2 Section 03 03 05 – General Concrete
- .3 Applicable Sections of Division 1

**1.2 REFERENCE STANDARDS**

- .1 Do concrete formwork in accordance with CSA/CAN-A23.1-94.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 All shop drawings shall be stamped by a Professional Contract Administrator registered in the Province of Manitoba and experienced in falsework design.

**1.4 MEASUREMENT FOR PAYMENT**

- .1 No measurement for payment will be made under this section.
- .2 Include costs in items of work for which concrete formwork is required.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Formwork materials: to CSA/CAN-A23.1-94.
- .2 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing set of film of concrete in contact with form.  
Acceptable product: Mineral Oil.

**PART 3 EXECUTION**

**3.1 EXECUTION**

- .1 Verify lines and levels before proceeding with formwork and ensure dimensions agree with drawings.
- .2 Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1-94.

- .3 All exposed edges and corners shall be chamfered 20 mm x 20 mm unless otherwise shown on the drawings. All inside edges and corners shall be chamfered.
- .4 Hand-trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .5 Align form joints and make watertight. Keep form joints to minimum.
- .6 Leave formwork in place for following minimum periods of time after placing concrete or as indicated on drawings.

Period from Pouring to Stripping for  
Portland Cement Concrete

Cold Weather    Normal Weather  
(3°C)            (above 18°C)

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<u>Forms for Part of Structure</u>	<u>Days</u>	<u>Days</u>
Beam sides, walls and columns	3	3
Slabs (props left under)	10	7
Beam supports (props left under)	14	7
Removal of props to slabs	28	28
Removal of props to beams	28	28

- .7 Re-use of formwork subject to requirements of CAN/CSA-A23.1-94, Clause 11.9.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 RELATED WORKS**

- .1 Section 03 03 05 – General Concrete
- .2 Applicable Sections of Division 1

**1.2 REFERENCE STANDARDS**

- .1 Do general work for concrete in accordance with work relating to the proper placement, securing, supporting and bending of reinforcement to follow CSA/CAN-A23.3 and CSA/CAN-A23.1.
- .2 Supply reinforcing steel in accordance with CSA G30.18-M92.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- .3 Detail placement of reinforcing where special conditions occur.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Reinforcing steel: to billet steel grade 400, deformed bars to CAN/CSA - G30.18.
- .2 Supports: to CAN/CSA - A23.1.

**2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CAN/CSA - A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

**PART 3 EXECUTION**

**3.1 FIELD BENDING**

- .1 Do not field bend reinforcement except where indicated or authorized by the Contract Administrator.

- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

### **3.2 PLACING**

- .1 Accurately place reinforcing steel in positions indicated and hold firmly during placing, compacting and setting of concrete.
- .2 Tie reinforcement where spacing in each direction is:
  - .1 Less than 300 mm: tie at alternate intersections.
  - .2 300 mm or more: tie at each intersection.
- .3 Alternate bars to have lap splices staggered 1500 mm in each face and opposite faces.

### **3.3 CLEANING**

- .1 Clean reinforcing before placing concrete.
- .2 Reinforcing steel to be clean of rust, mud, oil, laitance, concrete scale which could potentially reduce the concrete bond. Corrective action is to be taken prior to placing fresh concrete.

### **3.4 INSPECTION**

- .1 Do not place concrete until Contract Administrator or person authorized by the Contract Administrator has inspected and approved reinforcement work in place.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 RELATED WORK**

- .1 Applicable Sections of Division 1
- .2 Prefinished Metal Section 07 41 10
- .3 Sheet Metal Flashing and Trim Section 07 62 00
- .4 Applicable Sections of Division 15
- .5 Applicable Sections of Division 23
- .6 Applicable Sections of Division 26

**1.2 REFERENCE STANDARDS**

- .1 Perform welding work in accordance with CSA W59 unless specified otherwise.
- .2 All work to latest edition of specified standard.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Clearly indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

**1.4 SCOPE OF SUPPLY**

- .1 Miscellaneous metal fabrication includes the supply and installation of:
  - .1 Catwalk and Railing & other related components as indicated throughout the design.
  - .2 Access Hatches
  - .3 Grating
  - .4 Ladders.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Aluminum grates: to standard No. 157 CSA. Aluminum bearing bars: SG-114-T6 alloy.
- .2 Steel sections and plates: CAN3-G40.21, Grade 300W.



- .3 Hollow structural sections: to CAN3-G40.21, Grade 350W, Class H.
- .4 Stainless steel: Type 302. Exposed surfaces to have No. 4 polished finish.
- .5 Welding materials: to CSA W59.
- .6 Bolts and anchor bolts: Steel: to ASTM A307, Aluminum: Stainless Steel fasteners.
- .7 Galvanizing: unpassivated hot dipped galvanizing with minimum zinc coating of 600 g/sq.m. to CSA G164.
- .8 Shop coat primer: to CAN/CGSB-1.40.
- .9 Galvanized primer: zinc rich, ready mix to CGSB 1-GP181M+Amdt-Mar-78.
- .10 Grout: non-shrink, non-metallic, flowable, 24h. strength 15 MPa, pull-out strength 7.9 MPa.
- .11 Bituminous Paint: Best grade quick drying asphalt utility enamel.
- .12 Butyl Tape: Butyl Ribbon tape of required size.

## **2.2 FABRICATION**

- .1 Fit and assemble work in shop, where possible.
  - .1 Execute work according to details and approved shop drawings.
  - .2 Where shop fabrication is not possible make trial assembly in shop.
- .2 Welding shall conform to requirements of CSA W59 and be done by a fabricator fully approved by the Canadian Welding Bureau, to requirements of CSA W47.1 strength of connected members, unless otherwise detailed.
- .3 File or grind exposed welds smooth and flush.
  - .1 All welds to be chipped clean.
- .4 Weld connections where possible; where not possible, connections shall be rigid, neat and inconspicuously bolted or secured by approved method.
  - .1 Exposed fastening shall be countersunk bolts cut off flush with nuts as inconspicuous as possible.
- .5 Workmanship shall be best grade of modern shop and field practice by fabricators known to be recognized manufacturers specializing in this work.
  - .1 Joints and intersection members shall be accurately fitted, made in true planes, with adequate fastening.
  - .2 Build and erect work, plumb, true square, straight, level and accurate to sizes detailed, free from distortion, or defects detrimental to appearance and performance.
  - .3 All work shall conform to requirements of the local By-laws and all other authorities having jurisdiction.

- .6 Check all necessary site dimensions before proceeding with fabrication of work; accept concrete, steel framing and masonry as found and fabricate to "as-built" dimensions.
- .7 Use self-tapping shake-proof countersunk flat headed screws on items requiring assembly by screws or as indicated.
- .8 Coat all surfaces in contact with concrete with bituminous paint.

### **2.3 SHOP FINISHES**

- .1 Apply one coat of shop primer to metal items, with the exception of stainless steel, aluminum, galvanized, concrete encased or PVC-coated items.
- .2 Prime Finish: After fabrication, clean, scrape and remove rust, scale, grease or extraneous material.
  - .1 Except where specified otherwise, apply a full smooth priming coat in shop, to all miscellaneous metals
  - .2 Work paint into corners and open spaces and deliver item to site with primer undamaged and to satisfaction of Contract Administrator.
  - .3 Primer shall meet CAN/CGSB-1.40. Consult manufacturer to determine minimum temperature required for application.
- .3 Use zinc rich primer on all exterior surfaces, unless hot dip galvanizing is called for.
- .4 Galvanized Finish: Where galvanized finish is specified, prepare work and hot dip galvanize in accordance with CSA G164.
  - .1 Items shall be galvanized after fabrication where possible
  - .2 Galvanizing to G90 specifications.
  - .3 Coating shall be applied at the rate of 600 g per square metre (2 oz. per sq. ft.).

### **2.4 VENT PIPING**

- .1 Fabricate as detailed on drawings.
- .2 Unless otherwise noted vent pipes shall be fabricated of Schedule 40 galvanized steel complete with insect/bird screen and all components shall be hot dipped galvanized.

### **2.5 VENTILATION SECURITY SCREENS AND FRAMING**

- .1 Refer to Mechanical, Heating and Ventilation as well as Electrical Drawings and supply and install ventilation security screens and framing for all ventilation wall openings shown.
- .2 Screening to consist of 3 mm thick "heavy duty" expanded metal diamond mesh.

- .3 Screens to be welded to commercially available hot rolled standard steel shape framing.
- .4 Framing to be a minimum of 100 mm larger than ventilation opening.
- .5 Framing to be fastened to building wall with stainless steel lag bolts (masonry wall construction) or cad plated threaded rod or nuts and bolts (metal or wood wall construction).
- .6 All components to be of steel construction, hot dip galvanized after fabrication.
- .7 Submit shop drawing in accordance with Section 01 34 00.

### **PART 3 EXECUTION**

#### **3.1 ERECTION**

- .1 Erect metal work square, plumb, straight and true, accurately fitted with tight joints and intersections.
- .2 Provide suitable means of anchorage acceptable to Contract Administrator such as dowels, anchor clips, bar anchors expansion bolts and shields, toggles.
- .3 Anchor work as detailed, where not detailed provide concealed hangers, supports, anchors, etc. necessary to securely fasten work.
- .4 Insulate to prevent electrolysis due to aluminum to concrete contact.
  - .1 Use bituminous paint, butyl tape or other approved means.
- .5 All structural steel workmanship shall conform with the requirements of current CSA Standard S16.
- .6 Make structural steel field connections with high tensile bolts, or weld to CAN/CSA-S16.1.
- .7 Touch-up field welds, bolts and burnt or scratched surfaces after completion of erection.
- .8 Prime base metal, ungalvanized surfaces, damaged and abraded primed surfaces, and surfaces not previously primed, and leave ready for finish painting.
- .9 Furnish, set and secure framing brackets, hangers, anchors, inserts or similar supports for proper erection of stairs before concrete is placed.
- .10 Do all cutting, drilling and fitting necessary to attach work of this Section to adjoining work.

#### **3.2 INSTALLATION OF STAIRS**

- .1 Install in accordance with NAAMM, Metal Stair Manual.
- .2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.

- .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4 Do welding work in accordance with CSA W59 unless specified otherwise.
- .5 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

### **3.3 FASTENINGS**

- .1 Each trade, except where contract is for supply only, shall be responsible for all fastening required to complete work of that particular trade.
  - .1 Supply all fastenings, anchors and accessories and adhesives required for fabrication and erection of the work.
  - .2 Exposed metal fastenings and accessories shall be of same texture, colour and finish as base metal on which they occur.
  - .3 Metal flashings shall be for the same material as the metal which will not set up an electrolytic action which would cause damage to the fastening or metal component under moist conditions.
    - .1 In general, exterior anchors for windows, roofing sheet metal anchors occurring on or an in an exterior wall or slab wall be non-corrosive or hot dip galvanized steel.
  - .4 Anchoring and fastening devices or adhesive shall be of appropriate type and shall be used in sufficient quantity in such a manner as to provide positive permanent anchorage of the unit to be anchored in position.
    - .1 Install anchors at spacing to provide for required load carrying capacity.
  - .5 Exposed fastenings will not be permitted without approval by the Contract Administrator prior to use.
  - .6 Supply adequate instructions and templates and, if necessary, supervise installation where fastenings or accessories are required to be built into work of other trades.
  - .7 Fastenings which cause spalling or cracking of material to which anchorage is being made are not permitted.
  - .8 Do not use power actuated fastening devices which are stressed in withdrawal on any part of this work without written approval from the Contract Administrator.
    - .1 Take particular stringent safety precautions when using powder actuated fastenings. Only low velocity plunger-type devices are permitted.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 REFERENCES**

- .1 CAN/CSA-086.1, Design in Wood (Limit States Design). latest edition
- .2 CSA-0141, Softwood Lumber. latest edition
- .3 CAN/CSA-080 Series-M89, Wood Preservation. latest edition
- .4 NLGA Standard Grading Rules For Canadian Lumber, latest edition
- .5 CSA-0151, Canadian Softwood Plywood. latest edition
- .6 CSA-0121, Douglas Fir Plywood. latest edition

**1.2 SOURCE QUALITY**

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.
- .3 Coordinate with Sub-contractors for installation of escutcheons, plates and pipes through walls, etc.

**PART 2 PRODUCTS**

**2.1 LUMBER MATERIAL**

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:
  - .2 CSA 0141. latest edition
  - .3 NLGA Standard Grading Rules for Canadian Lumber, latest Edition.
  - .4 Main framing members shall be Grade: SPF No. 1 / No. 2 or better.
  - .5 Framing and board lumber: in accordance with NBC Subsection 9.3.2.
  - .6 Furring, blocking, nailing strips, grounds, rough bucks, fascia backing:
    - .1 S2S is acceptable.
    - .2 Board sizes: "Standard" or better grade.
    - .3 Dimension sizes: "Standard" light framing or better grade.

## **2.2 PANEL STANDARDS**

- .1 Panel standards: type, grade and thickness as specified indicated, in accordance with the latest edition of the following standards:
- .2 Douglas fir plywood (DFP): to CSA 0121, standard construction.
- .3 Canadian softwood plywood (CSP): to CSA0151, standard construction.
- .4 Poplar plywood (PP): to CSA 0153, standard construction.
- .5 Interior mat-formed wood particleboard: to CAN3-0188.1.
- .6 Waferboard: to CAN3-0188.2.
- .7 Hardboard: to CAN/CGSB-11.3.
- .8 Gypsum sheathing: to CSA A82.27. Type X where shown on Drawings.

## **2.3 FASTENERS**

- .1 Nails, spikes and staples: to CSA B111.
- .2 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .4 Galvanizing: to CSA G164, use galvanized fasteners for exterior work and interior highly humid areas.
- .5 Joist hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.
- .6 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material extruded 6063-T6 aluminum alloy type.

## **PART 3 EXECUTION**

### **3.1 CONSTRUCTION**

- .1 Comply with requirements of NBC Part 9 supplemented by following paragraphs.

### **3.2 ERECTION OF FRAMING MEMBERS**

- .1 Install members true to line, levels and elevations.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install spanning members with "crown-edge" up.

### **3.3 DEFACEMENT MARKS**

- .1 Install lumber and panel materials so that grade-marks and other defacing marks are not visible or are removed by sanding.

### **3.4 FURRING AND BLOCKING**

- .1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.
- .2 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.
- .3 Align and plumb faces of furring and blocking to tolerance of 1:600.

### **3.5 NAILING STRIPS, GROUNDS AND ROUGH BUCKS**

- .1 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

### **3.6 FASCIA BACKING**

- .1 Install nailers and other wood supports as required and secure using galvanized steel fasteners.

### **3.7 FASTENERS**

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.
- .3 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- .1 Supply and install as shown on drawings:
  - .1 Interior Trim

**1.2 EXAMINATION**

- .1 Be responsible for obtaining on site dimensions for millwork and confirming suitability of walls to receive millwork.

**1.3 SUBMITTALS**

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

**1.4 PRODUCT HANDLING**

- .1 Do not deliver to site until there is an acceptable, heated, dry storage area. Deliver with protective coverings.
- .2 Protect installed work and keep counter tops covered until final inspection.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

**PART 3 EXECUTION**

**3.1 ERECTION**

- .1 Sand smooth all exposed wood to be finished. Joints shall be accurately fitted, coped or mitered, well glued up. In finished surfaces, set nail heads and in stained work countersink screw or bolt heads and cover with side grain plugs.

**3.2 FINISHING**

- .1 Exposed wood to be primed and painted.
- .2 Submit sample to Contract Administrator for approval.

**3.3 CLEANING**

- .1 Clean millwork after installation in accordance with supplier's instructions. Clean woodwork to leave free from finish defects in any exposed part.



**END OF SECTION**

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**PART 1 GENERAL**

**1.1 SUBMITTALS**

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

**1.2 REFERENCES**

.1 ASTM International:

.1 ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.2 ASTM C1029 Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.

.3 ASTM C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

.4 ASTM D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

.5 ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics.

.6 ASTM D1940 Method of Test for Porosity of Rigid Cellular Plastics.

.7 ASTM D2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics.

.8 ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

.9 ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.10 ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

.11 ASTM E283 Standard Test Method for Determining Rate of Air Leakage.

.12 ASTM E413 Classification for Rating Sound Insulation.

.13 ASTM E2178 Standard Test Method for Air Permeance of Building Materials.

.14 ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

.15 B. CAN/ULC

.16 CAN/ULC-S774-VOC emissions profiling by Dynamic Chamber Analysis

.17 C. NFPA

.18 NFPA 285 Standard Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

- .19 NFPA 286 Standard Test Method of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
- .20 Section 015000 - Temporary Facilities and Controls; requirement to schedule work to prevent sunlight and weather exposure of materials beyond limits established by manufacturer; requirement to protect materials from damage after installation and prior to installation of enclosing work.

### **1.3 PREFORMANCE REQUIREMENTS**

- .1 Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test methods indicated below or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - .1 Surface Burning Characteristics (ASTM E84): 25 / 450.
  - .2 Assembly Fire Resistance Rating (NFPA 285): Passes NFPA 285 as part of an approved assembly.
  - .3 Combustion Characteristics (NFPA 286): Pass
- .2 Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 pounds per square foot) [0.02 liters per second per square meter at a pressure difference of 75 Pascals (0.02 L/(s·m<sup>2</sup>) @ 75 Pa)] when tested in accordance with ASTM E 2178 (unmodified). The water vapor permeance shall be determined in accordance with ASTM E 96 and shall be declared by the manufacturer. (ABAA Certified projects only)
- .3 Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.040 cubic feet per square foot per minute under a pressure differential of 0.3 in. water (1.57 pounds per square foot) [0.20 liters per second per square meter at a pressure difference of 75 Pascals (0.20 L/(s·m<sup>2</sup>) @ 75 Pa)] when tested in accordance with ASTM E 2357. Assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations. (ABAA Certified projects only)
  - .1 Assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement and shall transfer the load to the structure.
  - .2 Assembly air barrier material shall not displace adjacent materials in the assembly under full load.
  - .3 Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.
- .4 Adjacent Materials: Install closed-cell spray polyurethane foam to prevent air leakage at the following locations:

- .1 Foundation and walls, including penetrations, ties and anchors.
- .2 Walls, windows, curtain walls, storefronts, louvers and doors.
- .3 Different assemblies and fixed openings within those assemblies.
- .4 Wall and roof/ceiling connections.
- .5 Floors over unconditioned space.
- .6 Walls, floor and roof across construction, control and expansion joints.
- .7 Walls, floors and roof to utility, pipe and duct penetrations.
- .8 Seismic and expansion joints.
- .9 All other potential air leakage pathways in the building envelope.

#### **1.4 SUBMITTALS**

- .1 Submit in accordance with Division 01 requirements.

#### **1.5 WORK INCLUDED**

- .1 Roof insulation
- .2 Wall insulation

#### **1.6 WORK EXCLUDED**

- .1 Pipe insulation by mechanical trade.

#### **1.7 MEASUREMENT FOR PAYMENT**

- .1 Insulation will not be measured separately but will be included in the unit price for the work to which it is related.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- .1 Foamed-In-Place Insulation
  - .1 Medium Density Closed Cell Spray Polyurethane Foam Air Barrier Air barrier system shall not require the priming of substrates nor the application of sealing tape at wallboard seams and other wall penetrations.
  - .2 Third Party Verification: IAPMO ES #0146.
  - .3 Application Rate: Up to 3.5 inches in a single pass, to the total thickness required for the project.
  - .4 Physical Properties:
    - .1 Nominal Density (ASTM D1622): 2.0 lb/cu.ft.
    - .2 Compressive Strength, 1 inch thickness (ASTM D1621): 36 psi.
    - .3 Compressive Strength, 3 inch thickness (ASTM D1621): 30 psi.
    - .4 Closed-Cell Content (ASTM D1940): Greater than 90 percent.

- .5 K-Factor (ASTM C518 initial): 0.15.
- .6 K-Factor (ASTM C1029 180-day aged): 0.16.
- .7 R-Value (ASTM C518 initial): 7.0.
- .8 R-Value (ASTM C1029 180-day aged): 7.0.
- .9 Water Absorption (ASTM D2842): 0.020 (gm/cc).
- .10 Water Vapor Transmission (ASTM E96): 0.61 perms at 1.5 inches.
- .11 Air Infiltration (ASTM E283): 75 Pa 0.001 L/S/m<sup>2</sup> (1.57 psf) (less than 0.001 cfm/ft<sup>2</sup>); 300 Pa 0.001 L/S/m<sup>2</sup> (6.24 psf) (less than 0.001 cfm/ft<sup>2</sup>).
- .12 Air Permeance (ASTM E2178): 75 Pa 0.000055 L/S.m<sup>2</sup>.Pa 0.000117 ft<sup>3</sup>/min.mw.Pa; 300 Pa 0.000024 L/.m<sup>2</sup>.Pa 0.000051 ft<sup>3</sup>/min.mw.Pa.
- .13 Sound Transmission Coefficient (STC) (ASTM E90 and ASTM E413): 36 STC; 2x4 wood stud, 16 inches on centers, 2.76 of JM Corbond III SPF, 15/32 inch exterior OSB sheeting, 1/2 inch gypsum wallboard.
- .14 Recycled Content of Side B: 10 percent (pre- and post-consumer).
- .5 Transition Strip at Joint Between Wall and Foundation: Provide a minimum 40-mil self-adhering transition strip between the wall construction and the foundation to shed water to the exterior. Comply with both air barrier manufacturer's recommendations and material manufacturer's recommendations.
- .6 Acceptable Product: JM Corbond III, manufactured by Johns Manville or approved equal in accordance with B7.
- .2 Accessories
  - .1 Primer: As required by insulation manufacturer based on substrate materials and conditions.
- .3 Apply insulation to cured thicknesses shown on drawings.

### **PART 3 EXECUTION**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.2 EXAMINATION**

- .1 Examine substrates, areas, and conditions under which the air barrier assembly will be installed, with Installer present, for compliance with requirements.

- .1 Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- .2 Ensure that the following conditions are met:
  - .1 Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
  - .2 Concrete surfaces are cured and dry, smooth without large voids or sharp protrusions.
  - .3 Masonry joints are reasonably flush, and all excess mortar sitting on masonry ties has been removed.
- .3 Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
- .4 Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
- .5 Notify the Contract Administrator in writing of anticipated problems using closed-cell, medium density spray polyurethane foam over substrate prior to proceeding.

### **3.3 SURFACE PREPARATION**

- .1 Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
  - .1 Ensure that penetrating work by other trades is in place and complete.
  - .2 Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the closed-cell, medium density spray polyurethane foam.
  - .3 Where there are release agents or other non-compatible coatings, wipe down metal surfaces to remove these release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam.
  - .4 Ensure veneer anchors are in place.
- .2 Protection from Spray Applied Materials:
  - .1 Mask and cover adjacent areas to protect from overspray.
  - .2 Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
  - .3 Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
  - .4 Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

### 3.4 INSTALLATION

- .1 Spray Polyurethane Foam Installation: Install materials in accordance with manufacturer's recommendations, ULC S 705.2 and the following:
  - .1 Apply only after transition strip at foundation and wall intersection has been installed.
  - .2 Installer shall use proper personal protective equipment (PPE) during the installation of material in accordance with Government regulation.
  - .3 Warning signs shall be displayed and non-protected personnel shall be kept from the spray area in accordance with ULC S705.2.
  - .4 Equipment used to spray polyurethane foam shall comply with ULC S 705.2 and the manufacturer's recommendations for the specific type of application. Record equipment settings on the Daily Work Record as required by the ULC S 705.2 installation standard. Each proportioner unit shall supply only one spray gun.
  - .5 Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer or the ULC S 705.2 Installation standard.
  - .6 Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings. Passes shall be not less than 1/2 inch (12 mm) and not greater than 3.5 inches (75 mm). An additional pass shall only be done after the first pass has had time to cool down.
  - .7 Install within manufacturer's tolerances, but not more than minus 1/4 inch (6 mm).
  - .8 Do not install spray polyurethane foam within 3 inches (75 mm) of heat emitting devices such as light fixtures and chimneys.
  - .9 Finished surface of foam insulation to be free of voids and embedded foreign objects.
  - .10 Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
  - .11 Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.
  - .12 Clean and restore surfaces soiled or damaged by work of the section. Consult with section of work soiled before cleaning to ensure methods used will not damage the work.
  - .13 Complete connections to other components and repair any gaps, holes or other damage using material which conforms to ULC S 710.1 (single component) or ULC S 711.1 (two components) and installed in accordance with ULC S 710.2 or ULC S 711.2 as applicable.

**3.5 FIELD QUALITY CONTROL**

- .1 The City's Inspection and Testing: Cooperate with The City's testing agency. Allow access to work areas and staging. Notify the City's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.

**3.6 PROTECTION AND CLEANING**

- .1 Protect material from damage during installation and the remainder of the construction period, according to manufacturer's written instructions.
  - .1 Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the manufacturer.
- .2 Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.
- .3 Leave work area and adjacent materials clean.

**END OF SECTION**



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**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- .1 Rainwater gutters and leaders where noted.

**1.2 RELATED WORK BY OTHERS**

- .1 Louvres by Mechanical Contractor.

**1.3 REFERENCE STANDARD**

- .1 CGSB 93-GP-2M

**1.4 EXAMINATION**

- .1 Examine substrate before installation.
- .2 Commencement of work indicates acceptance of conditions.

**1.5 SUBMITTAL**

- .1 Submit colour samples, to the Contract Administrator for approval, for each of the different types of application prior to commencing the work.

**1.6 MEASUREMENT FOR PAYMENT**

- .1 No measurement for payment will be made under this section.
- .2 Include costs for work in pay item Building Superstructure.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Rain water leaders – 24 ga.125 mm prefinished metal, open face style.

**2.2 MANUFACTURERS**

- .1 Reynolds, Kaiser or approved equal in accordance with B7.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install strictly as per manufacturer's instructions.

- .2 Use concealed fasteners where possible.
- .3 Protect aluminum (by backpainting/from contact with dissimilar metals).
- .4 Make provision for expansion and contraction.
- .5 Protect adjacent materials from damage.
- .6 Install concrete splash pads at the ends of downspouts.

**3.2 TOUCH UP**

- .1 Touch up all scratches resulting from installation procedures.

**3.3 CLEAN UP**

- .1 Leave adjacent work free of defects caused by this installation.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00 Rough Carpentry
- .2 Section 07 90 00 Caulking
- .3 Section 09 51 50 Painting, Finishing and Coating.
- .4 Section 09 96 23 Graffiti Resistant Coating.

**1.2 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM C1186-08 2012 Standard Specification for Flat Fiber-Cement Sheets Grade II, Type A.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 National Research Council Canada (NRC)
  - .1 National Building Code of Canada [2015] (NBC).
- .4 Underwriters Laboratories' of Canada (ULC)
  - .1 CAN/ULC-S101 – Latest Edition, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC-S102 – Latest Edition, Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC-S114- Latest Edition, Standard Method of Test for determination of Non-Combustibility in Building Materials.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for cementitious materials, support system, fasteners, adhesives and accessories. Include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit [2] copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures 01 35 34 - Health and Safety Requirements. Indicate VOC's for cementitious materials.
- .3 Shop Drawings:
  - .1 Submit drawings in accordance with Section 0133 00 Submittal Procedures.

- .4 Samples:
  - .1 Submit samples of wall system including panel, support system and panel securement, representative of materials and all components, finishes and colours.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect material from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Separate, store and dispose of waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .5 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets (MSDS) acceptable to Labour Canada.

#### **PART 2 PRODUCTS**

- .1 Siding product: Cement Fiber Lap Siding and Accessories.
  - .1 Acceptable Product: Hardie Plank HZ5 Lap Siding, Select Cedarmill with ColorPlus Technology.
  - .2 Colour: See Drawings.
- .2 Siding product: Cement Fiber Vertical Siding and Accessories.
  - .1 Acceptable Product: Hardie Panel HZ10 Vertical Siding, Select Cedarmill with ColorPlus Technology.
  - .2 Colour: See Drawings.

#### **2.2 ACCESSORY COMPONENTS**

- .1 Install only manufacturers approved accessory components.

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**PART 3 EXECUTION**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Install material to manufacturers written installation instructions for the geographic area of installation.
- .2 Comply with applicable building codes.
- .3 Comply with all health and safety regulations when cutting and installing material.
- .4 Install only approved trim and accessories.
- .5 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Wash down exposed exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths.
  - .2 Leave Work area clean at end of each day.
- .6 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .7 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

**3.3 PROTECTION**

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

**END OF SECTION**

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**PART 1 GENERAL**

- .1 This section applies to the trim and flashing required for building penetrations and penetrations into fabricated junction boxes.

**1.1 RELATED SECTIONS**

- .1 Misc. Metals 05 50 00

**1.2 REFERENCES**

- .1 ASTM A167-88 specification for stainless and heat resisting chromium-nickel steel plate, sheet and strip.
- .2 ASTM A526M-85 specification for steel sheet, zinc-coated (galvanized) by the hot-dip process, commercial quality.
- .3 ASTM A591-77 (1983) specification for steel sheet, cold-rolled, electrolytic zinc-coated.
- .4 ASTM A606-85 specification for steel sheet and strip, hot-rolled and cold-rolled, high strength, low alloy with improved atmospheric corrosion resistance.
- .5 ASTM A792M-85a specification for steel sheet, aluminum zinc alloy coated by the hot dip process.
- .6 Canadian Roofing Contractors Association (CRCA).

**PART 2 PRODUCTS**

**2.1 SHEET METAL MATERIALS**

- .1 Zinc coated steel sheet: 24 gauge thickness, commercial quality to ASTM A526M, with Z275 designation zinc coating.
- .2 Prefinished Metal: Fabricate from 24 gauge zinc coated steel to Standard ASTM A-446 Grade A with G90 zinc coating. Surface with Stelco Series 5000 baked enamel finish. Colour from manufacturer's standard colour range. Cleats and concealed lock strip shall be 22 or 24 gauge of matching materials as found most suitable.

**2.2 ACCESSORIES**

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CGSB 37-GP-5Ma.
- .3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

- .4 Cleats: of same material and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .5 Concealed fasteners: of same material as sheet metal, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.
- .6 Exposed Fasteners No. 10 head cadmium plated with neoprene washers and same colour as metal.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .8 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .9 Touch-up paint: as recommended by pre-finished material manufacturer.
- .10 Solder: to ASTM B32 alloy composition 50% tin, 50% lead.

## **2.3 FABRICATION**

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA series details as indicated.
- .2 Form pieces in 2,400 mm maximum lengths. Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm. Miter and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

## **2.4 METAL FLASHINGS**

- .1 Form flashings, copings and fascias to profiles indicated of 26 ga.

## **2.5 PANS**

- .1 Form pans to receive roofing plastic from 26 ga prefinished sheet metal with minimum 75 mm upstand above finished roof and 100 mm continuous flanges with no open corners. Make pans minimum 50 mm wider than member passing through roof membrane.

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**2.6 REGLETS AND CAP**

- .1 Form surface mounted reglets of 24 ga sheet metal to be built-in masonry work for base flashings as detailed. Provide slotted fixing holes and steel/plastic washer fasteners.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install sheet metal work in accordance with CRCA.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using standing seams forming tight fit over hook strips.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level and caulk top of reglet with sealant.
- .7 Insert metal flashing into reglets and under cap flashing to form weather-tight junction.
- .8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .9 Caulk flashing at reglet and cap flashing with sealant.
- .10 Install pans where shown around items through roof membrane.

**END OF SECTION**



**Part 1      General**

**1.1      REFERENCE STANDARDS**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN-ULC-S101-04, Standard Methods of fire Endurance Tests of Building Construction and Materials.
  - .2 CAN-ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.2      ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .1 Submit [two] copies of WHMIS MSDS - Material Safety Data Sheets.
- .3 Samples: submit duplicate 300 x 300 mm size sample of exposed fireproofing for approval of texture and colour.
- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Test Reports:
    - .1 Submit product data including certified copies of test reports verifying fireproofing applied to substrate as constructed on project will meet or exceed requirements of Specification.
    - .2 Submit test results in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
    - .3 For assemblies not tested and rated, submit proposals based on related designs using accepted fireproofing design criteria.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
  - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within [3] days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

### **1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: company specializing in sprayed-on fireproofing approved by manufacturer with documented 5 years experience.
- .2 Mock-ups:
  - .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
  - .2 Apply fireproofing to approximately 5 m<sup>2</sup> area of surfaces of mock-up-matching surface to be treated.
  - .3 Mock-up will be used:
    - .1 To judge workmanship, substrate preparation and application of material.
  - .4 Allow 24 hours for inspection of mock-up by Contract Administrator before proceeding with fireproofing work.
  - .5 When accepted, mock-up will demonstrate minimum standard of quality required for this work.
- .3 Site Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning work of on-site installations with Contract Administrator to:
    - .1 Verify Project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review [manufacturer's] installation instructions and warranty requirements.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver packaged materials in original unopened containers, marked to indicate brand name, manufacturer and ULC markings.
- .2 Storage and Protection:
  - .1 Store materials indoors in dry location.
  - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
  - .3 Damaged or opened containers will be rejected.
  - .4 Packaging to indicate shelf-life and materials to be applied prior to expiration of shelf-life.

- .5 Provide temporary enclosures to prevent spray from contaminating air beyond application area.
- .6 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of fireproofing materials.
- .3 Waste Management and Disposal:
  - .1 Separate waste materials for [recycling] [reuse] in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **1.5 AMBIENT CONDITIONS**

- .1 At temperatures less than 5 degrees C, ensure that 5 degrees C air and substrate temperature is maintained during and for 24 hours after application. Ensure that natural ventilation to properly dry the fireproofing during and subsequent to its application is provided. In enclosed areas lacking openings for natural ventilation, ensure that interior air is circulated and exhausted to the outside.
- .2 Maintain relative humidity within limits recommended fireproofing manufacturer.
- .3 Ensure that natural ventilation to properly dry fireproofing during and subsequent to its application is provided.
- .4 In enclosed areas lacking openings for natural ventilation, provide minimum of 6 air exchanges per hour by forced air circulation.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Sprayed fireproofing: ULC certified cementitious fireproofing qualified for use in ULC Designs specified.
- .2 Curing compound: type recommended by fireproofing manufacturer, qualified for use in ULC Designs specified.
- .3 Sealer: type recommended by fireproofing manufacturer, qualified for use in ULC Design specified.
  - .1 Colour: white.
  - .2 Ensure spray-applied fireproofing: does not crack, spall or delaminate under downward deflection conditions.
  - .3 Spray-Applied fireproofing material: not contribute to corrosion of test panels.
- .4 Acceptable Product: Carboline Southwest Type 7TB or approved equal to the requirements of B.7.

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 PREPARATION**

- .1 Substrate: free of material which would impair bond.
- .2 Verify that painted substrates are compatible and have suitable bonding characteristics to receive fireproofing.
- .3 Remove incompatible materials.
- .4 Ensure that items required to penetrate fireproofing are placed before installation of fireproofing.
- .5 Ensure that ducts, piping, equipment, or other items which would interfere with application of fireproofing are not positioned until fireproofing work is completed.

**3.3 APPLICATION**

- .1 Apply bonding adhesive or primer to substrate as recommended by manufacturer.
- .2 Apply fireproofing to correspond with tested assemblies, and as recommended by manufacturer.
- .3 Apply fireproofing over substrate, building up to required thickness to cover substrate with monolithic blanket of uniform density and texture.
- .4 Apply fireproofing directly to open web joists without use of expanded lath.
- .5 Tamp smooth, surfaces as indicated visible in finished work.
- .6 Apply curing compound to surface of cementitious fireproofing as required by manufacturer.
- .7 Apply sealer to surface of mineral fibre fireproofing as required by manufacturer where fireproofing is to be painted and as indicated.

**3.4 FIELD QUALITY CONTROL**

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

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

**3.5 PATCHING**

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

**3.6 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Clean surfaces not indicated to receive fireproofing of sprayed material within 24 hours period after application.
- .3 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**PART 1 GENERAL**

**RELATED WORK**

- .1 Section 09 21 16 – Gypsum Board

**1.2 REFERENCES**

- .1 CAN4-S115-[M95], Standard Method of Fire Tests of Fire stop Systems. In accordance with the latest edition of the NBC, Article 2.7.3.2.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings and product data in accordance with Section 01 34 00.
- .2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
- .3 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

**1.4 DEFINITIONS**

- .1 Fire stops: Specially tested materials used to establish or re-establish the integrity of a fire rated wall, floor or other partition after the structure has been breached for the through-penetration of building utility items or to close off openings left due to construction methods.
- .2 Through-penetration: Pipes, conduits, ducts, cable trays, cable, wire or any other element passing completely through an opening in a fire rated barrier/assembly.
- .3 Membrane penetration: Any penetration of a fire rated barrier that breaches one side but does not pass completely through to the other side.
- .4 System: The combination of specific material s and/or devices, including the penetrating item(s) required to complete the fire stop, as tested by an independent third party test facility.
- .5 Barrier/Assembly: A wall, floor, or other partition with a fire-smoke rating of 1, 2, 3 or up to 4 hours.
- .6 F-Rating: the time a Fire stop, penetrating item building, material, fire stop material, can withstand direct flame without a burn through as tested to ASTM E814/UL 1479.
- .7 T-Rating: The amount of time a through-penetrating fire stop limits the temperature rise on the cold side-outside the test furnace - as tested to ASTM E814/UL 1479.

## **1.5 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalogue installation instructions, and product carton instructions for installation.
- .2 Maintain job site file and comply with Material Safety data Sheets (MSDS) for each product delivered to jobsite.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Fire stopping and smoke seal systems: in accordance with CAN4-S115.
  - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN4-S115 and not to exceed opening sizes for which they are intended, in accordance with ULC design numbers.
  - .2 Fire stop sealant: UL listed, one-part silicone based elastomeric, non-shrinking, asbestos free, AD Fire Protection Systems, A/D Firebarrier Silicone.
  - .3 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: to be elastomeric seal.
  - .4 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
  - .5 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
  - .6 Damming and backup materials, to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction. AD Fire Protection Systems, Firebarrier Mineral Wool.
  - .7 Sealants for vertical joints: non-sagging.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation [without interruption to vapour barrier].

- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

### **3.2 INSTALLATION**

- .1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to a neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.
- .6 Install fire stop material to obtain fire-resistance rating not less than the fire resistance rating of surrounding floor and wall assembly.
- .7 Install fire stopping materials appropriate to type of opening being sealed:
  - .1 Penetrations for the through passage of cable, cable tray, conduit, pipe, duct, electrical busway or other raceways through fire rated floor/ceiling (vertical barriers) and/or wall/partitions (horizontal barriers).
  - .2 Through penetrations in hazardous locations (Class 1 - Division 1) or those requiring environmental seals against waste/dust, or those requiring cable strain relief security.
  - .3 Gaps between the top of wall and ceiling, floor or roof assemblies.
  - .4 Expansion joints in fire related walls and floors.
  - .5 Openings around structural support members which penetrate floors/walls.
  - .6 Openings and penetrations in fire related walls or partitions containing fire doors.

### **3.3 SCHEDULE**

- .1 Fire stop and smoke seal at:
  - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - ~~.2 Edge of floor slabs at curtain wall and precast concrete panels.~~
  - .3 Top of fire-resistance rated masonry and gypsum board partitions.
  - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.



- .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
- .7 Openings and sleeves installed for future use through fire separations.
- .8 Around mechanical and electrical assemblies penetrating fire separations.
- .9 Rigid ducts: greater than 129cm: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct on each side of fire separation.

### **3.4 REPAIR AND MODIFICATIONS**

- .1 Identify damaged or re-entered seals requiring repair or modification.
- .2 Remove loose or damaged materials. If penetrating items are to be added, remove sufficient material to insert new elements. Cause no damage to the balance of the seal.
- .3 Ensure that surfaces to be sealed are clean and dry. Install materials in accordance with specified installation requirements herein. Use only materials approved by manufacturer as suitable for repair of original seal. Do not mix different manufacturers products.

### **3.5 FIELD QUALITY**

- .1 Fire stop penetration seals will be examined for proper installation, labelling, adhesion and curing as may be appropriate for the respective seal material.
- .2 Keep areas of work accessible and notify Contract Administrator of work completion released for inspection. When ready for inspection and prior to concealing for enclosing fires stopping materials and service penetration assemblies.

### **3.6 CLEAN UP**

- .1 Remove excess materials, abrade and clean adjacent surfaces immediately after applications.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- .1 Caulking at all openings and joints.
- .2 Work of this section shall include all caulking except where specified under the work of other sections, to make the building weather tight as indicated typically on drawings and as otherwise specified.

**1.2 ENVIRONMENTAL CONDITIONS**

- .1 Apply caulking and sealant only to completely dry surfaces and at air and material temperatures above minimum established by manufacturer's specifications.

**1.3 GUARANTEE**

- .1 Provide a written guarantee that caulking work is guaranteed for 3 years against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion or staining adjacent surfaces.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Sealant - one part - Tremco or approved equal in accordance with B.7.
- .2 Backing - Tremco Joint Backing.
- .3 Void Filler - loose glass fiber.
- .4 All materials suitable for the specific application.

**PART 3 EXECUTION**

**3.1 PREPARATION**

- .1 Remove by brushing, scrubbing, scraping or grinding loose mortar, dust, oil, grease, oxidation and all other materials affecting bonds of sealant and caulking to adjacent materials.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED WORK**

- .1 Caulking Section 07 90 00
- .2 Finishing Hardware Section 08 71 00
- .3 Painting and Finishing Section 09 91 50

**1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA).
  - .1 CSA A101-M1983, Thermal Insulation, Mineral Fiber, for Buildings.
  - .2 CAN/CSA-G40.21-M92, Structural Quality Steels.
  - .3 CSA W59-M1989, Welded Steel Construction (Metal Arc Welding).
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-1.181-92, Ready-Mixed Organic Zinc-Rich Coating.
  - .2 CGSB 41-GP-10Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
  - .3 CAN/CGSB-51.20-M87, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .4 CGSB 51-GP-21M-78, Thermal Insulation, Urethane and Isocyanurate, Unfaced.
- .3 Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA).
  - .1 CSDFMA, Specifications for Commercial Steel Doors and Frames, 1990.
  - .2 CSDFMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 1990.
- .4 National Fire Protection Association (NFPA).
  - .1 NFPA 80-1992, Fire Doors and Windows.
  - .2 NFPA 252-1990, Door Assemblies Fire Tests.

**1.3 SHOP DRAWINGS**

- .1 Provide shop drawings clearly indicating door and frame types, rates, swings, etc.
- .2 Submit shop drawings in accordance with Section 01 34 00.

**1.4 PRODUCT HANDLING**

- .1 Protect materials from rust and damage during delivery and storage.

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**PART 2 PRODUCTS**

**2.1 MATERIALS - INSULATED METAL DOORS**

- .1 Exterior Doors:
  - .1 16 ga. base steel with G90 galvanized finish. Label doors as noted on Schedule.
- ~~.2 Interior Doors:~~
  - ~~.1 18 ga. base steel with W25 wipe coat galvanized finish.~~
- .3 Reinforcing: Z bars at 150 mm o.c. 20 ga. base steel with 16 ga. end channels.
- .4 Vinyl Closer Cap: snap in black vinyl cap.
- .5 Glazing or Panel Stop Screws: oval head counter sunk cadmium plated.
- .6 Filler: two component epoxy type.
- .7 Hinge Reinforcing: 14 ga. steel bars continuously welded.

**2.2 HOLLOW METAL FRAMES (METRIC HEADS WHERE NOTED)**

- .1 Exterior Frames: 16 ga. base steel, welded seams, with G90 galvanized finish.
- ~~.2 Interior Frames: 16 ga. base steel with W25 wipe coat galvanized finish.~~
- .3 Channel Spreader Floor Anchors and Wall Anchors: 18 ga. base steel to ULC regulations for thickness of materials, spacing and anchorage methods.
- .4 Welded in Place Reinforcing for Hardware:
  - .1 Mortise Locksets and Deadlock 16 ga.
  - .2 Surface and Panic Devices 16 ga.
  - .3 Bored or Cylindrical Lock 16 ga.
  - .4 Surface Applied Closers 12 ga.
  - .5 Hold Open Arms 12 ga.
- .5 Door Bumpers: black neoprene double stud.
- .6 Reinforcing Channel: to CSA G40.21-M1978, Type 300 W.
- .7 Anchor Screws: 10 mm diameter flat head counter sunk galvanized screw anchors.

**2.3 FABRICATION OF DOORS**

- .1 Fabricate doors in accordance with details, reviewed shop drawings and ULC requirements.

- .2 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided by finish hardware supplier.
- .3 Provide for glazing as indicated and provide necessary glazing stops. Provide additional reinforcing as required to accommodate glazing.
- .4 Sand welds smooth with base metal surface.
- .5 Fill seam depressions, intersecting corners completely with epoxy filler and sand smooth.
- .6 Provide under cut doors where indicated.
- .7 Doors to be square and true.
- .8 Vinyl filler shall be installed and sealed to recessed channel and closure to top of doors.
- .9 Fill exterior doors with rigid fibreglass. Fill interior voids of doors with sound deadening core material.
- .10 After fabrication touch up doors with primer where galvanized finished damaged during fabrication.

## **2.4 FABRICATION HOLLOW METAL FRAMES**

- .1 Fabricate frames as detailed to Canadian Steel Door and Frame Manufacturer's Association "Canadian Manufacturing Specifications for Steel Doors and Frames", 1978; except where specified otherwise.
- .2 Cut miters and joints accurately and weld continuously on inside of frame profile.
- .3 Grind welded corners and joints to flat plane fill with metallic paste filler and sand to uniform smooth finish.
- .4 Touch up frames with primer where galvanized finish damaged during fabrication.
- .5 Extend frames to finish floor line and provide concealed floor anchors and removable metal spreader.
- .6 Supply six loose galvanized corrugated 'T' jamb anchors per door frame or as required by jamb type.
- .7 Anchors for labeled frames to conform to ULC regulations for thickness of materials, spacing and anchorage methods.
- .8 Reinforce head of frames wider than 1,200 mm.
- .9 Glazing or panel stops to be mitered or coped at corners and drilled for counter sunk screws.
- .10 Install three bumpers on strike jamb for each single door.

- .11 Fabricate thermally broken frames for exterior doors using steel core, separating exterior portion of frame from interior portion with polyvinyl chloride (PVC) thermal breaks.

**PART 3 EXECUTION**

**3.1 ERECTION**

- .1 Erect all units plumb, square and true, in proper alignment with other units. On completion caulk neatly around complete unit between steel and adjacent materials with silicone sealant suitable for materials caulked. Apply isolation coating to steel in contact with dissimilar metals, concrete or masonry.
- .2 Touch up with primer, galvanized finish damaged during installation.

**END OF SECTION**

.1 GENERAL

**1.2 RELATED SECTION**

- .1 Rough Carpentry Section 06 10 00
- .2 Painting and Finishing Section 09 91 50
- .3 Sheet Metal Flashing and Trim Section 07 62 00
- .4 General Concrete Section 03 03 05
- .5 Concrete Forming Section 03 10 00

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 0 05– General Requirements.
- .2 Leave protective covering in place until final cleaning of building

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Industrial quality, Aluminum.

**2.2 ACCESS HATCHES**

- .1 Interior Floor Access Hatch
  - .1 Size: 914 x 914 mm (36x36 inches.)
  - .2 Door: 6 mm aluminum construction,
  - .3 Frame: 6 mm aluminum.
  - .4 Gasketed
  - .5 Hardware: Stainless steel cam-action hinges, automatic hold open arm, and slam lock c/w removable key wrench.
  - .6 Stainless steel latch
  - .7 Product: Bilco Type J -4AL
- .2 Access Hatch Ladder Extension Post

- .1 Telescoping post, spring balanced.
- .2 Mount to top two rungs of access ladders.
- .3 Aluminum construction.
- .4 Product: Bilco Ladder Up Safety Post, Model LU-4.
- .3 Exterior Roof Access Hatch 1
  - .1 Size: Approximately 2134 mm long x 1727 mm wide
  - .2 Confirm size in field to fit existing opening.
  - .3 Door: 11 gauge aluminum construction,
  - .4 Frame: 11 gauge aluminum.
  - .5 Insulated
  - .6 Gasketed
  - .7 Hardware: Stainless steel cam-action hinges, automatic hold open arm, and slam lock c/w removable key wrench.
  - .8 Stainless steel latch
  - .9 Hasp with keyed padlock on exterior
  - .10 Product: Bilco Type D 50
- .4 Exterior Roof Access Hatch 2
  - .1 Size: mm long 2743 mm x 1423 mm wide.
  - .2 Door: 11 gauge aluminum construction,
  - .3 Frame: 11 gauge aluminum.
  - .4 Insulated
  - .5 Gasketed
  - .6 Hardware: Stainless steel cam-action hinges, automatic hold open arm, and slam lock c/w removable key wrench.
  - .7 Stainless steel latch
  - .8 Hasp with keyed padlock on exterior
  - .9 Product: Bilco Type D 50

### **PART 3 EXECUTION**

#### **3.1 LOCATION**

- .1 Location: Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

**END OF SECTION**





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**PART 1 GENERAL**

**1.1 RELATED WORK**

- .1 Steel Doors, Frames and Windows Section 08 10 00

**1.2 REFERENCE STANDARDS**

- .1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .2 CAN/CGSB-69.17-M86/ANSI/BHMA A156.2-1983, Bored and Preassembled Locks and Latches.
- .3 CAN/CGSB-69.18-M90/ANSI/BHMA A156.1-1981, Butts and Hinges.
- .4 CAN/CGSB-69.19-M89/ANSI/BHMA A156.3-1984, Exit Devices.
- .5 CAN/CGSB-69.20-M90/ANSI/BHMA A156.4-1986, Door Controls (Closers).
- .6 CAN/CGSB-69.21-M90/ANSI/BHMA A156.5-1984, Auxiliary Locks and Associated Products.
- .7 CAN/CGSB-69.23-M90/ANSI/BHMA A156.7-1981, Template Hinge Dimensions.
- .8 CAN/CGSB-69.24-M90/ANSI/BHMA A156.8-1982, Door Controls - Overhead Holders.
- .9 CAN/CGSB-69.29-M90/ANSI/BHMA A156.13-1980, Mortise Locks and Latches.
- .10 CAN/CGSB-69.32-M90/ANSI/BHMA A156.16-1981, Auxiliary Hardware.
- .11 CAN/CGSB-69.33-M90/ANSI/BHMA A156.17-1987, Self-closing Hinges and Pivots.
- .12 CAN/CGSB-69.34-M90/ANSI/BHMA A156.18-1984, Materials and Finishes.
- .13 CAN/CGSB-69.36-M90/ANSI/BHMA A156.20-1984, Strap and Tee Hinges and Hasps.

**1.3 HARDWARE LIST**

- .1 Door hardware as indicated on drawings.
- .2 Supply to the metal door frame manufacturer templates for hardware to be mounted on the frames, locating holes and cut-outs and showing screw sizes and types.
- .3 Supply a hardware list to enable satisfactory job organization of hardware showing all items to be supplied, locations to be used, manufacturers, models, sizes, finishes, colours, etc. This is a list of shop drawings under Section 01340.

#### 1.4 PACKAGING

- .1 Pack and mark each individual item showing content and location so that unopened packages may be correctly selected for installation in accordance with the Hardware List and include all parts required in each package.

#### 1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance data, parts list and manufacturer's instructions for each type of closer, lockset, fire exit hardware.
- .2 Supply two sets of wrenches for maintenance work.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Item	Manufacturer	Product Number
Hinges	Stanley	CB1960 114 x 102 NRP 630
Closures	LCN	4114 CUSH
Exit Devices	Von Duprin	98TP x990TP-R 630 L/C
Exit Device (exit only)	Von Duprin	98EO-630
Locksets	Schlage	
Deadbolt	Schlage	D10S 626 c/w Medeco Cyl.
Rim and Mortise Cylinders	Medeco	To Suit Von Duprin 98TP
Flushbolts	Ferrum / Glynn Johnson	FB6 626
Push-pull Kickplates	Standard Metal	SM80A - 630
Door Stop Holders	Ferrum / Glynn Johnson	F26 626
Weather Stripping	Reese	770C
Sweep Seals	Reese	773C
Threshold	Reese	S205A
Astragal (Full Length)	National Guard	1392SP

#### 2.2 FINISH

- .1 626 - Brushed Aluminum

#### 2.3 LOCKSETS

- .1 All locksets to be supplied on this project are to be keyed alike.

#### 2.4 KEYS

- .1 Supply Three keys for each lockset whether keyed alike to other locksets or not. Three master keys, all locks to be master keyed.
- .2 Keys to match City of Winnipeg's existing "Medeco" brand system. City of Winnipeg to provide lock number prior to keying.

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**PART 3 EXECUTION**

**3.1 MOUNTING HEIGHTS**

- |    |                        |         |
|----|------------------------|---------|
| .1 | Locksets and Latchsets | 1000 mm |
| .2 | Deadlocks              | 1525 mm |

**3.2 INSTALLATION INSTRUCTIONS**

- .1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .2 Furnish manufacturer's instructions for proper installation of each hardware component.
- .3 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .4 Where door stop contacts door pulls, mount stop to strike bottom of pull.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- .1 Supply and install:
  - .1 Painting of exterior fiber cement siding (touch up)
  - .2 Doors, Frames and Window Frames.
  - .3 Wood painted surfaces.
  - .4 Metal Painted Surfaces.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Specifications included on Drawings
- .2 Division 6
- .3 Mechanical General Provisions 15 01 00
- .4 Painting of Process Mechanical Equipment to Section 09 91 51 - Painting & Identification of Mechanical and Process Equipment

**1.3 REFERENCE STANDARDS**

- .1 Do work in accordance with CGSB 51-GP-39M and the Canadian Painting Contractors Association "Architectural Painting Specification Manual".

**1.4 SUBMITTALS**

- .1 Submit colour samples and product data sheets for approval.

**1.5 ADDITIONAL MATERIALS**

- .1 Leave on the premises for touch up a sufficient quantity of all colours and paint types.
  - .1 In any case not less than 1 litre.
- .2 Containers shall be full, tightly sealed and clearly labelled for identification.

**PART 2 PRODUCTS**

**2.1 INTERIOR PAINTED WOOD**

- .1 First Coat – Commercial Quality Acrylic Primer, Colour: White, Dulux, Sherwin Williams or approved equal in accordance with B7.
- .2 Two Coats Latex Semi-Gloss, Colour: White, Dulux, Sherwin Williams or approved equal in accordance with B7.

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**2.2 INTERIOR PAINTED PLAIN STEEL**

- .1 First Coat: Oil Base Primer, Zinsser or approved equal in accordance with B7.
- .2 Two Finish Coats: Oil Base Top Coat, Gloss Finish, Rust-Oleum or approved equal in accordance with B7.

**2.3 EXTERIOR PAINTED GALVANIZED STEEL**

- .1 First Coat: Galvanized Metal Primer Zinsser or approved equal in accordance with B7.
- .2 Two Finish Coats: Oil Base Top Coat, Gloss Finish, Rust-Oleum or approved equal in accordance with B7.

**PART 3 EXECUTION**

**3.1 GENERAL**

- .1 Paint all building surfaces, piping, tanks and equipment.
- .2 Touch up shop applied finishes damaged during installation.
- .3 Apply finish coats to shop primed equipment.

**3.2 PREPARATION OF WOOD SURFACES**

- .1 Ensure all joints are sanded smooth.
- .2 Ensure all surfaces are clean and dry.

**3.3 PREPARATION OF EQUIPMENT, PIPING, VALVES AND TANKS**

- .1 Commercial blast cleaning.
- .2 Drain water from vessels to prevent condensation whenever possible.

**3.4 PROTECTION OF SURFACES**

- .1 Protect surfaces not to be painted and if damaged, clean and restore such surfaces as directed.
- .2 Apply primer, paint, or pre-treatment as soon possible after surface has been cleaned and before deterioration of surface occurs.
- .3 If rusting occurs after completion of surface preparation, clean surfaces again.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of paint. Remove contaminants from surface and apply paint immediately.

- .5 Protect cleaned and freshly painted surfaces from excessive dust.

### **3.5 MIXING PAINT**

- .1 Do not dilute or thin paint for brush application; use as received from manufacturer.
- .2 Mix ingredients in container before use and ensure breaking up of lumps, complete dispersion of settled pigment, and a uniform composition.
- .3 Mix paint often enough during application to keep pigment in suspension and composition uniform.
- .4 Do not mix or keep paint in suspension by means of air bubbling through paint
- .5 Thin paint for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide a copy of instructions to Contract Administrator.

### **3.6 APPLYING PAINT**

- .1 Apply paint by brushing, spraying or a combination of both. Use sheepskins or daubers only when no other method is practical in places of difficult access.
- .2 Use dipping or roller coating method of application only when specifically authorized by Contract Administrator in writing.
- .3 Caulk open seams at contact surfaces of built up members with red lead paste, or other approved material. Apply second coat of primer to caulked areas.
- .4 Where surface to be painted is not under cover, do not apply paint when:
  - .1 Air temperature is below 5°C or when temperature is expected to drop to 0°C before paint has dried.
  - .2 Temperature of surface is over 50°C unless paint is specifically formulated for application at high temperatures.
  - .3 Fog or mist occur at site; it is raining or snowing; there is a danger of rain or snow; relative humidity is above 85%.
  - .4 Surface to be painted is wet, damp or frosted.
  - .5 Previous coats are not dry.
- .5 When paint must be applied in damp or cold weather apply paint under cover. Protect, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions specified in 3.9.4. Protect until paint is dry or until weather conditions permit.
- .6 Permit drying of applied paint which has been exposed to freezing, excess humidity, rain, snow or condensation. Remove paint from damaged areas, prepare surface again and repaint same as undamaged areas.

- .7 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .8 Brush application:
  - .1 Work paint into cracks, crevices and corners and paint surfaces not accessible to brushes by spray, daubers or sheepskins.
  - .2 Brush out runs and sags.
  - .3 Leave a minimum of brush marks in finished paint surfaces.
  - .4 Remove runs and sags from finished work and repaint.
- .9 Spray Application:
  - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
  - .2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.
  - .3 Keep paint ingredients properly mixed in spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
  - .4 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
  - .5 Brush out immediately all runs and sags.
  - .6 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray. In areas not accessible to spray gun, use brushes, daubers or sheepskins.
  - .7 Remove runs and sags from finished work and repaint.
- .10 Shop painting:
  - .1 Do shop painting after fabrication and before any damage to surface occurs from weather or other exposure.
  - .2 Spray paint contact surfaces of field assembled, bolted, friction type joints with primer coat only. Do not brush primer after spraying.
  - .3 Do not paint metal surfaces which will be embedded in concrete.
  - .4 Paint metal surfaces to be in contact with wood with either full paint coats specified or three shop coats of specified primer.
  - .5 Do not paint metal within 50 mm of edge to be welded. Give unprotected steel one coat of boiled linseed oil or other approved protective coating after shop fabrication is completed.
  - .6 Remove weld spatter before painting. Remove weld slag and flux.
- .11 Field Painting:
  - .1 Paint steel structures as soon as possible.
  - .2 Touch up metal which has been shop coated with same type of paint and to same thickness as shop coat. This touch-up to include cleaning and



- painting of field connections, welds, rivets, nuts, washers, bolts and damaged or defective paint and rusted areas.
- .3 Field paint surfaces (other than joint contact surfaces) which are accessible before erection but which will not be accessible after erection.
  - .4 If possible do not apply final coat of paint until concrete work is completed. If concreting or other operations damage any paint, clean and repaint damaged area. Remove concrete spatter and droppings before paint is applied.
  - .5 Where painting does not meet with requirements of specifications, and when so directed by Contract Administrator, remove all defective paint, thoroughly clean affected surfaces and repaint in accordance with these specifications.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- .1 Modified bituminous membrane roofing Work to the full intent of the Drawings and as specified herein.

**1.2 RELATED WORK**

- .1 Rough Carpentry Section 06 10 00  
.2 Insulation Section 07 21 00  
.3 Sheet Vapour Barrier Section 07 19 00  
.4 Sheet Metal Flashing and Trim Section 07 62 00  
.5 Caulking Section 07 90 00  
.6 Mechanical - Division 23 for Roof Drainage

**1.3 REFERENCE STANDARDS**

- .1 ASTM C1289 – Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.  
.2 ASTM D41 – Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.  
.3 ASTM D2822 – Asphalt Roof Cement.  
.4 ASTM D6162 – Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.  
.5 ASTM D6163 – Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.  
.6 ASTM D6164 – Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.  
.7 CSA O121M – Douglas Fir Plywood.  
.8 CSA O151M – Canadian Softwood Plywood.  
.9 CAN/CGSB 37-GP-9M – Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.  
.10 CAN/CGSB 37-GP-15M – Application of Asphalt Primer for Asphalt Roofing, Dampproofing and Waterproofing.  
.11 CAN/CGSB 37.29M – Rubber-Asphalt Sealing Compound.  
.12 CAN/CGSB 37-GP-56M – Membrane Modified, Bituminous, Prefabricated, and Reinforced for Roofing.  
.13 CAN/CGSB 51.33M – Vapour Barrier Sheet, Excluding Polyethylene, for use in Building Construction.  
.14 CAN/ULC S701 – Thermal Insulation, Polystyrene, Boards and Pipe Covering.

- .15 CAN/ULC S704 – Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Fixed.
- .16 FM (Factory Mutual) – Roof Assembly Classifications.
- .17 NRCA (National Roofing Contractors Association) – Roofing and Waterproofing Manual.
- .18 ULC (Underwriters Laboratories of Canada) – List of Equipment and Materials for:
  - (A) 1.3.22.1 Building Materials.
  - (B) 1.3.22.2 Fire Resistance.
  - (C) 1.3.22.3 Firestop Systems and Components.

#### **1.4 QUALITY ASSURANCE**

- .1 Qualification: Perform Work of this Section by a company that is a member in good standing of Canadian Roofing Contractors Association (CRCA) and has a minimum of 5 years proven, acceptable roofing experience on installations of similar complexity and scope.
- .2 Reference Standards: Where work required is not specified or shown meet applicable requirements of membrane manufacturer.
- .3 Modified Bitumen Membrane: Comply with requirements of CGSB 37-GP-56M.
- .4 Installation: Comply with membrane manufacturer's printed installation instructions.
- .5 Single Source: Obtain all materials from a single manufacturer.
- .6 Review safety requirements, including temporary fall-arrest measures.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Transport rolls of material vertically, tied in bundles to prevent edge deterioration.
- .2 Deliver and store materials until incorporation into work in original wrappings, bearing manufacturers and product names and relevant standards.
- .3 Store materials on raised platforms in approved manner at site preceding application and protect from inclement weather at all times. Materials which have become wet shall not be used.
- .4 Do not store insulation or roofing membrane on roof. Store them under cover while roofing Work is not in progress.

#### **1.6 SITE CONDITIONS**

- .1 Do not apply roofing materials during precipitation or over damp or otherwise unsuitable surfaces.

- .2 Apply materials only when air temperature is within limits specified by manufacturer.
- .3 Protect roofs at all times from the weather employing all temporary measures necessary. Replace damaged Work which cannot be satisfactorily repaired, restored or cleaned, at no cost to the City.

## **1.7 PROTECTION**

- .1 Prior to the start of work, conduct a site inspection to establish safe working practices and make sure that all procedures and proposed changes are approved to minimize the risk of fires.
- .2 At the end of each workday, use a heat detector gun to spot any smoldering or concealed fire. Job planning must be organized to ensure workers are still on location at least one hour after torch application.
- .3 Never apply the torch directly to old and wood surfaces.
- .4 Throughout roofing installation, maintain a clean site and have one approved ABC fire extinguisher within 6 metres of each roofing torch. Respect all safety measures described in technical data sheets. Torches must never be placed near combustible or flammable products. Torches should never be used where the flame is not visible or cannot be easily controlled.
- .5 Follow material manufacturers' recommendations when using propane torch. Maintain at all times 9 kg dry chemical fire extinguisher fully charged and in operable condition at location where open flames are in use.
- .6 Arrange for continuous fire watch by an individual solely responsible during the torching operations and for at least four (4) hours after each work period when propane torch was used. Check installation for hot spots, particularly at flashings and penetrations.
- .7 Prevent intrusion of moisture into roof system during installation.
- .8 Protect completed portions of roofing from damage due to traffic and materials handling until completion of work.
- .9 Use warning signs and barriers. Maintain in good order until completion of Work.

## **1.8 WARRANTY**

- .1 CRCA Standard Form of Guarantee is not acceptable.
- .2 Manufacturer's Warranty: Submit a written guarantee that the manufacturer will replace, at no cost to the City, any portion of the roofing membrane which experiences actual leaks resulting from defects in the manufacture of the membrane for a period of 15 years after Substantial Performance of the Work.

## **1.9 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Cap Sheet and Cap Sheet Flashing: Composite of fibreglass & polyester reinforcement and SBS modified bitumen, 3.5 mm thick. Top face: Contract Administrated multi-ply white film with an SRI of 96, with the under face covered with a thermofusible plastic film.  
  
Acceptable Product: IKO TP 250CAP Membrane granular finish: WHITE or approved equal in accordance with B.7.
- .2 Base Sheet: 2.2 mm thick SBS modified bituminous membrane, 180 g/m<sup>2</sup>, mop grade, polyester reinforced; to CGSB 37-GP-56M, Type 2, Class P, Grade 2; sand coated surface on underside, meltable polyethylene coating on upper surface.  
  
Acceptable Product: IKO TP-180 FF-Base or approved equal in accordance with B.7.
- .3 Base Sheet Flashing: Self-adhesive reinforced polyester mat, SBS modified bitumen coated. Used for flashing of parapets and equipment curbs.  
  
Acceptable Product: IKO Armourbond Flash peel and Stick or approved equal in accordance with B.7.
- .4 Overlay Board: Multi-ply, semi-rigid asphaltic roofing substrate board composed of a mineral fortified asphaltic core formed between two asphaltic saturated fibreglass liners. Length 1.2 m. x width 2.43 m x 6.0 mm thickness. Mechanically fastened to deck, abd tape joints with IKO approved tape.  
  
Acceptable Product: IKO Protecto Board or approved equal in accordance with B.7.
- .5 Insulation: Polyisocyanurate rigid board, as specified in Section 07200 - Insulation. with a minimum of 5.6 R value, Thicknesses and slopes as indicated on the Drawings.  
  
Acceptable Product: IKOTHERM or approved equal in accordance with B.7.

~~.6 Vapour Retarder for Application to roof decks: Self-adhesive SBS modified bitumen vapour retarder.~~

~~Acceptable Product: IKO MVP (Modified Vapor Protection) or approved equal.~~

## **2.2 ACCESSORIES**

- .1 Insulation Fasteners: Refer to Section 07200 - Insulation. Fasteners must meet Factory Mutual requirements.
- .2 Vapour Retarder Primer: As recommended by vapour retarder manufacturer.
- .3 Asphalt: Meeting requirements of CAN/CGSB-37-GP9Ma, Type 2 for slopes up to 1:15, Type 3 for slopes greater than 1:15.
- .4 Asphalt Primer: CAN/CGSB-37-GP9Ma.
- .6 Membrane Base Sheet Flashing Primer: As recommended by membrane base sheet flashing manufacturer.
- .7 Glue / Adhesive: As per manufacturers recommendation for product specified.
- .8 Flexible Flashing: Similar material to base and cap sheet roofing. Adhesive: as recommended by roof membrane manufacturer.
- .9 Fibre Cant: Purpose made, 75 x 75 mm, consisting of pre-shaped rigid glass fibre and an asphalt adhered kraft paper base cap cover.
- .10 Pitch Pockets (if required): Formed from 3mm galvanized steel with minimum 100mm deck flange and extending 150mm above finished roof surface.
- .11 Pitch Pocket Filler: Solvent-based mastic containing bitumen modified with SBS synthetic rubber and fibres to CAN/CGSB-37.29-M89.
- .12 Manufactured Roof Specialties:
  - (D) Specification is based on products by Thaler Roofing Specialties Products Inc. Equivalent approved products by Portals Plus Inc. are also acceptable in accordance with B.17.
  - (E) Vent and Cold Pipe Flashing: Thaler MEF-4A, size as required.
  - (F) Hot Pipe Flashing: Thaler MEF-3A.
- .13 Roof Scuppers and Rain Water Leaders: refer to Section 07620, Sheet Metal Flashing and Trim, and Division 23 - Mechanical.

## **2.3 EXECUTION**

### **.1 EXAMINATION**

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Contract Administrator. Commencement of Work means acceptance of existing conditions.

## **.2 PREPARATION**

- .1 Prior to commencement of Work ensure:
  - (G) Decks are smooth, dry, free of snow, ice or frost, swept clean of dust and debris and properly graded to outlets.
  - (H) Wood blocking and curbs are installed and correct. Do not install roofing over such items if method of attachment is inadequate to withstand stresses imposed by thermal movement of roofing components.
  - (I) Supply to trades concerned in ample time, inserts, reglets and accessories to be built into Work. Assist in setting such items.
  - (J) Co-operate with respective trades to determine methods and procedures to ensure watertight junctions to items passing through roof.

## ~~**.3 VAPOUR RETARDER**~~

- ~~.1 Apply self adhesive vapour retarder in strict conformance with manufacturer's recommendations.~~
- ~~.2 At penetrations and terminations extend vapour retarder up and back over top of insulation.~~
- ~~.3 Vapour retarder shall be continuous and complete at all locations. Connect to vapour retarder component of adjacent work.~~
- ~~.4 Attach additional layer of vapour retarder to base vapour retarder on parapet wall and extend sufficiently to prevent any air pockets.~~

## **.4 INSULATION**

- .1 Prior to installation of insulation, examine vapour retarder and make good damage.
- .2 Use full size insulation boards wherever possible, and minimum half boards at abutting vertical surfaces.
- .3 Install insulation promptly to avoid possibility of condensation beneath vapour retarder. Fasten insulation with adhesive in accordance with manufacturer's requirements.

## **.5 APPLICATION OVER WOOD DECK**

- .1 Install insulation and tapered insulation in locations shown on Contract Drawings and in accordance with shop drawings. Stagger joints between layers 150mm minimum.
- .2 Install cover board on top of insulation and stagger joints.

- .3 Fasten insulation and cover board with adhesive to manufacturer's specifications.
- .4 Place insulation boards in moderately tight contact at joints between boards and abutting surfaces. When cutting insulation board cut completely through board thickness; do not break or tear insulation board to fit a detail. Any areas of insulation system having voids will be rejected.
- .5 Do not lay more insulation than can be completely covered as a finished roofing system on the same day.
- .6 Do not cut off insulation in straight lines at the end of a Work period, allow stepped boards for tothing-in.

## **.6 ROOF MEMBRANE**

- .1 Roof membrane shall consist of two plies, base sheet and cap sheet.
- .2 Apply primer to substrates prior to installation of base sheet, in accordance with manufacturer's recommendations, and permit to dry.
- .3 Apply base sheet starting at bottom of slope, with half a sheet width. Run sheet perpendicularly to roof slope. Bond base sheet to cover board in hot asphalt at rate of 1 to 1.5 kg/m<sup>2</sup>, in accordance with membrane manufacturers' directions. Apply asphalt not more than 1 m ahead of roll.
- .4 Provide side laps minimum 100 mm and end laps minimum 150mm wide. Remove plastic film off the end of roll prior to completing end lap.
- .5 Take precautions to prevent undulations and fishmouths.
- .6 Place top sheet over base sheet and bond with propane torch. Stagger joints of top sheet from joints in base sheet by at least 300 mm.
- .7 Provide laps in top sheet similar to laps for base sheet. Laps shall be watertight, straight, flat and neat, with good asphalt "bleed-out", but avoid excessive seepage. Check lap integrity with pointed trowel. Embed matching granules while asphalt "bleed-out" is still hot
- .8 Reinforce membrane at changes of direction as recommended by membrane manufacturer.
- .9 At roof perimeter and penetrations provide 2 ply modified bitumen flashings, installed in accordance with system manufacturer's recommendations, to details shown.
- .10 Bond base sheet with adhesive as recommended by system manufacturer. Extend base sheet minimum 150 mm onto flat roof membrane and extend up and over curbs and parapets unless otherwise indicated. Mechanically secure top edge of base sheet.



- .11 Bond cap sheet to base sheet with propane torch proceeding from bottom up. Extend cap sheet minimum 150 mm onto flat roof membrane and up and over parapets/curbs and down the outside face, unless otherwise indicated.
- .12 Upon completion of top sheet installation, check all lap joints to ensure that they are positively sealed. Repair laps where necessary.
- .13 Provide minimum 2 hour fire watch immediately following each work period when torching equipment has been used.

**.7 ROOF ACCESSORIES**

- .1 Install roof accessories in accordance with manufacturer's instructions and at all locations where mechanical and electrical services penetrate the roofing system.

**.8 PITCH POCKETS**

- .1 Provide pitch pockets only where small roof penetrations prevent torched flashing in accordance with manufacturer's standard details. Pitch pocket shall be sized and adhered to roof deck to suit the support involved.

**.9 CLEANING**

- .1 Clean roofing, metal, all building facing materials, and similar items of dirt, cuttings, stains and foreign matter upon completion of Work.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Fiber Cement Wall Siding Section 07 46 46
- .2 Painting, Finishing and Coating Section 09 91 50

**1.2 MOCK-UP**

- .1 Construction mockup in accordance with Section 01 45 00 - Quality Control.
- .2 Before full-scale application, apply graffiti resistant coatings to samples of substrate
- .3 materials to be used on actual project to determine coverage rates, compatibility,
- .4 effectiveness, and aesthetics.
- .5 Apply graffiti resistant coatings in accordance with manufacturer's written instructions.
- .6 Allow 5 days curing time prior to applying graffiti paint to test samples. Apply graffiti
- .7 paint to test samples and allow at least 24 hours longer for paint to cure.
- .8 Apply manufacturer's recommended cleaner to test for ease of removal of graffiti. Repeat
- .9 cycles of cleanings as directed by Contract Administrator.
- .10 Do not proceed with coating work until Contract Administrator has reviewed and
- .11 accepted sample application.

**1.3 1.3 SUBMITTALS**

- .1 .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 .2 Submit manufacturer's product data for specified graffiti resistant coatings and cleaners,
- .3 specifications and application instructions. Submit description for protection of
- .4 surrounding areas and non-masonry surfaces, surface preparation, application, and final
- .5 cleaning.

**1.4 1.4 ENVIRONMENTAL CONDITIONS**

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

**1.5 PROTECTION**

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

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Graffiti-resistant coating: one component, water based, non-sacrificial, clear penetrating sealer.
- .2 Acceptable material: Sikagard AG Anti-Graffiti Coating or approved equal as per the requirements of B.7.

**PART 3 EXECUTION**

**3.1 PREPARATION**

- .1 .1 Prepare and clean substrate surfaces in accordance with coating manufacturer's printed
  - .2 instructions.
  - .3 .2 Mix and prepare coatings to manufacturer's instructions.
  - .4 .3 Take moisture tests on substrates to receive coating to ensure moisture levels are within
  - .5 limits specified by coating manufacturer.

**3.2 APPLICATION**

- .1 Apply coating using brush, roller or low pressure spraying apparatus, in accordance with manufacturer's printed instructions.
- .2 .Apply at manufacturer's recommended coverage rates for substrate. Adjust for substrate porosity and absorption characteristics.
- .3 Apply in uniform, even coats to fully wet substrate, without flooding or rundowns.

- .4 Allow area to dry completely before applying additional coats.

**3.3 3.3 SCHEDULE**

- .1 Apply graffiti-resistant coating to exterior fiber cement siding and acrylic elastomeric coated concrete.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- .1 Supply and install:
  - .1 Coating of exterior concrete surfaces

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Specifications included on Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- .2 Division 3
- .3 Division 6

**1.3 REFERENCE STANDARDS**

- .1 Do work in accordance with CGSB 51-GP-39M and the Canadian Painting Contractors Association "Architectural Painting Specification Manual".

**1.4 SUBMITTALS**

- .1 Submit colour samples and product data sheets for approval.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
- .2 Maintain containers in clean condition, free of foreign materials and residue.
- .3 Remove rags and waste from storage areas daily.

**1.6 ADDITIONAL MATERIALS**

- .1 Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- .2 Quantity: Furnish an additional 5 percent but not less than 1 gal. (3.8 L) of each material, color, and texture applied.
- .3 Containers shall be full, tightly sealed and clearly labelled for identification.

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**PART 2 PRODUCTS**

**2.1 EXTERIOR COATED CONCRETE**

- .1 Concrete Substrates: Elastomeric Coating System.
  - .1 Prime Coat: As recommended in writing by topcoat manufacturer.
  - .2 Intermediate Coat: As recommended in writing by topcoat manufacturer.
  - .3 Topcoat: Elastomeric, pigmented, exterior, water-based, flat coating:
  - .4 Approved Product: Sika Brand, Sikagard 850AG or approved equal in accordance with B7.
- .2 Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated.
- .3 Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.
- .4 Concrete Unit Masonry Block Filler: Elastomeric coating manufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.

**PART 3 EXECUTION**

**3.1 GENERAL**

- .1 Coat all building exterior concrete surfaces except for door entrance slabs.
- .2 Touch up shop applied finishes damaged during installation.

**3.2 PREPARATION OF CONCRETE SURFACES**

- .1 Comply with manufacturer's written instructions and recommendations in the "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- .2 Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
- .3 After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- .4 Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible Coatings and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- .5 Remove incompatible primers and re-prime substrate with compatible primers as required to produce coating systems indicated.

- .6 Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
- .7 Retain paragraph below for crack repair. Cracks must be filled before coating to maintain water-resistant protection and to prevent breaks in coating continuity that can allow deterioration. Crack treatment depends on crack size, and manufacturers may require specific procedures to suit their products on a Project-specific basis. Insert additional requirements below if required by manufacturers.
- .8 Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.
- .9 Ensure all surfaces are clean and dry.

### **3.3 PROTECTION OF SURFACES**

- .1 Protect surfaces not to be coated and if damaged, clean and restore such surfaces as directed.
- .2 Apply primer, Coating, or pre-treatment as soon possible after surface has been cleaned and before deterioration of surface occurs.
- .3 If rusting occurs after completion of surface preparation, clean surfaces again.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of Coating. Remove contaminants from surface and apply Coating immediately.
- .5 Protect cleaned and freshly coated surfaces from excessive dust.

### **3.4 MIXING COATING**

- .1 Do not dilute or thin coating for brush application; use as received from manufacturer.
- .2 Mix ingredients in container before use and ensure breaking up of lumps, complete dispersion of settled pigment, and a uniform composition.
- .3 Mix Coating often enough during application to keep pigment in suspension and composition uniform.
- .4 Do not mix or keep Coating in suspension by means of air bubbling through Coating
- .5 Thin Coating for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide a copy of instructions to Contract Administrator.

### **3.5 APPLYING COATING**

- .1 Apply elastomeric coatings according to manufacturer's written instructions.
- .2 Use equipment and techniques best suited for substrate and type of material being applied.
- .3 Coat surfaces behind movable items the same as similar exposed surfaces.
- .4 Apply each coat separately according to manufacturer's written instructions.
- .5 Primers: Apply at a rate to ensure complete coverage.
- .6 Block Fillers: Apply at a rate to ensure complete coverage with pores filled.
- .7 Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats similar to color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- .8 If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.
- .9 Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- .10 Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.
- .11 Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.
- .12 Caulk open seams at contact surfaces of built up members with red lead paste, or other approved material. Apply second coat of primer to caulked areas.
- .13 Where surface to be Coated is not under cover, do not apply Coating when:
  - .1 Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 90 deg F (10 and 32 deg C) unless otherwise permitted by manufacturer's written instructions.
  - .2 Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp, wet or frosted surfaces.
  - .3 Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.
  - .4 Previous coats are not dry.
- .14 When Coating must be applied in damp or cold weather apply Coating under cover. Protect, shelter, or heat surface and surrounding air to comply with



- temperature and humidity conditions specified in 3.9.4. Protect until Coating is dry or until weather conditions permit.
- .15 Permit drying of applied Coating which has been exposed to freezing, excess humidity, rain, snow or condensation. Remove Coating from damaged areas, prepare surface again and recoating same as undamaged areas.
  - .16 Apply each coat as a continuous film of uniform thickness. Recoat thin spots or bare areas before next coat is applied.
  - .17 Brush application:
    - .1 Work Coating into cracks, crevices and corners and Coating surfaces not accessible to brushes by spray, daubers or sheepskins.
    - .2 Brush out runs and sags.
    - .3 Leave a minimum of brush marks in finished Coating surfaces.
    - .4 Remove runs and sags from finished work and recoat.
  - .18 Spray Application:
    - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing coating to be applied, and equipped with suitable pressure regulators and gauges.
    - .2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.
    - .3 Keep coating ingredients properly mixed in spray pots or containers during coating application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
    - .4 Apply coating in a uniform layer, with overlapping at edges of spray pattern.
    - .5 Brush out immediately all runs and sags.
    - .6 Use brushes to work coating into cracks, crevices and places which are not adequately coated by spray. In areas not accessible to spray gun, use brushes, daubers or sheepskins.
    - .7 Remove runs and sags from finished work and recoat.
  - .19 Field Coating:
    - .1 Coating steel structures as soon as possible.
    - .2 Touch up metal which has been shop coated with same type of Coating and to same thickness as shop coat. This touch-up to include cleaning and coating of field connections, welds, rivets, nuts, washers, bolts and damaged or defective Coating and rusted areas.
    - .3 Field coating surfaces (other than joint contact surfaces) which are accessible before erection but which will not be accessible after erection.
    - .4 If possible do not apply final coat until concrete work is completed. If concreting or other operations damage any Coating, clean and recoat

damaged area. Remove concrete spatter and droppings before coating is applied.

- .5 Where coating does not meet with requirements of specifications, and when so directed by Contract Administrator, remove all defective paint, thoroughly clean affected surfaces and recoat in accordance with these specifications.

### **3.6 CLEANING AND PROTECTION**

- .1 At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- .2 After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- .3 Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by the Contract Administrator, and leave in an undamaged condition.
- .4 At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 GENERAL**

- .1 The specifications are an integral part of the Contract Documents.

**1.2 WORK INCLUDED**

- .1 Include all miscellaneous specialties listed below for installation by Division's 5, 6, 15, 23 and 26.

**1.3 RELATED WORK BY OTHERS**

- .1 Provision of backing for fastening purposes (Division's 5 & 6).

**PART 2 PRODUCTS**

**2.1 EXTERIOR SIGNAGE**

- .1 Building Address Number
- .2 1 - 100mm high numbers
- .3 black metal sign
- .4 To read: 91
- .5 Submit shop drawing to the Contract Administrator for approval.
- .6 Sign shall be mounted by the Contractor on the outside face of the building as designated by the Contract Administrator.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Erect in accordance with manufacturer's instructions.

**END OF SECTION**

**Part 1 General**

**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit drawings stamped and signed by professional Contract Administrator registered or licensed in Manitoba, Canada where indicated.
  - .2 Drawings to show:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .3 Drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
  - .4 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.

**1.2 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.
  - .2 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
  - .3 Maintenance data to include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.
  - .2 Make changes as required and re-submit as directed by Contract Administrator
- .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 As-Built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Contract Administrator for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .8 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.

- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

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

##### **2.1 Not Used**

- .1 Not Used.

#### **Part 3 Execution**

##### **3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 50 – Painting and Finishing.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

##### **3.2 SYSTEM CLEANING**

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

##### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.4 DEMONSTRATION**

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

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**3.6 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 SECTION INCLUDES**

- .1 Materials and installation for domestic water service used in the following:
  - .1 Polyvinyl chloride (PVC) domestic cold water services inside building.

**1.2 REFERENCE STANDARDS**

- .1 American Society of Mechanical Contract Administrators International (ASME)
  - .1 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 ASTM International
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
  - .3 ASTM F492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .3 American Water Works Association (AWWA)
  - AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 CSA Group
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .6 National Research Council (NRC)/Institute for Research in Construction
  - .1 National Plumbing Code of Canada (NPC) complete with Manitoba Amendments (MPC).

**1.3 SUBMITTALS**

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



- .2 Submit product data for following: valves.
- .3 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **Part 2 Products**

### **2.1 PIPING**

- .1 Domestic cold piping within building.
  - .1 Above ground:
    - .1 PVC: to CAN/CSA-B181.2
  - .2 Buried or embedded:
    - .1 HDPE in long lengths and with no buried joints.

### **2.2 FITTINGS**

- .1 PVC: to CAN/CSA-B181.2.

### **2.3 JOINTS**

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Teflon tape: for threaded joints.

### **2.4 BALL VALVES**

- .1 NPS 2 and under, threaded or solvent ends:
  - .1 PVC body, PVC and ABS ball, PTFE seat, EPDM O-Ring, ABS handle.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with NPC and local authority having jurisdiction.
- .2 Assemble piping using fittings manufactured to ANSI standards.
- .3 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .5 Buried tubing:

- .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
- .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .6 Valves
  - .1 Isolate equipment, fixtures and branches with ball valves.

### **3.3 PRESSURE TESTS**

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

### **3.4 PRE-START-UP INSPECTIONS**

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

### **3.5 START-UP**

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Certificate of static completion has been issued.
- .2 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 Rectify start-up deficiencies.

### **3.6 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
  - .1 AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
  - .2 ANSI/AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.
  - .3 ANSI/AWWA C702, Standard for Cold Water Meters-Compound Type.
- .3 CSA International
  - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
  - .2 CSA B79, Commercial and Residential Drains and Cleanouts.
  - .3 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Plumbing and Drainage Institute (PDI)
  - .1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
  - .2 PDI-WH201, Water Hammer Arresters Standard.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate on drawings to indicate accessories, dimensions, construction and assembly details, number of anchors, finishes, materials and method of anchorage.
- .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 Manufacturers' Field Reports: manufacturers' field reports specified.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 BACK FLOW PREVENTERS**

- .1 Preventers: to CSA-B64 Series, reduced pressure principle type.
- .2 Acceptable Manufacturers: Watts Model LF009M2-QT-909-AGC.

**2.2 WATER METERS**

- .1 Turbine type to AWWA C701 and as per City requirements.

**2.3 WATER HAMMER ARRESTORS**

- .1 Copper construction, piston type: to PDI-WH201.
- .2 Acceptable Manufacturers: Watts Series 15M2 or approved equal in accordance with B.7.

**2.4 HOSE BIBBS AND SEDIMENT FAUCETS**

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

**2.5 PRESSURE REDUCING VALVE**

- .1 Water pressure reducing valve and strainer shall be installed to reduce pressure to 241 KPa or less. The valve shall have a stainless steel seat with EPDM seat disc and diaphragm.

- .2 Material:
  - .1 Body: Cast Copper Silicon Alloy.
  - .2 Seat: Stainless Steel.
  - .3 Diaphragm: Reinforced EPDM.
  - .4 Valve Disc: EPDM.
- .3 Acceptable Manufacturers: Watts Series LF123 or approved equal in accordance with B.7.

**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 Install in accordance with provincial codes and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

**3.3 BACK FLOW PREVENTERS**

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
  - .1 Drains.
  - .2 Backwater Valves.
  - .3 Water Make-up Assembly.
  - .4 Grease Interceptors.

**3.4 WATER METERS**

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

**3.5 WATER HAMMER ARRESTORS**

- .1 Install on branch supplies to fixtures or group of fixtures where indicated.

**3.6 HOSE BIBBS AND SEDIMENT FAUCETS**

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

**3.7 START-UP**

- .1 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.

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**3.8 TESTING AND ADJUSTING**

- .1 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by authority having jurisdiction.
- .2 Application tolerances:
  - .1 Pressure at fixtures:  $\pm 70$  kPa.
  - .2 Flow rate at fixtures:  $\pm 20\%$ .
- .3 Vacuum breakers, backflow preventers, backwater valves:
  - .1 Test tightness, accessibility for O&M of cover and of valve.
  - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
  - .3 Verify visibility of discharge from open ports.
- .4 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .5 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .6 Water meters:
  - .1 Verify location and accessibility.
  - .2 Test metre reading accuracy.

**3.9 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.

**3.10 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Society of Mechanical Contract Administrators (ASME)
  - .1 ASME B31.1, Power Piping.
- .2 ASTM International
  - .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

**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 data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional Contract Administrator registered or licensed in Manitoba of Canada.
  - .2 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .5 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse by manufacturer of packaging materials, padding, crates and pallets in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58, ANSI B31.1 and
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

### **2.2 PIPE HANGERS**

- .1 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.
- .2 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .3 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.



- .4 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .5 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
- .6 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

### **2.3 RISER CLAMPS**

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

### **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

### **2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .3 Clevis plates:

- .1 Attach to concrete with four (4) minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

### 3.3 HANGER SPACING

- .1 Plumbing piping: to [Provincial Code] [National Plumbing Code of Canada (NPC)] [authority having jurisdiction].
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within [300] mm of each elbow.

<b>Maximum Pipe Size: NPS</b>	<b>Maximum Spacing Steel</b>	<b>Maximum Spacing Copper</b>
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .7 Pipework greater than NPS 12: to MSS SP69.

### 3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### 3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.6 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

### **3.7 FIELD QUALITY CONTROL**

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

### **3.8 CLEANING**

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

**END OF SECTION**

**Part 1      General**

**1.1          SUMMARY**

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

**1.2          QUALIFICATIONS OF TAB PERSONNEL**

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

### **1.3 PURPOSE OF TAB**

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

### **1.4 EXCEPTIONS**

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

### **1.5 CO-ORDINATION**

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

### **1.6 PRE-TAB REVIEW**

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

### **1.7 START-UP**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

### **1.8 OPERATION OF SYSTEMS DURING TAB**

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

### **1.9 START OF TAB**

- .1 Notify Contract Administrator seven (7) days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:

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

#### **1.10 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 HVAC systems:  $\pm 5\%$ .

#### **1.11 ACCURACY TOLERANCES**

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

#### **1.12 INSTRUMENTS**

- .1 Prior to TAB, submit to Contract Administrator list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

- .3 Calibrate within three (3) months of TAB. Provide certificate of calibration to Contract Administrator.

### **1.13 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.14 PRELIMINARY TAB REPORT**

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

### **1.15 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit TAB Report to Contract Administrator for verification and approval, complete with index tabs.

### **1.16 VERIFICATION**

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

### **1.17 SETTINGS**

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

### **1.18 COMPLETION OF TAB**

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

**1.19 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of this section or TAB standards of ASHRAE, NEBB, AABC and SMACNA.
- .2 Do TAB of systems, equipment, components, controls specified Division 23.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of NEBB or AABC.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

**1.20 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**



**Part 1      General**

**1.1      REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigeration and Air Conditioning Contract Administrators (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International Inc.
  - .1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .9 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

**1.2      DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

- .2 "EXPOSED" - means "not concealed" as previously defined.
- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
  - .1 CRD: Code Round Ductwork,
  - .2 CRF: Code Rectangular Finish.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
    - .2 Details of operation, servicing and maintenance.
    - .3 Recommended spare parts list.
  - .3 Samples:
    - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
    - .2 Mount sample on 12 mm plywood board.
    - .3 Affix typewritten label beneath sample indicating service.

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 INSULATION**

- .1 Mineral fibre: as 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 C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C553.

### **2.3 JACKETS**

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup>cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.

### **2.4 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: [hydraulic] setting on mineral wool, to ASTM C449.
- .4 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .5 Contact adhesive: quick-setting
- .6 Canvas adhesive: washable.
- .7 Tie wire: 1.5 mm stainless steel.
- .8 Banding: 19 mm wide, 0.5 mm thick stainless steel.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 PRE-INSTALLATION REQUIREMENTS**

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

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum two rows each side.

### **3.4 DUCTWORK INSULATION SCHEDULE**

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

TIAC Code	Vapour Retarder	Thickness (mm)	
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Exhaust duct between dampers and louvres	C-1	no	25

### **3.5 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.2 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 Provide all low voltage, (under 50vac), control devices wiring, conduit, transformers, contactors and hardware required to control the heating and ventilating systems included in this section.

**2.2 THERMOSTAT (LOW VOLTAGE)**

- .1 Low voltage wall thermostat:
  - .1 For use on 24 V circuit at 1.5 A capacity.
  - .2 Temperature setting range: 10 degrees C to 25 degrees C.
  - .3 With sub-base.

**2.3 Controller**

- .1 The ventilation system consists of the following components:
  - .1 Make Up Air Unit MUA-1 (Including Electric Heater, duct temperature sensor, outside air (ambient) sensor).

- .2 Outside air damper MD-1.
- .3 Exhaust air dampers MD-3 and MD-6.
- .4 Exhaust Fans EF-2 and EF-3.
- .5 Hazardous Gases Sensor.
- .2 The ventilation system shall operate as follows:
  - .1 Interlock dampers MD-1 to MUA-1, MD-3 to EF-2, MD-6 to EF-3 and the hazardous gases sensor to MUA-1. Interlock MUA-1, EF-2 and EF-3 to the Main Floor – Motor Room light switch. The MUA-1, EF-2 and EF-3 operate continuously during occupied and unoccupied mode.
  - .2 When the Main Floor – Motor Room light switch is turned ON (occupied) or the hazardous gases sensor reads LFL greater than 10, dampers MD-1, MD-3 and MD-6 are fully open and the MUA-1 fan, EF-2 and EF-3 operate at high speed. MUA-1 heater turns ON when the supplied air temperature is below 10C. The MUA-1 heater turns OFF when the supplied air temperature is above 10C.
  - .3 When the Main Floor – Motor Room light switch is turned OFF (unoccupied) or the hazardous gases sensor reads LFL lower than 10, dampers MD-1, MD-3 and MD-6 are fully open and MAU-1 fan, EF-2 and EF-3 operate at 50% the full speed. MUA-1 heater turns ON when the supplied air temperature is below 10C. The MUA-1 heater turns OFF when the supplied air temperature is above 10C.
  - .4 Controls contractor shall be responsible for specifying all control wiring and controls to meet the sequence.
- .3 Motor Room (Main Floor) cooling system consists of the following components:
  - .1 Supply Fan SF-1
  - .2 Outside air damper MD-2
  - .3 Exhaust dampers MD-4 and MD-5
  - .4 Wall mounted thermostat
- .4 Motor Room (Main Floor) cooling system shall operate as follows:
  - .1 When space temperature is below 35C (adjustable), SF-1 is OFF and MD-2, MD-4 and MD-5 are fully closed.
  - .2 When space temperature is above 35C (adjustable), SF-1 is ON and MD-2, MD-4 and MD-5 are fully open.
  - .3 Controls contractor shall be responsible for specifying all control wiring and controls to meet the sequence.
- .5 Wet Well Room ventilation system consists of the following components:
  - .1 Exhaust Fan EF-1
- .6 Wet Well Room ventilation system shall operate as follows:
  - .1 Interlock exhaust fan EF-1 with the Wet Well Room light switch. The exhaust fan EF-1 operates continuously during occupied.

- .2 When the Wet Well Room light switch is ON (occupied), the exhaust fan EF-1 is ON.
- .3 When the Wet Well Room light switch is OFF (unoccupied), the exhaust fan EF-1 is OFF.
- .4 Controls contractor shall be responsible for specifying all control wiring and controls to meet the sequence.

### **Part 3 Execution**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.2 INSTALLATION**

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

#### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

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**Part 1      PART 1 – GENERAL**

**1.1          SUBMITTALS**

- .1      Product Data: For each type of low profile modular indoor air handling unit indicated, include the following:
  - .1      Complete fan performance curves with system operating conditions indicated shall be tested in an AMCA Registered Chamber.
  - .2      Fan sound power rating shall be tested in an AMCA Registered Chamber.
  - .3      Certified coil performance ratings with system operating conditions indicated.
  - .4      Motor ratings, electrical characteristics, and motor and fan accessories.
  - .5      Material gages and finishes.
  - .6      Dampers, including housings, linkages, and operators.
- .2      Field Quality Control Test Reports: From manufacturer.

**1.2          QUALITY ASSURANCE**

- .1      Source Limitations: Obtain low profile modular indoor air handling units through one source from a single manufacturer.
- .2      Product Options: Drawings indicate size, profiles, and dimensional requirements of modular indoor air handling units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- .3      Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- .4      NFPA Compliance: Low profile modular indoor air handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A. "Installation of Air Conditioning and Ventilating Systems."
- .5      ARI Certification: Low profile modular indoor air handling units and their components shall be factory tested in accordance with UL 1995 and shall be listed and labeled by ARI. Fan must be sent to ETL for testing.
- .6      Comply with NFPA 70.

**1.3          COORDINATION**

- .1      Coordinate size and location of structural steel support members.

**1.4          EXTRA MATERIALS**

- .1      Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.



- .1 Filters: (One) 1 set(s) for each low profile modular indoor air handling unit.
- .2 Fan Belts: (One) 1 set(s) for each low profile modular indoor air handling unit.

## **Part 2 PART 2 – PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- .2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - .1 Greenheck or approved equal in accordance with B.7.

### **2.2 MANUFACTURED UNITS**

- .1 Low profile modular indoor air handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, plenums, filters, and accessories.

### **2.3 CABINET**

- .1 Materials: Formed double wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections gasketed.
  - .1 Outside Casing: 18 gauge, galvanized steel (G90)
  - .2 Inside Casing: 18 gauge, galvanized steel (G90)
  - .3 Floor Plate: 18 gauge, galvanized steel (G90)
  - .4 Utility Lugs: For lifting unit and fastening to permanent structure, 8 gauge, galvanized steel (G90)
- .2 Cabinet Insulation: Comply with NFPA 90A or NFPA 90B
  - .1 Materials: Fiber glass insulation
  - .2 Thickness: 1 inch (25 mm)
  - .3 Density: 1-1/2 (3) pounds per cubic foot.
  - .4 Thermal Conductivity (k-Value): 0.26 at 75°F (0.037 at 24°C) mean temperature.
  - .5 Fire-Hazard Classification: Maximum flame spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
  - .6 Location and Application: Encased between outside and inside casing.
- .3 Access Panels: Same materials and finishes as cabinet complete with threaded screw fasteners and gaskets. Inspection and access panels shall be sized and

located to allow periodic maintenance and inspections. Provide access panels in the following locations:

- .1 Fan Section: Inspection and access panels
  - .2 Access Section: Access panel
  - .3 Coil Section: Inspection panel
  - .4 Damper Section: Inspection and access panels
  - .5 Filter Section: Inspection and access panels to allow periodic removal and installation of filters.
- .4 Nameplate Mylar: Permanently affixed to cabinet. Include model, make, and serial number identification.

## **2.4 FAN SECTION**

- .1 Fan Section Construction: Belt driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, and support structure and equipped with formed steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with interior (neoprene) (spring) vibration isolation.
- .2 Centrifugal Fan Housings: Formed and reinforced steel panels to make curved scroll housings with shaped cutoff, spun metal inlet bell, and access panels or doors to allow entry to internal parts and components.
  - .1 Panel Bracing: Steel angle or channel iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  - .2 Horizontal Flanged Split Housing: Bolted construction.
  - .3 Drive Frame: Rail mounted, heavy gauge steel to allow frame to slide for easy belt tensioning.
- .3 Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
- .4 Forward Curved Fan Wheels: Galvanized steel and/or aluminum/painted steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.
- .5 Coatings (exterior only): Permatector, Baked Enamel, Hi-Pro Polyester, Polyester Resin.
- .6 Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
  - .1 Turned, ground, and polished (hot rolled) (stainless) steel with keyway. Ship with a protective coating of lubricating oil.
  - .2 Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

- .7 Pre-lubricated and Sealed Shaft Bearings: Self-aligning, pillow block type ball bearings.
  - .1 Ball-Bearing Rating Life: ABMA 9, L<sub>10</sub> of 100,000 hours.
- .8 Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation and with 1.5 service factor based on fan motor.
  - .1 Pulleys: Mechanical cast iron with split, tapered bushing dynamically balanced at factory.
  - .2 Motor Pulleys: Adjustable pitch. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - .3 Belts: Oil resistant, static free.
  - .4 Motor Mount: Adjustable for belt tensioning.
- .9 Fan Section Source Quality Control:
  - .1 Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."
- .10 Inlet/Outlet duct collars: Galvanized collars at each inlet and outlet of the unit. Flexible duct connection isolating discharge of scroll from discharge of fan.

## **2.5 MOTORS**

- .1 Noise Rating: Quiet
- .2 Maximum Ambient Temperature Rating: 120°F (50°C).

## **2.6 COILS**

- .1 Electrical Heating Coils, Controls, and Accessories: Comply with UL1995.
- .2 Casing Assembly: Slip in type with galvanized steel frame
- .3 Heating Elements: Open coil resistance wire of 80 percent nickel and 2- percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized steel frame.
- .4 Over-Temperature Protection: Disk type, automatically resetting thermal cutout, safety device, serviceable through terminal box without removing heater from duct or unit.
  - .1 Secondary Protection: Load carrying, manually resetting or manually replaceable, thermal cutouts, factory wired in series with each heater stage.

## **2.7 FILTER SECTION**

- .1 Filters: Comply with NFPA 90A

- .2 Filter Section: Provide filter holding frames arranged for vertical orientations, with access doors on both sides of unit. Filters shall be removable from both sides.
- .3 Extended Surface, Disposable Panel Filters: Factory fabricated, dry, extended surface filters with holding frames.
  - .1 Media: Fibrous material formed into deep-V shaped pleats and held by self supporting wire grid.
  - .2 Media and Media Grid Frame: Non-Flammable cardboard.

### **Part 3 PART 3 – EXECUTION**

#### **3.1 EXAMINATION**

- .1 Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- .2 Examine roughing-in of steam, hydronic, direct expansion and condensate drainage piping systems and electrical services to verify actual locations of connections have been corrected.

#### **3.2 INSTALLATION**

- .1 Install low profile modular indoor air handling units with the following vibration control devices.
  - .1 Units with Internally Isolated Fans: Secure units to anchor bolts installed in concrete bases.
  - .2 Suspended Units: Suspend units from structural steel support frame using threaded steel rods and neoprene hangers.
- .2 Arrange installation of units to provide access space around low profile modular indoor air handling units for service and maintenance.

#### **3.3 CONNECTIONS**

- .1 Drawings indicate general arrangement of ducts and duct accessories.
- .2 Electrical: Comply with applicable requirements.
- .3 Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### **3.4 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, including piping and electrical connections. Report results in writing.

- .1 Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

### **3.5 STARTUP SERVICE**

- .1 Engage a factory authorized service representative to perform startup service.
- .2 Final checks before startup. Perform the following:
  - .1 Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal overload protection is installed in motors, starters, and disconnect switches.
  - .2 Perform cleaning and adjusting specified in this section.
  - .3 Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts and install belt guards.
  - .4 Lubricate bearings, pulleys, belts, and other moving parts with factory recommended lubricants.
  - .5 Set zone dampers to fully open position for each zone.
  - .6 Set face and bypass dampers to full face flow.
  - .7 Set outside and return air mixing dampers to minimum outside air setting.
  - .8 Comb coil fins for parallel orientation.
  - .9 Install clean filters.
  - .10 Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- .3 Starting procedures for modular indoor air handling units include the following:
  - .1 Energize motor, verify proper operation of motor, drive system and fan wheel. Adjust fan to indicated rpm.
  - .2 Measure and record motor electrical values for voltage and amperage.
  - .3 Manually operate dampers from fully closed to fully open position and record fan performance.

### **3.6 ADJUSTING**

- .1 Adjust damper linkages for proper damper operation.

### **3.7 CLEANING**

- .1 Clean low profile modular indoor air handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

- .2 After completing system installation and testing, adjusting, and balancing modular indoor air handling and air distribution systems, clean filter housings and install new filters

**3.8 DEMONSTRATION**

- .1 Engage a factory authorized service representative to train the City's maintenance personnel to adjust, operate, and maintain modular indoor air handling units.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 GENERAL**

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

**2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m<sup>2</sup>.

## **2.3 ACCESS DOORS IN DUCTS**

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: foam rubber.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks [complete with safety chain].
  - .2 301 to 450 mm: four sash locks
  - .3 Hold open devices.

## **2.4 INSTRUMENT TEST**

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

## **2.5 SPIN-IN COLLARS**

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

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

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



- .5 When fan is running:
  - .1 Ducting on sides of flexible connection to be in alignment.
  - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 450 x 450 mm for servicing entry.
    - .2 150 x 150 mm for viewing.
    - .3 As indicated.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.
    - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Install insulation port extensions as required.
  - .4 Locations:
    - .1 For traverse readings:
      - .1 Ducted inlets to roof and wall exhausters.
      - .2 Inlets and outlets of other fan systems.
      - .3 Main and sub-main ducts.
      - .4 And as indicated.
    - .2 For temperature readings:
      - .1 At outside air intakes.
      - .2 In mixed air applications in locations as approved by Contract Administration
      - .3 At inlet and outlet of coils.
      - .4 Downstream of junctions of two converging air streams of different temperatures.
      - .5 And as indicated.
- .4 Turning Vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 -Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

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

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 CLOSEOUT SUBMITTALS**

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

**1.4 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 MOTORIZED DAMPERS**

- .1 Parallel blade type.
- .2 Construct all dampers on exterior walls with insulated aluminum interlocking blades, complete with extruded silicone seals on blades, sides and jamb, and thermally broken aluminum frame. Insulation to be installed inside blades and frame.
- .3 Pressure fit self-lubricated polycarbonate/acetal copolymer bearings.
- .4 Linkage: aluminum alloy crank arms, nickel plated trunnions and large diameter aluminum alloy linkage rods.
- .5 Operator:
  - .1 Two position, Power-open, spring-close, type with 120V electric motor, (Manufactured by Belimo or approved equal).

- .2 Modulating or on/off to suit application.
- .3 4-20mA or 0-10 VDC control signal for modulating application.
- .6 Acceptable material:
  - .1 Outside air and exhaust:
    - .1 Tamco 9000 c/w "Severe Cold Option", or approved equal in accordance with B.7.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

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

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .4 Underwriters' Laboratories (UL)
  - .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S110, Standard Methods of Tests for Air Ducts.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

**2.2 METALLIC - UNINSULATED**

- .1 Type 1: spiral wound flexible stainless steel, as indicated.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

**2.3 METALLIC - INSULATED**

- .1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and reinforced mylar/neoprene laminate jacket, as indicated.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

**Part 3 Execution**

**3.1 DUCT INSTALLATION**

- .1 Install in accordance with: SMACNA.

**3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 99, Standards Handbook.
  - .2 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional Contract Administrator registered or licensed in Manitoba, Canada.
  - .2 Provide:
    - .1 Fan performance curves showing point of operation, bhp (kW) and efficiency.
    - .2 Sound rating data at point of operation.
  - .3 Indicate:
    - .1 Motors, sheaves, bearings, shaft details.
    - .2 Minimum performance achievable with variable speed controllers.
- .4 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

**1.3 MAINTENANCE MATERIAL SUBMITTALS**

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

#### **1.4 DELIVERY, STORAGE AND HANDLING**

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

### **Part 2 Products**

#### **2.1 SYSTEM DESCRIPTION**

#### **2.2 FANS GENERAL**

- .1 Motors:
  - .1 For use with variable speed controllers.
  - .2 Sizes as indicated.
- .2 Factory primed before assembly in colour standard to manufacturer.
- .3 Scroll casing drains: as indicated.
- .4 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

#### **2.3 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)**

- .1 Casings: welded steel with welded motor support, bolted access plates and streamlined inlet cone and discharge bell sections.
- .2 Blade material: aluminum. Hub material: steel.
- .3 Supports:
  - .1 Floor mounted units: reinforced legs.
  - .2 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.
- .4 Bearings: ball or roller with extension tubes to outside of casing.
- .5 Belt drive:
  - .1 Drive fixed blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.
  - .2 Adjust blades for varying range of volume and pressure. Hubs to facilitate indexing of blade angle.
- .6 Acceptable Manufacturers: Cook, Greenheck.

#### **2.4 CENTRIFUGAL FANS**

- .1 Fan wheels:
  - .1 Welded aluminum construction.
  - .2 Backward inclined blades, as indicated.



- .3 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining and dust excluding seals.
- .2 Housings:
  - .1 Fan housing is to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
  - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
  - .3 Fan shall be of airtight PermaLock construction with the scroll panel material formed and embedded into the side panels.
  - .4 Housing shall be constructed of bolted steel members to prevent vibration and rigidly support the motor and wheel.
- .3 Fan Motors and Drive:
  - .1 Motors shall be open type enclosure and electronic commutation type motor (ECM) specifically designed for fan applications.
  - .2 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
  - .3 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
  - .4 Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
  - .5 Motor shall be a minimum of 85% efficient at all speeds.
- .4 Variable volume control devices:
  - .1 Mounted by fan manufacturer.
- .5 Acceptable Manufacturers: Greenheck or approved equal in accordance with B.7

## **2.5 EXPLOSION PROOF DIRECT DRIVE WALL MOUNTED PROPELER FANS**

- .1 Fan arrangement shall be exhaust, see drawings.
- .2 Totally enclosed, ball bearing motor with thermal overload protection.
- .3 The fan blades are well-balanced, heavy guage aluminum.
- .4 Rugged steel welded box housing with a durable powder coated finish.
- .5 Heavy wire chrome plated OSHA guards on intake side of fan.
- .6 Complete with aluminum louver shutters.
- .7 Single speed dual voltage explosion proof motor conforming to the following standards:
  - .1 Class I, Group C.
  - .2 Class I, Group D.
- .8 Acceptable Manufacturers: CANARM or approved equal in accordance with B.7.

## **2.6 DIRECT DRIVE WALL MOUNTED PROPELLER FANS**

- .1 General
  - .1 Fan arrangement shall be either supply or exhaust, see drawings.
- .2 Wheel
  - .1 Propeller shall be aluminum blade riveted to steel hub.
  - .2 A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft.
  - .3 Statically and dynamically balanced in accordance with AMCA Standard 204-05
  - .4 The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.
  - .5 Blades and housing shall be coated for corrosion resistance, where specified.
- .3 Panel
  - .1 Single piece fan panel and venture with welded corners has pre-punched mounting holes and electrical wiring knockout. Baked electrocoat enamel paint (grey) is applied to the galvanized steel panel after assembly. Hot-dipped galvanized or aluminum housing is also acceptable.
- .4 Motor
  - .1 Motor enclosures: Totally enclosed fan cooled
  - .2 Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at the specific voltage and phase.
  - .3 Accessible for maintenance.
- .5 Drives
  - .1 Drive frame assemblies and fan panels shall be galvanized steel.
  - .2 Drive frame shall have welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges and a deep formed one piece inlet venture.
- .6 A disconnect switch shall be factory installed and wired from the fan motor to a junction box within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.
- .7 All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
- .8 Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.
- .9 The direct drive panel fans must be licensed to bear the AMCA certified rating seal for air performance.
- .10 Accessories will include:

- .1 Wall housing to house damper, fan.
- .2 Disconnect switch.
- .3 Motor side guard – basket style or wire mesh.
- .4 Starter
- .5 Insect Screen
- .11 Acceptable Manufacturers: Greenheck, Loren Cook.

**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 FAN INSTALLATION**

- .1 Install fans as indicated, complete with resilient mountings, flexible electrical leads and flexible connections.
- .2 Access doors and access panels to be easily accessible.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No. 46, Electric Air-Heaters.

### **1.2 PRODUCT DATA**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for unit heaters. Include:
  - .1 Product characteristics
  - .2 Performance criteria
  - .3 Mounting Methods
  - .4 Physical size
  - .5 Kw rating, voltage phase
  - .6 Cabinet material thicknesses
  - .7 Limitations
  - .8 Colour and finish
- .3 Submit product data sheets for unit heaters.
  - .1 Include product characteristics, performance criteria, physical size, limitations and finish.

### **1.3 CLOSEOUT SUBMITTALS**

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

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 ELECTRIC UNIT HEATERS – HEAVY DUTY CORROSION RESISTANT**

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Heaters to be forced fan type of the kW rating, voltage and phase specified in the drawing schedule.

- .3 Entire heater shall be NEMA 4X type, corrosion resistant and suitable for washdown applications.
- .4 The heating elements shall be of stainless steel spiral-finned elements.
- .5 The motor shall be CSA Recognized, totally enclosed with permanently lubricated ball bearings, and designed to resist moisture and corrosion. Unit heaters shall come with wall thermostats or built in thermostat, refer to drawings for thermostat requirements. Where thermostat is not shown on the drawings assume built in. Mount remote thermostats 1500 mm above finished floor.
- .6 Enclosure to house element terminals and the following standard built-in controls: automatic reset over temperature cutout, 24V control transformer, fan delay relay, required contactors, and terminal block for field wiring.
- .7 Type 304 stainless steel, 16-ga enclosure, with 18-ga stainless steel inlet screen.
- .8 Provide swivel mounting brackets. Refer to drawings to determine wall or ceiling mountings.
- .9 Stainless steel, 18-ga outlet louvre, 45-degree blade angle.

## **2.2 MANUFACTURERS**

- .1 Acceptable Manufacturers: Ouellet, Ruffneck.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Suspend unit heaters from ceiling or mount on wall as indicated.
- .3 Make power and control connections.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and control operate correctly.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**3.4 PROTECTION**

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

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- |    |                |                  |
|----|----------------|------------------|
| .1 | Wires & Cables | Section 26 05 21 |
| .2 | Conduits       | Section 26 05 34 |
| .3 | Cable Trays    | Section 26 05 36 |

## **2 PRODUCTS**

### **2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended as indicated.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Secure equipment to masonry with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .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 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.
- .5 Support 2 or more cables or conduits on channels supported by 9 mm dia. threaded rod hangers at 1.5m OC where direct fastening to building construction is impractical.
- .6 Group conduits on support channels in all corridor ceilings.
- .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 trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**



## **1 GENERAL**

### **1.1 RELATED WORK**

- |    |  |                  |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Conduits                               | Section 26 05 34 |
| .3 | Fastenings and Supports                | Section 26 05 29 |

## **2 PRODUCTS**

### **2.1 LOCATION**

- .1 Locate splitters, junction and pullboxes as indicated or as needed for each system.

### **2.2 SPLITTERS**

- .1 Sheet metal enclosure and hinged gasketed cover, suitable for locking in closed position.
- .2 Main and branch lugs, to match required size and number of incoming and outgoing conductors, as indicated.
- .3 Provide minimum three spare terminals on each set of lugs in splitters.

### **2.3 JUNCTION AND PULLBOXES**

- .1 PVC construction with screw-on flat covers for surface or recessed mounting.
- .2 Covers with 1" (25 mm) minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Cast-type with gasketed covers where exposed to weather.

### **2.4 CABINETS**

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface-mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 3/4" (19 mm) GIS fir plywood backboard. Cabinets to be flush or surface-mounted as indicated.
- .3 Provide other systems' cabinets as specified in Divisions 26, 27 and 28 and located on the electrical drawings.

## **3 EXECUTION**

### **3.1 SPLITTER INSTALLATION**

- .1 Install splitters as indicated and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.
- .3 Use splitters only where indicated on the drawings.

### **3.2 JUNCTION PULLBOXES AND CABINETS**

- .1 Install pullboxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 74" (1.9 m) above finish floor.
- .3 Install terminal blocks, as indicated.
- .4 Provide pullboxes in conduit runs as described in Section 26 05 34.
- .5 Boxes and cabinets to be installed plumb and square with building lines.
- .6 Install junction and pullboxes clear of all mechanical ductwork and piping.

### **3.3 IDENTIFICATION**

- .1 Identify splitters with Size 5 nameplates.
- .2 Identify junction and pullboxes with Size 1 nameplates.
- .3 Identify cabinet with Size 5 nameplates.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Wiring Devices Section 26 27 26

### **1.2 REFERENCE STANDARDS**

- .1 CSA C22.1-Current version Canadian Electrical Code, Part 1.

## **2 PRODUCTS**

### **2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.

### **2.2 CONDUIT BOXES**

- .1 PVC FS or FD as manufactured by Ipex c/w ground stud.
- .2 Surface mounted outlet boxes shall be NEMA 4X (non-hazardous locations), NEMA 7 (hazardous locations) unless otherwise indicated.

### **2.3 FITTINGS GENERAL**

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

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.

- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 Provide correct size of openings in boxes for conduit and aluminum sheathed cable connections. Reducing washers are not allowed.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Fastenings and Supports Section 26 05 29

### **1.2 LOCATION OF CONDUIT**

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Electrical Subcontractor to produce layout sketches of conduit runs through mechanical and electrical service areas in order to pre-avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

## **2 PRODUCTS**

### **2.1 CONDUITS**

- .1 Electrical metallic tubing (EMT), with couplings: size as indicated. Minimum size 3/4" (19mm).
- .2 Rigid PVC conduit, minimum FT4 rating, minimum size 3/ 4" (19mmm). Installation shall be in compliance with CEC rules 12-1100 to 12-11222.
- .3 Conduit in hazardous areas shall be threaded rigid steel or aluminum epoxy coated conduit with zinc coating and corrosion resistant epoxy finish inside and outside. Minimum size 3/4" (19mm).
- .4 Liquid-tight flexible metal conduit: size as indicated, for equipment with vibrational aspects only.

### **2.2 CONDUIT FASTENINGS**

- .1 One hole straps to secure surface conduits 1 1/4" (32 mm) and smaller. Two hole straps for conduits larger than 1 1/4" (32 mm).
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 U-channel type supports for two or more conduits at 60" (1.52 m) intervals (surface-mounted or suspended). 4 1/4" (6 mm) diameter threaded rods to support suspended channels. One rod shall be non-ferrous.

### **2.3 CONDUIT FITTINGS**

- .1 Fittings manufactured for use with conduit specified. Coating shall be same as

conduit.

- .2 Manufacturer elbows where 90° bends are required for 2 2" (64 mm) and larger conduits.
- .3 Die cast set screw connectors and couplings. Insulated throat liners on connectors.
- .4 Raintight connector fittings, complete with O-rings, for use on weatherproof or sprinklerproof enclosures. Raintight couplings to be used for surface conduit installations exposed to moisture or sprinkler heads. Raintight connectors shall be used for all top entries to panels, contactors and motor control centres.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical, electrical and process rooms.
- .3 Use Rigid steel or aluminum conduits in hazardous areas, PVC conduits in wet locations and electrical metallic tubing (EMT) conduits in all other areas except where noted otherwise.
- .4 Wiring home runs to panels and main branch wiring runs in ceiling spaces to be run in conduit. Wiring drops from conduit systems into boxes for wiring devices in steel stud partitions may be wired with AC-90. AC-90 drops to light fixtures shall not run horizontally more than 5' (1.5 m) from conduit system junction boxes in ceiling space. AC-90 drops from conduit system in the ceiling space to feed outlets in steel stud partitions shall not run more than 5' (1.5 m) horizontally from the ceiling outlet box to the point where the AC-90 drops vertically into the partition. Where the total length of AC-90 is greater than 3m in the ceiling, provide conduit to a junction box closer to drop location.
- .5 Use liquid-tight flexible metal conduit for connection to motors, transformers and equipment subject to movement or vibration. Provide a separate insulated grounding conductor within flexible conduit.
- .6 Provide a separate insulated grounding conductor within PVC conduit.
- .7 All wiring under computer floors shall be in liquid-tight flexible metal conduit, or teck cable, where indicated.
- .8 Motor connections (use liquid-tight flexible metal conduit only) shall not exceed 6' (1.83m) except where expressly allowed by the Contract Administrator.

- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Install polypropylene fish cord in empty conduits.
- .11 Where conduits become blocked, remove and replace blocked section.
- .12 The length of any conduit run shall not exceed 150' (45 m) and no conduit run shall have more than four 90° bends (or equivalent in accordance with B.7) before a pullbox is installed. Pullboxes shall be installed in accessible ceiling spaces. Conduits shall be supported within 12" (300 mm) of entering any junction box, pullbox, cabinet, or panelboard.
- .13 Conduit to be sized as per Canadian Electrical Code or as shown on drawings. 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.
- .14 Provide separate bonding conductor for EMTs if installed/located in concrete or masonry slabs in contact with the earth or in any location where material having a deteriorating effect may come in contact with the EMT.
- .15 All conduits originating in an area containing corrosive or explosive gases and entering panels, junction boxes, MCC's or any other equipment shall be suitably sealed at point of entry to prevent any ingress of corrosive or explosive gases.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not locate conduits within 78" (2 m) of infrared or gas-fired heaters.
- .3 Group conduits wherever possible on suspended or surface channels.
- .4 Do not pass conduits through structural members, except as indicated.
- .5 Do not locate conduits less than 6" (150 mm) to steam or hot water lines.

### **3.3 CONCEALED CONDUITS**

- .1 Do not install conduit home runs horizontally in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings, unless otherwise indicated.

### **3.4 CONDUIT IDENTIFICATION**

- .1 Color code coverplates of junction boxes in conduit systems shall match City/facility standard or if none exists as per the color code list below.
- .2 Color code by spray painting the coverplate on each junction box in the conduit run.
- .3 In addition to color coding coverplates on junction boxes with power wiring, the circuits being run in the box shall be identified on the inside coverplate with permanent felt marker.
- .4 

120/250V Normal Power	yellow
120/250V Emergency/Standby Power	fluorescent red
347/600V Normal Power	orange
347/600V Emergency/Standby Power	fluorescent orange
Fire Alarm	red
Data/Voice	blue
Security	white
Controls	brown

Provide 50mm wide colour coded tape on all conduits at 3.5m centres.

**END OF SECTION**



## **1 GENERAL**

### **1.1 RELATED WORK**

- |    |  |                  |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Wire and Cable                         | Section 26 05 21 |
| .3 | Conduits                               | Section 26 05 36 |

### **1.2 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 26 05 01.

## **2 PRODUCTS**

### **2.1 CONDUIT**

- .1 Heavy wall rigid PVC conduits, size as indicated.
- .2 FRE duct, size, as indicated.
- .3 Provide pull boxes as required. Install underground pull box minimum every 200 feet unless otherwise approved. Coordinate location of pull boxes before rough-in.

### **2.2 FITTINGS**

- .1 Rigid PVC opaque solvent welded type watertight couplings, bell end fittings, plugs, caps adaptors, as required to make complete installation.
- .2 Expansion joints as required.
- .3 FRE duct couplings, bends, adapters, caps, etc., as required.

### **2.3 GROUNDING**

- .1 Provide a separate insulated ground wire in each PVC or FRE conduit run.

### **2.4 DIRECT BURIED SINGLE AND MULTI-CONDUCTOR CABLES**

- .1 Single conductor and multi-conductor direct buried cables to Section 26 05 21.

### **2.5 WIRE**

- .1 Wire in conduit to Section 26 05 21.

### **3 EXECUTION**

#### **3.1 INSTALLATION OF DIRECT BURIED CABLES AND CONDUITS**

- .1 Conduits and multi-conductor cables to be laid out and spaced appropriately.
- .2 Single conductor cables to be spaced 6" (150 mm) apart.
- .3 Install sand 6" (150 mm) below and 6" (150 mm) above cables and conduits.
- .4 Install conduit with watertight couplings. Make transitions, offsets and changes in direction using 5° bend sections. Do not exceed a total of 20° with conduit offset. Clean conduits before laying. Cap ends of conduits during construction and after installation to prevent entrance of foreign materials. Install pull cords in empty conduits.
- .5 Install continuous overlapping cuprinol-treated planking 6" (150 mm) above cables and conduits before backfilling. Install continuous yellow marker tapes 6" (150 mm) above treated planking.

#### **3.2 INSPECTIONS**

- .1 Advise Contract Administrator that he may inspect cable and conduit installation prior to backfilling.

#### **3.3 AS-CONSTRUCTED DRAWINGS**

- .1 Include on As-constructed Drawings, exact dimensioned position and routing of all underground cable feeders, pullboxes, etc.

#### **3.4 COORDINATION**

- .1 Coordinate underground installations with Utilities (including underground work of other trades) before commencing any work.
- .2 Coordinate underground installations with other trades before commencing any work.

**END OF SECTION**

## **PART 1      GENERAL**

### **1.1          SCOPE**

- .1 Collect and record all field information for the new distribution within the facility to facilitate a short-circuit and protective device coordination study.

### **1.2          RELATED SECTIONS**

- .1 Panelboards.
- .2 Main Distribution Switchboard.
- .3 Starters / VFD's.

### **1.3          REFERENCES**

- .1 Institute of Electrical and Electronics Contract Administrators, Inc. (IEEE):
  - .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
  - .2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
  - .3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
  - .4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
  - .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
  - .6 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.
- .2 American National Standards Institute (ANSI):
  - .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
  - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
  - .3 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
  - .4 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
  - .5 ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents.
- .3 The National Fire Protection Association (NFPA):
  - .1 NFPA 70 - National Electrical Code, latest edition.

- .2 NFPA 70E – Standard for Electrical Safety in the Workplace.
- .4 The Canadian Standards Association (CSA):
- .5 Z462-12 – Workplace Electrical Safety.

#### **1.4 SUBMITTALS FOR CONSTRUCTION**

- .1 The collected information shall include the following:
  - .1 One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations.
  - .2 Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.
  - .3 Executive Summary including source of information and assumptions made.

### **PART 2 PRODUCTS**

#### **2.1 STUDIES**

- .1 The future study will allow coordination of breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 600 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives and distribution switchgear.

#### **2.2 DATA COLLECTION**

- .1 Contractor shall furnish all field data as required to complete a power system studies in the renovated facility. The Contractor shall expedite collection of the data to eliminate unnecessary delays. Refer to attached data collection/check list forms for details.
- .2 Source combination may include present and future utility supplies, motors, and generators.
- .3 Load data utilized may include existing and proposed loads obtained from Contract Documents provided by City or Contractor.

#### **2.3 REPORT SECTIONS**

- .1 The collected information shall include the following input data for all new equipment:
  - .1 Utility three-phase and line-to-ground available contribution with associated X/R ratios.
  - .2 Short-circuit reactance of rotating machines with associated X/R ratios.
  - .3 Cable type, construction, size, # per phase, length, impedance and conduit type.

- .4 Bus duct type, size, length, and impedance.
- .5 Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
- .6 Reactor inductance and continuous ampere rating.
- .7 Aerial line type, construction, conductor spacing, size, # per phase, and length.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Mechanical Drawings and Specifications
- .2 Basic Electrical Materials and Methods Section 26 05 01
- .3 Wire and Cable Section 26 05 21
- .4 Outlet Boxes and Fittings Section 26 05 32
- .5 Conduits Section 26 05 34

### **1.2 SYSTEM DESCRIPTION**

- .1 Provide complete electrical power and control connections for mechanical equipment, and process equipment and controls as noted herein, or as noted on the drawings. Coordinate all requirements with mechanical and process shop drawings.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical and process equipment, unless otherwise indicated.
- .2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical and process equipment, except for temperature/humidity control systems.
- .3 Unless otherwise noted, motors and control devices shall be supplied by Mechanical Division/Contractor. Motor horsepower ratings shall be as shown in the Mechanical Division specifications. Motor voltage and phase ratings shall be as shown on the Electrical Division drawings.
- .4 Provide the Mechanical Contractor with a copy of the Motor Schedule and ensure conformance with voltage shown. Additional prints of Motor Schedule will be made available by the General Contractor.

## **3 EXECUTION**

### **3.1 POWER WIRING**

- .1 Install branch circuit wiring for mechanical and process equipment system control panels, time clocks, and control transformers.
- .2 Install main power feeders to starter/control panels furnished by mechanical Divisions. Install branch wiring from starter/control panels to controlled equipment such as motors, electric coils, etc.
- .3 Flexible connections to motors shall not exceed 6 feet (1.83 m), unless approved by Contract Administrator.

### **3.2 CONTROLS**

- .1 Install all electrical controls in accordance with Motor Schedule Equipment list.
- .2 Wire and connect flow switches, float switches, pressure switches, alternators, alarms, etc. for sump pumps, sewage pumps, domestic hot water, sludge pumps, air blowers, circulation pumps and mixers.
- .3 Wire and connect line voltage remote thermostats and P/E switches for furnaces, condensing units, force flows, electric heaters and rooftop units.
- .4 In general conduit, wire, devices and fittings required to wire and connect low voltage controls which are an integral part of the trade supplying the packaged unit, unless otherwise indicated. Control wiring shall be installed in conduit.
- .5 In general: conduit, wire, devices and fittings required to wire and connect low voltage temperature control systems, shall be supplied and installed by the trade supplying the temperature control system. Control wiring shall be installed in conduit.

### **3.3 COORDINATION**

- .1 Refer to Mechanical Drawings for the exact location of motor control devices, and mechanical equipment requiring an electrical connection.
- .2 Obtain full information from Mechanical Divisions, regarding wiring controls, overload heaters, equipment ratings and over-current protection. Notify the Mechanical Subcontractor, at once, if any information provided is incorrect or unsatisfactory.
- .3 Coordinate control wiring requirements with Mechanical Divisions and provide all control wiring and connections as required to make the control systems operate as specified.
- .4 Refer to Mechanical Division specifications for any further electrical requirements.
- .5 Review both electrical and mechanical drawings and specifications and coordinate all controls with Mechanical Subtrades through General Contractor.

Report all discrepancies to Contract Administrator before close of tender. No additional money will be justified for assumptions made on any duplication of information.

- .6 Submit to General Contractor, as part of the tender submission, a list of controls and wiring to be provided in the Contract.

**END OF SECTION**



## **1 GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements for commissioning of electrical equipment systems.
- .2 Related Sections:
  - .1 Section 019113 General Commissioning
  - .2 Section 220800 Commissioning of Plumbing
  - .3 Section 238000 Commissioning of HVAC

### **1.2 INTENT**

- .1 Provide commissioning of electrical equipment and systems in accordance with this, Section 019113 and related sections.

### **1.3 MANUFACTURER'S SERVICE ON SITE**

- .1 Arrange and pay for qualified Manufacturer's representatives to supervise starting and testing of following electrical equipment and systems:
  - .1 Communications System
  - .2 Control Equipment
- .2 Use manufacturers factory trained personnel where required to maintain manufacturer's warranty.
- .3 Maintain documentation of all equipment start-up and commissioning and provide to Commissioning Agent.

### **1.4 REFERENCE DOCUMENTS**

- .1 Perform tests in accordance with:
  - .1 These Contract Documents.
  - .2 Requirements of authorities having jurisdiction.
  - .3 Manufacturer's published instructions.
  - .4 Applicable CSA, IEEE, IPCEA, EEMAC, NEMA and ASTM standards.

### **1.5 CONTRACTOR AND MANUFACTURER REPORTS**

- .1 Arrange for Manufacturer to submit copies of all production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment to the Contract Administrator prior to shipping.

### **1.6 TESTING QUALIFICATIONS**

- .1 Arrange and pay for services of testing agent(s) to perform tests and verifications specified in this Section that are not within the capabilities of the Contractor.
- .2 Required Testing Qualifications:

- .1 Minimum of five years experience in the maintenance and testing of electrical equipment and systems at all voltage levels up to and including 1000V class.
- .2 Personnel involved in power system testing shall have proven experience in the use of the following test equipment:
  - .1 Insulation Resistance Testers (Meggers) at 250 V, 1000 V and 2500 V.
  - .2 Capacitance bridges.
  - .3 Transformer ratio test equipment.
  - .4 Contact resistance testers (ductor). Protective relay test equipment of current injection type for testing and calibration of induction disc and solid state protective devices.

## **2 PRODUCTS**

- .1 None

## **3 EXECUTION**

### **3.1 GENERAL**

- .1 Commission all equipment and systems installed as part of this contract. Typical required information or actions are listed below for each equipment or system.
- .2 Provide check sheets for equipment not listed in this section.
- .3 Document the commissioning process by completing the Component Verification Forms, System Tests and Integrated System Tests.

### **3.2 MAIN DISTRIBUTION SWITCHGEAR**

- .1 Enclosure:
  - .1 Visually inspect.
  - .2 Torque all bus connections to Manufacturers requirements and seal with red lacquer.
  - .3 Megger test main bus at 1000 V.
  - .4 Check phasing and continuity of horizontal and vertical bus. This includes phasing and phase rotation of two incoming services or supplies.
- .2 Wiring Checks:
  - .1 Check all control, relaying and instrumentation wiring against vendor wiring schematics, three line diagrams, and project specifications.
  - .2 Test each circuit for continuity using a buzzer or similar device.
  - .3 All current circuits shall be injected, all voltage circuits shall be powered at 120 Volts, all devices functioned and checked against control schematic diagram.
  - .4 Check polarity and verify phase relationships on all three phase metering circuits.

- .5 Where errors are discovered and changes are required, mark up and note required corrective action on vendor prints.
- .3 Instrumentation:
  - .1 Test and calibrate all meters in accordance with Manufacturers bulletins.
  - .2 Check calibration on all ammeters using 5 Amp secondary injection test.
  - .3 Perform wiring checks as listed above.
- .4 Breakers - Industrial Air Circuit Breakers (where applicable):
  - .1 Visually inspect.
  - .2 Clean and lubricate.
  - .3 Contact resistance (ductor) test and adjust contacts.
  - .4 Insulation resistance (Megger) test.
  - .5 Mechanical function test.
  - .6 Electrical function test.
  - .7 Test and calibrate, to settings provided, all elements of solid state trip unit as follows:
    - .1 Inspect and test in accordance with Manufacturer's most recent installation and maintenance brochure.
    - .2 Perform tests using Manufacturer's relay test unit as applicable, with corresponding test instruction.
    - .3 If the Manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.
    - .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.
    - .5 Check C/T and P/T ratios.
- .5 Fused Disconnect Switches:
  - .1 Visually inspect and clean.
  - .2 Ductor test across switch blade contact surfaces.
  - .3 Megger test.
  - .4 Mechanical function test.

### **3.3 DISTRIBUTION PANELS**

- .1 Enclosure:
  - .1 Visually inspect.
  - .2 Torque all bus connections.
- .2 Breakers:
  - .1 Visually inspect.
  - .2 Ductor test.
  - .3 Megger test.
  - .4 Mechanical function test.
  - .5 Set all units with adjustable magnetic trip units.

- .6 Where solid state protection is provided with large breakers, test units as follows:
  - .1 Inspect and test in accordance with Manufacturer's most recent installation and maintenance brochure.
  - .2 Perform tests using Manufacturer's relay test unit as applicable, with corresponding test instruction.
  - .3 If Manufacturer's tester is not available, use an approved relay tester unit with the proper test data and test accessories.
  - .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.
  - .5 Check C/T and P/T ratios.

### **3.4 ELECTRICAL START-UP AND TESTING**

- .1 Energizing Main Electrical System:
  - .1 Prior to energizing main electrical system:
    - .1 Verify supply authority voltage and phase rotation.
    - .2 Ensure all testing has been completed and deficiencies have been corrected.
    - .3 Megger test all feeders and record results on approved test report forms.
- .2 Testing of Wiring and Wiring Devices:
  - .1 Test conductors at distribution centres and panelboards for insulation resistance to ground (megger test).
  - .2 Test service grounding conductors for ground resistance.
  - .3 Test all wiring devices for correct operation and circuitry.
- .3 Ground Resistance Testing:
  - .1 Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4- and Canadian Electrical Code.
- .4 Load Balance Testing:
  - .1 Perform load tests with as many building loads on as possible prior to Interim Acceptance.
  - .2 Test load balance on all feeders at distribution centres, motor control centres and lighting panelboards.
  - .3 If load unbalance exceeds 15%, reconnect circuits to balance loads. Revise panelboard directories and wiring identification accordingly.
- .5 Power Factor Testing:
  - .1 Record power factor readings at 15 minute intervals for full 72 hour period during a normal work week, once during summer and once during winter.
  - .2 Take readings at the following locations on power distribution system:
    - .1 Main Breaker.
    - .2 All motor control centres.
    - .3 Feeder breakers which control large motor loads (e.g. air blowers).

- .6 Voltage Testing and Adjusting:
  - .1 Test voltage at service entry point, motor control centres and secondary of transformers above 45 kVA. Record voltages at Interim Acceptance for a period of ten hours (07:00 to 17:00) during a normal work day.
  - .2 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by the City.
- .7 Starting Motors:
  - .1 Prior to starting motors:
    - .1 Confirm motor nameplate data with motor starter heater overloads, setting of MCPs and sizing of fuses.
    - .2 Verify rotation.
    - .3 Ensure disconnects if required are installed.
    - .4 Confirm labelling of motors, disconnects and starters.
  - .2 Measure and record operating load amp readings for all three phase motors.

### **3.5 HARMONIC DISTORTION TESTING (Where required)**

- .1 Perform harmonic distortion testing at following locations:
  - .1 Main incoming service.
  - .2 All 600 volt distribution centres.
  - .3 All 208 volt distribution centres
- .2 Harmonic tests to include phase and neutral currents and voltages for each order of harmonic up to 50th order.
  - Allow for four hours of sampling at each location.
- .3 Ensure all sources of harmonic distortion such as adjustable speed drives, uninterruptible power supplies, computer and microelectronics equipment are energized before performing tests.
- .4 Perform tests prior to interim acceptance.
- .5 Certified test results sealed by professional Contract Administrator are to include harmonic distortion of each harmonic from 1 to 50 in graphic or tabular form. Results for main incoming service shall include harmonics coming in from utility and outgoing harmonics generated on facility power system.
- .6 Recommended limits of distortion are to be based on ANSI/IEEE 519-1981 IEEE Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

### **3.6 LIGHTING**

- .1 Function test all light switches, luminaries, dimmers and lighting control equipment.
- .2 Record all photocell and time-clock settings.

- .3 Prior to energizing dimming system, ensure Manufacturer has checked all equipment and wiring for proper installation and termination. Manufacturer to check that all pre-set levels are set and operate as specified.
- .4 Check operation of all emergency lighting units, exit lights and connection of exit lights to emergency power as specified.
- .5 Verify that correct luminaires/drivers have been used.
- .6 Record lighting levels for typical rooms and specialized areas.
- .7 Confirm operation of battery operated emergency lighting units including battery size and operating time.
- .8 Confirm operation of exit lights and connections of exit lights to emergency lighting panels.
- .9 Check all terminations and label all lighting circuits.

### **3.7 WIRING AND WIRING DEVICES**

- .1 Test all receptacles for proper polarity.
- .2 Verify panelboard directories and branch circuit designations as indicated on record drawings, directories and lamacoid labelling.

### **3.8 SURGE SUPPRESSION**

- .1 Test and verify operation in accordance with Manufacturers recommendations.
  - .1 Terminated prior to testing.

### **3.9 VOICE AND DATA CABLE TESTING**

- .1 Test all runs upon completion of permanent terminations, using instrumentation acceptable to the City. Before commencing testing, submit sample test data sheet(s) and information with respect to test instrumentation to be used.
- .2 Copper Media:
  - .1 Test for the following:
    - .1 Continuity.
    - .2 Pair placement and polarity.
    - .3 DC resistance.
    - .4 Characteristics at highest contemplated frequency Hz:
      - .1 Attenuation - data cable.
      - .2 Mutual Capacitance - data cable.
      - .3 Near-end crosstalk (NEXT) - data cable.
      - .4 Run length.
  - .2 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of the predicted value. Retest runs with:

- .1 Resistance and capacitance readings more than 10% above or below predicted values.
- .2 NEXT values 5 dB higher than predicted values.
- .3 Attenuation values 2 dB higher than predicted values.
- .3 Reconnect or re-install and retest as necessary to correct excessive variations.
- .4 Check installation of all equipment.
- .5 Ensure all cables are properly identified at each end and correctly terminated prior to testing.

**3.10 ELECTRICAL EQUIPMENT AND SYSTEMS DEMONSTRATION AND INSTRUCTION**

- .1 Provide operation and maintenance instruction and demonstrations in accordance with Section 019113.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01

### **1.2 SUBMITTALS**

- .1 Submit product data in accordance with Section 26 05 01.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Dry-type transformers: to CSA C9-02 and CAN/CSA-C802.2.
- .2 Use distribution transformers of one manufacturer throughout project.

### **2.2 TRANSFORMERS - VENTILATED**

- .1 Type: ANN.
- .2 3-phase, 600V Delta, primary 120/208V "Y", secondary 60 Hz.
- .3 kVA capacities as indicated.
- .4 150°C (302°F) temperature rise insulation system.
- .5 Basic Impulse Level (BIL): standard.
- .6 Minimum K4 rating.
- .7 Hi-pot: standard.
- .8 Average sound level: standard.
- .9 Impedance at 170°C (338°F): standard.
- .10 Enclosure: air ventilated sprinklerproof, removable metal front panel. Rear panel to be unremovable.
- .11 Mounting: floor or ceiling suspended as indicated.
- .12 Finish: in accordance with Section 26 05 01.
- .13 Primary taps: two 2 1/2% FCAN and two 2 1/2% FCBN.

### **2.3 TRANSFORMERS NON-VENTILATED**



- .1 Epoxy potted.
- .2 3-phase, 600V Delta, primary 120/208V "Y", secondary 60 Hz.
- .3 115° temperature rise insulation system.
- .4 Basic Impulse Level (BIL): standard.
- .5 Minimum K4 rating.
- .6 Hi-pot: standard.
- .7 Average sound level: 45 dB.
- .8 Impedance at 170°C([338°F): standard.
- .9 Enclosure: sealed.
- .10 Mounting: floor or wall as indicated.
- .11 Finish: in accordance with Section 26 05 01.

## **2.4 MANUFACTURERS**

- .1 Acceptable manufacturers: Cutler Hammer, Schneider Canada, Hammond, BeMag. Delta.

## **3 EXECUTION**

### **3.1 MOUNTING**

- .1 Mount dry-type transformers on floor with a 4" (100 mm) high concrete housekeeping pad, unless otherwise indicated.
- .2 Suspend dry-type transformers from structure on a U-channel and threaded rod support system, as indicated.
- .3 Allow 6" (150 mm) of clearance from walls and 4" (100 mm) from adjacent equipment for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Mount transformers with vibration isolators.
- .8 Install epoxy potted transformers on wall, unless otherwise indicated.

- .9 Use liquid tight flexible conduit for termination.

### **3.2 CONNECTIONS**

- .1 Make connections shown on wiring diagram.
- .2 Energize transformers immediately after installation is completed, where practicable.

### **3.3 EQUIPMENT IDENTIFICATION**

- .1 Size 7 label in accordance with Section 26 05 01.

**END OF SECTION**





## **1 GENERAL**

### **1.1 RELATED WORK**

- |    |  |                  |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Wire and Cable                         | Section 26 05 21 |
| .3 | Grounding                              | Section 26 05 28 |
| .4 | Conduit                                | Section 26 05 34 |
| .5 | Circuit Breakers                       | Section 26 28 21 |

### **1.2 DESCRIPTION OF EQUIPMENT**

- .1 Main distribution board incorporates service entrance cable connection section, main breaker complete with MCC sub-feeder distribution sections and customer metering section, factory assembled in one enclosure.

### **1.3 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Indicate:
- .1 Floor anchoring method and foundation template.
  - .2 Dimensioned cable entry and exit locations.
  - .3 Dimensioned position and size of bus.
  - .4 Overall length, height and depth.
  - .5 Dimensioned layout of internal and front panel mounted components.
  - .6 Shipping sections and weights.

### **1.3 MAINTENANCE DATA**

- .1 Provide data for incorporation into Maintenance Manual specified in Section 26 05 01.

### **1.5 MAINTENANCE MATERIALS**

- .1 One set spare parts as recommended by manufacturer.
- .2 Fuses:
- .1 3 fuses for each type above 600A.

- .2 6 fuses for each type up to and including 600A.

## **1.6 SOURCE QUALITY CONTROL**

- .1 Refer to Section 26 05 01.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Service entrance board: to CSA C22.2 No.31.
- .2 Molded case circuit breakers: to CSA C22.2 No.5.
- .3 Fuse holder assemblies: to CSA C22.2 No.39.
- .4 HRC Fuses: to CSA C22.2 No.106.
- .5 Meters: to CSA C17.
- .6 Meter mounting devices: to CSA C22.2 No.115.
- .7 Analogue instruments: to ANSI C39.1.
- .8 Instrument transformers: to CSA C13.

### **2.2 POWER SUPPLY**

- .1 Power supply: 3 phase, 4 wire, grounded neutral, 60 Hz. Amperage, voltage and short circuit current withstand rating as indicated on the drawings.

### **2.3 SERVICE ENTRANCE SWITCHBOARD**

- .1 Ampere rating: as indicated on the drawings.
- .2 Enclosure:
  - .1 Free-standing, totally enclosed sheet steel, 'sprinklerproof' enclosure with steel frame.
  - .2 Sheet steel barriers to separate adjoining sections.
  - .3 Provision for installation of supply authority metering transformers.
  - .4 Customer metering instruments, transformers and selector switches.
  - .5 Distribution section or sections - see single line include spaces and spares as indicated.
  - .6 Hinged access panels with captive knurled thumb screws. Utility metering section to have provision for utility seals.

- .7 High conductivity copper bus.
- .8 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .9 Identify phases with color coding.

## **2.4 MAIN BREAKER SECTION**

- .1 The main circuit breaker shall be a manually operable, fixed mounted molded case circuit breaker. Breaker shall be equipped with solid state o/c relay to provide the following time/current curve shaping adjustments: (1) long time pick-up setting; (2) long time delay; (3) short time pick-up; (4) short time delay. Frame size ampere rating to be as indicated on the drawings. All LSI(G) functions shall be fully adjustable. Frame size ampere rating to be as indicated on the drawings.
- .2 The relay shall be provided with three light emitting diodes (L.E.D.'s) to indicate tripping occurred from long time overload, instantaneous or ground fault current. The relay shall be provided with contacts for remote indication. The breaker shall be equipped with in-built current sensors on each phase and neutral. Current sensors ampere tap setting shall be rated to match the frame size of the main breaker. Shunt trip shall be direct acting solenoid-type powered by the sensor/relay energy.

## **2.5 GROUNDING**

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end sized for grounding cable.
- .3 Bond non-current carrying metal parts to ground bus.
- .4 Connect to station ground and building ground bus.

## **2.6 CUSTOMER METERING SECTION**

- .1 Digital metering
  - .1 Standards: ANSI-C6241, IEEE-587.
  - .2 Phase selectable current and voltage (L-L and L-N).
  - .3 Capable of displaying kW, kVA, MWHR, kilowatt demand, current demand, kVA demand, frequency, power factor.
  - .4 LCD or LED display.
  - .5 Resettable minimum and maximum for current, voltage and p.f.

- .2 Potential transformers: if required.
- .3 Potential transformers fused with separate fuse block, equipped with fuse holder and fuses. Fuses to Section 26 28 14.
- .4 Current transformers: as indicated dry type for indoor use with the following characteristics:
  - .1 nominal voltage class as indicated
  - .2 rated frequency: 60 Hz
  - .3 primary circuit rated to match ampere rating of main breaker trip. Secondary current rated at 5 amp.

## **2.7 SECONDARY DISTRIBUTION**

- .1 Refer to section 26 24 14.
- .2 Each breaker shall be manually operated, field adjustable trip and fully adjustable LSI type for breakers 150A and larger. Fixed trip to 125A ratings as shown on the drawings.
- .3 Protective breaker for transformers shall be fully adjustable LSI type with instantaneous setting greater than transformer inrush current (12 x primary current at 0.10 second)
- .4 Breakers shall have a minimum interrupting capacity as indicated.
- .5 The distribution section to be provided with sufficient spaces for breakers and spare spaces as indicated on drawings.

## **2.8 FINISHES**

- .1 Apply finishes in accordance with Section 26 05 01:
  - .1 service entrance switchboard finish to be exterior gray
  - .2 supply 2 spray cans of touch-up enamel
  - .3 treated to inhibit rusting.

## **2.9 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01.
- .2 Nameplates:
  - .1 black plate, white letters, size 7, to indicate voltage, amp rating and designation



- .2 complete switchboard: labelled as above main disconnect: labelled "Main Breaker"
- .3 sub-breakers: labelled to indicate panel or equipment fed.

## **2.10 SHOP FABRICATION**

- .1 Assemble and wire complete service entrance board.
- .2 Energize switchboard.
- .3 Check meters and phase selector switches.
- .4 Prepare switchboard for shipment to site.

## **2.11 MANUFACTURERS**

- .1 Acceptable manufacturers: Cutler-Hammer, Square D, Siemens.

## **2.12 ENERGY MANAGEMENT**

- .1 Provide terminal board and wiring from separate customer CT's and PT's to facilitate the future installation of thermal demand, watt hour energy management equipment, recorders, etc, and connect to connect to the building management system.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate service entrance switchboard as indicated.
- .2 Connect main secondary service entrance cables to line terminals of switchboard.
- .3 Connect load terminals of distribution breakers to outgoing feeders, as indicated.
- .4 Check factory-made connections for mechanical security and electrical continuity.
- .5 Run one #3/0, bare copper, grounding conductor in 1" (25 mm) conduit from ground bus to the main building ground.
- .6 Adjust relay settings to those indicated in shop drawings to ensure proper working and protection of components.
- .7 Manufacturer to provide test equipment and field test overload, magnetic and ground fault tripping. Include test report in Maintenance Manuals.
- .8 Perform 3 phase load testing under normal building load after project is

deemed substantially complete. Measure voltage, current and power factor for 4 hours, sampling every 5 minutes and recording peak load. Customer metering device may be used for sampling. Recording instrument to be supplied by distribution manufacturer or third party - cost to be included.

- .9 Arrange for main distribution switchboard to be mounted on 4" (100 mm) housekeeping pad.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 Related Work**

- .1 Concrete Housekeeping Pads
- .2 Basic Electrical Materials and Methods Section 26 05 01
- .3 Mechanical Equipment Connections Section 26 05 80
- .4 Motor Starters Section 26 29 10

**1.2 Source Quality Control**

- .1 Conduct equipment inspection at manufacturer's plant.
- .2 Provide manufacturer's Test Certificates.

**1.3 Shop Drawings**

- .1 Submit shop drawings in accordance with Section 26 05 01.
- .2 Include:
  - .1 Outline dimensions.
  - .2 Configuration of identified compartments.
  - .3 Floor anchoring method and dimensioned foundation template.
  - .4 Cable entry and exit locations.
  - .5 Dimensioned position and size of bus bars and details of provision for future extension.
  - .6 Schematic and wiring diagrams.
  - .7 Complete nameplate schedule.

**1.4 Operation and Maintenance Data**

- .1 Provide data for incorporation into Maintenance Manuals specified in Section 26 05 01.
- .2 Include data for each type and style of starter.

**1.5 Maintenance Materials**

- .1 Provide maintenance materials in accordance with Section 26 05 01.

**1.6 Materials**

- .1 Control equipment and enclosures: to CSA C22.2 No. 14.
- .2 Industrial control resistors: to EEMAC 13E-1.
- .3 Auto transformers: to CSA C22.2 No. 47.
- .4 Circuit breakers: to CSA C22.2 No. 5.
- .5 Disconnect switches: to CSA C22.2 No. 4.

**1.7 Supply Characteristics**

- .1 600V, 60 Hz, 3Ø, 4W.

**1.8 Motor Control Centre**

- .1 Compartmentalized vertical sections with common power bus bars.
- .2 Floor mounting, free-standing, enclosed dead front.
- .3 Indoor "sprinkler proof" enclosure c/w gasketed doors. Minimum EEMAC 1A rated enclosure.
- .4 Accommodating combination magnetic starters, panels, transformers and disconnect switches. General arrangement of components as shown on the drawings.
- .5 Floor mounting, as indicated.
- .6 Class 2, Type C.
- .7 Each M.C.C. section to have its interior painted white.

**1.9 Vertical Section Construction**

- .1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.
- .2 Each vertical section divided into compartment units, minimum 305mm high or as indicated.
- .3 Each unit to have complete top and bottom steel plate for isolation between units.
- .4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control center, isolated from bus bars by steel barriers.
- .5 Vertical wireways for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

- .6 Openings, with removable coverplates, inside of vertical sections for horizontal wiring between sections.
- .7 Incoming cables to enter at top.
- .8 Provision for outgoing cables to exit via top or bottom.
- .9 Removable lifting means.
- .10 Provision for future extension of both ends of motor control center, including bus bars without need for further drilling, cutting or preparation in field.
- .11 Where applicable, divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

## **PART 2 PRODUCTS**

### **2.1 Sills**

- .1 Continuous 2" (50 mm) channel iron floor sills for mounting bases with 3/4" (19 mm) diameter holes for bolts.

### **2.2 Bus bars**

- .1 Main horizontal and branch vertical, three-phase high conductivity copper bus bars in separate compartment insulated, self-cooled, extending entire width and height of motor control center, supported on insulators and rated as indicated.
- .2 Branch vertical bus bars for distribution of power to units in vertical sections, rated at minimum 300A. Horizontal bus to be rated as indicated on the drawings (600A minimum).
- .3 No other cables, wires, equipment in main and branch bus bar compartments.
- .4 Brace bus work to withstand a short-circuit current of 42 kA RMS symmetrical.
- .5 Bus supports: high dielectric strength, low moisture absorption, high impact material, with long creepage surface designed to discourage collection of dust.

### **2.3 Ground Bus**

- .1 Copper ground bus size 2" x 1/2" (50 x 6 mm), extending entire width of motor control center, located at bottom.

### **2.4 Motor Starters and Devices**

- .1 Combination magnetic starters of size, type and rating as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.

- .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Power and control terminals.
  - .4 Wiring and schematic diagram inside starter enclosure in visible location.
  - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination-type starters to include magnetic-only circuit breaker rated at 42,000 A.I.C. (sym) with operating lever on outside of enclosure and provision for:
- .1 Locking in "OFF" position with padlock.
  - .2 Locking in "ON" position.
  - .3 Independent locking of enclosure door.
  - .4 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Solid-state reduced-voltage starter/soft starters, shall be provided where shown on the contract drawings. The solid-state reduced-voltage starter or soft starter shall be UL and CSA listed in the motor control center, and consist of an SCR-based power section, logic board and paralleling bypass contactor. The paralleling bypass contactor shall be energized when the motor reaches full speed. Each solid-state reduced voltage starter shall have an addressable communication card capable of transmitting control and diagnostic data over an open network to either a personal computer or Logic Controller via network translator to DeviceNet, MODBUS/TCP or ETHERNET/IP or approved by control contractor.
- .4 Accessories:
- .1 Pushbutton selector switches: as indicated.
  - .2 Indicating lights LED (green for "OFF", and red for "ON").
  - .3 2-N/O and 3-N/C spare auxiliary contacts, unless otherwise indicated.
  - .4 Control transformer with fuses.
  - .5 HOA selector switch.
- .5 Starter units for motors above 25 HP at 208V or 50 HP at 600V shall be reduced voltage, closed transition auto transformer-type unless otherwise indicated.

## **2.5 Starter Unit Compartments**

- .1 Units EEMAC Size 4 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while bus is energized.
- .2 Unit mounting:
  - .1 Engaged position - unit stabbed into vertical bus.
  - .2 Withdrawn position - unit isolated from vertical bus, but supported by structure. Terminal block accessible for electrical testing of starter.
  - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
  - .4 Stab-on connectors, free-floating, silver-plated clips, self-aligning, backed up with steel springs.
- .3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "ON" position. Provision for padlocks to lock operating handle in "OFF" position and lock door closed.
- .4 Hinge unit doors on same side.
- .5 Overload relays manually reset from front with door closed.
- .6 Pushbuttons and indicating lights mounted on door front.
- .7 Devices and components by one manufacturer to facilitate maintenance.

## **2.6 Space for Future Units**

- .1 Provide spaces for VFD's, starters, breakers, etc. in the MCC for equipment designated "Future". Fully equip these spaces with horizontal and vertical bus bars and all fittings necessary to accommodate the future equipment with a minimum of field alterations and additions. Provide bolted on blank covers.

## **2.7 Wiring Identification**

- .1 Provide wiring identification in accordance with Section 26 05 01.

## **2.8 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01.
  - .1 Motor control center main nameplate Size No. 7 engraved with name, number and system.
  - .2 Individual compartment nameplates Size No. 5 engraved with motor number, name and horsepower.

**2.9 Finishes**

- .1 Apply finishes in accordance with Section 26 05 01
- .2 Paint motor control center exterior light gray and interiors white.

**2.10 Manufacturers**

- .1 Acceptable manufacturers: Allen-Bradley; Cutler Hammer; Schneider;

**PART 3 EXECUTION**

**3.1 Installation**

- .1 Set and secure motor control center in place on channel bases, rigid, plumb and square to concrete housekeeping pad.
- .2 Interconnect MCC cubicles with bus bar and wiring connectors supplied by manufacturer.
- .3 Check factory made connections for mechanical security, electrical continuity and current phasing.
- .4 Make grounding connection between equipment ground busses and building grounding system.
- .5 Make all power and control field wiring connections.
- .6 Ensure correct overload heater elements are installed against motor nameplate data.
- .7 After finishing work, remove all foreign material including dust before energizing equipment.

**3.2 Tests**

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control center, motors, control devices, control sequences, etc.

**END OF SECTION**



## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Panelboards shall be provided as indicated and required for the systems served and supplied under electrical Divisions.
- .2 Circuit breakers, switches and accessories shall be provided as indicated and required for a complete installation.

### **1.2 SUBMITTALS**

- .1 Shop drawings shall be submitted for approval for all panelboards.
- .2 Voltage and amperage test results shall be submitted to the Contract Administrator, prior to the final site observation.
- .3 Short Circuits, Coordination study and Arc Flash Hazard Analysis shall be submitted prior or at the same time with shop drawing submission.

## **2 PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- .1 Panelboards shall be as manufactured by Schneider Canada, Cutler Hammer, Siemens.
- .2 Panelboards and all of the related components shall be supplied by only one of the indicated manufacturers. Partial or split packages of equipment are not acceptable.

### **2.2 GENERAL**

- .1 Panel ratings, sizes, mounting, and components shall be as indicated on the drawings.
- .2 Multiple circuit breakers shall be common trip type.
- .3 All bussing shall be full height at the panelboard rated capacity.
- .4 Provide lockable covers for all CDP's and panels.
- .5 Covers shall be hinged, locking type with concealed trim clamps. Covers will not be required for distribution type panelboards.
- .6 Main circuit breakers and disconnect switches shall not be branch-mounted unless explicitly indicated.
- .7 Branch circuit breakers shall have a minimum interrupting capacity of

10,000 amps at 120/208 volts and 18,000 amps at 347/600 volts or as shown on drawings. Refer to single line drawing.

- .8 Provide CDP type panels where indicated.
- .9 All CDP's shall be sprinkler proof and CSA enclosure type 12. Panels shall be CSA type 12 enclosure and sprinkler proof.
- .10 Provide 3 spare 15 amp 1 Pole breakers for each panelboard and 1 spare 15 amp 3 Pole for each CDP.
- .11 Provide GFCI breakers as indicated.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Wall mounted panels shall be mounted with tops at 6'-0" and mounted to 3/4" plywood equipment mounting panels which are painted with a gray fire-retardant.
- .2 Floor mounted panels shall be provided with a 4" concrete housekeeping pad.
- .3 Typed circuit directories shall be provided for all circuit breaker panelboards. Include supply disconnect location and size of feeder.
- .4 Laminated (black/white) plastic nameplates with 3/16" letters shall be provided for each panelboard and for each device in the distribution panelboard(s).
- .5 Loads shall be evenly balanced on all phases.

#### **3.2 TESTING**

- .1 Voltage and amperage readings shall be taken on the incoming line side of each panelboard with the maximum possible number of systems operating to simulate peak operating conditions.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Outlet Boxes and Fittings Section 26 05 32

### **1.2 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

## **2 PRODUCTS**

### **2.1 SWITCHES**

- .1 Toggle-operated AC switches 15A and 20A, 120V AC and 347V AC, single pole, double pole, three-way and four-way switches as indicated, with the following features:
  - .1 Heavy duty mounting strap.
  - .2 Spring loaded back wired.
  - .3 Green hex head grounding terminal.
  - .4 All screws socket/slotted head suited to accommodate #6 socket head screwdriver.
  - .5 Silver alloy contacts.
  - .6 Urea molding.
  - .7 Spring loaded back wired.
  - .8 One piece Lexan toggle, lever and cam.
  - .9 Fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .2 Switches of one manufacturer throughout project.
- .3 Switches to be premium specification grade.
- .4 Switches in ordinary and humid corrosive location shall be manufactured by Bryant, Arrow Hart, Leviton No. 1201. Number to suit application and amperage.

- .5 Switches in Zone 1 hazardous locations shall be manufactured by Crouse-Hinds No. EFS/EDS. Number to suit application and amperage.

## **2.2 RECEPTACLES**

- .1 Single and duplex receptacles, NEMA No. 5-15R, 125V AC, 15A, U-ground, heavy duty specification grade with the following features:
  - .1 Heavy duty nylon face with steel reinforcing plate in centre.
  - .2 Spring loaded suitable for No. 10 back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Raised ground for safety.
  - .5 Contacts shall have spring steel clips to reduce contact fatigue.
  - .6 All screws shall be combination slotted socket head design to accept #6 socket head screwdriver on all screws.
- .2 Receptacles to be of one manufacturer throughout project.
- .3 Receptacles in ordinary and humid corrosive locations shall be manufactured by Bryant, Arrow Hart, Leviton No. 5262 duplex receptacle.
- .4 Receptacles in Zone 1 hazardous locations shall be manufactured by Crouse-Hinds No, ENR.

## **2.3 SPECIAL WIRING DEVICES**

- .1 Special wiring devices: as indicated on drawings.
- .2 Pushbutton stations to be flush or surface-mounted as required. Units to be complete with up/down or start/stop buttons, as required, and green pilot light.
- .3 Floor mounted, pedestal-type receptacle to consist of a 5" (127 mm) square low profile, 2-piece fitting with steel frame with black plastic housing and 2 duplex receptacles. Bottom plate to be complete with knockout and AC-90 connector for centred installation.
- .4 Floor mounted, pedestal-type combination telephone/receptacle to consist of a 5" x 10" (127 mm x 250 mm), low profile, 2-piece fitting with steel barriered frame with black plastic housing with 2 duplex receptacles and space for two Amphenol jack connectors. Bottom plate to be complete with AC-90 connector in power section and slot for conduit entry in telephone section

- .5 Floor mounted, flush-type receptacle to consist of a Hubbell #B-2529 round formed steel shallow concrete pour box, #S-3925 round cover (brass) and duplex receptacle.

## **2.4 COVERPLATES**

- .1 Coverplates from one manufacturer throughout project to match switches and receptacles.
- .2 PVC coverplates for wiring devices surface mounted in surface mounted outlet boxes.
- .3 Stainless steel coverplates for wiring devices mounted in flush-mounted outlet boxes.
- .4 Sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.
- .5 Cast gasketed coverplates for wiring devices mounted in surface mounted FS or FD.
- .6 Weatherproof double lift spring-loaded cast aluminum coverplates, complete with gaskets for duplex receptacles as indicated.
- .7 Weatherproof coverplates, complete with gaskets for single receptacles or switches as indicated.

## **3 EXECUTION**

### **3.1 INSTALLATION - SWITCHES**

- .1 Install single throw switches with handle in "UP" position when switch closed.
- .2 Install switches in gang-type outlet box when more than one switch is required in one location.
- .3 Mount toggle switches at height specified in Section 26 05 01 or as indicated.

### **3.2 INSTALLATION - RECEPTACLES**

- .1 Install receptacles in gang-type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles horizontally at height specified in Section 26 05 01, or as indicated.
- .3 Install cord sets on ranges and dryers.

**3.3           INSTALLATION - COVERPLATES**

- .1     Install suitable common coverplates where wiring devices are ganged.
- .2     Do not use coverplates intended for flush outlet boxes on surface mounted boxes.
- .3     Provide a coverplate on each outlet. Stainless steel, unless otherwise directed.

**3.4           IDENTIFICATION**

- .1     Identify receptacles with size  $\emptyset$  nameplate indicating panel and circuit number. Nameplates to be pre-glued with peel-off paper backing.

**END OF SECTION**

**1 GENERAL**

**1.1 Related Work**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Disconnect Switches Section 26 28 23

**1.2 Submittals**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Submit fuse melting and clearing time-current characteristics for each fuse type and size above 400A.

**1.3 Maintenance Manuals**

- .1 Provide maintenance materials in accordance with Section 26 05 01.
- .2 Three spare fuses of each type and size.

**1.4 Delivery and Storage**

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboards or disconnects.
- .3 Store spare fuses in storage cabinet.

**2 PRODUCTS**

**2.1 Fuses - General**

- .1 Plug and cartridge fuses: to CSA C22.2 No.59.
- .2 HRC fuses: to CSA C22.2 No.106 (R1967) to have interrupting capability of 200,000 amps symmetrical.
- .3 Fuses: product of one manufacturer.

**2.2 Fuse Types**

- .1 Form I, HRC fuses, Class L:
  - .1 Type L1, time delay, capable of carrying 500% rated current for 4s minimum.
  - .2 Type L2, fast-acting.

- .2 Form I, HRC fuses, Class J:
  - .1 Type J1, time delay, capable of carrying 500% rated current for 10s minimum.
  - .2 Type J2, fast-acting.
- .3 Form I, HRC fuses, Class R:
  - .1 Type R1, time delay, capable of carrying 500% rated maximum let-through limits.
  - .2 Type R2, time delay, capable of carrying 500% rated current for 10s minimum, to meet UL Class K5 maximum let-through limits.
  - .3 Type R3, fast-acting Class R, to meet UL Class K1 maximum let-through limits.
- .4 Form II, HRC fuses, Class C:
  - .1 Type C, current limiting.

### **2.3 Manufacturers**

- .1 Acceptable manufacturer's products: FuseTek, Buss, English Electric, Gould.

## **3 EXECUTION**

### **3.1 Installation**

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.

**END OF SECTION**



## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Panelboards Section 26 24 17

### **1.2 SUBMITTALS**

- .1 Submit product data in accordance with Section 26 05 01.
- .2 Include with requests for equal (in accordance with B.7) time-current characteristic curves for breakers with ampacity of 800A and over, or with interrupting capacity of 25,000A symmetrical RMS and over at system voltage.

## **2 PRODUCTS**

### **2.1 BREAKERS - GENERAL**

- .1 Bolt-on molded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C (104°F) ambient.
- .2 Common-trip breakers with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.

### **2.2 STATIC TRIP (LSI) BREAKERS**

- .1 All upstream breakers to protect transformers shall be equipped with LSI fully adjustable type breaker. Instantaneous setting of the breakers shall be greater than transformer inrush current (12x primary rated current).
- .2 All breakers with 150A rating or greater shall be fully adjustable LSI type.
- .3 All LSI breakers as indicated in the drawings shall be fully adjustable. Fixed setting is not accepted.

### **2.3 THERMAL MAGNETIC BREAKERS**

- .1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

### **2.4 GROUND FAULT CIRCUIT INTERRUPTERS**

- .1 Molded case circuit breakers as above with integral Class A Group 1 ground fault interrupter.

## **2.5 ARC FAULT CIRCUIT INTERRUPTERS**

- .1 Molded case circuit breakers as above with integral Arc Fault Circuit Interrupter to CSA-C22.2 No. 5.1.
- .2 Series, parallel and ground protection.

## **2.5 MANUFACTURERS**

- .1 Acceptable manufacturers: Cutler Hammer, Schneider Canada, Siemens.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**END OF SECTION**

**1 GENERAL**

**1.1 Related Work**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Fastenings and Supports Section 26 05 29
- .3 Mechanical Equipment Connections Section 26 05 80

**1.2 Submittals**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

**2 PRODUCTS**

**2.1 Disconnect Switches**

- .1 Fusible and non-fusible disconnect switches in EEMAC 4X and 7, size as indicated.
- .2 Zone 1 Hazardous locations: Fusible and non-fusible disconnect switches shall be EEMAC Type 7, size as indicated.
- .3 Category 2 Wet locations, Ordinary locations: Fusible and non-fusible disconnect switches shall be EEMAC Type 4X, size as indicated.
- .4 Provision for padlocking in "ON-OFF" position with 3 padlocks. Mechanically interlocked door to prevent opening when handle in "ON" position.
- .5 Disconnect shall be front operational, heavy duty, industrial grade, quick make, quick-break type.
- .6 Fuse holders: suitable without adaptors, for type and size of fuse indicated.
- .7 "ON-OFF" switch position indication on switch enclosure cover.
- .8 Fuses as indicated in accordance with Section 26 28 14.
- .9 Single-phase motor disconnect switches shall be one or two-pole toggle-type, 20 amp, 120/227V AC, brown handle with side and back wiring complete with pilot light.
- .10 Three-phase motor disconnect switches shall be as manufactured by Cooper Crouse-Hinds GHG series, Arrow Hart AH series, Cutler-Hammer HD series, Schneider Canada Square D CHU series or approved equal in accordance with B.7.

**3 EXECUTION**

**3.1 Installation**

- .1 Install motor disconnect switches (complete with fuses) where indicated.
- .2 Install fused circuit disconnect switches where indicated or where required by the inspection authorities and/or for equipment supplied by other trades.

**3.2 Identification**

- .1 Indicate name of load controlled on Size 4 nameplate to Section 26 05 01.

**3.3 Manufacturers**

- .1 Acceptable manufacturers: Cutler Hammer, SquareD, Siemens or approved equal in accordance with B.7.

**END OF SECTION**

## **1 GENERAL**

### **1.1 SCOPE**

- .1 The Contractor shall furnish and install the low voltage motor starters as specified herein and as shown on the contract drawings.

### **1.2 RELATED SECTIONS**

- .1 Mechanical Equipment Connections Section 26 05 80
- .2 Circuit Breakers Section 26 28 21

### **1.3 REFERENCES**

- .1 The motor starters shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI, UL and CSA.

### **1.4 SUBMITTALS – FOR REVIEW/APPROVAL**

- .1 The following information shall be submitted to the Contract Administrator:
  1. Master drawing index
  2. Dimensioned outline drawings
  3. Conduit entry/exit locations
  4. Cable terminal sizes
  5. Wiring diagrams
  6. Nameplate schedule
  7. Ratings including:
    - a. Voltage
    - b. Horsepower and/or continuous current
  8. Product data sheets

### **1.5 SUBMITTALS – FOR CONSTRUCTION**

- .1 The following information shall be submitted for record purposes:
  1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process.
  2. Wiring diagrams
  3. Seismic certification as specified

### **1.6 QUALIFICATIONS**

- .1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- .2 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

- .3 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Contract Administrator, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

## **2 PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Eaton / Cutler-Hammer
- .2 Schneider
- .3 Allen-Bradley
- .4 Siemens

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Contract Administrator ten (10) days prior to bid date.

### **2.2 MANUAL MOTOR CONTROL**

- .1 Single-Phase Manual Starters
  1. Manual single-phase starters 1 hp or smaller shall be Cutler-Hammer type MS starters or approved equal in accordance with B.7. The starter shall have a quick-make/quick-break toggle mechanism. The overload shall have a field adjustment allowing up to +/- 10% variance in ratings of the nominal heater value
  2. Manual single-phase starters above 1 hp shall be Cutler-Hammer type B100 or approved equal in accordance with B.7. The starter shall have quick-make/quick-break mechanism. The closure of the contacts shall be blocked while the line terminals are exposed. The operating handle or button shall clearly indicate whether the unit is ON, OFF or TRIPPED
  3. The enclosure shall be NEMA 12 sprinkler proof or as indicated on the contract drawings.
- .2 Three-Phase Manual Starters
  1. The starter shall have quick-make/quick-break operating mechanism
  2. The operating handle or button shall clearly indicate whether the unit is ON, OFF or TRIPPED

3. The closure of the contacts shall be blocked while the line terminals are exposed
4. The enclosure shall be NEMA 12 sprinkler proof or as indicated on the contract drawings]
5. Manual three-phase motor starters shall be Cutler-Hammer type B100 or equal in accordance with B.7.

## **2.3 ELECTROMECHANICAL MOTOR CONTROL**

### **.1 Non-Reversing Starters**

1. Magnetic starters through NEMA Size 9 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter shall have one 2 NO and 2 NC auxiliary contacts
2. Coils shall be permanently marked with voltage, frequency and part number
3. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have (+/-) 24% adjustability, single-phase sensitivity, and isolated alarm contact, and manual or automatic reset
4. NEMA Size 1 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any arrangement normally open or normally closed. Size 3 through 8 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any arrangement normally open or normally closed
5. Motor starters shall be Cutler-Hammer Freedom Series or approved equal in accordance with B.7.

### **.2 Reversing Starters**

1. Reversing starters shall consist of two (2) contactors and a single overload relay assembled together. The contactors shall be mechanically and electrically interlocked to prevent line shorts and the energizing of both contactors simultaneously
2. Magnetic starters through NEMA Size 8 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring
3. Coils shall be permanently marked with voltage, frequency and part number
4. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have +/-

24% adjustability, single-phase sensitivity, and isolated alarm contact and manual or automatic reset

.3 Two-Speed Starters

1. Magnetic starters through NEMA Size 6 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring
2. Coils shall be permanently marked with voltage, frequency and part number
3. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have +/- 24% adjustability, single-phase sensitivity, and isolated alarm contact and manual or automatic reset
4. NEMA Size 1 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any combination of normally open or normally closed contacts. Sizes 3 through 6 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any combination of normally open or normally closed contacts
5. Two-speed magnetic starters for motors up to 400 hp, 600 volts shall be Cutler-Hammer Freedom Series type AN700 or approved equal in accordance with B.7.

**2.4 SOLID-STATE REDUCED-VOLTAGE MOTOR CONTROL**

.1 Reduced Voltage Motor Starter Type S801

1. Controller shall be Cutler-Hammer type S801
2. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing
3. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV
4. Units using triacs or SCR/diode combinations shall not be acceptable
5. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects
6. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits
7. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns



8. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current
9. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions
10. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIP switch setting on the device keypad
11. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter
12. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad
13. Starter shall be capable of either an electronic or mechanical reset after a fault
14. Units using bimetal overload relays are not acceptable
15. Over temperature protection (on heat sink) shall be standard
16. Starters shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via a DIP switch on the device keypad
17. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50% current differential between any two phases is encountered. This feature can be disabled via a DIP switch on the device keypad
18. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via a DIP switch on the device keypad
19. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via a DIP switch on the device keypad
20. Starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload)
21. The following control function adjustments on the device keypad are required:
  1. Selectable Torque Ramp Start or Current Limit Start
  2. Adjustable Kick Start Time: 0–2 seconds
  3. Adjustable Kick Start Torque: 0–85%
  4. Adjustable Ramp Start Time: 0.5–180 seconds

5. Adjustable Initial Starting Ramp Torque: 0–85%
6. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
22. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues
23. Maximum continuous operation shall be at 115% of continuous ampere rating

## **2.5 VARIABLE FREQUENCY DRIVES**

### **.1 Manufacturers**

1. The AC drive shall be provided by Cutler-Hammer SVX 9000, Schneider Altivar 71, Allen-Bradley Powerflex 70.
2. Alternate control techniques other than sine wave by pulse width modulated (PWM) are not acceptable.

### **.2 Description**

1. The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage as defined in the following sub-sections.
2. The input power section shall contain external 5% line reactor. The line reactor should provide a minimum of 5% impedance based on the drive operating at its continuous output current rating.
3. The input power section shall utilize a full wave bridge design incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage. This power section shall be insensitive to phase rotation of the AC line. The DC voltage shall be filtered.
4. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBT's) or intelligent power modules (IPM's) as required by the current rating of the motor.
5. The AC Drive's output shall be connected to output 3% load reactor for distances shorter than 30m or dv/dt filter for distances longer than 30m. Load reactors and/or dv/dt filters to be Transcoil KDR or V1k series or approved equal in accordance with B.7.

### **.3 Motor Data**

1. The AC Drive shall be sized to operate the following AC motor:
  - a. Motor Horsepower: As indicated on drawings
  - b. Motor RPM: 1800
  - c. Motor Voltage: 575VAC, 60Hz
  - d. Motor Service Factor: 1.15

### **.4 Application Data**

1. The AC Drive shall be sized to operate a constant torque load.
  2. The motor speed range shall be from a minimum speed of 1.0Hz to a maximum speed of 60Hz.
  3. The AC Drive shall have a minimum turndown ratio of 5:1.
- .5 Environment Ratings
1. The AC Drive shall be designed to operate in an ambient temperature from 0°C to 40°C.
  2. The storage temperature range shall be -40°C to 70°C.
  3. The maximum relative humidity shall be 95% at 40°C, non-condensing.
  4. The AC Drive shall be rated to operate at altitudes less than or equal to 3,300 ft. (1000m) For altitudes above 3,300 ft., derate the AC Drive by 1% for every 300 ft. (100m)
- .6 Ratings
1. The AC Drive shall be designed to operate from an input voltage of 500 to 600 VAC +/- 10%.
  2. The AC Drive shall operate from an input voltage frequency range from 47Hz to 63Hz.
  3. The displacement power factor shall not be less than 0.96 lagging under any speed or load condition.
  4. The efficiency of the AC Drive at 100% speed and load shall not be less than 97%.
  5. The constant torque rated AC Drive overcurrent capacity shall be not less than 150% for 1 minute.
  6. The output carrier frequency of the AC Drive shall be selectable from 1.0 to 6kHz depending on AC Drive rating. For low noise operation, derating may be required.
  7. The output frequency shall be from 0.1Hz to 320Hz.
- .7 Protection
1. Upon power-up, the AC Drive shall automatically test for valid operation of memory, dynamic brake failure, power and the pre-charge circuit.
  2. The power converter shall be protected against short circuits between output phases and output phases to ground. The AC Drive shall safely shut down without damaging any power circuit devices.
  3. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function should provide up to 10 programmable restart attempts with lock-out after the last attempt. The programmable time delay before restart attempts will range from 1 to 60 seconds. This feature can be defeated if not required.

4. The rotating motor auto start on power-up function could be enabled/disabled if required.
  5. The AC Drive shall be capable of running without a motor connected for setup and testing.
  6. The deceleration mode of the AC drive shall be programmable for normal and fault conditions. The stop modes shall include free-wheel stop, emergency stop and DC injection braking.
  7. Upon loss of the analog process follower reference signal, the AC drive shall fault and/or operate at a user defined speed set between software programmed low speed and high speed settings.
  8. The AC drive shall have solid state I<sup>2</sup>t protection that is UL listed and meets UL 508 as a Class 10 overload protection and meets IEC 947. The minimum adjustment range shall be from 50% to 110% of the current output of the AC Drive.
  9. There shall be a minimum of 2 skip frequency ranges that can each be programmed with a programmable bandwidth from 0 to 10Hz. The skip frequencies shall be programmed independently, back to back or overlapping.
  10. The AC Drive shall have internal over temperature protection.
- .8 Adjustments and Configurations
1. If required, a password should be available to allow the terminal keypad to be locked out from unauthorized personnel.
  2. The acceleration and deceleration ramp times shall be adjustable from 0.1 to 3000 seconds.
  3. The memory shall retain and record run status, operating time and fault type of the past 10 faults.
  4. Slip compensation shall be a software enabled function.
  5. The AC Drive shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator continuously, at start and/or at stop. The level of current will be adjustable between 15-150% of rated current.
  6. The AC Drive shall be fully programmed to match motor nameplate data as installed on site.
  7. The AC Drive shall be programmed, commissioned and tuned to site process conditions and per process requirements.
  8. As a minimum, the following parameters shall be accessible:
    - a. Maximum speed
    - b. Minimum speed
    - c. Current limit

- d. Thermal overload
- e. Restart limit
- f. Skip frequency and bandwidth
- g. Preset speed

.9 Operator Interface

1. The operator interface terminal shall feature an alphanumeric display with six indicators for speed controller status. (Run, direction, ready, stop, alarm, fault) and three indicators for control (I/O terminal, keypad, bus/communication.)
2. There are also three LED indicators for Ready (green), Run (green) and Fault (red). The terminal should allow the modification of AC drive adjustment via a keypad. All electrical values, configuration parameters, application and activity function access, faults, local control, adjustment storage will be in plain English.
3. The display will be a high resolution LCD backlighted screen capable of displaying two lines of alphanumeric characters. The use of coded or abbreviated displays shall not be acceptable.
4. The following monitoring values shall be accessible and available when in the operating mode:
  - a. Frequency (Hz) and/or motor speed (RMP)
  - b. Motor current (A), motor voltage (V), motor torque (%), motor power (%)
  - c. AC Drive temperature (°C)
  - d. Motor temperature (%)
  - e. Values or status of analog and digital I/O
5. The operator terminal shall allow the user to display up to three user selectable monitoring values on the same screen concurrently.
6. The operator terminal shall offer a general menu consisting of parameter setting, fault history, and drive configuration. A software lock with password will limit access to the main menu or parameters.
7. There will be function keys allowing the ability to scroll through menus and screens, select or activate functions or increase the value of the selected parameter.
8. A data entry key will allow the user to confirm a selected menu or numeric value.
9. The following control functions shall be available on the keypad:
  - a. Start
  - b. Stop

- c. Select
  - d. Reset
  - e. Direction control
10. A Reset key will allow a parameter to return the existing value if adjustment is not required and the value is displayed.
11. The AC Drive shall have an LED (green) on the keypad to indicate RUN status of the drive.
- .10 Control
- 1. External pilot devices shall be able to be connected to a terminal strip for starting/stopping the AC Drive, speed control and displaying operator status. All outputs will be software assignable.
  - 2. The control power for the digital inputs and outputs shall be 24 VDC.
  - 3. There will be two (2) analog inputs. The analog inputs will be hardware selectable and consist of the following configurations:
    - a. 0(4)-20mA
    - b. 0-10V
    - c. +/- 10V
  - 4. There will be six (6) digital inputs that shall be individually user assignable to perform the various control functions available.
  - 5. There will be one (1) software assignable analog output that can be selected and assigned in the software. The analog output assignments shall be programmable for 0(4)-20mA or 0-10V.
  - 6. Two form "C" configurable relay output contacts and an open collector output (24 VDC) to power a relay or pilot light shall be provided. Each shall be programmable to indicate one of the following.
    - a. Run
    - b. Fault
    - c. Ready
    - d. At speed
    - e. Current limit
    - f. Follower present
    - g. Auto speed mode
    - h. Reverse indicator
    - i. PID control active
    - j. Over-temperature alarm

7. There shall be available additional hardware input/output cards for incorporating alternate control signals including AC voltage logic inputs, PTC thermistor inputs and encoder feedback inputs.

.11 Communications

1. The AC Drive shall be capable of communicating with the main plant PLC/PAC (Ethernet IP) without the need for an external protocol converter.

## 2.6 ENCLOSURES

- .1 The enclosure shall be as indicated on the contract drawings.
- .2 Starters shall have an adjustable instantaneous motor circuit protector (HMCP) type disconnect device.

## 2.7 OPTIONS

- .1 Each starter shall be equipped with a fused control power transformer (100 va minimum) HOA selector switch, green “run” pilot light, red “stop” pilot light, 2 no/2 NC auxiliary contacts and or as indicated on the contract drawings.
- .2 Pushbuttons and selector switches shall be standard heavy duty oil tight, labelled as indicated.
- .3 Pilot Lights shall be push-to-test heavy duty oil tight LED type

## 3 EXECUTION

### 3.1 FACTORY TESTING

- .1 Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA, UL and NEMA standards.
- .2 The manufacturer shall provide three (3) certified copies of factory test reports.

### 3.2 FIELD QUALITY CONTROL

1. Provide a detailed motor list indicating the size and type of overloads installed for each motor.
2. Include motor overload list in operation and maintenance manuals.

### 3.3 SPARE PARTS

1. Provide three spare overloads of each size installed.
2. Provide two fuses of each rating.

3. Provide one operating coil for each starter size supplied.
4. List local suppliers for all above parts.

### **3.4 VARIABLE FREQUENCY DRIVES**

#### **.1 Inspection**

- .1 Verify that the location is ready to receive work and the dimensions are as indicated.
- .2 Do not install AC Drive until the building environment can be maintained with the service conditions required by the manufacturer.

#### **.2 Protection**

- .1 Before and during the installation, the AC Drive equipment shall be protected from site contaminants.

#### **.3 Installation**

- .1 AC Drives shall be installed in motor control centers as indicated. Installation shall be in compliance with manufacturer's instructions, drawings and recommendations.

#### **.4 Training**

- .1 An on-site training course of 1 day shall be provided by a representative of the AC Drive supplier to facility and/or maintenance personnel.

#### **.5 Inspection**

- .1 The supplier of the AC Drive shall have a factory trained service representative in domestic residence within 1000km (average) of the job site. The factory representative shall be trained in the maintenance and troubleshooting of the equipment as specified herein.

**END OF SECTION**



## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Control Panels Section 40 10 00

### **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 26 00 05.

### **1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for uninterruptible power supply for incorporation into the Operation and Maintenance Manual as specified in Section 26 00 05.

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Line interactive uninterruptible power supplies for computer station, instrumentation, control panels and network communication systems as indicated.
- .2 Compact, reliable UPS system units based on AVR technology.
- .3 Microprocessor controlled.
- .4 Auto-sleep mode, instant restart, protection against power variations and overload.

### **2.2 UNINTERRUPTIBLE POWER SUPPLIES**

- .1 Capacity: 1 phase, 120VAC, VA as required
- .2 Input:
  - .1 Nominal voltage: 120 VAC
  - .2 Voltage range: 80-140 VAC
  - .3 Nominal input frequency: 60 Hz, +/- 5 Hz
  - .4 Input power factor correction (PFC): >0.98 @ full load
  - .5 Input short circuit protection: Circuit breaker on front of the UPS

- .6 Connection: NEMA 5-15P receptacle c/w 1.8m cord.
- .3 Output:
  - .1 Nominal Output Voltage: 100/110/115/120 VAC
  - .2 Voltage distortion: Less than 5% at full load
  - .3 Output voltage regulation: <3% @ linear load
  - .4 High efficiency mode (AC to AC): >86%
  - .5 Crest factor: 5:1
  - .6 Output frequency: 60 Hz, +/- 3 Hz
  - .7 Output waveform: Sine wave at less than 3% THD
  - .8 Connection: Minimum four (4) NEMA 5-15P receptacles
- .4 Overload protection: Sustaining at least 120 seconds at 101-110% load, 111-150% max 12 seconds. Immediate shutdown and transfer of load to bypass at 150% load. Auto transfer back to UPS when overload is removed.
- .5 Battery:
  - .1 Maintenance-free, sealed, lead-acid battery with suspended electrolyte, leakproof, hot swap.
  - .2 Backup Time: 30 minutes at half load
  - .3 Recharge Time: 3 hours to 90%
- .6 Transfer: On-line, double conversion technology with zero transfer time (<1ms)
- .7 Operation: Transition from or to battery operation is accomplished with no interruption of power to the load. Upon restoration of input power, the UPS will automatically resume normal operation and recharge the battery.
- .8 LED Indicators:
  - .1 Normal AC mode
  - .2 Battery backup mode
  - .3 UPS fault/alarms:
    - .1 Backup DC mode

- .2 Low battery voltage
- .3 Frequency error
- .4 Charger failure
- .5 Overload
  
- .9 Communication Interface: RS-232 port
  
- .10 Environmental:
  - .1 Operating temperature: 0 to 40°C
  - .2 Storage temperature: -15 to 50°C
  - .3 Humidity: 0% to 95%, non-condensing
  - .4 Acceptable manufacturer: Eaton 5110 Series, Leviton VRM Series, APC Smart-UPS.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 UPS's to be supplied factory installed in control panels as indicated.

#### **3.2 STORAGE AND HANDLING**

- .1 Store all UPS's indoor in heated spaces. Care shall be taken to protect UPS and all other temperature sensitive equipment from extreme hot or cold.
- .2 Keep equipment doors locked. Protect equipment from damage and dust.

**END OF SECTION**

**1 GENERAL**

**1.1 SCOPE**

- .1 The Contractor shall provide Surge Protective Device (SPD) equipment which is integral to the switchboards indicated on the single line diagram and have electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers.

**1.2 RELATED SECTIONS**

- .1 Main Distribution Switch Board 26 24 13
- .2 Panelboards 26 24 17

**1.3 STANDARDS**

- .1 SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition)

**1.4 SUBMITTALS – FOR REVIEW/APPROVAL**

- .1 The following information shall be submitted to the Contract Administrator:
  - .1 Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (In).
  - .2 Where applicable the following additional information shall be submitted to the Contract Administrator.
    - .1 Descriptive bulletins.
    - .2 Product sheets.

**1.5 SUBMITTALS – FOR CONSTRUCTION**

- .1 The following information shall be submitted for record purposes:

- .1 Final as-built drawings and information for items listed in section 1.4 and shall incorporate all changes made during the manufacturing process.

## **1.6 QUALIFICATIONS**

- .1 The Manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- .2 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- .3 The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Contract Administrator, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- .4 The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

## **1.8 OPERATION AND MAINTENANCE MANUALS**

- .1 Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

## **2 PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Same as distribution equipment manufacturer.
  - .1 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Contract Administrator ten (10) days prior to bid date.

### **2.2 VOLTAGE SURGE SUPPRESSION – GENERAL**

.1 Electrical Requirements:

- .1 Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
- .2 Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
- .3 The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
- .4 Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection Modes			
	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

- .5 Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.
- .6 ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

- .1 Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- .2 Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
- .3 Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
- .4 Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
- .5 Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
  - .1 Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
    - .1 For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
    - .2 For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
    - .3 The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate

whether power is present on a particular phase shall not be accepted.

- .2 Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition. Connect dry contacts to overall SCADA system.
- .3 Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
- .4 Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of  $50 \pm 20A$  occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
  - .1 The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- .6 Overcurrent Protection:
  - .1 The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
- .7 Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
- .8 Safety Requirements:
  - .1 The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs



containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

- .2 SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

## 2.4 SYSTEM APPLICATION

- .1 The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- .2 Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGOR Y	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

- .3 .SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

## 2.5 SUBPANEL AND LIGHTING PANEL PROTECTION

- .1 The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
  - .1 The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

- .2 SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
  - .3 The panelboard shall be capable of re-energizing upon removal of the SPD.
  - .4 The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker,
  - .5 The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
  - .6 The SPD shall be of the same Manufacturer as the panelboard.
  - .7 The complete panelboard including the SPD shall be UL67 listed.
- .2 Switchgear, Switchboard, MCC and Busway Requirements:
- .1 The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
  - .2 The SPD shall be of the same Manufacturer as the switchgear, switchboard, MCC, and busway.
  - .3 The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer.
  - .4 Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
  - .5 The SPD shall be connected through a disconnect. The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible
  - .6 The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
  - .7 All monitoring and diagnostic features shall be visible from the front of the equipment.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 The Contractor shall install all equipment per the Manufacturers' recommendations and the contract drawings.

**3.2 FACTORY TESTING**

- .1 Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

**3.3 WARRANTY**

- .1 The Manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with Manufacturers' written instructions and any applicable national or local code.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Fastenings and Supports Section 26 05 29
- .3 Outlet boxes Section 26 05 32

### **1.2 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified for approval by Contract Administrator.

### **1.3 GUARANTEE**

- .1 Replace:
  - .1 LED luminaires burning out within 12 months of takeover.
  - .2 Drivers that fail within 12 months of takeover.

### **1.4 COORDINATION**

- .1 Coordinate luminaire locations with work of other trades.
- .2 Coordinate luminaire types with ceiling finishes to ensure compatibility.

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Luminaires shall carry the CSA label.
- .2 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.
- .3 Provide lenses or diffusers of glass or acrylic material as indicated. Acrylic lenses shall be a minimum of .125" (3 mm) thick, and shall be mounted in a hinged frame.
- .4 Include finishes to Section 26 05 01 and as indicated.
- .5 Where soffits or ceilings have thermal insulation, provide fixtures which are CSA approved for such use.

## 2.2 LAMPS

- .1 Provide lamps as indicated.
- .2 Lamps shall be 4000K, CRI 85 (or greater).

## 2.3 DRIVERS AND ACCESSORIES

- .1 Provide drivers and accessories as indicated.
- .2 Only Manitoba Hydro Power Smart approved drivers will be accepted.

## 2.4 EXIT LIGHTS

- .1 Provide exit lights as indicated, complete with directional arrows, as shown on the drawings.
- .2 Units to be provided with full panel LED's.
- .3 Faceplate to remain captive during relamping.
- .4 Arrange exit lights as required, to allow exits to be visible from access to egress locations.

## 3 EXECUTION

### 3.1 INSTALLATION (LUMINAIRES)

- .1 Install luminaires at locations indicated, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories, as required.
- .2 Install luminaires and lens materials in architectural details, as indicated.
- .3 Install luminaires parallel with building lines. Wall-mounted luminaires to be installed plumb.
- .4 Review all ceiling types, construction details and mounting arrangements before placing luminaire orders and ensure that all mounting assemblies, frames, rings and similar features are included for and match the required installation.
- .5 All luminaires and assemblies shall be properly secured and supported. Support luminaires independent of the ceiling construction, complete with all fasteners, framing and hangers, as may be required. Do not secure luminaires to mechanical ductwork or other vibration producing apparatus.
- .6 Where a luminaire is suspended from the ceiling using a self-aligning box cover, an additional ground wire from the outlet box to the luminaire shall be provided.

- .7 Coordinate the installation of luminaires with the work of other trades, ensuring that the necessary depths and mounting spaces are provided. Luminaires which cannot be installed due to a conflict with structural members, pipes, o/h doors or ductwork shall be relocated to a more suitable location, as directed by the Contract Administrator and/or Architect.
- .8 Do not handle specular lenses with bare hands. Use plastic gloves as recommended by supplier.

### **3.2 WIRING**

- .1 Connect luminaires to lighting circuits as indicated.
- .2 Circuit breakers for exit light circuits shall be provided with lock-on devices.
- .3 Wiring for exit and night light circuits shall be installed in a separate conduit system.
- .4 Connect luminaires to contactor controlled circuits where indicated. In general corridor, alternating fixtures on separate contactors.

### **3.3 TESTS**

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Check luminaires and replace defective luminaires, drivers/ballasts, lenses and accessories.

### **3.4 CLEANING**

- .1 Prior to take-over of the project, clean the lenses and reflectors of all luminaires with a damp cloth to remove dust, smudges and fingerprints.
- .2 Do not handle specular lenses with bare hands. Use plastic gloves as recommended by supplier.

**END OF SECTION**

**EMERGENCY LIGHTING VERIFICATION**

The following document shall be dated and signed by E.C. and G.C. upon final completion, witnessing and verification of installed, fully operational emergency lighting systems (including installation and testing of all exit lights and emergency lights) as outlined in drawings and electrical specifications.

This **Emergency Lighting Verification** document must be submitted to Contract Administrator **PRIOR** to submitting request for 'Substantial Completion'.

Company Name: \_\_\_\_\_ Date: \_\_\_\_\_  
(Electrical Contractor)

Printed Name: \_\_\_\_\_ Signature: \_\_\_\_\_

I hereby verify that all emergency lighting systems as noted above are complete and have been commissioned on above noted date.

Company Name: \_\_\_\_\_ Date: \_\_\_\_\_  
(General Contractor)

Printed Name: \_\_\_\_\_ Signature: \_\_\_\_\_

I hereby verify that all emergency lighting systems as noted above are complete and have been commissioned on above noted date.

Witness (circle one):

Contract Administrator representative \_\_\_\_\_ Date: \_\_\_\_\_

Printed Name: \_\_\_\_\_ Signature: \_\_\_\_\_

I hereby verify that all emergency lighting systems as noted above are complete and have been commissioned on above noted date.

The above does not constitute a waiver of any of the contract document requirements.

## **1 GENERAL**

### **1.1 RELATED WORK**

- |    |  |                  |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Wire and Cable                         | Section 26 05 21 |
| .3 | Outlet Boxes and Fittings              | Section 26 05 32 |
| .4 | Conduit                                | Section 26 05 34 |

### **1.2 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 26 05 01.
- .2 Data to indicate system components, mounting method, source of power and special attachments.
- .3 Battery bank sizing criteria.

### **1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide data for incorporation into Maintenance Manual specified in Section 26 05 01.
- .2 Operation and Maintenance Manual to include:
  - .1 Operation and maintenance instructions for complete battery system to permit effective operation and maintenance.
  - .2 Technical data - illustrated parts lists with parts catalogue numbers.
  - .3 Copy of approved shop drawings.

### **1.4 MAINTENANCE MANUALS**

- .1 Provide maintenance manuals in accordance with Section 26 05 01.

### **1.5 WARRANTY**

- .1 Provide a written guarantee, stating that the battery for emergency lighting is guaranteed against defects in material and workmanship for a period of ten years, with a no-charge replacement during the first five years and a pro-rate charge on the second five years from the date of the Final Acceptance from the City.

### **1.6 SYSTEM DESCRIPTION**



- .1 The system to include battery unit(s) remote heads, wire and conduit, etc., to provide backup emergency lighting in the event of a loss of AC power to the normal lighting system.
- .2 Unit equipment certified to CSA Standard C22.2 No. 141.

## **2 PRODUCTS**

### **2.1 BATTERY BANK**

- .1 Supply voltage: 120 volt.
- .2 Output voltage: 12 VDC.
- .3 Battery: long life sealed lead, maintenance-free.
- .4 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected, modular constructed.
- .5 Solid state transfer.
- .6 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .7 Signal lights: solid state, life expectancy 100,000 h minimum, for "AC Power ON" and "High Charge".
- .8 Lamp heads: integral on unit and remote as indicated. Adjustable mounting, swivel type, complete with LED lamp. Minimum twin heads required per location.
- .9 Cabinet: suitable for wall mounting and complete with knockouts for conduit.
- .10 Auxiliary equipment:
  - .1 test switch
  - .2 battery disconnect device
  - .3 AC input and DC output terminal blocks inside cabinet
  - .4 shelf
  - .5 cord and plug connection for AC
  - .6 RFI suppressors

### **2.2 REMOTE HEADS**

- .1 Double adjustable heads, as indicated.

### 2.3 **MANUFACTURERS**

- .1 Acceptable Manufacturers: Lumacell, Emergi-Lite, ReadyLite.

## 3 **EXECUTION**

### 3.1 **INSTALLATION**

- .1 Install unit equipment for emergency lighting in accordance with CSA C22.1.
- .2 Install conduit and wiring as indicated.
- .3 Install unit equipment and remote mounted fixtures as indicated.
- .4 Cut and re-cap cord to remove surplus.
- .5 Direct heads as indicated.
- .6 Mount double remote heads on outlet box such that two heads will be horizontal with the building lines.
- .7 Provide “dark test” at the end of the project to direct heads as indicated and required to provide adequate egress lighting. Confirm test complete before requesting substantial performance and/or final on-site review by Contract Administrator.
- .8 Charge the batteries and test the system for proper operation (minimum of 35 minutes discharge time).

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- |    |  |                  |
|----|--|------------------|
| .1 | Concrete                               | Section 03 00 00 |
| .2 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .3 | Conduit                                | Section 26 05 34 |
| .4 | Wire and Cable                         | Section 26 05 21 |
| .5 | Underground Conduit and Cables         | Section 26 05 43 |

### **1.2 COORDINATION WITH HYDRO SUPPLY AUTHORITY**

- .1 Make all arrangements and coordinate with Hydro supply authority to ensure availability of service when required.
- .2 Contact: MB Hydro – TBD
- .3 Submit all required drawings to supply authority for their approval.
- .4 Refer to Section 26 05 01 for cash allowance requirements associated with electrical service by the supply authority.

### **1.3 COORDINATION WITH TELEPHONE AUTHORITY**

- .1 Make all arrangements and coordinate with telephone utility to ensure availability of service when required.
- .2 Contact: BellMTS: neteng.control@bellmts.ca
- .3 Refer to Section 26 05 01 for cash allowance requirements associated with telephone service by the telephone utility.

## **2 PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Underground conduit in accordance with Section 26 05 43.
- .2 Conduit and fittings to Section 26 05 34.

## **3 EXECUTION**

### **3.1 PAD MOUNTED TRANSFORMER**

- .1 Pad mounted transformer is existing.

### **3.2 PRIMARY CABLES**

- .1 Primary cables to the utility supplied pad mounted transformer to be provided by the Hydro utility.
- .2 Coordinate shut down and re-servicing with utility.

### **3.3 SECONDARY CABLES**

- .1 Install secondary cables from pad mounted transformer to CSTE, via a trench as indicated. Allow adequate conductor length for termination. Backfill trench and restore surface to original condition.
- .2 Arrange for inspection of cables in trench by Contract Administrator BEFORE backfill, or provide and pay for Certificate of Inspection by Utility.

### **3.4 TELEPHONE ENTRANCE CONDUIT**

- .1 Provide new telephone Utility service entrance.

**END OF SECTION**

**1 GENERAL**

**1.1 RELATED WORK**

- .1 Plywood backboard.
- .2 Conduit systems to Section 26 05 34.

**1.2 DESCRIPTION OF SYSTEM**

- .1 Existing incoming telephone service is overhead. Coordination with the utility provider for the disconnection/reconnection to accommodate building renovation is the responsibility of the Contractor.

**1.3 PAYMENT**

- .1 Arrange and pay for all Utility services charges.

**2 PRODUCTS**

**2.1 MATERIALS**

- .1 Grounding: To Section 26 05 28, Grounding - Secondary.
- .2 Telephone Raceway System: To Section 26 05 14.
- .3 Conduits, conduit fastenings, and conduit fittings to Section 26 05 34.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install telephone conduit and service entrance. Support as per Canadian Electrical Code and utility requirements.
- .2 Install plywood backboard for main telephone distribution. Paint backboard with two coats of fire retardant paint.
- .3 Install grounding facilities, and make connections.

**END OF SECTION**

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## **1 GENERAL PROVISIONS**

### **1.1 GENERAL REQUIREMENTS**

- .1 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.
- .2 All Sections of Divisions 01 to 40 inclusive form part of the Contract Documents.

### **1.2 DESCRIPTION**

- .1 This section specifies the general provisions for the supply, delivery, installation, calibration and commissioning of the process control and instrumentation system, including all control and graphic displays, as specified herein and/or detailed on the drawings.
- .2 It is the intent of these specifications and drawings to provide for a complete and fully operating control and instrumentation system, with facilities and services to meet the requirements described herein, and in complete accord with applicable codes and ordinances. The specifications do not purport to cover details entering into the design of the system which shall be the responsibility of the contractor.
- .3 The work to be done shall include the provision of all labour, materials, tools and equipment as well as the application of a competent knowledge of construction, whether or not directly specified or shown on the plans, required for the installation testing and placing into service the complete control and instrumentation system, except when it is specifically mentioned that certain materials and/or labour are not part of the contract.
- .4 These specifications shall apply to and govern all trades doing control and instrumentation work and shall be read in conjunction with and form a part of the general specifications of the project.
- .5 The Control and Instrumentation work includes but is not limited to the following:
  - .1 Control panels
  - .2 Programmable Logic Controller (PLC) System: to provide the functions as described. PLC system to be programmed to provide all required interface and interlocks with Vendor supplied equipment.
  - .3 Primary elements for measurement of flow, level, pressure, temperature, etc.
  - .4 Indicators and annunciators
  - .5 Uninterruptable power supplies (UPS)

- .6 Control wiring and conduit
- .7 Communication systems
- .8 Spare Parts and Manuals

### **1.3 EQUIPMENT MANUFACTURERS**

- .1 All equipment shall be manufactured by experienced manufacturers who can demonstrate in-use records for all equipment offered.
- .2 The majority of equipment shall be supplied by a single manufacturer, particularly where aesthetics are of concern, such as in panels.
- .3 Requests for approval of alternative suppliers shall be submitted to the Contract Administrator. Refer to Section 26 00 05.

### **1.4 CODES PERMITS AND FEES**

- .1 The work shall comply with the requirements of the current edition of the Canadian Electrical Code – Part 1 and all local, provincial and municipal rules, laws and ordinances pertaining to the work.
- .2 Obtain the required construction permits, arrange for inspections and supply the Contract Administrator with approval certificates including a certificate of final inspection.

### **1.5 REFERENCE STANDARDS**

- .1 Unless otherwise specified, equipment shall conform to appropriate standards and recommendations of:
  - .1 The American Society of Mechanical Contract Administrators (ASME Standards)
  - .2 The Instrument Society of America (ISA)
  - .3 The Canadian Standards Association (CSA)
- .2 All equipment shall be metric – SI Standard.

### **1.6 MANUALS**

- .1 Provide operating and maintenance brochures for all equipment and arrange for their insertion into the operation and maintenance manuals. The brochures shall

- include all applicable, descriptive and technical data, maintenance and operating procedures, wiring diagrams, spare parts lists, service representatives, and suppliers for replacement parts. The brochures shall be neatly and orderly assembled in binders.
- .2 Provide training manuals specific to the lift station. Training manual to contain screen captures of all HMI screens along with text describing the system operation and user interface as it relates to each screen.
  - .3 Requirements for operation and maintenance of process control and instrumentation equipment shall be as specified in various sections of Division 40.

## **1.7 SHOP DRAWINGS**

- .1 Provide layout drawings of instrument and control panels and schematic diagrams, network diagrams as well as detailed loop drawings of all devices listed in the instrumentation data sheets and any equipment connected to the control panel. All control system drawings shall be sealed by a Professional Contract Administrator registered in the province having jurisdiction in the location of the installation.
- .2 The contract administrator's review of shop drawings shall be for general arrangement only and shall not relieve the Contractor from responsibility for errors, proper fitting, construction or the work and furnishing of materials.
- .3 Control drawings shall be updated as the work progresses and shall be submitted to the Contract Administrator as Drawings of Record when the work is completed.
- .4 Submit shop drawings for the following items:
  - .1 Control Panels
  - .2 Panel layout drawings
  - .3 Specific loop drawings for each item connected to the control system – no typical loop drawings are permitted.
  - .4 Field instruments
  - .5 Power supplies
  - .6 PLC and I/O enclosures
  - .7 PLC and I/O modules
  - .8 PLC terminals
  - .9 Control System hierarchy/Network drawings
  - .10 Interconnection drawings, showing system equipment and field device connections
  - .11 PLC software documentation, which shall include as a minimum:



- .1 I/O listing entailing a complete list of all system addresses, both used and spare, with a service description for each including mnemonics.
- .2 Ladder diagram listing, complete with description headings, comments for each rung and mnemonics for each element.
- .3 Data table listing, identifying all preset values and their service.
- .4 Written description of the program(s).

### **1.8 DRAWINGS OF RECORD**

- .1 Submit all control drawings and PLC programs for the instrumentation system

### **1.9 COORDINATION OF WORK**

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make suitable arrangements with other trades to make provision for the control and instrumentation work and be responsible for the assurance that such provisions are satisfactory for the control and instrumentation work.
- .3 Check drawings and specifications of other trades for conflict and coordination with the control and instrumentation trade. If any conflicts are found, obtain a ruling from the Contract Administrator before proceeding.

### **1.10 AS-BUILT DOCUMENTATION**

- .1 As work progresses, record one (1) set of contract drawings, any change to conduit layout as well as any approved changes and deviations from the original contract and/or working drawings. At completing of work, submit to the Contract Administrator. Refer to 26 00 05.
- .2 In addition to the as-built contract drawings, submit as-built documentation for inclusion in the Maintenance Manuals.
- .3 Provide as-built PLC and/or HMI programming hard copy and back-ups (2 copies) on compatible USB memory stick to the Contract Administrator.
- .4 All software development packages and manufacturer's development manuals shall be turned over to the Contract Administrator.
- .5 No final contract payment shall be made until all as-built documentation has been accepted by the Contract Administrator.

### **1.11 WARRANTY**

- .1 Warranty system assembly, installation, hardware, software, and communications operation for all parts and labour for a period of one (1) year from date of project total performance.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 All materials shall be new and the best of their respective kind.
- .2 All materials shall bear the approval of the Canadian Standards Association (CSA)
- .3 All materials shall be suitable for full operation in hazardous or non-hazardous locations as indicated on the drawings.

### **1.2 POWER SUPPLY**

- .1 Provide all necessary power supplies for controls and instruments.
- .2 Power wiring to field devices shall be minimum #12 AWG.

### **1.3 CONTROL WIRING**

- .1 Unless otherwise specified, all conductors for control wiring shall be copper with RW90, X-link insulation, 300V volts.
- .2 Neutral conductors shall be white, grounding conductors shall be green, DC conductors shall be blue and AC conductors shall be red.
- .3 Instrumentation wiring for analog signals shall be individually shielded, multipair cable #16 AWG (7x16) tinned copper.
- .4 Control wiring for level and pressure switches shall be #14 THHN Black.
- .5 Where dimensional drawings are required work with applicable structural and architectural drawings.
- .6 The contractor is responsible for correcting any work completed contrary to the intent of the drawings and specification and shall bear all costs for correcting same.

### **1.4 CONDUIT WIRING AND CABLE**

- .1 Supply and install all conduit, wiring, control and instrumentation cables for the control, instrumentation and low and line voltage control for building services.

- .2 Conduit and wiring for power, lighting, miscellaneous electrical systems, power supplies to control instrumentation fed from panel boards, and building service panels including other components requiring line voltage power supply shall be supplied and installed as specified in Division 26.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install and interconnect all process and control system equipment and components as indicated.
- .2 Install all equipment in accordance with the manufacturer's recommendations and in a manner that will ensure satisfactory operation upon completion.
- .3 Provide all labour and necessary equipment including timbers, scaffolding, tools and rigging materials for installation of the equipment.
- .4 Contractor shall be responsible for coordinating all mechanical, electrical and other works for the equipment being installed.
- .5 Installation shall meet the minimum standards set forth by Standards and Practices for Instrumentation, Tenth Edition – 1989.
- .6 Use trained personnel to install systems and controls as per approved shop drawings and in accordance with manufacturer's recommendations.
- .7 Follow building lines with all piping and electrical wiring runs. Utilize proper separation and wiring techniques.
- .8 The in-line mechanical installation of certain items specified to be supplied in this section are specified to be installed in Mechanical Division.

#### **1.2 TESTING**

- .1 Thoroughly test all control equipment, components, and systems for proper operation and report in writing to the satisfaction of the Contract Administrator.
- .2 Tests shall include:
  - .1 Complete operational test including interlocks, functions, features, options, etc. for all instrumentation and PLC system control operations.
  - .2 Operation of alarm initiating devices.
  - .3 Calibration of all instruments.

- .3 Supply all necessary test equipment and personnel to completely test the entire instrumentation and process control system.

### **1.3 START-UP AND COMMISSIONING**

- .1 Upon completion of the installation, the Contractor shall be responsible for testing to confirm correct system operation and sequences as intended in the Contract Documents. Process Instruments such as flow, level, pressure transmitters, etc., shall be checked for operation prior to process start-up, by manipulating operating controls like set points, auto-manual selectors, etc. Status and alarm contacts to be checked by manipulation or jumpering at the sensing element.
- .2 Results of tests are to be logged by the Contractor and submitted to the Contract Administrator. Any apparent defects shall be reported and corrected.
- .3 When preliminary checks have been completed and process equipment is operating or ready to operate, individual systems shall be calibrated in accordance with the latest ISA recommendation.
- .4 After calibration, the system shall be placed in operation in conjunction with the Contract Administrator and/or the City's designated operating personnel.

### **1.4 SPARE PARTS**

- .1 The Contractor shall provide the following spare parts:
  - .1 Two (2) plug-in control relays of each type used complete with base
  - .2 Two (2) plug-in time delays relays of each type used complete with base
  - .3 Ten (10) fuses of each type used
  - .4 Five (5) indicating lights of each type used
  - .5 One (1) push button assembly including contact blocks of each type used.
  - .6 One (1) selector switch assembly including contact blocks of each type used.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Fastenings and Supports Section 26 05 29
- .3 Programmable Logic Controller Section 40 20 00

### **1.2 SCOPE**

- .1 This section covers the supply and installation of all field located motor control stations and control panels.

### **1.3 QUALITY ASSURANCE**

- .1 Control equipment to CSA C22.2 No. 14-M1987

### **1.4 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 40 05 00 and include schematic wiring diagrams and mounting information.

## **2 PRODUCTS**

### **2.1 OPERATOR CONTROL STATIONS**

- .1 All enclosures and devices shall be rated EEMAC 12 in non-hazardous environments, EEMAC 3R in outdoor environments or EEMAC 7 in hazardous environments unless otherwise noted.

### **2.2 PUSHBUTTONS**

- .1 Heavy duty oiltight, operator flush, black with 1-NC and 1-NO contacts rated at 10A, 120VAC, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position.
- .2 Acceptable manufacturer shall be Telemecanique, Allen-Bradley.

### **2.3 INDICATING LIGHTS**

- .1 Heavy duty oiltight, push to test LED type, lens colour as indicated, supply voltage as required, labels as indicated.
- .2 Acceptable manufacturer shall be Telemecanique, Allen-Bradley.

### **2.4 SELECTOR SWITCHES**

- .1 Number of positions as required, labelled as indicated, heavy duty oiltight, operators as indicated, contact arrangements as indicated, rated 120VAC, 10A.
- .2 Acceptable manufacturer shall be Telemecanique, Allen-Bradley

## **2.5 CONTROL RELAYS**

- .1 Number of poles as required, must be double throw type.
- .2 Removable relay cube from base
- .3 Acceptable manufacturer shall be Omron, Weidmuller

## **2.6 DC POWER SUPPLIES**

- .1 Wattage as required by connected load plus minimum 50% spare capacity.
- .2 Acceptable manufacturer shall be Omron, Weidmuller

## **2.7 TERMINALS**

- .1 Provide Weidmuller "W" series terminals, number indicated plus 20% spare
- .2 Terminals to be rated for connected load
- .3 Double stack terminals will not be permitted unless written approval is obtained from the Contract Administrator.

## **2.8 INDUSTRIAL ETHERNET SWITCH**

- .1 Provide one Industrial Ethernet switch for communication to all process equipment control panels.
- .2 Ethernet switch to have sufficient ports to connect all communicating equipment and control panels, programming access point plus 20% spare ports.
- .3 Industrial Ethernet managed switch as indicated. Acceptable manufacturer shall be Moxa EDS series, N-Tron #7000 series or approved equal in accordance with B.7.

## **2.9 REMOTE ACCESS ETHERNET MODEM**

- .1 Provide remote access Ethernet modem for communication to lift station control system as indicated. Acceptable manufacturer shall be Rockwell Automation #9300-RADES.

## **2.10 GENERAL**

- .1 Supply the control panels in accordance with the general arrangement and

dimensions indicated on the appropriate drawings. Panels must be complete with all instruments, meters, switches, indicating lights, relays, etc. as specified herein or as indicated.

- .2 Provide removable lamacoid nameplates having letters not smaller than 6mm to identify equipment.

## **2.11 CONSTRUCTION**

- .1 Minimum EEMAC 12 construction for all panels unless otherwise specified.
- .2 Unless otherwise specified fabricate floor mounted panels of high grade, cold rolled smooth sheet metal steel no thinner than 3mm thick with all doors and edges neatly turned and finished smoothly. Visible welding seams will not be accepted.
- .3 Construct rigid panels and racks with an angle iron or channel supporting frame, suitable braced and stiffened to prevent any deformation during shipping or installation, and provide a surface free from dents, warping or other deformation. Provide a four-sided channel iron mounting base with front recess.
- .4 Provide flush fitting, gasketed doors, hung on piano type hinges with three point latches and locking type handles. (CSA Type 12 construction).
- .5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.
- .6 Use rear connected fittings to hold equipment and instrument cases on the panel, but where not possible, any front fixing required shall be only by means of chrome-plated, brass or stainless steel machine screws.
- .7 Panel surfaces shall be thoroughly cleaned and degreased before painting. One primer coat shall be covered by two finished paint coats.
- .8 The surface finish shall be free of runs, drips, ridges, waves and laps. The paints shall be applied in such manner as to provide an even film covering corners and crevices. The interior finish shall be white and the exterior finish shall be grey.
- .9 Panel accessories: A pocket, 250mm wide x 150mm high x 25mm deep to hold pertinent drawings and manuals on the lower half of the inside door.

## **2.12 INTENRAL WORKS**

- .1 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120VAC supply
- .2 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments. Conductors shall be extra flexible stranded

- copper of gauges sufficient to carry the required currents and shall in no case be smaller than #16 AWG extra flexible.
- .3 Identify all wiring by means of plastic slip-on type or thermally printed heat-shrink type markers. Install all wiring neatly and laced or bunched into cable from using plastic wire clips, and where practical, contained in plastic wiring channels with covers. Provide wire gutter divider to ensure analog signal wiring is kept separate from digital signal or power wiring as appropriate.
  - .4 Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals. Provide all necessary terminal block accessories such as manufactured jumpers and marking tape.
  - .5 Mount all internally mounted equipment on DIN rail or mount on a rack and arrange for ease of access and removal when necessary.
  - .6 Arrange all terminal blocks in the panel in groups such that all low level signals such as 4-20mA DC are located in one area, followed by contact closure type signals (limit switches, etc.) that do not subsequently energize starters, etc. but are for status indication, and the remainder that contain powered circuits are to be arranged in such a manner and location so as to prevent interference into the low level signal.
  - .7 Submit proposed terminal block layout and identification scheme for review prior to manufacture.
  - .8 Provide suitable space around the terminal blocks for incoming and outgoing conductors or cable assemblies, with a minimum of 5cm between terminals and wire trough.
  - .9 Provide plastic cable troughs equal to Panduit (in accordance with B.7) complete with snap-on covers for containing the cables. Cables are not to be bunched and tied, but laid in.

### **2.13 PANEL MANUFACTURER**

- .1 Panel assembly, subcomponents and all internal components shall be CSA approved. Cabinet construction shall be performed by an established panel manufacturer who shall comply with all building codes, factory, and Department of Labour regulations and has CSA approval as manufacturer for all components of the work including control panels, service entrance, etc. Local approvals for panel construction including CSA will not be accepted.
- .2 Acceptable panel manufacturer shall be Celco Controls Ltd, Manco Control Systems Inc, Tri-Star Automation, Indus Automation, 3 Phase Power Systems.

### **2.14 MAIN CONTROL PANEL**



- .1 Control panel to contain all items indicated on the drawings including:
  - .1 EEMAC 12 rated pad mounted stand alone enclosure, 12 gauge, c/w hinged lockable doors.
  - .2 Terminal strips (identified) for all wiring
  - .3 Identification nameplates on all components, interior and exterior
  - .4 Extra flexible wire to door components
  - .5 Circuit breakers and/or fuses as required
  - .6 Transient Voltage Surge Suppressor
  - .7 UPS as specified in Section 26 33 53
  - .8 DC power supply
  - .9 PLC c/w digital/analog input/output expansion cards needed to connect various equipment, sensors, etc. as specified in Section 40 20 00.
  - .10 HMI screen: Schneider 10.4" GTO Magelis Panel.
  - .11 Ethernet switch as specified in Section 40 10 00
  - .12 Alarm auto-dialler
  - .13 City of Winnipeg to supply cellular auto-dialler for inclusion in RTU panel.
  - .14 Panel finish shall be white epoxy paint for interior and ASA 61 light grey enamel for exterior.

## **2.15 SF-1 CONTROL PANEL**

- .1 Control panel to contain all items indicated on the drawings including:
  - .1 EEMAC 12 rated wall mounted enclosure, 12 gauge, c/w hinged lockable doors.
  - .2 Terminal strips (identified) for all wiring
  - .3 Identification nameplates on all components, interior and exterior
  - .4 Extra flexible wire to door components
  - .5 Circuit breakers and/or fuses as required

- .6 Panel finish shall be white epoxy paint for interior and ASA 61 light grey enamel for exterior.

## **2.16 SF-2 CONTROL PANEL**

- .1 Control panel to contain all items indicated on the drawings including:
  - .1 EEMAC 7 rated wall mounted enclosure and EEMAC 7 rated disconnect, selector switches, indicator lights, etc.
  - .2 Terminal strips (identified) for all wiring
  - .3 Identification nameplates on all components, interior and exterior
  - .4 Extra flexible wire to door components
  - .5 Circuit breakers and/or fuses as required

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install pushbutton stations, control and relay panels, control devices as indicated and interconnect as indicated.

### **3.2 TESTS**

- .1 Perform tests in accordance with Sections 26 00 05 and 40 00 05.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.
- .5 Submit one copy of test results to the Contract Administrator.

### **3.3 START-UP AND COMMISSIONING**

- .1 Perform all panel start-up and commissioning in accordance with Section 40 00 05.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 Basic Electrical Materials and Methods Section 26 05 01
- .2 Fastenings and Supports Section 26 05 29
- .3 Control Panels Section 40 10 00

### **1.2 SCOPE**

- .1 This section covers the supply and installation of the programmable controller.

### **1.3 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 40 00 05 and include details on all CPU functions, programming, flow charts, operator menus, control sequences, schematics, component dimensions, data storage quantity, data storage speed, data storage back-ups, and program storage back-ups.

## **2 PRODUCTS**

### **2.1 TYPICAL PLC**

- .1 A typical PLC system shall be as shown on the drawings and include:
  - .1 Central processing unit (CPU) including power supply
  - .2 I/O modules: discrete input, discrete output, analog input and analog output
  - .3 Remote monitoring hardware
  - .4 All necessary supporting hardware, e.g. PLC backplane, terminal strips, etc.
  - .5 PLC programming
- .2 Environmental Conditions:
  - .1 Temperature ratings:
    - .1 Storage temperature: -40° to 85°C
    - .2 Operating temperature: 0° to 60°C
  - .2 Humidity: 0-93% non-condensing
  - .3 Altitude: 2000 meters full operation
  - .4 Vibration and shock:

- .1 Shock (half sine wave): 15g peak, 11 msec, 3 pulses/axis
- .2 Vibration: 10-57Hz @ 0.075mm d.a. 57-150Hz @ 1G.
- .3 Free fall: 1 m
  
- .5 RFI and EMF Protection:
  - .1 RFI/EMF susceptibility: 27 to 500MHz: 10V/m
  - .2 Electrostatic discharge: 8 kV/4 kV contact
  - .3 Surge withstand: IEC 801-5 2000 V, shield to ground
  
- .3 Central processing unit (CPU):
  - .1 General:
    - .1 The CPU shall consist of rack-mounted sub-assemblies (modules) which solve application logic, store the application program, store numerical values related to the logic, and interface to the I/O modules.
    - .2 The CPU shall provide local diagnostic information via LED indicators and relay contact outputs. All indicators shall be marked as to their respective function.
    - .3 A dry contact shall provide for remote PLC failure alarm indication. The CPU shall come complete with necessary software to provide for this alarm function.
    - .4 Power back-up for one year via lithium battery, or capacitor to allow PLC to store program to non-volatile memory prior to shutdown on power loss.
    - .5 On board Ethernet port or Ethernet communication module to be included in system.
  
  - .2 Program Storage:
    - .1 1 MB program memory minimum
    - .2 PLC program storage medium shall be solid state RAM. RAM memory shall have battery back-up capability of retaining all stored program data through a continuous power outage for 12 months under worst conditions, or capacitor to allow PLC to store program to non-volatile memory prior to shutdown. Capability shall exist to remove battery from RAM module without interrupting system power.
    - .3 50 ms maximum scan time
    - .4 Time-of-day clock
    - .5 Watchdog timer
  
  - .3 Programming Languages:
    - .1 All five programming languages according to IEC 61131-3: FBD (Function Block diagram), LD (Ladder diagram), ST (Structured text), IL (Instruction list) and SFC (Sequential function chart).

.4 Input/Output (I/O) Modules:

.1 General:

- .1 All I/O modules shall be of the rack-mounted plug-in type modular design. Each I/O module shall be keyed to prevent module insertion into the wrong rack slot.
- .2 LED indicators adjacent to each I/O point.
- .3 All user wiring to the I/O modules shall be through a heavy duty terminal strip. Removable, push-in type terminal strip shall allow for module replacement without disturbing field wiring. Pressure type screw terminals shall be used to provide fast, secure wire connections.
- .4 Malfunction of an I/O module shall not affect the operation of the remaining I/O modules or the CPU.
- .5 CPU shall retain status of all I/O points of the failed I/O module.
- .6 Isolation shall be provided between all internal logic and external power circuits. Isolation shall meet minimum specification of 1500V RMS.
- .7 System shall contain one Ethernet communication module dedicated for communication with remote equipment such as VFD's.
- .8 System shall contain one Ethernet communication module dedicated to HMI/ communications.

.2 Discrete Inputs:

- .1 Number of modules as required
- .2 Description: Isolated input module
- .3 Number of points: As required plus 20% or minimum 6 spare points of each type of input card used, whichever is greater.
- .4 Operating voltage: 10-30VDC, 120VAC as required by system.
- .5 Points per group: Isolated

.3 Discrete Outputs:

- .1 Number of modules as required
- .2 Description: Relay (NO) output module
- .3 Number of points: As required plus 20% or minimum 4 spare points, whichever is greater
- .4 Points per group: Isolated
- .5 Maximum current/point: 2A resistive

.4 Analog Input:

- .1 Number of modules as required
- .2 Description: Analog input module (Uni-Polar)
- .3 Number of channels: As required plus 20% or minimum 4 spare points, whichever is greater.

- .4 Operating current: 4-20mA
- .5 Isolation: 1000VAC Channel to Bus
- .6 Accuracy: 0.05% of full scale current
  
- .5 Analog Output:
  - .1 Number of modules as required
  - .2 Description: Analog output module (Uni-Polar)
  - .3 Number of channels: As required plus 20% or minimum 2 spare points, whichever is greater
  - .4 Operating current: 4-20mA
  - .5 Isolation: 2500 VDC channel to bus
  - .6 Accuracy: 0.2% of full scale current
  
- .5 Remote Communication Hardware:
  - .1 Communication interface module: Ethernet TCP/IP
  - .2 External remote access dial-in Ethernet modem c/w all necessary cables, programmed to provide access to all networked controllers and HMI hardware in the facility. Provide username, password and dial-up instructions for any vendor supplied equipment. Standard of acceptance shall be Allen-Bradley 9300-RADES or approved equal in accordance with B.7.
  
- .6 Accessories:
  - .1 For systems requiring a backplane, backplane shall be supplied to house the CPU, AC power supply, communication module, discrete input, discrete output, analog input, and analog output modules as required. Backplane shall include a minimum 2 spare slots.
  
- .7 Programmable Logic Controller Acceptable Manufacturers/product group:
  - .1 Schneider M580

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Mount and install PLC and associated equipment in control panels as indicated on the drawings and as specified in Section 40 10 00.
- .2 Complete PLC and control system installation, testing, start-up and commissioning shall be as described in Section 40 00 05.

**END OF SECTION**

## **1 GENERAL**

### **1.1 RELATED WORK**

- |    |  |                  |
|----|--|------------------|
| .1 | Basic Electrical Materials and Methods | Section 26 05 01 |
| .2 | Fastenings and Supports                | Section 26 05 29 |
| .3 | Control Panels                         | Section 40 10 00 |
| .4 | Programmable Logic Controller          | Section 40 20 00 |

### **1.2 SCOPE**

- .1 This section specifies the supply, installation, field testing and placing into operation of flow, pressure, temperature, level, turbidity and other instruments of control and instrumentation.

### **1.3 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 40 00 05.

## **2 PRODUCTS**

### **2.1 INSTRUMENTS**

- .1 Provide each instrument with mechanisms that are corrosion resistant.
- .2 Provide each instrument with mechanisms enclosed in a dustproof and moisture proof case.
- .3 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.
- .4 Potentiometric signals shall have a "live" zero or positive minimum value in the signal range
- .5 Each component shall be carefully selected and designed for a long lifetime with ample margin to withstand transient and other surge voltages, which may occur in the circuits from any source in the power supply.
- .6 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings, eg. Horizontal, vertical or sloped position.
- .7 The Contractor shall provide all power supplies. Instruments shall be powered from the same control panel to which the measured signal is being transmitted, unless specifically noted otherwise. The power source to each instrument shall be individually fused, fuse size based on instrument power requirements.

- .8 Integrating counters and elapsed time meters shall show the total quantity that has passed through the meter and shall not require the use of a multiplier other than cipher additions. The integrators shall have at least seven figures.
- .9 All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.
- .10 All materials shall conform to the standards of the Canadian Standards Association (CSA).
- .11 For factory calibrated instruments, the factory calibration sheets shall be submitted in the O&M manual.
- .12 For field calibrated instruments, the field calibration sheets shall be submitted in the O&M manual.
- .13 All instruments to be installed per manufacturer's recommended installation guidelines.
- .14 Provide instrument tag fastened to each instrument. Instrument tag to be stainless steel or powder coated aluminum.

## **2.2 ULTRASONIC LEVEL TRANSMITTERS**

- .1 Ultrasonic level sensing transmitters suitable for hazardous locations and wastewater applications as indicated for monitor lift station wet well levels.
- .2 Power Supply: 120VAC
- .3 Output: 4-20mA, Hart protocol.
- .4 Minimum Range: 0-10m (coordinate wet well depth with mechanical)
- .5 CSA Approved
- .6 Chemical resistant polyester/polycarbonate alloy surface mounted EEMAC 4X rated enclosure complete with LCD and bar graph display.
- .7 Level sensing transducers complete with built-in temperature compensation and submersible transducer shield. Remotely mount transducers in wet well above highest incoming sewer main. Coordinate exact location with mechanical. Supply necessary length of transducer cable between transducer and panel mounted transmitter.
- .8 Acceptable manufacturer shall be Siemens Milltronics MultiRanger 100/200.

## **2.3 H<sub>2</sub>S DETECTOR**



- .1 Provide hydrogen sulfide detectors suitable for wastewater applications as follows:
  - .1 Transmitter Display: Multi-Colour LED
  - .2 Output: 4-20mA
  - .3 Power: 24VDC
  - .4 Transmitter Operation Temperature: -55 to 85°C
  - .5 Transmitter Enclosure: Surface mount/pipe mount, NEMA 7
  - .6 Sensor Response Time: 90% in 30 seconds
  - .7 Sensor Operating Temperature: -40 to 75°C
  - .8 Sensor Enclosure: Aluminum or 316 SS
  - .9 Provide one complete new calibration kit to left on site following commissioning.
  - .10 Provide hardware and cables required for remote mounting of sensor head as per drawings.
  - .11 Acceptable manufacturer shall be Net-Safety model Millennium II, Det-Tronics Model GTD1AN25W2 c/w GTSG2100P, Honeywell Sensepoint, MSA Ultima X Series or approved equal in accordance with B.7.

## **2.4 FLOAT SWITCHES**

- .1 Provide float switches as indicated, teardrop shaped submersible, weighted and encapsulated in an enclosure suitable for immersion in wastewater. Acceptable manufacturer shall be Flygt ENM-10.
- .2 Float switches shall be individually suspended y means of submersible cable affixed to a galvanized steel float bracket as indicated on the drawings. Provide float rings to prevent cable entanglement. Acceptable manufacturer shall be Flygt 13-520006.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Coordinate the work of this Section with the installation of the equipment specified in the relevant mechanical sections and shown on the mechanical and electrical drawings.

- .2 Perform all work in compliance with the relevant sections of this Division.

### **3.2 FIELD INSTRUMENT MOUNTING**

- .1 "Mounting" shall mean the positioning and fastening with proper brackets in the position required.
- .2 All equipment shall be mounted in accordance with manufacturer's recommendations.
- .3 Locations of all field instruments are subject to modification by the Contract Administrator who reserves the right to move any item up to 3 meters from the position shown, without change to the contract price, provided notice is given before the related work has commenced.
- .4 Exact locations of all field instruments shall be site determined by the Contractor to the satisfaction of the Contract Administrator to ensure proper operation of the device.
- .5 Employ and all means of trade, skill and workmanship to install all field instruments to the satisfaction of the Contract Administrator.

### **3.3 COMMISSIONING**

- .1 Instrument manufacturer's qualified service representative shall be on site as required to perform instrument calibration, testing and commissioning and to instruct City of Winnipeg's representative in all aspects of instrument operation and maintenance.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
  - .1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
  - .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual.
  - .3 IAQ Guideline for Occupied Buildings Under Construction.

**1.2 SUBMITTALS**

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

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 SEAL CLASSIFICATION**

.1 Classification as follows:

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

.2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with or combination thereof.
- .3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

**2.2 SEALANT**

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

**2.3 TAPE**

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

**2.4 DUCT LEAKAGE**

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

**2.5 FITTINGS**

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

- .1 Rectangular: standard radius. Centreline radius: 1.5 times width of duct.
- .2 Round: five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

- .1 To 400 mm: with single thickness turning vanes.
- .2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

- .1 Rectangular main and branch: with radius on branch 1.5 times width of duct.
- .2 Round main and branch: enter main duct at 45 degrees with conical connection.

- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.
- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
  - .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

## 2.6 DUCT MATERIAL

- .1 To SMACNA. Aluminum type: 3003-H-14 or 5052-H-32.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

## 2.7 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
  - .2 Hanger configuration: to SMACNA.
  - .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA following table :

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
  - .2 For steel joist: manufactured joist clamp.
  - .3 For steel beams: manufactured beam clamps:
  - .4 For wood trusses: steel plate washer.

## Part 3 Execution

### 3.1 GENERAL

- .1 Do work in accordance with SMACNA.

- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA.
- .4 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

### **3.2 HANGERS**

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

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

### **3.3 SEALING AND TAPING**

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

### **3.4 LEAKAGE TESTS**

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Make trial leakage tests as instructed to demonstrate workmanship.
- .3 Do not install additional ductwork until trial test has been passed.
- .4 Complete test before performance insulation or concealment Work.

### **3.5 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .4 Society of Automotive Engineer (SAE)

**1.2 SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Indicate the following:
  - .1 Pressure drop.
  - .2 Face area.
  - .3 Free area.

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

**2.2 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: minimum 3 mm thick with reinforcing bosses and maximum blade length of 1500 mm

- .4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: anodized. Colour: to Contract Administrator approval.

### **2.3 GRILLS AND DIFFUSERS**

- .1 Double-deflection wall grille:
  - .1 Double deflection type with two sets of fully adjustable deflection blades spaced 19 on center.
  - .2 Front set of blades shall run parallel to the (long/short) dimension of the grille.
  - .3 Off-white enamel finish.
- .2 Accessories:
  - .1 Provide unless otherwise indicated.
  - .2 Grills/diffusers shall be provided with opposed blade balancing dampers, unless damper in duct is indicated on drawings.
- .3 Approved Manufacturer: EH Price, Titus or approved equal in accordance with B.7.

## **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 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.



- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**