

**Government of Canada  
Upgrades to TBU 61  
Regina, Saskatchewan  
Project No. 1004207  
(Stantec # 144401453)**

**Issued for Tender & Construction**



April 15, 2016



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1.1     General             Owner  
Government of Canada

Project  
Upgrades to TBU 61  
Regina Saskatchewan

1.2     Location of Site

.1       Regina Saskatchewan

1.3     Examination of Site

.1       The Subcontractor, by submitting his Bid, acknowledges that he has satisfied himself as to the nature and location of the Work, the general and local conditions, particularly those affecting transportation, disposal, handling and storage of materials, availability of labour, water, power, roads, and uncertainties of weather, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during the execution of the Work and all other matters which can in any way affect the Work or the cost thereof under this Subcontract. The Subcontractor further acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials to be encountered. Any failure by the Subcontractor to do so will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the Work.

1.4     Bidder's Responsibility

.1       It shall be the responsibility of the Bidder to clarify any questions regarding the nature and scope of the work prior to closing of Bids. Failure to comply with this requirement on the part of the Subcontractor will not relieve him of the cost of providing all work and materials to complete the work in its entirety as indicated in the Drawings and Specifications.

.2       The Bidder shall be solely responsible for providing his Sub-subcontractors with all information required and ensuring that they are familiar with these Instruction to Bidders, the Project Schedule, the Dominion Construction Health and Safety Program, the General Requirements, the Drawings and Specifications, and the form of Subcontract to which special attention is directed.

.3       Scope of work is not governed by Bid Depository trade definition.

1.5     Interpretation of Bid Documents

.1       Clarifications given by the Engineer during the bidding period, which affect the scope or value of the work, will be incorporated in addenda which will be available to all bidders. All addenda shall become part of the Subcontract.

.2       Verbal instruction or interpretations of drawings and specifications will not be binding under the Subcontract if such instruction are not verified by written addenda.

1.7 Conditions of Work

- .1 Each bidder must inform himself fully of the conditions relating to the construction of the project. Failure to do so will not relieve the successful Bidder of the obligation to furnish all material and labour necessary to carry out the provisions of this Construction Subcontract.

1.8 Alternates and Equals

- .1 Each Subcontract is based on the materials, equipment, methods and product as described in the specifications or as shown on the drawings, and may be identified by manufacturer's name, type and catalogue number. The Bid shall be based on the use of only these selected Products. The Engineer, as identified hereinafter, is required before any materials, equipment, or methods may be substituted for those specified or shown on the drawings.
- .2 Where the phrase "or equal" or "or equal as approved" occurs in the Specification or on the Drawings, do not assume that any particular substitute material, equipment, or method will be approved by the Engineer. Requests for substitution(s) must be made in writing not later than indicated in the Invitation to Tender Documents, SI02.
- .3 When a request for substitution is made to the Engineer, the Engineer will review the request to determine if the substitute will achieve the same results as the specified material, equipment, or method. The Bidder is responsible for ensuring that all requests for substitutions include sufficient information and detail to enable the Engineer to make his determination. The request will identify all changes required in the applicable work, and all changes in the work of others, which would become necessary to accommodate the requested substitution.
- .4 The Engineer, if satisfied that the requested substitute will achieve the same results as the specified material, equipment, or method, he will approve, by Addendum, the substitution as an equal, unless otherwise instructed by the Owner. All Bidders may then use that material, equipment, or method in place of those specified, and all costs/savings will be included in the Stipulated Sum Construction Bid.
- .5 Unsolicited Alternates will not be considered.

1.9 Building Permit

- .1 The Contractor shall obtain a Building Permit. The Subcontractor is responsible for any and all other permits that may be required with respect to the execution of their work.

1.10 Signage

- .1 All jobsite signage must be approved by the Client.

1.11 Shop Drawings and Product Data

- .1 Contractor's use of consultant's drawing files for shop drawings.
  - .1 On request of the Contractor or Subcontractor, the Consultant or Subconsultants may at their sole discretion, provide to the Contractor or Subcontractors AutoCAD files (at the Contractor's or Subcontractors's expense) to assist in the preparation of shop drawings.
  - .2 The Contractor's or Subcontractors' use of Consultant or Subconsultants' drawing files is acceptable only under the following terms and conditions:
    - .1 The Consultant's and Subconsultants' electronic drawing files are compatible with AutoCAD 2014. There is no representation made as to the compatibility of these files with other software.
    - .2 The Consultant and Subconsultants cannot guarantee that any files are virus-free and assume no responsibility or liability for damage caused by virus infected files. It remains the responsibility of the Contractor and Subcontractors to check downloaded files for viruses.
  - .3 Contractor and Subcontractors acknowledge and agree that any drawing files downloaded are instruments of service of, and are under the sole ownership of the Consultant or Subconsultants, who shall retain all common law, statutory law and other rights, including copyrights.
  - .4 The Contractor and Subcontractors agree not to reuse these electronic drawing files, in whole or in part, for any purpose other than for this Project. The Contractor and Subcontractors agree not to transfer these electronic files to others without the prior written consent of the Consultant or Subconsultants.
  - .5 The Consultant and Subconsultants provide no warranty, expressed or implied, or assume any responsibility or liability for the accuracy or completeness of drawing files made available to the Contractor or Subcontractors. In case of any discrepancy between the electronic drawing files and the hard copy of drawing files available at the office of the Consultant, the hard copy of drawing files at the office of the Consultant shall govern. The Contractor or Subcontractors are responsible for determining if any conflict exists.
  - .6 The Contractor or Subcontractors are not relieved of their duty to fully comply with the Contract Documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordination of the Work.
  - .7 Any use of drawing files by the Contractor or Subcontractors will be at the Contractor or Subcontractors sole risk, and without liability or legal exposure to the Consultant and Subconsultants.
  - .8 The Contractor and Subcontractors agree to make no claim and hereby waive any claim or cause of action of any nature against the Consultant and Subconsultants, that may arise out of or in connection with the Contractor or Subcontractors use of the electronic drawing files.
  - .9 The Consultant and Subconsultants's name and logo shall not be reproduced on shop drawings.
- .2 Consultant drawings
  - .1 As part of the shop drawing preparation subcontractors may be requesting AutoCAD and / or REVIT files from the tender set. Stantec has prepared

drawings using a combination of Revit and AutoCAD, and therefore are required to transfer and cleanup drawings for use by subcontractors / contractors.

- .2 To update the drawings and provide them in the appropriate format as well as the administrative time to process, prepare, distribute and track Stantec will be invoicing the owner \$100 per sheet plus GST to cover this administrative time. The costs associated with providing the drawings to the contractor will be credited against the project as a Change Order. The change order will be issued each time a request is made and the drawings will be provided following receipt of a signed Change Order. The consultant will be compensated through the client.
- .3 Prior to sending out the drawings Stantec will require a signed "Electronic Document Transfer Agreement" and "Confidentiality Agreement" (copies will be sent out when required). Stantec will require these documents to be signed by the representatives requesting an electronic document.
- .4 Stantec will be working on keeping the drawings as "LIVE" and updated as possible, therefore the versions may vary depending on who is asking for them and when. It will still be the responsibility of the person receiving the drawings to ensure that they are updated to reflect the current status of the project and their required detailing. What Stantec does not want to see is our drawing sent back with the subtrades logo on it without any modifications.
- .5 All requests for drawings are to go through the general contractor to client.

1.12 Substantial and Final Performance of the Work

1. Based on the scope of work and anticipated sequencing of completion there are four (4) substantial performance of work planned. The following denote the four areas, in no particular order:
  1. Floor 2
  2. Floor 3
  3. Floor 4
  4. Crawlspace and remaining scope of work, including the roof top and site works.
2. Based on the scope of work we propose two (2) final completion reviews:
  1. Floors 2, 3, 4
  2. Crawlspace and remaining scope of work, including the roof top and site works.
3. Through no fault of the owner or consultant, failure to be substantially or finally complete, which will require the consultant to undertake additional site visits, shall entitle the Architect to be paid a sum in the amount of \$800.00 for each extra site visit per consultant. This amount shall be retained by the Owner and be deducted from the Contract stipulated price through a Change Order. The additional site visits will be undertaken after receipt of a signed Change Order.

**END OF SECTION**

**Part 1 General**

**1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract comprises renovation of the TBU 61 Building, located at the Training Academy, Regina, SK; and further identified as "D' Block Building Crawlspace Improvements and Associated Work.

**1.2 CONTRACT METHOD**

- .1 Construction Work under price stipulated in Bid and Acceptance Form.

**1.3 WORK BY OTHERS**

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Engineer.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Engineer, in writing, any defects which may interfere with proper execution of Work.

**1.4 WORK SEQUENCE**

- .1 Construct Work in stages to accommodate Owner's continued use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.
- .3 Construct Work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage.
- .4 Access to the central loading dock shall be maintained, coordinate limited use with Owner.
- .5 Work regarding the existing heating system must be completed prior to the fall heating season and must be reflected on the construction schedule. The Owner's will be turning over an entire wing at one time to allow for a continuous work schedule.
- .6 Maintain fire access/control.

**1.5 CONTRACTOR USE OF PREMISES**

- .1 Unrestricted use of site until Substantial Performance.
- .2 Limit use of premises for Work, for storage, and for access, to allow:
  - .1 Owner occupancy.
  - .2 Partial owner occupancy.
  - .3 Work by other contractors.
- .3 Co-ordinate use of premises under direction of Client.
- .4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .5 Remove or alter existing work to prevent injury or damage to portions of

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existing work which remain.

- .6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Engineer.
- .7 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

#### **1.6 OWNER OCCUPANCY**

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

#### **1.7 PARTIAL OWNER OCCUPANCY**

- .1 Schedule and substantially complete designated portions of Work for Owner's occupancy prior to Substantial Performance of entire Work.
- .2 Owner will occupy designated areas for purpose of installation of equipment.
- .3 Execute Partial Interim Certificate of Completion for each designated portion of Work prior to Owner occupancy. Contractor shall allow:
  - .1 Access for Owner personnel.
  - .2 Use of parking facilities.
  - .3 Operation of HVAC and electrical systems.
  - .4 2<sup>nd</sup> Floor – Contractor access provided from July 23 – August 15, 2016 for the entire floor.
  - .5 3<sup>rd</sup> floor – Contractor access provide to Rooms 301 – 335 from July 19 – 30, 2016; Rooms 336 – 379 from July 11 – 22, 2016.
  - .6 4<sup>th</sup> floor – Contractor access provided to Rooms 401 – 433 from August 15 – 31, 2016; Rooms 434 – 479 from August 15 – 30, 2016.

#### **1.8 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations occupants, and normal use of premises. Arrange with Client to facilitate execution of work.
- .2 Use only elevators existing in building for moving workers and material.
  - .1 Protect walls of passenger elevators, to approval of Client prior to use.
  - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.

#### **1.9 EXISTING SERVICES**

- .1 Notify, Client and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Client 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out



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work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.

- .3 Provide alternative routes for pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Engineer of findings.
- .5 Submit schedule to and obtain approval from Client for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by Client to maintain critical building and tenant systems.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic. Emergency exiting to be maintained from building.,
- .8 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.
- .11 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

#### **1.10 DOCUMENTS REQUIRED**

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

#### **Part 2 Products**

#### **2.1 NOT USED**

Part 3	Execution
3.1	NOT USED

END OF SECTION

**Part 1 General**

**1.1 ACCESS AND EGRESS**

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

**1.2 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Client to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Client will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Use only elevators existing in building for moving workers and material.
  - .1 Protect walls of passenger elevators, to approval of Client prior to use.
  - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Closures: protect work temporarily until permanent enclosures are completed.

**1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations occupants, public and normal use of premises. Arrange with Client to facilitate execution of work.

**1.4 EXISTING SERVICES**

- .1 Notify Client and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Client 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for personnel, pedestrian and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

**1.5 SPECIAL REQUIREMENTS**

- .1 Carry out noise generating Work Monday to Friday from 18:00 to 07:00 hours and on Saturdays, Sundays and statutory holidays.

- .2 Submit schedule in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
- .3 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .4 Keep within limits of work and avenues of ingress and egress.
- .5 Ingress and egress of Contractor vehicles at site is limited to McCarthy Gate Access off of Dewdney Avenue.
- .6 Deliver materials outside of peak traffic hours 17:00 to 07:00 and 13:00 to 15:00 unless otherwise approved by Client.

#### **1.6 SECURITY CLEARANCES**

- .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
- .2 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

#### **1.7 SECURITY ESCORT**

- .1 Personnel employed on this project must be escorted when executing work.
- .2 Submit an escort request to Client at least 14 days before service is needed. For requests submitted within time noted above, costs of security escort will be paid for by Client.
- .3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort.
- .4 Calculation of costs will be based on average hourly rate of security officer for minimum of eight hours per day for late service request and of four hours for late cancellations.

#### **1.8 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions. Smoking is allowed only in designated areas.

#### **Part 2 Products**

##### **2.1 NOT USED**

#### **Part 3 Execution**

##### **3.1 NOT USED**

**END OF SECTION**

**Part 1 General**

**1.1 APPLICATIONS FOR PROGRESS PAYMENT**

- .1 Make applications for payment on account as provided in Agreement as Work progresses.
- .2 Date applications for payment last day of agreed payment period and ensure amount claimed is for value, proportionate to amount of Contract, of Work performed and Products delivered to Place of Work at that date.
- .3 Submit to Client and Consultant, at least 10days before first application for payment. Schedule of values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment. See General Conditions R2850D.

**1.2 SCHEDULE OF VALUES**

- .1 Provide schedule of values supported by evidence as Client may reasonably direct and when accepted by Client, be used as basis for applications for payment.
- .2 Include statement based on schedule of values with each application for payment.
- .3 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Client may reasonably require to establish value and delivery of products.

**1.3 PROGRESS PAYMENT**

- .1 Engineer will issue to Owner, no later than 10 days after receipt of an application for payment, certificate for payment in amount applied for or in such other amount as Engineer determines to be due. If Engineer amends application, Engineer will give notification in writing giving reasons for amendment.

**1.4 INTERIM COMPLETION OF WORK**

- .1 Prepare and submit to Engineer comprehensive list of items to be completed or corrected and apply for a review by Engineer to establish Interim Completion of Work when Work is substantially performed. Failure to include items on list does not alter responsibility to complete Contract.
- .2 No later than 10 days after receipt of list and application, Engineer will review Work to verify validity of application, and no later than 7days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.
- .3 Engineer: state date of Interim Completion of Work in certificate.
- .4 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish reasonable date for finishing Work.
- .5 The following four (4) interim reviews are anticipated:
  - 1. 2<sup>nd</sup> Floor
  - 2. 3<sup>rd</sup> Floor
  - 3. 4<sup>th</sup> Floor
  - 4. Crawlspace and remaining project.

**1.5 FINAL PAYMENT**

- .1 Submit application for final payment when Work is completed.
- .2 Engineer will, no later than 10 days after receipt of application for final payment, review Work to verify validity of application. Engineer will give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.
- .3 Engineer will issue final certificate for payment when application for final payment is found valid.
- .4 For the final progress claim approval, all deficiencies are to be completed and all close out material is to be submitted and approved. Only one (1) final payment will be made. If it is agreed to by the client that sequential release of the progress claim will occur after substantial completion and prior to the final progress claim, shall entitle the architect to be paid a sum of \$400.00 for each extra progress claim per consultant reviewing the progress claim. This amount shall be retained by the Owner and be deducted from the Contract stipulated price through a Change Order. The additional site visits will be undertaken after receipt of a signed Change Order. Payment shall be made monthly to the Architect and be deducted from the current Certificate for Payment payable to the General Contractor.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**1. GENERAL**

- .1 The General Conditions of the Contract, Supplementary Conditions, General Requirements, Instructions to Bidders and Form of Tender supersedes the specification and drawings.
- .2 Perform all work in accordance with the National Building Code of Canada 2010, and local codes and bylaws.
- .3 Provide dust tight temporary enclosures as required to protect existing building.
- .4 Schedule and phase all work with Owner to minimize disruption of operation.
- .5 The current building is fully occupied. Owner will arrange for swing spaces to allow for interior mechanical work to occur in "wings" at one time.
- .6 Work on the heating system must be completed during the non-heating season.

**2. EXISTING CONSTRUCTION**

- .1 All information concerning existing construction has been taken from original Drawings. Contractor to confirm all existing dimensions and details prior to commencement of work. Should information differ significantly from that shown on drawings, notify the consultant prior to proceeding. All existing construction altered or damaged during course of work, to be made good, to match.

**3. DEMOLITION**

- .1 Refer to drawings for extent of work.
- .2 Salvageable materials shall become property of Contractor after the owner's review and possible selection.
- .3 Perform any demolition work in accordance with CSA Code of Practice for Safety to CAN3-S350-M80 and all relative Sections of the Saskatchewan Occupational Health and Safety Act.
- .4 Protect all disturbed portions of the existing building.
- .5 Any areas damaged during demolition or construction to be repaired or replaced by Contractor.
- .6 Legally dispose from site all debris on a regular basis.

**4. RENOVATIONS**

**.1 CONCRETE WORK**

- .1 Replace all disturbed concrete sidewalks and steps to original conditions.

**.3 CARPENTRY**

- .1 Erect members and components to details indicated or as required, conforming to requirements of CAN3-086.

- .4 BUILDING INSULATION AND VAPOUR BARRIER
  - .1 Provide all necessary materials and work for the proper and complete thermal and vapour protection, as detailed.
- .5 NEW ROOFING
  - .1 Provide new roofing as required to suit new details shown.
  - .2 Provide all other related work for new roofing, and associated work as indicated in drawings and specified herein.
- .6 PREFINISHED METALS
  - .1 Supply and install all prefinished metal as indicated on drawings, including supply of all prefinished metal material necessary and required for Roofing systems.
- .7 SEALANTS
  - .1 Provide all necessary Sealant work as required and as specified under Section 07 92 00.
- .8 ASSOCIATED INTERIOR RENOVATIONS
  - .1 General
    - .1 Allow for and provide necessary demolition and/or removal of existing wall and ceiling components, to facilitate new mechanical and electrical work. Remove with care, existing ceiling tiles and stockpile in designated area, for reinstallation. Repair, replace disturbed areas, with new salvaged materials and finish to match existing.
    - .2 Allow for all work required to install new windows as noted on the drawings.
    - .3 Allow for cutting new openings thru the existing metal roof deck and concrete deck for the new mechanical duct penetrations. Reinforce as noted.
    - .4 Coordinate all aspects of the work with operations staff and employees as this is a fully operational building.
  - .2 Gypsumboard and related materials:
    - .1 Standard Gypsum Wallboard: to CSA A82.27M 1977, thicknesses as indicated. 1200mm wide x maximum permissible length, ends square cut, tapered edges and paper faced.
    - .2 Mould-Resistant Gypsum Board: to ASTM C630, ASTM C1177, CSA A82.27M, inorganic coated glass fibre mattes embedded into face and back of mould-resistant gypsum core, mould resistant to ASTM D3273. Thickness as indicated, 1220 wide x maximum practical length, ends square cut, edges tapered. Standard gypsum and type X ULC fire rated, non-combustible core to ASTM E136. Acceptable product: GP Gypsum DensArmor Plus Interior Guard.
    - .3 Screws: to ASTM C646 No. 6 x 31mm or 63mm for single or double thickness application, of self-tapping, countersunk head, rust resistant type.
    - .4 Corner and Casing Beads: 0.5mm thick, shaped to suit condition, designed for filling and sanding.



- .5 Acoustic Sealant: to CGSB 19-GP-21M, non-hardening, specifically for acoustic purposes by manufacturer of wallboard used.
- .6 Adhesive: Type as recommended by gypsum board manufacturers.
- .7 Joint Treatment Material (joint compound, joint type and topping compound): to CSA A82.31-1980, asbestos free.
- .8 Control/expansion joint: back to back plaster stops plus 0.100mm polythylene continuous air seal.
- .9 Workmanship
  - .1 Construct framing/furring/suspension systems to configurations and layouts as indicated and required.
  - .2 Do work to CSA A82.31, including appendices, except where specified otherwise herein.
  - .3 Coordinate installation of service utilities, access panels, plaster rings and like items. Ensure items are properly located and sized.
  - .4 Provide control joints at not over 6 metres o.c., maximum or where indicated.
  - .5 Reinforce field joints and internal angles with paper tape as specified, and apply joint filler in three coats, in strict accordance with printed instructions of manufacturer of gypsum wallboard or joint filler. After final coat has thoroughly dried, sand and leave work ready to receive finish.
  - .6 Provide reveals with corner beads around all existing door frames to create a black 12mm joint.
- .3 Painting
  - .1 Paints shall be of best (top-line) quality.
  - .2 Thoroughly examine all surfaces scheduled to receive paint for conditions which will adversely affect execution and quality of work. Advise contractor prior to commencing work.
  - .3 Clean all surfaces free from dust, dirt and all other foreign matter detrimental to finished appearance.
  - .4 Workmanship shall be of best quality.
  - .5 All surfaces scheduled to be painted will be finished with one (1) coat of recommended primer and two (2) finish coats.
  - .6 Finish - alkyd eggshell or alkyd semi-gloss. Provide samples for Consultant's approval.
- .4 Patch and repair all openings thru existing walls, floors and ceiling finishes to accommodate work as indicated.

**END OF SECTION**



**Part 1 General**

**1.1 ADMINISTRATIVE**

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Engineer.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Engineer.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Distribute copies of minutes within three days after meetings and transmit to meeting participants and, affected parties not in attendance.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

**1.2 PRECONSTRUCTION MEETING**

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of Engineer, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Schedule of Work: in accordance with 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
  - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
  - .5 Delivery schedule of specified equipment.
  - .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
  - .7 Proposed changes, change orders, procedures, approvals required, overtime, administrative requirements.

- .8 Owner provided products.
- .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .12 Monthly progress claims, administrative procedures, photographs, hold backs.
- .13 Appointment of inspection and testing agencies or firms.
- .14 Insurances, transcript of policies.

**1.1 PROGRESS MEETINGS**

- .1 During course of Work, schedule progress meetings monthly.
- .2 Contractor, major Subcontractors involved in Work and Engineer are to be in attendance
- .3 Notify parties minimum 5 days prior to meetings.
- .4 Consultants will record minutes of meetings and circulate to attending parties and affected parties not in attendance within 3 days after meeting.
- .5 Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Maintenance of quality standards.
  - .11 Review proposed changes for affect on construction schedule and on completion date.
  - .12 Other business.

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 NOT USED**

**END OF SECTION**

**Part 1 General**

**1.1 DEFINITIONS**

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Engineer to enable monitoring of project work in relation to established milestones.

**1.2 REQUIREMENTS**

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

### **1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Engineer within 30 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Engineer within 5 working days of receipt of acceptance of Master Plan.

### **1.4 PROJECT MILESTONES**

- .1 Project milestones form interim targets for Project Schedule.

### **1.5 MASTER PLAN**

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Engineer will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

### **1.6 PROJECT SCHEDULE**

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
  - .1 Award.
  - .2 Shop Drawings, Samples.
  - .3 Permits.
  - .4 Mobilization.
  - .5 Excavation.
  - .6 Backfill.
  - .7 Building footings.
  - .8 Landscaping.
  - .9 Asphalt paving.
  - .10 Plumbing.
  - .11 Lighting.
  - .12 Electrical.
  - .13 Piping.
  - .14 Controls.
  - .15 Heating, Ventilating, and Air Conditioning.
  - .16 Testing and Commissioning.
  - .17 Supplied equipment long delivery items.
  - .18 Client supplied equipment required dates.

**1.7 PROJECT SCHEDULE REPORTING**

- .1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

**1.8 PROJECT MEETINGS**

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.

**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 ADMINISTRATIVE**

- .1 Submit to Engineer 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, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Engineer. 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 Engineer, 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 Engineer's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer 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 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.
- .3 Allow 10 days for Engineer's review of each submission.
- .4 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.

- .5 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter, in duplicate, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .7 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .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.
- .8 After Engineer's review, distribute copies.
- .9 Submit 4 copies of Operation and Maintenance Manuals for requirements requested in specification Sections and as requested by Engineer.
- .10 Delete information not applicable to project.
- .11 Supplement standard information to provide details applicable to project.
- .12 If upon review by Engineer, 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.

- .13 The review of shop drawings by Government Services Canada is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that GSC 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.
- .14 Consultant review of Maintenance Manual submissions.
  - .1 The consultant will review the first submission and should the consultant find five (5) deficient items within the maintenance manuals, the manuals will be returned to the contractor for review and confirmation that all items have been submitted.
  - .2 If a second submission is required and five (5) deficient items within the maintenance manuals, the manuals will be once again be returned to the contractor for review and confirmation that all items have been submitted.
  - .3 If additional maintenance manual reviews are required a fee of \$500 will be assessed by each consultant requiring a review of the maintenance manuals. The manuals will be returned every time the consultant reached five (5) deficient items within the maintenance manuals. This amount shall be retained by the Owner and be deducted from the Contract stipulated price through a Change Order. The additional maintenance manual reviews will be undertaken after receipt of a signed Change Order.
  - .4 The contractor is responsible for verifying that he maintenance manuals include all of the requested items noted within the specification. The consultants will not be developing a punch list of missing elements.

### 1.3 SAMPLES

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

**1.4            MOCK-UPS**

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

**Part 2            Products**

**2.1            NOT USED**

**Part 3            Execution**

**3.1            NOT USED**

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Health and safety considerations required to ensure that GSC shows due diligence towards health and safety on construction sites, and meets the requirements laid out in GSC/RPB Departmental Policy DP 073 - Occupational Health and Safety - Construction.

**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 Saskatchewan
  - .1 Occupational Health and Safety Act, 2015

**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 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 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Engineer and/or authority having jurisdiction, weekly.
- .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 WHMIS MSDS - Material Safety Data Sheets.
- .7 Client will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within days after receipt of plan. Revise plan as appropriate and resubmit plan to Engineer within 10 days after receipt of comments from Engineer.
- .8 Client'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 Client.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

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**1.4 FILING OF NOTICE**

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

**1.5 SAFETY ASSESSMENT**

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

**1.6 MEETINGS**

- .1 Schedule and administer Health and Safety meeting with Client prior to commencement of Work.

**1.7 REGULATORY REQUIREMENTS**

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

**1.8 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 Client may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

**1.9 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.

**1.10 COMPLIANCE REQUIREMENTS**

- .1 Comply with Occupational Health and Safety Act, General Safety Regulations, O.I.C.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

**1.11 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 Client verbally and in writing.

**1.12 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 site-related working experience specific to activities associated with this

type of work.

- .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.

#### **1.13 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 Client.

#### **1.14 CORRECTION OF NON-COMPLIANCE**

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

#### **1.15 POWDER ACTUATED DEVICES**

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

#### **1.16 WORK STOPPAGE**

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

### **Part 2 Products**

#### **2.1 NOT USED**

- .1 Not used.

### **Part 3 Execution**

#### **3.1 NOT USED**

- .1 Not used.

**END OF SECTION**





**Part 1 General**

**1.1 DEFINITIONS**

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavorably 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.

**1.2 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Client. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.
- .3 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .4 Environmental protection plan: include:
  - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
  - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
  - .3 Names and qualifications of persons responsible for training site personnel.
  - .4 Descriptions of environmental protection personnel training program.
  - .5 Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
  - .6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
  - .7 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
  - .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including methods for protection of features to be preserved within authorized work areas.
  - .9 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.
- .12 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan: to be included and updated, as required.

### **1.3 FIRES**

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

### **1.4 DISPOSAL OF WASTES**

- .1 Do not bury rubbish and waste materials on site unless approved by Client.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

### **1.5 DRAINAGE**

- .1 Provide erosion and sediment control plan that identifies type and location of erosion and sediment controls to be provided. Plan: include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sedimentations control plan.
- .3 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .4 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

### **1.6 SITE CLEARING AND PLANT PROTECTION**

- .1 Protect trees and plants on site and adjacent properties where 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.
- .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 Engineer.

#### 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 sandblasting and other extraneous materials from contaminating air and waterways beyond application area, by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

#### 1.8 NOTIFICATION

- .1 Client 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 Client of proposed corrective action and take such action for approval by Client.
- .3 Client 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

##### 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 REFERENCES**

1. Federal Legislation
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
  - .2 Canadian Environmental Assessment Act, 1992, c. 37 (CEAA).
  - .3 Transportation of Dangerous Goods Act 1992, c. 34 (TDGA).
  - .4 Motor Vehicle Safety Act 1993, c. 16 (MVSA).

**1.2 DEFINITIONS**

- .1 Alternate Disposal: reuse and recycling of materials by designated facility, user or receiving organization which has valid Certificate of Approval to operate. Alternative to landfill disposal.
- .2 Deconstruction: systematic dismantling of structure to salvage materials for reuse. What cannot be reused is considered subsequently for recycling. Ultimate objective is to recover potentially valuable resources while diverting from landfill what has traditionally been significant portion of waste stream.
- .3 Demolition: rapid destruction of structure with or without prior removal of hazardous materials.
- .4 Disassembly: physical detachment of materials from structure and may include: prying, pulling, cutting, unscrewing.
- .5 Hauler: company (possessing appropriate and valid Certificate of Approval) contracted to transport waste, reusable or recyclable materials off site to designated facility, user or receiving organization.
- .6 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.
- .7 Processing: tasks which are subsequent to disassembly and may include: moving materials, denailing, cleaning, separating and stacking.
- .8 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .9 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .10 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .11 Reuse: repeated use of product in same form but not necessarily for same purpose.

Reuse includes:

- .1 Salvaging reusable materials from remodelling projects before the demolition stage, for resale, reuse on current project or for storage for use on future projects.
- .2 Returning reusable items may include pallets and unused products to vendors.
- .12 Salvage: removal of structural and non-structural structure materials from industrial, commercial and institutional structure deconstruction/disassembly projects for purpose of reuse or recycling.

### 1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 WMC is responsible for fulfillment of reporting requirements.

### 1.4 QUALITY ASSURANCE

- .1 Qualifications: provide adequate workforce training through meetings and demonstrations. Have someone on site with deconstruction experience throughout project for consultation and supervision purposes.

### 1.5 SITE CONDITIONS

- .1 Existing Conditions:
  - .1 Should materials resembling spray or trowel applied asbestos or other designated substance listed as hazardous be encountered in course of deconstruction, stop work, take preventative measures, and notify Client immediately. Do not proceed until written instructions have been received.
  - .2 Storage:
    - .1 Store materials in locations as directed by Client.
    - .2 Maximum permitted duration of material storage on site determined in consultation with Client after project completion.

### 1.6 ENVIRONMENTAL PROTECTION

- .1 Ensure Work is done in accordance with Section 01 35 43 - Environmental Procedures.
- .2 Ensure deconstruction work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air noise pollution.
- .3 Fires and burning of waste or materials is not permitted on site.
- .4 Do not bury waste or materials on site.
- .5 Do not dispose of waste or volatile materials into watercourses, storm or sanitary sewers.
- .6 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties in accordance with authorities having jurisdiction.

- .7 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with as directed by Client.
- .8 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .9 Prevent extraneous materials from contaminating air beyond deconstruction area, by providing temporary enclosures during Work.
- .10 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on temporary roads.
- .11 Use natural lighting to do Work where possible.
  - .1 Shut off lighting except those required for security purposes at end of each day.
- .12 Organize site and workers in manner which promotes efficient flow of materials through disassembly, processing, stockpiling, and removal.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Obtain necessary permits and approvals.
- .2 Post signs in visible locations which indicates to workers, subcontractors, haulers, and public, location of stockpiling of each material.

### **3.2 REMOVAL FROM SITE**

- .1 Transport material designated for alternate disposal using approved haulers and in accordance with applicable regulations.
- .2 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

**END OF SECTION**





**Part 1 General**

**1.1 REFERENCES AND CODES**

- .1 Perform Work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.

**1.2 HAZARDOUS MATERIAL DISCOVERY**

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Client.
- .2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Client.
- .3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Client.

**1.3 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with Client smoking restrictions and municipal by-laws.

**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            INSPECTION**

- .1 Allow Engineer 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 Engineer 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 Engineer will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Client shall pay cost of examination and replacement.

**1.2            INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by Engineer for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Client.
- .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 Client at no cost to Client. Pay costs for retesting and reinspection.

**1.3            ACCESS TO WORK**

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

**1.4            PROCEDURES**

- .1 Notify appropriate agency Engineer 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.

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**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 Engineer 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 Engineer it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner 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 Engineer.

**1.6 REPORTS**

- .1 Submit 4 copies of inspection and test reports to Engineer.
- .2 Provide copies to subcontractor of work being inspected or tested.

**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 Engineer and may be authorized as recoverable.

**1.8 MILL TESTS**

- .1 Submit mill test certificates as requested.

**1.9 EQUIPMENT AND SYSTEMS**

- .1 Submit adjustment and balancing reports for mechanical, electrical systems.

**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 REFERENCES**

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.2 SUBMITTALS**

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

**1.3 INSTALLATION AND REMOVAL**

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

**1.4 DEWATERING**

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

**1.5 WATER SUPPLY**

- .1 Client will provide continuous supply of potable water for construction use.
- .2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.
- .3 Client will pay for utility charges at prevailing rates.

**1.6 TEMPORARY HEATING AND VENTILATION**

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 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.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:

- .1 Prevent 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 contaminants.
- .6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 Ensure Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Engineer.
- .9 Client will pay utility charges when temporary heat source is existing building equipment.
- .10 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with 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.
- .11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

#### **1.7 TEMPORARY POWER AND LIGHT**

- .1 Client will provide and pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts 30 amps.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.
- .3 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Client.

#### **1.8 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.
- .3 Hot work permits must be obtained before any work is carried out.

**Part 2            Products**

**2.1                NOT USED**

.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 or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2            Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3            Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

**END OF SECTION**





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**Part 1            General**

**1.1            REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
  - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-0121-M1978(R2003), Douglas Fir Plywood.
  - .3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
  - .4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**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 area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be graveled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 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, swing staging, platforms, temporary stairs.

**1.5 ELEVATORS**

- .1 Designated existing elevators to be used by construction personnel and transporting of materials. Co-ordinate use with Client.
- .2 Provide protective coverings for finish surfaces of cars and entrances.

**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 CONSTRUCTION PARKING**

- .1 Contractor parking will be in the contractor parking lot directly south of the works building with the exception of whatever the contractor wants to park within the lay down area (well of D Block) keeping in mind access to the loading dock must be maintained throughout the project..
- .2 Provide and maintain adequate access to project site.

**1.8 SECURITY**

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

**1.9 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.

**1.10 SANITARY FACILITIES**

- .1 Sanitary facilities for work force in accordance with governing regulations and ordinances will be provided by the Client.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

**1.11 CLEAN-UP**

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

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**Part 2            Products**

**2.1                NOT USED**

.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 or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2                Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3                Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

**END OF SECTION**



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**Part 1            General**

**1.1            REFERENCES**

- .1    Canadian General Standards Board (CGSB)
  - .1    CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2    CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2    Canadian Standards Association (CSA International)
  - .1    CSA-O121-M1978(R2003), Douglas Fir Plywood.
- .3    Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

**1.2            INSTALLATION AND REMOVAL**

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

**1.3            HOARDING**

- .1    Erect temporary site enclosures using construction grade lumber framing at exterior grade fir plywood to CSA O121.
- .2    Apply plywood panels vertically.
- .3    Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.

**1.4            GUARD RAILS AND BARRICADES**

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

**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            FIRE ROUTES**

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

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

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

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**1.8 PROTECTION OF BUILDING FINISHES**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Engineer locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, Client reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be borne by Client 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 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 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.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Engineer based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 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 Engineer 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 Engineer at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Engineer 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 cementitious 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 Engineer.
- .9 Touch-up damaged factory finished surfaces to Engineer'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 Engineer in writing, of conflicts between specifications and manufacturer's instructions, so that Engineer will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Engineer Consultant 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 Client if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Client reserves 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



Engineer, whose decision is final.

**1.8 CO-ORDINATION**

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

**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 Engineer if there is interference. Install as directed by Engineer.

**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 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Engineer of conflicting installation. Install as directed.

**1.12 FASTENINGS**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

**1.13 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.14 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 Engineer.

**1.15 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, and/or building occupants.
- .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.

**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            EXISTING SERVICES**

- .1        Before commencing work, establish location and extent of service lines in area of Work and notify Engineer of findings.

**1.2            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 Engineer of impending installation and obtain approval for actual location.
- .4        Submit field drawings to indicate relative position of various services and equipment when required by Engineer.

**1.3            RECORDS**

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

**1.4            SUBSURFACE CONDITIONS**

- .1        Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2        After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

**Part 2            Products**

**2.1            NOT USED**

**Part 3            Execution**

**3.1            NOT USED**

**END OF SECTION**



**Part 1 General**

**1.1 SUBMITTALS**

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

**1.2 MATERIALS**

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

**1.3 PREPARATION**

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

**1.4 EXECUTION**

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

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Executionnot Used**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions "C", In Effect as Of: May 14, 2004.

**1.2 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Client. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7 Dispose of waste materials and debris off site.
- .8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

**1.3 FINAL CLEANING**

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.

- .4 Remove waste products and debris including that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Client. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .8 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .9 Remove dirt and other disfiguration from exterior surfaces.
- .10 Sweep and wash clean paved areas.
- .11 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .12 Clean roofs, downspouts, and drainage systems.
- .13 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .14 Remove snow and ice from access to building.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 WASTE MANAGEMENT GOALS**

- .1 Prior to start of Work conduct meeting with Client to review and discuss Waste Management Plan and Goals.
- .2 Waste Management Goal is to divert as much project waste as possible from landfill sites. Provide Engineer documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.

**1.2 REFERENCES**

- .1 LEED Canadian Green Building Council (CGBC), Green Building Rating System, For New Construction and Major Renovations LEED Canada-NC, Version 1.0 - December 2004.

**1.3 DEFINITIONS**

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .3 Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .4 Inert Fill: inert waste - exclusively asphalt and concrete.
- .5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8 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.
- .9 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 demolition 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.

- .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11 Separate Condition: refers to waste sorted into individual types.
- .12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

#### **1.4 SUBMITTALS**

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

#### **1.5 STORAGE, HANDLING AND PROTECTION**

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

#### **1.6 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 Keep records of construction waste including:
  - .1 Number and size of bins.

- .2 Waste type of each bin.
- .3 Total tonnage generated.
- .4 Tonnage reused or recycled.
- .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.
- 1.7 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.]
- 1.8 SCHEDULING**
  - .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.
- Part 2 Products**
- 2.1 NOT USED**
  - .1 Not Used.
- Part 3 Execution**
- 3.1 APPLICATION**
  - .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
- 3.2 CLEANING**
  - .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
  - .2 Clean-up work area as work progresses.
  - .3 Source separate materials to be reused/recycled into specified sort areas.
- 3.3 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT**
  - .1 Schedule E - Government Chief Responsibility for the Environment:
    - Saskatchewan Saskatchewan 306-787-2700 306-787-3941  
Environment and  
Resource Management  
3211 Albert Street  
Regina SK S4S 5W6

**END OF SECTION**



**Part 1 General**

**1.1 INSPECTION AND DECLARATION**

- .1 Contractor's Inspection: Contractor and Subcontractors: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
  - .1 Notify Engineer in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
  - .2 Request Engineer's Inspection.
- .2 Engineer's Inspection: Engineer and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
  - .1 Work has been completed and inspected for compliance with Contract Documents.
  - .2 Defects have been corrected and deficiencies have been completed.
  - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
  - .4 Certificates required by Fire Commissioner have been submitted.
  - .5 Operation of systems have been demonstrated to Owner's personnel.
  - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Engineer, and Contractor. If Work is deemed incomplete by Owner and Engineer, complete outstanding items and request reinspection.
- .5 Declaration of Substantial Completion: when Owner Engineer consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Completion.
- .6 Commencement of Warranty Periods: date of Owner's acceptance of submitted declaration shall be date for commencement for warranty period. Refer to General Conditions 3.13
- .7 Final Payment: when Owner and Engineer consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. If Work is deemed incomplete by Owner and Engineer, complete outstanding items and request reinspection.

**1.2 CLEANING**

- .1 In accordance with Section 01 74 11 - Cleaning.
- .2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 NOT USED**

**END OF SECTION**



**Part 1      General**

**SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Copy will be returned after final inspection, with Engineer's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Two weeks prior to Interim Completion of the Work, submit to the Engineer, one final hard copy of operating and maintenance manuals in English and one electronic PDF of final Maintenance Manuals
- .6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 Furnish evidence, if requested, for type, source and quality of products provided.
- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

**1.2      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. 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. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

### 1.3 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Consultant 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. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

### 1.4 AS-BUILTS AND SAMPLES

- .1 Maintain, at site for Engineer 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. 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. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Engineer.

### 1.5 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, provided by Engineer.



- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. 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 inspection certifications, required by individual specifications sections.

## 1.6 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

## 1.7 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.

- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 - General Commissioning (Cx) Requirements.
- .15 Additional requirements: as specified in individual specification sections.

## **1.8 MATERIALS AND FINISHES**

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

## **1.9 SPARE PARTS**

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

## **1.10 MAINTENANCE MATERIALS**

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

**1.11 SPECIAL TOOLS**

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.

**1.12 STORAGE, HANDLING AND PROTECTION**

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.

**1.13 WARRANTIES AND BONDS**

- .1 Submit, warranty information made available during construction phase, to Engineer for approval prior to each monthly pay estimate.
- .2 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Interim Completion is determined.
- .3 Respond in a timely manner to oral or written notification of required construction warranty repair work.
- .4 Written verification will follow oral instructions. Failure to respond will be cause for the Client to proceed with action against Contractor.

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 NOT USED**

**END OF SECTION**



**Part 1 General**

**1.1 DESCRIPTION**

- .1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of interim completion.
- .2 Owner 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 Owner'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 Engineer's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.

**1.4 CONDITIONS FOR DEMONSTRATIONS**

- .1 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .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.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

**1.2 GENERAL**

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

**1.3 COMMISSIONING OVERVIEW**

- .1 Section 01 91 31 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.

- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 Consultant will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Consultant.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O M training has been completed.

#### 1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

#### 1.5 PRE-CX REVIEW

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative DCC Representative Consultant.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Consultant.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Consultant for review and approval.
  - .10 Ensure "As-Built" system schematics are available.



- .4 Inform Consultant in writing of discrepancies and deficiencies on finished works.

## **1.6 CONFLICTS**

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

## **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

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

## **1.8 COMMISSIONING DOCUMENTATION**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Consultant to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Consultant.

## **1.9 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, re-verification.
  - .4 Training.

## **1.10 COMMISSIONING MEETINGS**

- .1 Convene Cx meetings following project meetings: Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

- .4 At 60% construction completion stage Consultant to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Consultant Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

#### **1.11 STARTING AND TESTING**

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

#### **1.12 WITNESSING OF STARTING AND TESTING**

- .1 Provide 14 days-notice prior to commencement.
- .2 Consultant to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

#### **1.13 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Consultant.
  - .3 Arrange for Consultant to witness tests.
  - .4 Obtain written approval of test results and documentation from Consultant before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative DCC Representative Consultant
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.

- .2 Ability to interpret test results accurately.
- .3 To report results in clear, concise, logical manner.

#### 1.14 PROCEDURES

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

#### 1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Consultant 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 DCC Representative to repeat start-up at any time.

**1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

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

**1.17 TEST RESULTS**

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

**1.18 START OF COMMISSIONING**

- .1 Notify Consultant at least 14 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

**1.19 INSTRUMENTS / EQUIPMENT**

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

**1.20 COMMISSIONING PERFORMANCE VERIFICATION**

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

**1.21 WITNESSING COMMISSIONING**

- .1 Consultant to witness activities and verify results.

**1.22 AUTHORITIES HAVING JURISDICTION**

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

**1.23 EXTRAPOLATION OF RESULTS**

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

**1.24 EXTENT OF VERIFICATION**

- .1 Elsewhere:
  - .1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Consultant.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Consultant.

**1.25 REPEAT VERIFICATIONS**

- .1 Assume costs incurred by Consultant for third and subsequent verifications where:
  - .1 Verification of reported results fail to receive Consultant's approval.
  - .2 Repetition of second verification again fails to receive approval.
  - .3 Consultant deems Contractor's request for second verification was premature.

**1.26 SUNDRY CHECKS AND ADJUSTMENTS**

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

**1.27 DEFICIENCIES, FAULTS, DEFECTS**

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

**1.28 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 Departmental Representative.

**1.29 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.

**1.30 TRAINING**

- .1 In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

**1.31 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

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

**1.32 OCCUPANCY**

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

**1.33 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 Consultant.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

**1.34 PERFORMANCE VERIFICATION TOLERANCES**

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

**1.35 OWNER'S PERFORMANCE TESTING**

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

**Part 2            Products**

**2.1            NOT USED**

.1            Not Used.

**Part 3            Execution**

**3.1            NOT USED**

.1            Not Used.

**END OF SECTION**





**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

**1.2 REFERENCES**

- .1 American Water Works Association (AWWA)
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA-13-02, Installation of Sprinkler Systems Handbook.
  - .2 NFPA-14-02, Automatic Sprinkler Systems Handbook.
  - .3 NFPA-20-03, Standard for the Installation of Stationary Fire Pumps for Fire Protection.
- .3 Public Works and Government Services Canada (PWGSC)
  - .1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.
- .4 Underwriters' Laboratories of Canada (ULC)

**1.3 GENERAL**

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

- .3 Process and methodology for successful Cx.
- .4 Acronyms:
  - .1 Cx - Commissioning.
  - .2 BMM - Building Management Manual.
  - .3 EMCS - Energy Monitoring and Control Systems.
  - .4 MSDS - Material Safety Data Sheets.
  - .5 PI - Product Information.
  - .6 PV - Performance Verification.
  - .7 TAB - Testing, Adjusting and Balancing.
  - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.
- 1.4 DEVELOPMENT OF 100% CX PLAN**
  - .1 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
    - .1 Approved shop drawings and product data.
    - .2 Approved changes to contract.
    - .3 Contractor's project schedule.
    - .4 Cx schedule.
    - .5 Contractor's, sub-contractor's, suppliers' requirements.
    - .6 Project construction team's and Cx team's requirements.
  - .2 Submit completed Cx Plan to Consultant and obtain written approval.
- 1.5 REFINEMENT OF CX PLAN**
  - .1 During construction phase, revise, refine and update Cx Plan to include:
    - .1 Changes resulting from Client program modifications.
    - .2 Approved design and construction changes.
  - .2 Revise, refine and update every 4 weeks during construction phase. At each revision, indicate revision number and date.
  - .3 Submit each revised Cx Plan to Consultant for review and obtain written approval.
  - .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.
- 1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM**
  - .1 Consultant to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
  - .2 Project Manager will select Cx Team consisting of following members:
    - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.

- .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
  - .1 Review of Cx documentation from operational perspective.
  - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
  - .3 Protection of health, safety and comfort of occupants and O M personnel.
  - .4 Monitoring of Cx activities, training, development of Cx documentation.
  - .5 Work closely with members of Cx Team.
- .3 Consultant is responsible for:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Witnessing, certifying accuracy of reported results.
  - .4 Witnessing and certifying TAB and other tests.
  - .5 Developing BMM.
  - .6 Ensuring implementation of final Cx Plan.
  - .7 Performing verification of performance of installed systems and equipment.
  - .8 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
  - .1 Testing.
  - .2 TAB.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx documentation.
  - .5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.
- .5 Contractor's Cx agent implements specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Preparation, submission of test reports.
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## 1.7 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:
    - .1 Equipment and systems except as noted.
  - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.

- .1 To include performance verification.
- .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
- .4 Specialist Cx agency:
  - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
- .5 Client: responsible for intrusion and access security systems.
- .6 Ensure that Cx participant:
  - .1 Could complete work within scheduled time frame.
  - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:
    - .1 Modify ventilation rates to meet changes in off-gassing.
    - .2 Changes to heating or cooling loads beyond scope of EMCS.
    - .3 Changes to EMCS control strategies beyond level of training provided to O M personnel.
    - .4 Redistribution of electrical services.
    - .5 Modifications of fire alarm systems.
    - .6 Modifications to voice communications systems.
- .7 Provide names of participants to Consultant and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

## 1.8 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment:
  - .1 HVAC and exhaust systems:
    - .1 HVAC systems.
    - .2 General exhaust systems.
    - .3 Exhaust systems and related systems.
- .2 Commission electrical systems and equipment:
  - .1 High voltage:
    - .1 High voltage switch gear and transformation equipment.
  - .2 Low voltage below 750 V:
    - .1 Low voltage equipment.

## 1.9 DELIVERABLES RELATING TO O M PERSPECTIVES

- .1 General requirements:
  - .1 Compile English documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.

- .2 Project record documentation.
- .3 Inventory of spare parts, special tools and maintenance materials.
- .4 Maintenance Management System (MMS) identification system used.
- .5 WHMIS information.
- .6 MSDS data sheets.
- .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

#### **1.10 DELIVERABLES RELATING TO THE CX PROCESS**

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

#### **1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Items listed in this Cx Plan include the following:
  - .1 Pre-Start-Up inspections: by Consultant prior to permission to start up and rectification of deficiencies to Departmental Representative's DCC Representative's Consultant's satisfaction.
  - .2 Consultant to use approved check lists.
  - .3 Consultant will monitor some all of these pre-start-up inspections.
  - .4 Include completed documentation with Cx report.

- .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by DCC Representative and does not form part of Cx specifications.
- .6 Consultant will monitor some of these inspections and tests.
- .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - MECHANICAL:
  - .1 Plumbing systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 Complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
  - .2 HVAC equipment and systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 At this time, complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
    - .4 Perform TAB on systems. TAB reports to be approved by Departmental Representative DCC Representative Consultant.
  - .3 EMCS:
    - .1 EMCS trending to be available as supporting documentation for performance verification.
    - .2 Perform point-by-point testing in parallel with start-up.
    - .3 Carry out point-by-point verification.
    - .4 Demonstrate performance of systems, to be witnessed by Consultant prior to start of 30 day Final Acceptance Test period.
    - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
    - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .3 Pre-Cx activities - ELECTRICAL:
  - .1 High voltage distribution systems over 750 V:
  - .2 Low voltage distribution systems under 750 V:
    - .1 Requires independent testing agency to perform pre- energization and post-energization tests.

## 1.12 START-UP

- .1 Start-up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
  - .1 \_\_\_\_\_.
- .3 DCC Representative to monitor some all of these start-up activities.
  - .1 Rectify start-up deficiencies to satisfaction of Consultant.
- .4 Performance Verification (PV):

- .1 Approved Cx Agent to perform.
  - .1 Repeat when necessary until results are acceptable to Consultant.
- .2 Use procedures modified generic procedures to suit project requirements.
- .3 Consultant to witness and certify reported results using approved PI and PV forms.
- .4 Consultant to approve completed PV reports and provide to Departmental Representative.
- .5 Consultant reserves right to will verify up to 30% of reported results at random.
- .6 Failure of randomly selected item shall result in rejection of PV report or report of system start-up and testing.

#### **1.13 CX ACTIVITIES AND RELATED DOCUMENTATION**

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

#### **1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION**

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Consultant and approved by Departmental Representative.
- .2 Tests to be witnessed by Consultant and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Consultant and submitted to Departmental Representative for review.
- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
  - .1 HVAC and associated systems forming part of integrated HVAC systems.
- .6 Identification.

#### **1.15 INSTALLATION CHECK LISTS (ICL)**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

#### **1.16 PRODUCT INFORMATION (PI) REPORT FORMS**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

#### **1.17 PERFORMANCE VERIFICATION (PV) REPORT**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

## **1.18 DELIVERABLES RELATING TO ADMINISTRATION OF CX**

- .1 General:
  - .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

## **1.19 CX SCHEDULES**

- .1 Prepare detailed critical path Cx Schedule and submit to Consultant for review and approval same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Pre-TAB review: 28days after contract award, and before construction starts.
    - .3 Cx agents' credentials: 60 days before start of Cx.
    - .4 Cx procedures: 3 months after award of contract.
    - .5 Cx Report format: 3months after contract award.
    - .6 Discussion of heating/cooling loads for Cx: 3 months before start-up.
    - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
    - .8 Notification of intention to start TAB: 21 days before start of TAB.
    - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
    - .10 Notification of intention to start Cx: 14 days before start of Cx.
    - .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14days before start of integrated system Cx.
    - .12 Identification of deferred Cx.
    - .13 Implementation of training plans.
    - .14 Cx reports: immediately upon successful completion of Cx.
  - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.
  - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

## **1.20 CX REPORTS**

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



**1.21 ACTIVITIES DURING WARRANTY PERIOD**

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

**1.22 TESTS TO BE PERFORMED BY OWNER/USER**

- .1 None is anticipated on this project.

**1.23 TRAINING PLANS**

- .1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

**1.24 FINAL SETTINGS**

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

**1.25 PAYMENTS FOR CX**

- .1 \_\_\_\_\_.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

.1

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Commissioning forms to be completed for equipment, system and integrated system.

**1.2 INSTALLATION/START-UP CHECK LISTS**

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

**1.3 PRODUCT INFORMATION (PI) REPORT FORMS**

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

**1.4 PERFORMANCE VERIFICATION (PV) FORMS**

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

**1.5 SAMPLES OF COMMISSIONING FORMS**

- .1 Consultant will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

**1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS**

- .1 When additional forms are required, but are not available from Consultant develop appropriate verification forms and submit to Consultant for approval prior to use.
  - .1 Additional commissioning forms to be in same format as provided by Consultant

**1.7 COMMISSIONING FORMS**

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
  - .1 Consultant provides Contractor project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per design criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.
  - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .6 Record analytical and substantiating data.
  - .7 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Consultant.
  - .9 Submit immediately after tests are performed.
  - .10 Reported results in true measured SI unit values.
  - .11 Provide Consultant with originals of completed forms.
  - .12 Maintain copy on site during start-up, testing and commissioning period.
  - .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 91 51 - Building Management Manual (BMM).

**1.8 LANGUAGE**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1                Not Used.

.1

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
- .2 This Section specifies roles and responsibilities of Commissioning Training.

**1.2 TRAINEES**

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

**1.3 INSTRUCTORS**

- .1 Consultant will provide:
  - .1 Descriptions of systems.
  - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
  - .1 Start-Up, operation, shut-down of equipment, components and systems.
  - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
  - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
  - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

**1.4 TRAINING OBJECTIVES**

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

**1.5 TRAINING MATERIALS**

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
  - .1 "As-Built" Contract Documents.

- .2 Operating Manual.
- .3 Maintenance Manual.
- .4 Management Manual.
- .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
  - .1 Transparencies for overhead projectors.
  - .2 Multimedia presentations.
  - .3 Manufacturer's training videos.
  - .4 Equipment models.

## **1.6 SCHEDULING**

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

## **1.7 RESPONSIBILITIES**

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

## **1.8 TRAINING CONTENT**

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



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

#### **1.9 VIDEO-BASED TRAINING**

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written approval 3 months prior to commencement of scheduled training.
- .2 On-Site training videos:
  - .1 Videotape training sessions for use during future training.
  - .2 To be performed after systems are fully commissioned.
  - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be professional quality.
  - .1

#### **Part 2 Products**

##### **2.1 NOT USED**

- .1 Not Used.

#### **Part 3 Execution**

##### **3.1 NOT USED**

- .1 Not Used.
  - .1

**END OF SECTION**



**Part 1            General**

**1.1            SUMMARY**

- .1        Section Includes:
  - .1        This section is limited to portions of the Building Management Manual (BMM) provided to Departmental Representative by Contractor.
- .2        Acronyms:
  - .1        BMM - Building Management Manual.
  - .2        Cx - Commissioning.
  - .3        HVAC - Heating, Ventilation and Air Conditioning.
  - .4        PI - Product Information.
  - .5        PV - Performance Verification.
  - .6        TAB - Testing, Adjusting and Balancing.
  - .7        WHMIS - Workplace Hazardous Materials Information System.

**1.2            GENERAL REQUIREMENTS**

- .1        Standard letter size paper 216 mm x 279 mm.
- .2        Methodology used to facilitate updating.
- .3        Drawings, diagrams and schematics to be professionally developed.
- .4        Electronic copy of data to be in a format accepted and approved by Departmental Representative.

**1.3            APPROVALS**

- .1        Prior to commencement, co-ordinate requirements for preparation, submission and approval with Departmental Representative.

**1.4            GENERAL INFORMATION**

- .1        Provide Consultant the following for insertion into appropriate Part and Section of BMM:
  - .1        Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.
  - .2        Summary of architectural, structural, fire protection, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
    - .1        Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
  - .3        Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.
  - .4        System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.
  - .5        Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.
  - .6        Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.

- .7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.
- .8 Operating and maintenance manual - Section 3.2 of BMM.
- .9 Final commissioning plan as actually implemented.
- .10 Completed commissioning checklists.
- .11 Commissioning test procedures employed.
- .12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Consultant.
- .13 Commissioning reports.

#### **1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL**

- .1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.
- .2 Consultant to review and approve format and organization within 12 weeks of award of contract.
- .3 Include original manufactures brochures and written information on products and equipment installed on this project.
- .4 Record and organize for easy access and retrieval of information contained in BMM.
- .5 Include completed PI report forms, data and information from other sources as required.
- .6 Inventory directory relating to information on installed systems, equipment and components.
- .7 Approved project shop-drawings, product and maintenance data.
- .8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O M, shutdown and training materials.
- .9 Inventory and location of spare parts, special tools and maintenance materials.
- .10 Warranty information.
- .11 Inspection certificates with expiration dates, which require on-going re-certification inspections.
- .12 Maintenance program supporting information including:
  - .1 Recommended maintenance procedures and schedule.
  - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

#### **1.6 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES**

- .1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:
  - .1 General:
    - .1 Finalized commissioning plan.
    - .2 WHMIS information manual.
    - .3 Approved "as-built" drawings and specifications.
    - .4 Procedures used during commissioning.
    - .5 Cross-Reference to specification sections.

- .2 Mechanical:
  - .1 Installation permits, inspection certificates.
  - .2 Piping pressure test certificates.
  - .3 Ducting leakage test reports.
  - .4 TAB and PV reports.
  - .5 Charts of valves and steam traps.
  - .6 Copies of posted instructions.
- .3 Electrical:
  - .1 Installation permits, inspection certificates.
  - .2 TAB and PV reports.
  - .3 Electrical work log book.
  - .4 Charts and schedules.
  - .5 Locations of cables and components.
  - .6 Copies of posted instructions.
- .2 Assist Departmental Representative with preparation of BMM.
- 1.7 LANGUAGE**
  - .1 English Language to be used.
- 1.8 IDENTIFICATION OF FACILITY**
  - .1 When submitting information to Departmental Representative for incorporation into BMM, use following system for identification of documentation:
    - .1 Project title and number as per contract documents.
- 1.9 USE OF CURRENT TECHNOLOGY**
  - .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.
  - .2 Obtain Departmental Representative's approval before starting Work.
- Part 2 Products**
  - 2.1 NOT USED**
    - .1 Not Used.
- Part 3 Execution**
  - 3.1 NOT USED**
    - .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Methods for removal of existing asphalt pavement.

**1.2 RELATED SECTIONS**

- .1 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal if applicable.
- .2 Divert unused asphalt materials from landfill to local facility approved by Consultants.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Use cold milling, planning or grinding equipment with automatic grade controls capable of operating from stringline, and capable of removing part of pavement surface to depths or grades indicated.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Prior to beginning removal operation, inspect and verify with General Contractor areas, depths and lines of asphalt pavement to be removed.

**3.2 PROTECTION**

- .1 Protect existing pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of Consultants at no additional cost.

**3.3 REMOVAL**

- .1 Remove existing asphalt pavement to lines and grades as existing in field.
- .2 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.
- .3 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.
- .4 Provide for suppression of dust generated by removal process.

**3.4 STOCKPILING OF MATERIAL**

- .1 Dispose of removed asphalt pavement by stock-piling in location designated by Construction Manager if required.

- .2 Removed asphalt pavement which is to be recycled in hot mix asphalt concrete under this contract may be stockpiled at designated asphalt plant site.

**3.5 FINISH TOLERANCES**

- .1 Finished surfaces in areas where asphalt pavement has been removed to be within +/- 5 mm of grade specified but not uniformly high or low.

**3.6 SWEEPING**

- .1 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Methods and procedures for demolition of concrete and disposal of materials.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .3 Section 01 35 43 - Environmental Procedures.
- .4 Section 01 35 29 - Health and Safety Requirements.

**1.3 DEFINITIONS**

- .1 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.
- .2 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as co-ordinating related, required submittal and reporting requirements.
- .3 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill.
- .4 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA.

**1.4 SUBMITTALS**

- .1 Not applicable

**1.5 QUALITY ASSURANCE**

- .1 Meetings:
  - .1 Prior to start of Work arrange for site visit with Engineer to examine existing site conditions adjacent to demolition work.
  - .2 Ensure key personnel attend.
  - .3 Meetings should be scheduled by the Contractor as needed based on changing conditions.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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**1.7 ENVIRONMENTAL PROTECTION**

- .1 Ensure Work is done in accordance with Section 01 35 43 - Environmental Procedures.
- .2 Ensure that demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .3 Do not bury rubbish waste materials.
- .4 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .5 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

**1.8 EXISTING CONDITIONS**

- .1 Should material resembling spray or trowel applied asbestos or other substance listed as hazardous be encountered in course of demolition, stop work, take preventative measures, and notify Consultant immediately. Do not proceed until written instructions have been received and reviewed by general contractor.

**1.9 SCHEDULING**

- .1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.
  - .1 In event of unforeseen delay notify Consultant in writing.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Power-driven hand tools for removal of concrete to the depths required will be permitted with the following restrictions:
  - .1 Jack hammers and chipping hammers heavier than a nominal 15 kg shall not be used to remove concrete.
  - .2 Jack hammers or mechanical chipping tools shall not be operated at an angle in excess of 45 degrees measured from the surface of the pile.
  - .3 Mechanical scabblers, 8m-N (6ft.lb) impact, and grinders capable of removing the concrete and producing the specified finished surface.
- .2 Concrete cutting saws capable of sawing to the depths indicated on the drawings.
- .3 Hand tools such as hammers and chisels.
- .4 Water or jet blasting equipment is not acceptable.

**Part 3 Execution**

**3.1 PROTECTION**

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades parts of existing building to remain.
  - .1 Repair damage caused by demolition as directed by Engineer.

- .2 If safety of structure being demolished or adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify Engineer.
- .3 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
- .4 Ensure that rebar specified to remain in tact is not affected by demolition procedures.

### 3.2 PREPARATION

- .1 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 3.3 DEMOLITION

- .1 Remove the concrete within the areas and depths designated as noted on the drawings. Removal outside the designated areas or specified depths will not be included in the paid quantities. All quantities designated for removal shall be measured and approved by the Engineer prior to proceeding with the work.
- .2 Removal of the concrete shall be by utilization of such equipment that will not damage the underlying concrete or the existing concrete which is to remain.
- .3 Use hand tools to remove final particles of concrete or to achieve the required depth.
- .4 Ensure the finish surface of prepared concrete surfaces are free of grooves, holes and loose concrete and are suitable for application of a new concrete patch. Deviations and peaks and valleys of greater than +5 mm or -5 mm are not acceptable.
- .5 Do not damage the existing reinforcement or underlying concrete.

### 3.4 REMOVAL FROM SITE

- .1 Remove and dispose of demolished materials off site at the City of Regina Landfill.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 This specification covers the requirements and procedures for removal and disposal of asbestos-containing materials (ACMs), where necessary, to facilitate the Work of this Contract.
- .2 Furnish all labour; materials, services; insurance and equipment in accordance with requirements of Occupational Health and Safety Regulations Part XXIII Asbestos, Saskatchewan Environment and Resources Management (SERM) and other regulatory agencies to complete the work of this section.
- .3 Any quantities listed are approximate and must be confirmed by the Contractor during the site tour.
- .4 Work will be subject to frequent inspection and air monitoring by Bersch and Associates (further referred to herein as the Hazardous Materials Consultant).

**1.2 SCOPE OF WORK**

- .1 The Work of this Contract will involve the removal and disposal of various ACMs, only in those locations where disturbance to the materials is required to facilitate any other task associated with other Work of this Contract.
- .2 Locations, identities and quantities of ACMs are indicated in the following documents, see Appendixes A, B, C at end of specifications.
  - .1 "Asbestos Report" for Structure No. 124 ("D" Block), marked with Survey Date of 01/25/2005 and Last Inspected Date of 03/31/2015. This report includes tables identifying room-by-room sampling, assessment and re-assessment findings pertaining to suspected (and confirmed) ACMs in the overall facility. Further referred to herein as "ACM TABLES"
  - .2 Photographic record excerpts for "D Block, Building 124" from Golder Associates Report Entitled "Asbestos Materials Survey , "Depot" Division, Regina, Saskatchewan", prepared for Public Works and Government Services Canada, dated April 1, 2015, reference number 051325.0016.
  - .3 Drawing record excerpts for Project " DEPOT, REGINA, SASKATCHEWAN", Location "BUILDING #124 "D" BLOCK", Project Number 05-1325-0016, dated March 2005. Further referred to herein as "ACM DRAWINGS".
- .3 Unless otherwise determined through risk assessment conducted by the Contractor's qualified person, remove and dispose of the following using High Risk asbestos abatement procedures, in ONLY THOSE LOCATIONS WHERE THE MATERIAL IS ASBESTOS-CONTAINING AND DISTURBANCE/ALTERATION ARE REQUIRED TO FACILITATE THE WORK OF THIS CONTRACT:
  - .1 Asbestos-containing pipe fitting compound on locations including, but not limited to, elbows, tees, hangers, expansions and valves of mechanical piping systems.
    - .1 Glove Bag and/or wrap-and-cut methods may be utilized, if deemed appropriate through risk assessment conducted by the Contractor's qualified person
  - .2 Asbestos-containing straight-run pipe insulation.

- .1 Glove Bag and/or wrap-and-cut methods may be utilized, if deemed appropriate through risk assessment conducted by the Contractor's qualified person.
- .4 Unless otherwise determined through risk assessment conducted by the Contractor's qualified person, and if power tools with HEPA filtration will be used to cut, grind or abrade the materials during the removal process, then remove and dispose of the following using Moderate Risk asbestos abatement procedures in ONLY THOSE LOCATIONS WHERE THE MATERIAL IS ASBESTOS-CONTAINING AND DISTURBANCE/ALTERATION ARE REQUIRED TO FACILITATE THE WORK OF THIS CONTRACT:
  - .1 Asbestos-containing cement ("Transite") rainwater leaders.
  - .2 Asbestos-containing drywall/gypsum board filler compound (walls and ceilings).
- .5 Unless otherwise determined through risk assessment conducted by the Contractor's qualified person, and if removal will be conducted without sanding, cutting or similar disturbance, then remove and dispose of the following using Low Risk asbestos abatement procedures, in ONLY THOSE LOCATIONS WHERE THE MATERIAL IS ASBESTOS-CONTAINING AND DISTURBANCE/ALTERATION ARE REQUIRED TO FACILITATE THE WORK OF THIS CONTRACT:
  - .1 Asbestos-containing cement ("Transite") rainwater leaders.
  - .2 Asbestos-containing drywall/gypsum board filler compound (walls and ceilings).

### 1.3 REGULATIONS, CODES AND STANDARDS

- .1 The current issue of the following regulations and guidelines shall govern. Where conflict among these requirements or with these specifications exists, the more stringent requirements shall apply.
  - .1 The Occupational Health and Safety Act and Regulations.
  - .2 Saskatchewan Environment and Resources Management (SERM).
  - .3 Transportation of Dangerous Goods Regulations.
- .2 The current issue of the following codes and standards shall govern. Where conflict among these requirements or with these specifications exists, the more stringent requirements shall apply.
  - .1 CGSB 1-GP-205M Standard for: Sealer for Application to Asbestos-Fibre Releasing Materials.
  - .2 CSA Standard Z94.4"M2003, Selection, Care, and Use of Respirators.
  - .3 CSA Standard S269.2cM1980, Scaffolding Construction.

### 1.4 QUALITY ASSURANCE

- .1 The removal and handling of asbestos-containing or contaminated materials shall be performed by persons experienced in the methods, procedures; and industry practices of asbestos abatement.
- .2 The contractor is responsible to ensure that work proceeds to schedule, meeting all requirements of this section. The contractor shall complete this work so that at no time shall airborne asbestos, waste or asbestos waste-water runoff contaminate areas adjacent to work areas.
- .3 The Hazardous Materials Consultant is empowered to inspect adherence to specified work procedures and materials and to inspect for final cleanliness and completion.

- Additional labour or materials expended by the contractor to provide satisfactory performance to the level specified shall be at no additional cost.
- .4 The Hazardous Materials Consultant is empowered to order a shutdown of work when a leakage of asbestos-containing or contaminated materials has occurred or is likely to occur. These conditions include, but are not limited to, failure of negative pressure systems, inadequate wetting, failure of critical barriers or decontamination enclosure systems, water leaks, excessive airborne fibre levels in areas adjacent to the work area or in clean room or holding room areas and the contamination of clean room or holding room areas by asbestos-containing or asbestos-contaminated materials. Additional labour or materials to rectify these or other unsatisfactory conditions shall be at no cost to the owner.
  - .5 Inspections and air monitoring services performed as a result of the contractor's failure to conform to specified procedures or level of cleanliness, as determined by the Hazardous Materials Consultant at the time of a milestone inspection, may be charged to the contractor at the Hazardous Materials Consultant's discretion.
  - .6 All work of this section involving electrical, mechanical, plumbing and glazing work shall be performed by skilled tradesmen regularly engaged in the work in question and under the direct supervision of a currently qualified journeyman.
  - .7 Provide on-site a project supervisor, who has authority to oversee all aspects of the work of this section including the estimation and negotiation of changes to the contract; submission requirements, scheduling, man power requirements; equipment requirements and production.
  - .8 Provide on-site, for each shift, a shift supervisor who is outside of the containment, who has authority to oversee all aspects of the work of this section related to manpower requirements, equipment requirements and production.
  - .9 Replacement of supervisory personnel cannot be undertaken without the written approval of the Hazardous Materials Consultant.

## 1.5 SUBMITTALS

- .1 Before commencing work Contractor shall:
  - .1 Submit proof satisfactory to the Hazardous Materials Consultant that the site location, required permits and arrangements for transport and disposal of asbestos-containing or contaminated materials have been obtained. Ensure required manifest documentation regarding disposal is submitted in accordance with these specifications.
  - .2 Submit written and individually signed forms to the Hazardous Materials Consultant establishing that all personnel have received instruction on the hazards of asbestos exposure, and work procedures. Submit to the Hazardous Materials Consultant, documentation of respirator fit tests conducted for all personnel entering the removal site.
  - .3 Not later than 14 days before beginning the process, submit notice of the intention to begin a high risk asbestos process to Saskatchewan Labour.
  - .4 Submit to the Hazardous Materials Consultant, manufacturer's information, including test results, material safety data sheets and product specifications, of all equipment and materials proposed for use on this project.
  - .5 Submit certification or other documentation, acceptable to the Hazardous Materials Consultant, certifying all air movement and vacuum equipment; intended for use on this project have had a filter integrity test. Negative air

units' must have the filter integrity test conducted on a per project basis and vacuums must be tested with the last 12 months.

## **1.6 SITE SUPERVISION**

- .1 During time of hazardous material handling (work at risk of dislodging asbestos-containing material) supervisory personnel shall co-ordinate work and take full responsibility for the health and safety of all personnel working within contaminated areas.
- .2 The contractor shall employ at least one supervisory person within enclosure(s) and one outside at all times.
- .3 Contractor shall ensure supervisory personnel has attended a training course on asbestos removal (two day minimum duration) and has performed a supervisory function on at least two comparable projects in occupied buildings.

## **1.7 SCHEDULING OF WORK**

- .1 The contractor shall prepare and submit the construction schedule for review by the Hazardous Materials Consultant three days prior to the start of work. The schedule shall include milestone inspections and all other critical events relating to the work of this section and the work of others. The construction schedule shall incorporate Substantial Performance dates, turnover dates respecting related work elsewhere and time constraints as outlined by the building owner.
- .2 The work of this section must comply with the General Contract and Owner's requirements with regard to working hours, phasing, access restrictions and operational requirements.
- .3 The contractor shall allow sufficient time for fibre settling and final air monitoring (minimum 8 hours) following each stage of removal.
- .4 The contractor shall ensure consultants approval of work area preparation and clean-up is obtained as specified.
- .5 The contractor shall allow sufficient time for inspection of site by consultant following site preparations and prior to the execution of the work of this section.

## **1.8 DEFINITIONS**

- .1 Abatement: procedures to control fibre release from asbestos-containing materials. Includes encapsulation, repair, and removal.
- .2 Removal: all herein specified procedures necessary to strip all asbestos-containing materials from the designated areas and to dispose of these materials at an acceptable site.
- .3 Encapsulation: all herein specified procedures necessary to coat all asbestos-containing materials with an encapsulant to control the possible release of asbestos fibres into the ambient air.
- .4 Enclosure: all herein specified procedures necessary to complete the enclosure of all asbestos- containing materials within airtight, impermeable barriers.
- .5 Repair: all herein specified procedures necessary to complete containment of all asbestos- containing material using materials impermeable to the release of asbestos fibre.
- .6 Authorized Visitor: Owner and/or his appointed representative, consultant and persons representing regulatory agencies.
- .7 Work Area: Areas where work at risk of increasing airborne fibre is to take place.



- .8 Negative Pressure: Air pressure within the work area resulting from air movement equipment established in the area to maintain a minimum pressure differential of 0.50 mm (0.02 inches) of water column relative to adjacent unsealed areas.
- .9 Airlock: System for permitting ingress and egress without permitting air movement between contaminated area and uncontaminated area, typically consisting of two curtain doorways at least 1800 mm (6 feet) apart.
- .10 Curtain Doorway: Device to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed by placing two overlapping sheets of plastic over existing or temporarily framed doorway, securing each along top of doorway, securing vertical edge of one sheet along one vertical side of doorway, and securing vertical edge of other sheet along opposite vertical side of doorway. Free edges of polyethylene shall be reinforced with duct tape and bottom edge shall be weighted to ensure automatic closing.'
- .11 Filter Integrity Test: Leak testing using liquid dioctylphthalate (DOP) or polyalphaolefin (PAO) generated into an aerosol used for challenging HEPA filter assemblies.
- .12 Critical Barrier: A barrier constructed of a 38 mm by 89 -mm timber framework, covered on both sides with 6 mil plastic sheeting, taped along all free edges and interfaces to prevent the movement • of airborne asbestos fibre from the contaminated work area to adjacent uncontaminated areas, Exposed surfaces in public service areas shall be sheathed with plywood. Plywood to be finished with white, eggshell latex paint.
- .13 Contaminated: defines the state of materials, surfaces or areas which by virtue of physical contact with asbestos-containing materials or with airborne asbestos fibre shall require cleaning, removal and/or disposal, as specified in this section.
- .14 Air Monitoring: the process of measuring the fibre content of a specific volume of air in a stat13d period of time.
- .15 Surfactant: a chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.
- .16 Amended Water: a water to which a surfactant has been added.
- .17 Decontamination Enclosure: a series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. A decontamination enclosure system always contains at least one airlock .
- .18 Worker Decontamination Area: a decontamination area for workers, typically consisting of a clean area, bucket of clean tepid water, soap and towels .
- .19 Equipment Decontamination Area: a decontamination area for materials and equipment, typically consisting of a designated area of the work area, a wash area, a holding area, and an uncontaminated area.
- .20 Clean Area: an uncontaminated area or room which is part of the worker decontaminated area, with provisions for storage of workers' street clothes and protective equipment.
- .21 Equipment Room: a contaminated area or room which is part of the worker decontamination area, with provisions for storage of contaminated clothing and equipment
- .22 Wash Area: an area between the work area and the holding area in the equipment decontamination area. The wash area may comprise an airlock.
- .23 Holding Area: a chamber between the wash area and an uncontaminated area in the equipment decontamination area. The holding area may comprise an airlock.

- .24 Fixed Object: a unit of equipment or furniture in the work area which cannot be removed from the work area.
- .25 Moveable Object: a unit of equipment or furniture in the work area which can be removed from the work area.
- .26 HEPA Filter: a throwaway extended-pleated-medium dry-type filter with (1) a rigid casing enclosing the full depth of the pleats, (2) a minimum removal efficiency of 99.97% for thermally generated monodisperse DOP smoke particles with a diameter of 0.3 micrometers and (3) a maximum pressure drop of 1.0 in w.g. when clean and operating at its rated airflow capacity.
- .27 Encapsulant (Sealant): a liquid material which can be applied to asbestos-containing material and which controls the possible release of asbestos fibres from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).
- .28 Wet Cleaning: the process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as asbestos-contaminated waste.
- .29 Crated: solid self-supporting structure built over equipment or materials of sufficient strength to protect same from damage or contamination for the duration of the work of this section. A 38 mm x 89 mm (2"x 4") timber frame covered with plastic sheeting and hoarded with 10 mm (3/8") plywood shall be standard of acceptance.
- .30 Milestone Inspection: inspection of the work area by Hazardous Materials Consultant at a defined point in the abatement procedure.
- .31 Immediate Vicinity: a four (4) foot area surrounding an asbestos application or either side of a line application or such an area as defined by Hazardous Materials Consultant.
- .32 Threshold Limit Value (TLV) as published by the American Congress of Governmental Industrial Hygienists (ACGIH). The TLV = 0.1l/cc for all fibre types .
- .33 Investigative Criteria: the airborne fibre level in fibres per cubic centimetre of air (flee) which corresponds with one half of the Occupational Exposure Limit; If high levels continue after,• corrective measures are taken, work must immediately stop until the reasons for the high levels are identified and corrected.
- .34 Hazardous Materials Consultant: the Hazardous Materials Consultant contracted directly by the Owner/Client.

## 1.9 PERSONNEL PROTECTION

- .1 For Low Risk and Moderate Risk work, half-face piece, negative pressure, dual cartridge, P100 filter respirators shall be used by all workers, at a minimum.
- .2 For High Risk work, full-face piece, Powered Air Purifying Respirators with P100 filters shall be used by all workers, at a minimum.
- .3 Respirators shall be personally issued and approved by the National Institute of Occupational Health and Safety (NIOSH). A review of respiratory protection requirements may be necessary, as dictated by air monitoring results obtained by The Demolition Contractor's Hazardous Materials Consultant.
- .4 Provide workers, including other sub-trades, with full-body disposable coveralls. Once coveralls are worn in work area, they shall be treated asbestos contaminated waste and

disposed of accordingly. Provide other body protection, including CSA approved safety footwear, required under applicable safety regulations.

- .5 Provide two complete sets of protective clothing and respirators must be present at all times outside the entrance to the work area for use by Owner and/or his appointed representative, consultant and persons representing regulatory agencies who have authority over the project.
- .6 Workers shall be clean-shaven to ensure an adequate respirator face piece seal. Unshaven workers shall not be allowed in the work area.
- .7 Workers shall be fully protected with respirators and protective clothing at all times when the possibility

#### **1.10 BUILDING PROTECTION**

- .1 Provide lockable doors sufficient to ensure work area security in the Clean Room and in the Holding Area of Decontamination Enclosure Systems. Ensure building security at all other points of entry to the building including windows and doors demounted to accommodate the installation and exhaust of air movement equipment used through the work of this section.
- .2 The contractor shall be responsible to make good all building systems and finishes damaged through the work of this section, when such building systems and finishes are not subject to demolition.

#### **1.11 AIR MONITORING**

- .1 Air monitoring shall be performed by the Hazardous Materials Consultant in accordance with NIOSH 7400.
- .2 The contractor shall assist the Hazardous Materials Consultant in the collection of air samples including the provision of workers to wear sampling pumps for up to a full work shift period and the provision of adequate, uninterrupted power for low amperage vacuum/pressure type pumps.
- .3 Allow sufficient time for fibre settling and final air monitoring (minimum 8 hours) following each phase of removal.
- .4 Airborne fibre, levels found, in excess of the "shut down criteria", in areas adjacent to the work area or in clean room or holding room areas, shall indicate asbestos contamination of these areas. Such areas shall be isolated and cleaned in a manner similar to the work area, at no additional cost to the owner. Such areas shall be considered to be contaminated until acceptable airborne fibre levels are established in the area.
- .5 Airborne fibre levels found, in excess of "investigative criteria", in areas adjacent to the work area or in clean room or holding room areas, shall initiate an investigation by the Contractor and the Hazardous Materials Consultant into the source of excess airborne fibre levels.
- .6 Where airborne fibre levels in the work area exceed the Action Level or Maximum Use Concentration for the respiratory protective equipment observed in use, the Hazardous Material Consultant shall take measures outlined in Quality Assurance.
- .7 Air monitoring within the work area to establish acceptable clearance and tear down conditions shall be conducted following a visual inspection, approval of work area clean-up procedures and the application of a slow drying sealer to all surfaces within the work area. Acceptable air clearance levels have been established by Saskatchewan Labour at <0.01 f/cc.

## 1.12 INSPECTION

- .1 The Hazardous Materials Consultant is empowered by the owner to periodically inspect site conditions and work procedures inside and outside of the work area.
- .2 The Hazardous Materials Consultant, at their discretion, shall undertake the following milestone inspections which shall be included as critical events in the construction schedule:
  - .1 Milestone Inspection A - Pre-contamination inspection of work area preparation and set-up prior to disturbance and removal of asbestos-containing or asbestos-contaminated materials.
  - .2 Milestone Inspection B - Visual clearance inspection of work area following clean-up work procedures but prior to final tear-down procedures .
  - .3 Milestone Inspection C - Air clearance inspection and air monitoring of work area following Milestone Inspection B and the application of a slow drying sealer in the work area, but prior to final tear-down procedures.

## 1.13 EXISTING CONDITIONS

- .1 Reports and information pertaining to ACMS to be handled, removed, or otherwise disturbed and disposed of during this Project are indicated in Appendices A,B,C.
- .2 Notify Hazardous Materials Consultant of suspected asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Hazardous Materials Consultant.

## Part 2 Products

### 2.1 MATERIALS

- .1 Deliver all materials and disposable equipment in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name. Material that becomes contaminated with asbestos shall be disposed of in accordance with the applicable regulations.
- .2 Plastic sheet of 0.25 mm (10 mil) and 0.15 mm (6 mil) thick polyethylene, unless otherwise specified, sized to minimise the frequency of joints.
- .3 Reinforced polyethylene: polyethylene or polyolefin materials, coated on each side, with a unit weight equivalent to or exceeding 107 g/sq. m (4.6oz/sq. yd) and 12 mil thick.
- .4 Duct Tape: Suitable for sealing polyethylene to surfaces encountered and to itself under both wet and dry conditions including use of amended water .
- .5 Wetting agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether or other product approved by consultant mixed with water in concentration to provide total penetration and wetting of asbestos fibre .
- .6 Amended water: Water with non-ionic water surfactant added for purpose of reducing surface tension to allow thorough wetting of asbestos fibre,
- .7 Asbestos waste receptors: 0.25 mm minimum thickness labelled polyethylene. Container must be acceptable to disposal site selected and provincial Ministry of Environment.

- .8 Disposable coveralls: Standard of acceptance - full body coveralls with attached hood, manufactured by Dupont Tyvek, Kimberley Clarke or approved equal.
- .9 Warning labels and signs: delineating entry and protective equipment requirements and providing warning of the potential health effects of exposure to airborne asbestos fibre.
- .10 Encapsulant: an encapsulant and or lagging adhesive meeting the requirements of CAN/CGSB 1205-94. Standard of acceptance is Baker 120-19.
- .11 Plywood sheeting: good one side 10 mm (3/8") plywood.
- .12 Glove Bag: a clear, prefabricated, purpose-made, co-extruded poly-vinyl-chloride or polyethylene bag with integral gloves of suitable material. Continuous use bags shall be equipped with reversible double-pull, double-throw zippers with protective flaps to facilitate installation and progressive movement along pipe. Collars should be well defined to facilitate sealing the bag around the pipe.
- .13 Solvent (mastic remover): Orangsol or approved equivalent.
- .14 Duct Caps: of suitable thickness and fabrication to match duct materials, appropriately formed to allow attachment.

## 2.2 TOOLS AND EQUIPMENT

- .1 Spray equipment for application of amended water or slow drying sealer: Standard of Acceptance -.Grayco Hydraspray Airless spray unit.
- .2 HEPA vacuum equipment appropriate vacuum equipment equipped with High Efficiency - Particulate Absolute air filters capable of capturing and retaining 99.97% of all fibrous material 0.3 microns or larger.
- .3 Removal tools: suitable tools for asbestos removal including pliable nylon brushes for the removal of base and finish application.
- .4 Air Movement Equipment: low velocity, high volume centrifugal fan units enclosed in a sealed cabinet incorporating HEPA filter assemblies in their design and manufacture and conforming to specified testing and certification requirements. No air movement equipment shall discharge asbestos fibres outside the work area:
- .5 Temporary Lighting: Grounded halogen light fixtures.
- .6 Ground fault electrical panel: temporary service panel NBLP type 100 amp, 120/208 volt, 3 phase wire equipped exclusively with ground fault interrupter circuit.

## Part 3 Execution

### 3.1 PREPARATION OF WORK AREA

- .1 In areas where Low Risk or Moderate Risk partial containment is required:
  - .1 Cover all openings (windows, doors, ducts, diffusers, etc.) with polyethylene sheeting and seal with duct tape.
  - .2 Provide a worker decontamination area at the entrance to the work area consisting of a bucket of clean tepid water, soap and towels.
- .2 In High Risk containment areas:
  - .1 Establish critical barriers at all points of entry to the work area.

- .2 Line walls and critical barriers with 0.15 mm (6 mil) plastic sheet and seal with duct tape. Cover all openings in the ceilings (ducts, diffusers, etc.) with polyethylene sheeting and seal with duct tape.
  - .3 Ensure that the plastic linings provide a continuous barrier and that a seal is maintained around penetrating objects, tears and elsewhere as required by the Owner.
  - .4 Crate over and protect from damage all fixed objects in the removal area.
  - .5 Using HEPA filtered negative air cabinets, establish and maintain 0.02 inches negative pressure. One air change every 15 minutes shall be required. Ensure negative pressure requirements are maintained relative to pressures maintained in existing mechanical systems. Exhaust ducting from all air movement equipment installed in the work area shall extend outside of the building to areas meeting the approval of the Hazardous Materials Consultant. Air movement equipment shall operate continuously from the time of initial asbestos disturbance until approval of clean-up procedures by the Hazardous Materials Consultant or as directed by the Hazardous Materials Consultant.
  - .6 Remove window(s), using qualified trades, to allow exhaust of air movement equipment. Install plywood panels to maintain building security.
- .3 General Preparation Requirements:
- .1 Moderate Risk personnel protection procedures shall apply during work area preparation if risk of dislodging asbestos exists.
  - .2 If current lighting is inadequate, provide and install temporary lighting to provide one (1) lamp for every 20 square meters of work area.
  - .3 Ensure that all holes or openings in existing wall, ceiling and floor structures are adequately sealed.
  - .4 Remove floor mounted objects and other moveable objects which interfere with asbestos abatement. Clean and store movable objects in areas designated by the owner or others and protect from re-contamination.
  - .5 Maintain emergency and fire exits from the work areas, or, establish alternative exits satisfactory to fire officials,
  - .6 Seal all elevator and other shafts to prevent air leakage from or into these spaces,

### 3.2 DECONTAMINATION ENCLOSURES

- .1 Worker Decontamination Unit
- .1 Worker Decontamination Enclosures shall be constructed in locations approved by the Hazardous Materials Consultant.
  - .2 Locate work area water supply shutoff outside of the work area.
  - .3 Build equipment and access room between shower room and contiguous with the work area, with two curtain doorways: one to shower room and to work area.
  - .4 Build shower room between clean room and equipment and access room, with two curtain doorways, one to clean room and one to equipment and access room. Shower rooms shall be walk through type, ensure entry and exit through actual showers by opposing doors, such that access to clean room from shower room must be through actual showers. Contractor shall provide hot and cold water supply in each work area and must provide a minimum of two shower heads, self-activating pump for disposal of waste water and leak proof connections to water supply.

- .5 Build clean room between shower room and clean areas outside of enclosures, with one curtain doorway leading to shower room and second lockable door to outside of enclosures. Provide lockers or hangers for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly. Provide one clean towel per worker per decontamination for all workers on site.
- .2 Waste Transfer Enclosure
  - .1 Build container cleaning room between staging area and holding room with two doorways, one to staging area and one to holding room. Room shall be built of sufficient size to allow proper washing of equipment and drums and/or double bagging of asbestos waste. Wash water shall be treated as asbestos contaminated waste.
  - .2 Build holding room between washroom and un-contaminated area, with two curtain doorways, one to washroom and one to un-contaminated area, and a lockable door to outside of enclosures. Holding room shall be of sufficient size to accommodate largest item of equipment used and all waste containers,
- .3 General Requirements for Decontamination Enclosures
  - .1 Construction shall be of quality and design to assure against leakage of asbestos fibres and/or water to areas outside scope of work.
  - .2 Build curtain doorways designed so when workers or drums and equipment move through doorway, one of two barriers comprising doorways always remains closed.
  - .3 Provide lockable doors at entrances to clean room and holding room of the decontamination enclosure systems,
  - .4 Enclosures shall be maintained in clean and tidy condition.
  - .5 Visually inspect enclosures regularly and at the beginning of each working period. Repair damaged barriers and remedy defects immediately upon discovery.

### 3.3 ASBESTOS DISTURBANCE AND REMOVAL

- .1 Wetting and removal of asbestos materials shall not proceed until Milestone Inspection A (pre- contamination inspection) is undertaken by the Hazardous Materials Consultant.
- .2 Pipe fitting compound, lineal pipe insulation (High Risk), transite cement rainwater leader, drywall/gypsum board compound (Moderate or Low Risk):
  - .1 Remove pipe fitting compound and lineal pipe insulation using appropriate tools to facilitate complete removal from pipes, to the extent required to allow for completion of other Work of this Contract, in each location. Glove-Bag abatement methodology is acceptable.
  - .2 Remove joint compound from walls and ceilings, where present using appropriate tools to facilitate complete removal from framing, to the extent required to allow for completion of other Work of this Contract, in each location.
  - .3 Remove transite cement rainwater leaders using appropriate tools to facilitate complete removal of pipes to the extent required to allow for completion of other Work of this Contract, in each location.
  - .4 Place asbestos waste and associated debris in sealed, labelled asbestos waste receptors.
  - .5 Wet clean or HEPA vacuum, as appropriate, all floor surfaces within each work area.

- .6 Apply a slow drying sealer to all surfaces following Milestone Inspection B.
- .7 Notify the Hazardous Materials Consultant that the site is ready for Milestone Inspection C, where applicable.

### 3.4 GENERAL CLEAN-UP

- .1 Upon receipt of acceptable air clearance results from the Hazardous Materials Consultant (where applicable), Contractor's supervisory personnel must perform a visual inspection to ensure the work has been performed as specified.
- .2 Wet clean or HEPA vacuum entire work area including floor, wall and curtain doorway surfaces to a high standard of cleanliness.
- .3 Tear-down critical barriers, plastic linings, curtain doorways and air-locks and dispose of as contaminated waste. Remove and dispose all asbestos-contaminated materials.
- .4 Dispose of all cloths, mops, sponges, rags, nylon brushes, brooms and any bristled tools as asbestos waste.
- .5 Wet clean and bag all boots, tools before removal from site.
- .6 Clean and seal wood planks and ladders with removal from site.
- .7 Final clean-up and dismantling procedures shall be undertaken by workers suitably protected with half face respirators equipped with HEPA filters and disposable coveralls.

### 3.5 DISPOSAL

- .1 As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled asbestos waste and dispose of in an authorised disposal area in accordance with the requirements of the disposal authority.
- .2 Comply with Federal, Provincial and Municipal authorities regarding the transport and disposal of asbestos waste materials.
- .3 Dumpsters, lockable bins or covered vans only shall be used for the disposal of asbestos. Bins or dumpsters shall be firmly and securely covered with tarpaulins and provided with hazardous waste identification placards at all times and prior to transportation.
- .4 Ensure each shipment of containers to landfill is accompanied by Contractor's representative who shall supervise dumping of containers, supply equipment operators with appropriate personal protective equipment and ensure guidelines and regulations are followed. Each load shall require completion and signing of waste manifest forms. Consignor's copies of manifests to be retained by the Hazardous Materials Consultant. Ensure compliance of manifest system requirements for disposal of hazardous waste.
- .5 Ensure landfill operator is fully aware of hazardous material being disposed of and equipment operators have been fully briefed in management of asbestos containers after delivery to the landfill.

**END OF SECTION**



**Part 1 General**

**1.1 WORK INCLUDED**

- .1 Forming of all cast-in-place concrete indicated on drawings and subsequently remove all such forms.

**1.2 RELATED SECTIONS**

- .1 Section 03 20 00 Concrete Reinforcement
- .2 Section 03 30 00 Cast-in-Place Concrete

**1.3 DESIGN AND CODE REQUIREMENTS**

- .1 Formwork and supporting falsework shall be designed and constructed in accordance with the requirements of CSA-S269.3-R2013, CSA S269.1- R2003 and CSA A23.1 – 09 (R2014) as applicable to the work.
- .2 Assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.
- .3 Retain a Professional Engineer to design falsework which consists of shoring more than one tier in height or which is a framed structure. The Engineer shall be registered in the Province of Saskatchewan and shall inspect the shoring prior to its use.
- .4 The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

**1.4 HANDLING AND STORAGE**

- .1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

**Part 2 Products**

**2.1 QUALITY AND STRENGTH**

- .1 The quality and strength of formwork material shall comply with the requirements set forth in this Specification and CSA A23.1 – 14.

**2.2 FINISHES**

- .1 Form materials for concrete surfaces which will be exposed to view, or which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edges, smooth panels of plywood, metal or plastic to approval of the Consultant. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.

- .2 Square edged, tongue and groove or shiplap lumber may be used to form concrete which will not be exposed to view or which does not require smooth uniform surface for other purposes.
- .3 Provide 20 mm chamfers at column and beam corners, if showed on drawings.

## 2.3 MATERIALS

- .1 Form plywood: exterior grade, Douglas Fir conforming to CSA Standard O121-08 (R2013). Plywood shall be resin coated one side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make up or patching strips between panels shall be kept to a minimum.
- .2 Lumber for forms, falsework, shoring and bracing: conform to CSA Standard 0141-05 (R2014) for Softwood Lumber, and the applicable authorized grading authority. All lumber shall be a grade to which allowable unit stresses may be assigned in accordance with the National Building Code. All lumber shall be grade marked by the authorized grading authority.
- .3 Form ties:
  - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
  - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .4 Form release agent: Proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.
- .6 Falsework materials: to CSA-S269.1.

## Part 3 Execution

### 3.1 FABRICATION AND ERECTION

- .1 Examine the excavations and foundations for adequate working room and support for the work of this section.
- .2 Verify lines, levels and centre lines before proceeding with the work and ensure that dimensions agree with drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Report to the Consultant discrepancies in other work which affect the work of this section.

### 3.2 PREPARATION

- .1 Coat the inside surfaces of forms with a form release agent, used in accordance with the manufacturer's instructions.
- .2 Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.

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**3.3 ASSEMBLY AND ERECTION**

- .1 Construct the formwork and shoring and bracing to meet the design and code requirements, accurately so that the resultant finished concrete shall conform to the shapes, lines and dimensions shown on the drawings, within the specified tolerances.
- .2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that the concrete will not be damaged during its removal.
- .3 Review locations of ties and form panels for exposed concrete work with the Consultant.
- .4 Check and correct formwork as required, both horizontally and vertically, during the placing of the concrete.
- .5 Construct formwork to maintain the following maximum tolerances:
  - .1 Deviation from horizontal and vertical lines:  
6 mm in 3000 mm  
20 mm in 12000 mm.
  - .2 Deviation in cross sectional dimensions of thickness of walls: plus or minus 6 mm.
- .6 Obtain Consultant's approval for use of earth forms.

**3.4 JOINTS IN FORMS**

- .1 Make form joints tight in order to prevent leakage of mortar.
- .2 Clean all edges and contact surfaces before erection.
- .3 Where required, install pvc waterstop to manufacturer's instructions and without displacing reinforcement. Do not distort or pierce waterstop.

**3.5 SHORING AND BRACING**

- .1 Provide bracing to ensure the stability of the formwork as a whole.
- .2 Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

**3.6 EMBEDDED PARTS AND OPENINGS**

- .1 Provide formed openings where required for pipes, conduit, sleeves and other work to be embedded in and passing through concrete members. Accurately locate and set in place items which are to be cast directly into the concrete. Co-ordinate the work of other sections and co-operate with the trade involved in the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. No such forming or setting of openings, slots, recesses, chases, sleeves, or parts shall be done unless specifically shown on the drawings or approved prior to installation.
- .2 Obtain Consultant's approval before framing openings in concrete not specifically detailed on structural drawings.

- .3 Provide temporary ports or openings where required to facilitate cleaning and inspection. Openings at the bottom of forms shall be located so that flushing water will drain from the forms.
- .4 Close the temporary ports or openings with tight fitting panels, flush with the inside face of the forms, neatly fitted so that the joints will not be apparent in exposed concrete surfaces.
- .5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval in writing of all modifications from the Consultant before placing concrete.

### 3.7 FIELD QUALITY CONTROL

- .1 Inspect and check the completed formwork, shoring and bracing to ensure that the work is in accordance with the formwork design, and that the supports, fastenings, wedges, ties and parts are secure. The Engineer responsible for the design of the formwork shall assist in this inspection.
- .2 Inform the Consultant when the formwork is complete and has been cleaned. Obtain the approval of the engineer responsible for the design of the formwork and the general approval of the Consultant before placing concrete.
- .3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the cleanout ports.

### 3.8 CLEANING

- .1 Clean the forms as erection proceeds to remove foreign matter.
- .2 Remove cuttings, shavings and debris from within the forms.
- .3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the cleanout ports.

### 3.9 REMOVAL OF FORMWORK

- .1 Notify the Consultant before removing formwork.
- .2 Reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.
- .3 Do not remove forms and shoring before concrete has attained sufficient strength to ensure safety of structure. If evidence to verify concrete strength is not available, the forms and shores shall not be removed before the following minimum intervals after concrete is placed.
  - .1 Walls and grade beams - 5 days.
- .4 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.
- .5 Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by Consultant.

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- .6 Store removed forms, for exposed architectural concrete, in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
  - .7 Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.
  - .8 Re-use of formwork and falsework is subject to the requirements of CSA A23.1-14.

**END OF SECTION**



**Part 1 General**

**1.1 WORK INCLUDED**

- .1 Supply and install all bonded reinforcement and associated items required and/or indicated on the Drawings for all cast-in-place concrete and reinforced masonry work.

**1.2 RELATED WORK**

- .1 Section 03 10 00 - Concrete Formwork
- .2 Section 03 30 00 - Cast-in-Place Concrete
- .3 Section 03 20 33 - Concrete Reinforcing

**1.3 INSPECTION AND TESTING**

- .1 Upon request, provide certified copy of mill test report of steel supplied, showing physical and chemical analysis.

**1.4 REFERENCES**

- .1 American Concrete Institute (ACI)
  - .1 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
  - .2 American National Standards Institute/American Concrete Institute (ANSI/ACI)
  - .3 ANSI/ACI 315-99, Details and Detailing of Concrete Reinforcement.
  - .4 American Society for Testing and Materials (ASTM)
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA-A23.1-09 (R2014), Concrete Materials and Methods of Concrete Construction.
  - .2 CAN3-A23.3-14, Design of Concrete Structures.
  - .3 CAN/CSA-G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.
  - .4 CAN/CSA-G40.20-13/CAN/CSA-G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steels.

**1.5 Shop Drawings**

- .1 Prepare and submit reinforcing steel and mesh placing drawings and bar bending and cutting schedules for all steel reinforcement shown or specified in accordance with General Conditions.
- .2 All drawings and schedules shall be prepared and checked under the direct supervision of a qualified Professional Engineer who is experienced in this work.
- .3 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 - 315 Manual of Standard Practice and Metric Supplement by Reinforcing Steel Institute of Ontario.
- .4 Design and detail lap lengths and bar development lengths to CSA A23.3-14, unless specified on drawings.
- .5 Review of shop drawings is for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

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**1.6 SUBSTITUTES**

- .1 Substitution of different size bars permitted only upon written approval of the Consultant.

**1.7 DELIVERY AND STORAGE**

- .1 Reinforcing steel, welded wire fabric and accessories shall be delivered, handled and stored in a manner which prevents contamination from bond reducing or foreign matter and damage to its fabricated form.

**Part 2 Products**

**2.1 MATERIALS**

- .1 All reinforcing steel, unless noted otherwise on the drawings or herein shall be deformed bars of new billet steel conforming to the current CSA G.30.18-09 (R2014), Grade 400, plain finish for all bars. Minimum splice for 10M bars to be 450 mm. Minimum lap splice for all other bars to be 36 bar diameters or 675 mm, whichever is greater.
- .2 Welded wire fabric: Provide in flat sheets only.
- .3 Tie wires shall be 1.29 mm or heavier annealed wire or a patented system approved by the Consultant.
- .4 Reinforcing steel supports shall conform to ACI Standard 315 unless otherwise approved by the Consultant.
- .5 Mechanical splices are subject to the approval of the Consultant.

**2.2 FABRICATION**

- .1 Fabricate bends, splices and ties and supply bar supports and accessories in accordance with the requirements of CSA A23.3-14. Spacing and arrangements of supports in accordance with ACI 315.
- .2 All intermediate grade reinforcing bars shall be bend cold without hickeying. All high strength steel shall be preheated.
- .3 Reinforcing bars shall not be straightened or re-bent.
- .4 Location of reinforcement splices not shown on the drawings are subject to approval by the Consultant and shall, for beams and slabs be away from points of maximum stress in the steel.
- .5 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

**2.3 SOURCE QUALITY CONTROL**

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

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Examine the work upon which this section depends and report any discrepancies to the Consultant.
- .2 Commencement of the work shall imply acceptance of conditions.



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**3.2 PLACING**

- .1 Reinforcement of the size and shapes shown on the drawings shall be accurately placed in accordance with the approved shop drawings, the structural drawings and the requirements of the current National Building Code.
- .2 Clear distances between bars, except for columns shall be not less than the nominal diameter of the bar, or 25 mm or one and one-third the maximum size of the coarse aggregate. Bars placed in two or more layers shall have a minimum clear distance between the layers of not less than 25 mm and shall be placed directly above and below each other.
- .3 Clear distance between bars in columns shall be not less than one and one-half the nominal diameter of the bar or 40 mm or one and one-half times the maximum size of the coarse aggregate.
- .4 Reinforcing steel shall, where not otherwise shown on the structural drawings, be protected by the clear cover of concrete over the reinforcement as follows:
  - .1 75mm where concrete is formed against earth.
  - .2 Where concrete placed against forms is to be exposed to the weather or be in contact with the ground, 50 mm for bars larger than 15M, 40 mm for bars 15M and smaller.
  - .3 20mm for slabs and walls not exposed to the ground or weather.
  - .4 In beams, girders and columns not exposed to the ground or weather, 40 mm to principal reinforcement, ties and stirrups.The foregoing clear covers shall be maintained within 5 mm.
- .5 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with the latest ACI Standard 315.
- .6 For slabs on grade, footings or similar construction, concrete blocks may be used in place of metal chairs.
- .7 Review with the Consultant, placement of reinforcement prior to concreting.
- .8 Notify the Consultant 24 hours prior to placing concrete.

**3.3 CLEANING**

- .1 All materials shall be clean and free of all form oil or deleterious materials.
- .2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Consultant.

**END OF SECTION**



**Part 1 General**

**1.1 WORK INCLUDED**

- .1 All plain and reinforced cast-in-place concrete shown on drawings.
- .2 Setting anchors, inserts, frames, sleeves and other items supplied by other Sections.
- .3 Repairing concrete imperfections.
- .4 Finishing formed concrete surfaces.

**1.2 RELATED SECTIONS**

- .1 Section 031000 Concrete Formwork
- .2 Section 032000 Concrete Reinforcement
- .3 Section 033000 Cast in Place Concrete

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .2 ASTM C309-07, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .3 ASTM C330/C330M-13, Standard Specification for Lightweight Aggregates for Structural Concrete.
  - .4 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
  - .5 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-09 (R2014), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.
  - .3 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .4 CSA-A3001-03, Cementitious Materials for Use in Concrete.

**1.4 ACRONYMS AND TYPES**

- .1 Cement: hydraulic cement or blended hydraulic cement.
  - .1 Type GU or GUb - General use cement.
  - .2 Type MS or MSb - Moderate sulphate-resistant cement.
  - .3 Type MH or MHb - Moderate heat of hydration cement.
  - .4 Type HE or Heb - High early-strength cement.
  - .5 Type LH or LHb - Low heat of hydration cement.
  - .6 Type HS or HSb - High sulphate-resistant cement.

- .2 Fly ash:
  - .1 Type F - with CaO content less than 8%.
  - .2 Type CI - with CaO content ranging from 8 to 20%.
  - .3 Type CH - with CaO greater than 20%.
- .3 GGBFS - Ground, granulated blast-furnace slag.

#### 1.5 QUALITY ASSURANCE

- .1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Section.
- .2 For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.
- .3 Perform cast-in-place concrete work to requirements of CSA A23.1-09 (R2014)- "Concrete Materials and Methods of Concrete Construction".
- .4 Submit proposed mix design for each class of concrete to Consultant for approval two weeks prior to commencement of work.

#### 1.6 PRODUCT HANDLING

- .1 Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.
- .2 In the event of damage, immediately make all repairs and replacements necessary to approval of the Consultant and at no additional cost to the Owner.

#### 1.7 SHOP DRAWINGS

- .1 Review of the shop drawings by the Engineer is intended to assist the Contractor and does not relieve the Contractor of responsibility for the completeness and accuracy of the work and its conformance with the contract drawings and specifications.
- .2 Fabrication that commences prior to shop drawing review by the Engineer is at the risk of the Contractor.

#### 1.8 INSPECTION AND TESTING

- .1 Inspection and testing is to be performed by a firm approved by the Consultant and paid for by the Contractor.
- .2 Provide free access to all portions of work and co-operate with appointed firm.
- .3 Advise testing firm 24 hours in advance of concrete placement.
- .4 One concrete test, consisting of three test cylinders, is to be taken each day concrete is placed for each class of concrete placed. One cylinder to be tested at 7 days, the remaining two cylinders to be tested at 28 days.
- .5 One (1) slump test and one (1) air content test is to be taken for each set of test cylinders taken.
- .6 Testing of concrete is to be performed in accordance with CSA A23.2-09 (R2014) "Method of Test for Concrete".
- .7 Test results are to be issued to the Contractor, Consultant, and Owner. Test reports are to be numbered consecutively beginning with number one.
- .8 Required retesting is to be paid for by the Contractor.

- .9 Testing firm is to take one additional test cylinder during cold weather concreting and cure on job site under same conditions as the concrete it represents.
- .10 Testing firm is to report results of tests immediately to the Contractor. The Contractor is responsible for ensuring that the concrete meets the requirements of the specifications. Report adverse test results to the Engineer immediately.

## Part 2 Products

### 2.1 MATERIALS

- .1 Cement: Normal – Type GU and Sulphate Resistant – Type HS Portland Type, to CSA-A3000-13 “Cementitious Materials Compendium”
- .2 Supplementary Cementing Material
  - .1 Concrete may contain up to 15% fly ash. Fly ash to be type F or C.
- .3 Fine and Coarse Aggregates: conforming to CSA A23.1-09 (R2014) -“Concrete Materials and Methods of Concrete Construction”. The fine and coarse aggregate for concrete slabs, toppings and sidewalks shall contain a maximum of 0.4% low density particles as determined by CSA Test A23.2-4A “Low Density Granular Material in Aggregate”.
- .4 Water: clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material. Water to CSA A23.1-09 (R2014).
- .5 Admixtures
  - .1 Air-entraining admixtures are to conform to the requirements of ASTM C260. The admixture is to be of uniform consistency and quality within each container and from shipment to shipment.
  - .2 Water-reducing admixtures are to conform to the requirements of ASTM C494, Type A or D. The admixture is to be of uniform consistency and quality within each container and from shipment to shipment.
  - .3 Superplasticizers, if approved by the Engineer, (high-range water reducers) are to conform to the requirements of ASTM C494, Type F or G.
- .6 Accessories
  - .1 Curing Compounds: shall conform to the requirements of the latest issue of ASTM Standard C309 and CSA A23.1/ A23.2 -09 (R2014).
  - .2 Void Form: 150 thick cardboard honeycomb form suitable for project conditions. Top sheet to be 10mm OSB or plywood. Cover and wrap edges with 0.15 mm poly vapour barrier.
  - .3 Joint Sealant: non-staining, non-sagging, grey polyurethane base.
  - .4 Embedded Dowels: 2 component epoxy adhesive, complete with non-abrasive fillers conforming to ASTM c881, Type IV – Grade 3.
  - .5 Non-Shrink Grout: Pre-mixed compound consisting of non metallic aggregate, cement, water reducing and plasticizing agents. Pre-mixed in strict accordance with manufacturer’s instructions to obtain compressive strength of 16 mpa in 24 hours and 50 mpa in 28 days.

### 2.2 MIXES

- .1 Mechanical mix concrete in accordance with the requirements of CSA A23.1-09 (R2014).
- .2 Submit proposed mix design to Consultant two weeks prior to commencement of work. Provide certification that mix proportions selected will produce concrete of specified quality and that strength will comply with CSA A23.1 – 09 (R2014).

- .3 Each load of ready-mixed or transit-mixed concrete delivered to the project site shall be accompanied by duplicate delivery slips providing the following information:
  - .1 Name of ready-mix batch plant
  - .2 Serial number of ticket
  - .3 Date and truck number
  - .4 Name of contractor
  - .5 Specific designation of project
  - .6 Specific class of concrete
  - .7 Amount of concrete in cubic metres
  - .8 Time of loading or first mixing of aggregate, cement and water
- .4 Use accelerating admixtures in cold weather only when approved by Consultant.
- .5 Use set-retarding admixtures during hot weather only when approved by the Consultant.
- .6 Use of plasticizers only when approved by Consultant.
- .7 Do not use calcium chloride or admixtures containing calcium chloride.
- .8 Use all admixtures in strict accordance with the manufacturer's recommendations.
- .9 Documentation indicating the compatibility of the water reducing admixture, the air entraining admixture, the superplasticizing admixture (if any), the cement, the silica fume (if any) and the fly ash (if any) is to be submitted with the mix design for review by the Engineer.

### Part 3 Execution

#### 3.1 PREPARATION

- .1 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- .2 Verify that all items to be embedded in concrete are in place.
- .3 Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.
- .4 During concreting operations:
  - .1 Development of cold joints not allowed.
  - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .5 Pumping of concrete is permitted after approval of equipment and mix supplier.
- .6 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .7 Remove all wood scraps and debris from the formed areas in which concrete will be placed.
- .8 Thoroughly clean the forms to ensure proper placement and bonding of concrete.
- .9 Thoroughly wet the forms, except in freezing weather, or oil them; remove all standing water.
- .10 Thoroughly clean all transporting and handling equipment.

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**3.2 DISCREPANCIES**

- .1 In the event of discrepancy, immediately notify the Consultant.
- .2 Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

**3.3 PLACING CONCRETE**

- .1 Place concrete in accordance with requirements of CSA A23.1-09 (R2014) and as indicated on Drawings.
- .2 Notify Consultant and Inspection and Testing Firm a minimum of 24 hours prior to commencement of concreting operations.
- .3 Do not place concrete against frozen ground, frozen concrete or frosted forms.
- .4 Ensure all anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause undue hardship in placing concrete.
- .5 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- .6 Ensure reinforcement, inserts, embedded parts, formed joints and fitments are not disturbed during concrete placement.
- .7 Prepare previously placed concrete by cleaning with steel brush.
- .8 Do not place concrete older than 2 hours from batch time.
- .9 Do not add water after batching unless in strict accordance with CSA A23.1, Clause 5.2.4.3.2 and such that concrete conforms with the specified mix design parameters.
- .10 Pour concrete continuously between predetermined construction and control joints. All construction joints subject to approval of the Consultant.
- .11 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Contractor can place the planned casting without stopping.
- .12 Convey concrete to the place of final deposit by methods which will prevent the segregation or loss of material.
- .13 Equipment to be such that when concreting has once started, the depositing of concrete is to proceed at a rate and sequence such that concrete is at all times sufficiently plastic to ensure proper bonding of successive layers or panels.
- .14 Conveying and placing equipment to be free of hardened concrete and foreign material. Clean at frequent intervals.
- .15 Concrete to be deposited as close as practicable to final position. Avoid segregation due to re-handling or flowing. Place in horizontal lifts to maintain a level surface.
- .16 Vertical height of free fall of concrete not to exceed maximum required for good practice. If segregation occurs, chutes and spouts to be used.
- .17 Consolidate thoroughly and uniformly by tamping, hand tools, vibrators and finishing machines. Secure dense, homogeneous structure, close bond with reinforcement and smooth formed surfaces. Use internal vibrators wherever practicable. External-type vibrators only where satisfactory surfaces cannot be obtained with internal type.
- .18 Internal vibrators applied at the point of deposit in the areas of freshly placed concrete. Allow to sink in the concrete until penetrated into the previous layer of concrete. Withdraw immediately at the same speed at which they sank. Move about 300 mm to a

new location and then repeat process. Extreme care to be taken not to disturb the reinforcing steel or the forms.

- .19 Saw cut slabs on grade as indicated on Drawings. Saw cut control joints within 24 hours after finishing. Vacuum clean saw cut prior to installation of sealant.
- .20 Excessive honeycomb or embedded debris in concrete is not acceptable. Remove and replace defective concrete. Excessive honeycomb is when eraser end of a pencil fits into cavity.

### 3.4 CURING

- .1 Cure and protect concrete in accordance with CSA-A23.1.
- .2 Initial curing: Keep concrete surfaces continuously moist and cure at a minimum temperature of 10°C for three days or for the time required to obtain 35% of the required 28 day strength.
- .3 Final curing: Immediately following initial curing and before the concrete has dried, maintain curing to ensure required strengths and durability are obtained. Moist cure the following concrete at a minimum temperature of 10°C for the times noted or for the time required to obtain 70% of the 28 day strength.
  - .1 Foundation concrete exposed to sulphate attack to be continuously moist cured for a minimum of seven days.
  - .2 Exterior exposed concrete to be continuously moist cured for a minimum of seven days.
- .4 Protect concrete from sudden temperature changes as noted in CSA-A23.
- .5 Acceptable curing methods:
  - .1 Ponding or continuous sprinkling.
  - .2 Absorptive mat or fabric kept continuously wet.
  - .3 Continuous steam vapour mist bath not exceeding 70°C.
  - .4 Curing compounds approved by the Engineer for type and rate of application.
  - .5 Waterproof paper or plastic film.
  - .6 Watertight forms left in place. Wood forms are not considered watertight unless coated or sealed to prevent moisture absorption.
  - .7 Other moisture-retaining method approved by the Engineer.
- .6 Where curing compounds are approved, apply in two applications at right angles to each other.
- .7 Do not use curing compounds on concrete surfaces to receive topping, hardener or other type of bonded finish unless approved by the Engineer. Confirm that the coatings and curing compound are compatible.
- .8 Protect freshly placed and consolidated concrete against damage or defacement from curing methods or adverse weather conditions.
- .9 Exterior concrete to be protected and allowed to air dry for 30 days prior to application of de-icing chemicals.
- .10 Exposed concrete walking surfaces not to receive an integral hardener: Coat with curing compound of type that provides permanent seal.
- .11 Do not use water curing during freezing weather.
- .12 During hot weather, begin curing process immediately after finishing. Use continuous water or absorptive mats.



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**3.5 PROTECTION**

- .1 Hot Weather Protection
  - .1 When the air temperature is at or above 27 degrees C, hot weather requirements shall be applicable.
  - .2 Time of initial mixing to complete discharge shall not exceed one hour and fifteen minutes and concrete placed shall not exceed 30 degrees C.
  - .3 Concrete forming surfaces and reinforcing steel shall be sprinkled with cool water just prior to placing concrete. Standing water or puddles shall be removed prior to concrete placement.
  - .4 Special wind protection shall be provided as directed by the Consultant.
  - .5 Walls shall be kept continuously damp for twenty-four (24) hours by normal curing procedures as outlined by this Specification. Slabs cured by the applications of sealing, shall have curing compound applied immediately after finishing of the slab but before evaporation of surface moisture.
  - .6 The use of water reducing agents shall be subject to the approval of the Consultant when hot weather conditions prevail.
- .2 Cold Weather Protection
  - .1 Concrete shall be placed within an insulated and heated hoarding. At the time of placing and during curing, concrete surfaces shall be protected from direct exposure to combustion gases or drying from heaters. The hoarding shall be of sufficient size so as to ensure perimeter sections of the concrete structure are properly heated and cured.
  - .2 After the curing period, the heat shall be turned off and the hoarding left in place for at least 24 hours.

**3.6 CONSTRUCTION JOINTS**

- .1 The location and detail of all construction joints not detailed on the structural drawings shall be approved by the Consultant.
- .2 Where fresh concrete is to be placed against concrete which has set or has partially set, the surface of the set or partially set concrete shall be roughened, cleaned of all laitance, and thoroughly soaked with water prior to the placement of fresh concrete.
- .3 In general the construction joints in floor and roof systems shall be located at the 1/3 points of the spans of slabs, beams and girders. Proper key and dowels or extensions of reinforcing shall be provided at all construction joints.
- .4 Concrete placed in wall and column forms shall be struck off flush with the underside of the floor and roof systems.

**3.7 DEFECTIVE CONCRETE**

- .1 Concrete not meeting the requirements of the Specifications and drawings shall be considered defective concrete.
- .2 Concrete not conforming to the lines, details and grade specified herein or as shown on the drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Consultant. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified in the Formwork Section of these Specifications.
- .3 Concrete not properly placed resulting in excessive honeycombing and all honeycombing and other defects in critical areas of stress, shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Consultant.

- .4 Concrete of insufficient strength or improper consistency shall be, as required by the Consultant, subject to one or more of the following:
  - .1 Changes in mix proportions for the remainder of the work.
  - .2 Cores drilled and tested from the areas in questions as directed by the Consultant and in accordance with CSA A23.2-14. The test results shall be indicative of the in-place concrete.
  - .3 Load testing of the structural elements in accordance with CSA A23.3-14.
  - .4 The changes in the mix proportions and the testing shall be at the Contractor's expense.
- .5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Consultant.

### **3.8 PATCHING CONCRETE**

- .1 After the removal of the forms concrete surfaces may be subject to inspection by the Consultant.
- .2 All exposed metal form ties, nails, wires, shall be removed, fins broken off and all loose concrete removed.
- .3 Form tie pockets shall be thoroughly wetted and patched with patching concrete followed by proper curing.
- .4 Redundant dowel holes, honeycombed and other defective surfaces shall be chipped away to a depth of not less than 25 mm with the edges perpendicular to the surface, thoroughly wetted and patched with non-shrink grout followed by proper curing.
- .5 Non-shrink grout shall be thoroughly compacted into place and finished in such a manner as to match the adjoining concrete. The design mix of the non-shrink grout shall be approved by the Engineer.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Work Included**

- .1 Patching and repairing existing masonry work as required for alteration and renovation work of this project.
- .2 Review drawings and coordinate masonry work with work of other trades to determine full extent of work required.

### **1.2 RELATED SECTIONS**

- .1 Section 02 41 16: demolition, removal and cutting openings in existing masonry.
- .2 Loose steel lintels, Section 05 50 00 - Metal Fabrications: angle lintels.

### **1.3 References**

- .1 Canadian Standards Association (CSA)
  - .i CSA A82.1 Burned Clay Brick (Solid Masonry Units Made From Clay or Shale).
  - .2 CSA A179 Mortar and Grout for Unit Masonry.
  - .3 CSA A371 Masonry Construction for Buildings.
  - .4 CSA A370 Connectors for Masonry.
  - .5 CSA A165 Series (CSA-A165.1) CSA Standards on Concrete Masonry Units.

### **1.4 SUBMITTALS**

- .1 Shop Drawings
  - .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples: submit 1 full size sample of Stone to compare to the existing units.

### **1.5 QUALITY ASSURANCE**

- .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 31 19.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Storage space on project site is limited.
- .2 Deliver and store materials only areas in designated by Contractor.

### **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

## **2. Products**

### **2.1 MASONRY UNITS**

- .1 The new stone band below the new windows shall match the existing Tyndall stone on the building. Submit samples for Consultant's approval.
- .2 Use salvaged brick for patching exterior exposed masonry veneer.
- .3 Standard concrete masonry units: to CSA A165 Series:
  - .1 Classification: H/15/C/M standard weight and H/15/A/M lightweight to CSA A165.1-M. Use lightweight units for fire rated partitions.
  - .2 Size: modular, as indicated.

### **2.2 MORTAR MATERIALS**

- .1 Mortar and grout: to CSA A179.
- .2 Cement:
  - .1 For concrete unit masonry, clay brick: normal Portland to -A5.
  - .2 For stone: non-staining cement, Medusa or non-staining masonry cement, Stoneset or equal.
- .3 Admixture: No admixtures or other constituents permitted except upon approval of Consultant.
- .4 Grout: to CSA A179, Table 3.
- .5 Mortar types: Type S based on Proportion specifications.

### **2.3 ACCESSORIES**

- .1 Connectors: to CSA A370, corrosion resistant or non-corroding connectors at exterior cavity walls.
- .2 Reinforcement: to CSA A371.
- .3 Masonry flashing: self-adhesive modified bitumen sheet membrane: minimum 40 mils thick. Bakelite Blueskin SA; WR Grace Perm-A-Barrier; Soprema Colphene 1500.
- .4 Weep hole tubes: purpose made plastic, designed to drain cavities to exterior by means of 9 mm diameter sloped tubing.
- .5 Sealants: in accordance with Section 07 90 00, colour selected by Consultant.

## **3. Execution**

### **3.1 WORKMANSHIP**

- .1 Do masonry work in accordance with CSA A371, except where specified otherwise.
- .2 Do masonry mortar and grout work in accordance with CSA A179, except where specified otherwise.
- .3 Install masonry connectors and reinforcement in accordance with CSA A370 and CSA A371, unless specified otherwise.
- .4 Build masonry plumb, level, and true to line, with vertical joints in alignment where applicable.

- .5 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .6 Masonry courses to be of uniform height, both vertical and horizontal joints to be of equal and uniform thickness.
- .7 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.
- .8 Where new masonry abuts fully set masonry, clean existing surfaces and dampen if necessary to obtain bond.

### 3.2 JOINTING

- .1 Strike flush all joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint of similar thin finish coating.
- .2 For patchwork in exposed masonry match adjacent jointing.
- .3 For exposed concrete block provide concave joints.

### 3.3 REMEDIAL WORK

- .1 Patch and repair existing masonry work where indicated, and as required for alteration and renovation work.
- .2 Use new materials to match, except where indicated or specified otherwise.
- .3 Align coursing and vertical joints with existing adjacent work. Tooth new units into existing. Make patchwork in exposed masonry as inconspicuous as possible.
- .4 Infill openings in existing masonry partitions with concrete block.
- .5 Infill openings in exterior masonry veneer cavity walls.
- .6 Use salvaged brick for patching exposed brick veneer.
- .7 Where ductwork, piping, etc. has been removed from masonry walls infill openings.
- .8 Where new openings have been cut in existing masonry walls and partitions for installation of new ductwork, piping and equipment, patch and repair around openings.
- .9 Provide new concrete block lintels over openings cut in concrete block walls. SPEC NOTE: Posts are normally grouted in with non-shrink cementitious grout, welded to embedded plates or welded to plates then attached to concrete. Determine method used on project and specify here.

### 3.4 HORIZONTAL REINFORCING

- .1 Install horizontal reinforcing in block walls.
- .2 Provide continuous horizontal reinforcing spaced at vertical intervals 400 mm]maximum,
- .3 Overlap splices minimum 150 mm.

### 3.5 REINFORCED LINTELS

- .1 Install reinforced masonry lintels over openings. Make joints in lintels to match adjacent walls. End bearing not less than 200 mm.
- .2 Place and grout reinforcing in accordance with CSA S371. Use 20 MPa (2900 psi) grout or concrete.

### **3.6 JOINING OF WORK**

- .1 Where necessary to temporarily stop horizontal runs of masonry, and in building corners:
  - .1 Step-back masonry diagonally to lowest course previously laid.
  - .2 Do not "tooth" new masonry.
  - .3 Fill in adjacent courses before heights of stepped masonry reach 1200 mm.

### **3.7 CUTTING**

- .1 Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.
- .2 Make cuts straight, clean, and free from uneven edges. Use masonry saw where necessary.

### **3.8 BUILDING-IN**

- .1 Build in items required to be built into masonry.
- .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

### **3.9 PROVISIONS FOR OTHER TRADES**

- .1 Provide openings in masonry walls where required or indicated.
- .2 Accurately locate chases and openings and neatly finish to the required sizes.
- .3 Where masonry encloses conduit or piping, bring to proper level indicated and as directed. Do not cover pipe or conduit chases or enclosures until advised that work has been inspected and tested.

### **3.10 PROVISION FOR MOVEMENT**

- .1 Leave minimum 3 mm space below shelf angles. Install backer rod and sealant in accordance with Section 07 90 00.
- .2 Leave 12 mm space between top of non-load bearing walls and partitions and structural elements.

### **3.11 CLEANING**

- .1 Clean all new masonry work, and exposed patchwork.
- .2 Allow mortar droppings on unglazed units to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.
- .3 For final cleaning brush clean with fibre bristle brush, preferably dry, or with minimum amounts of water.
- .4 For clay brick and glazed masonry units use only proprietary cleaning agents approved by masonry manufacturer.

**END OF SECTION**

**Part 1 General**

**1.1 WORK INCLUDED**

- .1 Forming of all cast-in-place concrete indicated on drawings and subsequently remove all such forms.

**1.2 RELATED SECTIONS**

- .1 Section 03 20 00 Concrete Reinforcement
- .2 Section 03 30 00 Cast-in-Place Concrete

**1.3 DESIGN AND CODE REQUIREMENTS**

- .1 Formwork and supporting falsework shall be designed and constructed in accordance with the requirements of CSA-S269.3-R2013, CSA S269.1- R2003 and CSA A23.1 – 09 (R2014) as applicable to the work.
- .2 Assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.
- .3 Retain a Professional Engineer to design falsework which consists of shoring more than one tier in height or which is a framed structure. The Engineer shall be registered in the Province of Saskatchewan and shall inspect the shoring prior to its use.
- .4 The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

**1.4 HANDLING AND STORAGE**

- .1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

**Part 2 Products**

**2.1 QUALITY AND STRENGTH**

- .1 The quality and strength of formwork material shall comply with the requirements set forth in this Specification and CSA A23.1 – 14.

**2.2 FINISHES**

- .1 Form materials for concrete surfaces which will be exposed to view, or which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edges, smooth panels of plywood, metal or plastic to approval of the Consultant. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.

- .2 Square edged, tongue and groove or shiplap lumber may be used to form concrete which will not be exposed to view or which does not require smooth uniform surface for other purposes.
- .3 Provide 20 mm chamfers at column and beam corners, if showed on drawings.

## 2.3 MATERIALS

- .1 Form plywood: exterior grade, Douglas Fir conforming to CSA Standard O121-08 (R2013). Plywood shall be resin coated one side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make up or patching strips between panels shall be kept to a minimum.
- .2 Lumber for forms, falsework, shoring and bracing: conform to CSA Standard 0141-05 (R2014) for Softwood Lumber, and the applicable authorized grading authority. All lumber shall be a grade to which allowable unit stresses may be assigned in accordance with the National Building Code. All lumber shall be grade marked by the authorized grading authority.
- .3 Form ties:
  - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
  - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .4 Form release agent: Proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.
- .6 Falsework materials: to CSA-S269.1.

## Part 3 Execution

### 3.1 FABRICATION AND ERECTION

- .1 Examine the excavations and foundations for adequate working room and support for the work of this section.
- .2 Verify lines, levels and centre lines before proceeding with the work and ensure that dimensions agree with drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Report to the Consultant discrepancies in other work which affect the work of this section.

### 3.2 PREPARATION

- .1 Coat the inside surfaces of forms with a form release agent, used in accordance with the manufacturer's instructions.
- .2 Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.



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**3.3 ASSEMBLY AND ERECTION**

- .1 Construct the formwork and shoring and bracing to meet the design and code requirements, accurately so that the resultant finished concrete shall conform to the shapes, lines and dimensions shown on the drawings, within the specified tolerances.
- .2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that the concrete will not be damaged during its removal.
- .3 Review locations of ties and form panels for exposed concrete work with the Consultant.
- .4 Check and correct formwork as required, both horizontally and vertically, during the placing of the concrete.
- .5 Construct formwork to maintain the following maximum tolerances:
  - .1 Deviation from horizontal and vertical lines:  
6 mm in 3000 mm  
20 mm in 12000 mm.
  - .2 Deviation in cross sectional dimensions of thickness of walls: plus or minus 6 mm.
- .6 Obtain Consultant's approval for use of earth forms.

**3.4 JOINTS IN FORMS**

- .1 Make form joints tight in order to prevent leakage of mortar.
- .2 Clean all edges and contact surfaces before erection.
- .3 Where required, install pvc waterstop to manufacturer's instructions and without displacing reinforcement. Do not distort or pierce waterstop.

**3.5 SHORING AND BRACING**

- .1 Provide bracing to ensure the stability of the formwork as a whole.
- .2 Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

**3.6 EMBEDDED PARTS AND OPENINGS**

- .1 Provide formed openings where required for pipes, conduit, sleeves and other work to be embedded in and passing through concrete members. Accurately locate and set in place items which are to be cast directly into the concrete. Co-ordinate the work of other sections and co-operate with the trade involved in the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. No such forming or setting of openings, slots, recesses, chases, sleeves, or parts shall be done unless specifically shown on the drawings or approved prior to installation.
- .2 Obtain Consultant's approval before framing openings in concrete not specifically detailed on structural drawings.

- .3 Provide temporary ports or openings where required to facilitate cleaning and inspection. Openings at the bottom of forms shall be located so that flushing water will drain from the forms.
- .4 Close the temporary ports or openings with tight fitting panels, flush with the inside face of the forms, neatly fitted so that the joints will not be apparent in exposed concrete surfaces.
- .5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval in writing of all modifications from the Consultant before placing concrete.

### 3.7 FIELD QUALITY CONTROL

- .1 Inspect and check the completed formwork, shoring and bracing to ensure that the work is in accordance with the formwork design, and that the supports, fastenings, wedges, ties and parts are secure. The Engineer responsible for the design of the formwork shall assist in this inspection.
- .2 Inform the Consultant when the formwork is complete and has been cleaned. Obtain the approval of the engineer responsible for the design of the formwork and the general approval of the Consultant before placing concrete.
- .3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the cleanout ports.

### 3.8 CLEANING

- .1 Clean the forms as erection proceeds to remove foreign matter.
- .2 Remove cuttings, shavings and debris from within the forms.
- .3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the cleanout ports.

### 3.9 REMOVAL OF FORMWORK

- .1 Notify the Consultant before removing formwork.
- .2 Reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.
- .3 Do not remove forms and shoring before concrete has attained sufficient strength to ensure safety of structure. If evidence to verify concrete strength is not available, the forms and shores shall not be removed before the following minimum intervals after concrete is placed.
  - .1 Walls and grade beams - 5 days.
- .4 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.
- .5 Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by Consultant.

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- .6 Store removed forms, for exposed architectural concrete, in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
  - .7 Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.
  - .8 Re-use of formwork and falsework is subject to the requirements of CSA A23.1-14.

**END OF SECTION**



**Part 1 General**

**1.1 WORK INCLUDED**

- .1 Supply and install all bonded reinforcement and associated items required and/or indicated on the Drawings for all cast-in-place concrete and reinforced masonry work.

**1.2 RELATED WORK**

- .1 Section 03 10 00 - Concrete Formwork
- .2 Section 03 30 00 - Cast-in-Place Concrete
- .3 Section 03 20 33 - Concrete Reinforcing

**1.3 INSPECTION AND TESTING**

- .1 Upon request, provide certified copy of mill test report of steel supplied, showing physical and chemical analysis.

**1.4 REFERENCES**

- .1 American Concrete Institute (ACI)
  - .1 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
  - .2 American National Standards Institute/American Concrete Institute (ANSI/ACI)
  - .3 ANSI/ACI 315-99, Details and Detailing of Concrete Reinforcement.
  - .4 American Society for Testing and Materials (ASTM)
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA-A23.1-09 (R2014), Concrete Materials and Methods of Concrete Construction.
  - .2 CAN3-A23.3-14, Design of Concrete Structures.
  - .3 CAN/CSA-G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.
  - .4 CAN/CSA-G40.20-13/CAN/CSA-G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steels.

**1.5 Shop Drawings**

- .1 Prepare and submit reinforcing steel and mesh placing drawings and bar bending and cutting schedules for all steel reinforcement shown or specified in accordance with General Conditions.
- .2 All drawings and schedules shall be prepared and checked under the direct supervision of a qualified Professional Engineer who is experienced in this work.
- .3 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 - 315 Manual of Standard Practice and Metric Supplement by Reinforcing Steel Institute of Ontario.
- .4 Design and detail lap lengths and bar development lengths to CSA A23.3-14, unless specified on drawings.
- .5 Review of shop drawings is for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

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**1.6 SUBSTITUTES**

- .1 Substitution of different size bars permitted only upon written approval of the Consultant.

**1.7 DELIVERY AND STORAGE**

- .1 Reinforcing steel, welded wire fabric and accessories shall be delivered, handled and stored in a manner which prevents contamination from bond reducing or foreign matter and damage to its fabricated form.

**Part 2 Products**

**2.1 MATERIALS**

- .1 All reinforcing steel, unless noted otherwise on the drawings or herein shall be deformed bars of new billet steel conforming to the current CSA G.30.18-09 (R2014), Grade 400, plain finish for all bars. Minimum splice for 10M bars to be 450 mm. Minimum lap splice for all other bars to be 36 bar diameters or 675 mm, whichever is greater.
- .2 Welded wire fabric: Provide in flat sheets only.
- .3 Tie wires shall be 1.29 mm or heavier annealed wire or a patented system approved by the Consultant.
- .4 Reinforcing steel supports shall conform to ACI Standard 315 unless otherwise approved by the Consultant.
- .5 Mechanical splices are subject to the approval of the Consultant.

**2.2 FABRICATION**

- .1 Fabricate bends, splices and ties and supply bar supports and accessories in accordance with the requirements of CSA A23.3-14. Spacing and arrangements of supports in accordance with ACI 315.
- .2 All intermediate grade reinforcing bars shall be bend cold without hickeying. All high strength steel shall be preheated.
- .3 Reinforcing bars shall not be straightened or re-bent.
- .4 Location of reinforcement splices not shown on the drawings are subject to approval by the Consultant and shall, for beams and slabs be away from points of maximum stress in the steel.
- .5 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

**2.3 SOURCE QUALITY CONTROL**

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

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Examine the work upon which this section depends and report any discrepancies to the Consultant.
- .2 Commencement of the work shall imply acceptance of conditions.

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**3.2 PLACING**

- .1 Reinforcement of the size and shapes shown on the drawings shall be accurately placed in accordance with the approved shop drawings, the structural drawings and the requirements of the current National Building Code.
- .2 Clear distances between bars, except for columns shall be not less than the nominal diameter of the bar, or 25 mm or one and one-third the maximum size of the coarse aggregate. Bars placed in two or more layers shall have a minimum clear distance between the layers of not less than 25 mm and shall be placed directly above and below each other.
- .3 Clear distance between bars in columns shall be not less than one and one-half the nominal diameter of the bar or 40 mm or one and one-half times the maximum size of the coarse aggregate.
- .4 Reinforcing steel shall, where not otherwise shown on the structural drawings, be protected by the clear cover of concrete over the reinforcement as follows:
  - .1 75mm where concrete is formed against earth.
  - .2 Where concrete placed against forms is to be exposed to the weather or be in contact with the ground, 50 mm for bars larger than 15M, 40 mm for bars 15M and smaller.
  - .3 20mm for slabs and walls not exposed to the ground or weather.
  - .4 In beams, girders and columns not exposed to the ground or weather, 40 mm to principal reinforcement, ties and stirrups.The foregoing clear covers shall be maintained within 5 mm.
- .5 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with the latest ACI Standard 315.
- .6 For slabs on grade, footings or similar construction, concrete blocks may be used in place of metal chairs.
- .7 Review with the Consultant, placement of reinforcement prior to concreting.
- .8 Notify the Consultant 24 hours prior to placing concrete.

**3.3 CLEANING**

- .1 All materials shall be clean and free of all form oil or deleterious materials.
- .2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Consultant.

**END OF SECTION**





**Part 1 General**

**1.1 WORK INCLUDED**

- .1 All plain and reinforced cast-in-place concrete shown on drawings.
- .2 Setting anchors, inserts, frames, sleeves and other items supplied by other Sections.
- .3 Repairing concrete imperfections.
- .4 Finishing formed concrete surfaces.

**1.2 RELATED SECTIONS**

- .1 Section 031000 Concrete Formwork
- .2 Section 032000 Concrete Reinforcement
- .3 Section 033000 Cast in Place Concrete

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .2 ASTM C309-07, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .3 ASTM C330/C330M-13, Standard Specification for Lightweight Aggregates for Structural Concrete.
  - .4 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
  - .5 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-09 (R2014), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.
  - .3 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .4 CSA-A3001-03, Cementitious Materials for Use in Concrete.

**1.4 ACRONYMS AND TYPES**

- .1 Cement: hydraulic cement or blended hydraulic cement.
  - .1 Type GU or GUb - General use cement.
  - .2 Type MS or MSb - Moderate sulphate-resistant cement.
  - .3 Type MH or MHb - Moderate heat of hydration cement.
  - .4 Type HE or Heb - High early-strength cement.
  - .5 Type LH or LHb - Low heat of hydration cement.
  - .6 Type HS or HSb - High sulphate-resistant cement.

- .2 Fly ash:
  - .1 Type F - with CaO content less than 8%.
  - .2 Type CI - with CaO content ranging from 8 to 20%.
  - .3 Type CH - with CaO greater than 20%.
- .3 GGBFS - Ground, granulated blast-furnace slag.

#### 1.5 QUALITY ASSURANCE

- .1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Section.
- .2 For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.
- .3 Perform cast-in-place concrete work to requirements of CSA A23.1-09 (R2014)- "Concrete Materials and Methods of Concrete Construction".
- .4 Submit proposed mix design for each class of concrete to Consultant for approval two weeks prior to commencement of work.

#### 1.6 PRODUCT HANDLING

- .1 Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.
- .2 In the event of damage, immediately make all repairs and replacements necessary to approval of the Consultant and at no additional cost to the Owner.

#### 1.7 SHOP DRAWINGS

- .1 Review of the shop drawings by the Engineer is intended to assist the Contractor and does not relieve the Contractor of responsibility for the completeness and accuracy of the work and its conformance with the contract drawings and specifications.
- .2 Fabrication that commences prior to shop drawing review by the Engineer is at the risk of the Contractor.

#### 1.8 INSPECTION AND TESTING

- .1 Inspection and testing is to be performed by a firm approved by the Consultant and paid for by the Contractor.
- .2 Provide free access to all portions of work and co-operate with appointed firm.
- .3 Advise testing firm 24 hours in advance of concrete placement.
- .4 One concrete test, consisting of three test cylinders, is to be taken each day concrete is placed for each class of concrete placed. One cylinder to be tested at 7 days, the remaining two cylinders to be tested at 28 days.
- .5 One (1) slump test and one (1) air content test is to be taken for each set of test cylinders taken.
- .6 Testing of concrete is to be performed in accordance with CSA A23.2-09 (R2014) "Method of Test for Concrete".
- .7 Test results are to be issued to the Contractor, Consultant, and Owner. Test reports are to be numbered consecutively beginning with number one.
- .8 Required retesting is to be paid for by the Contractor.

- .9 Testing firm is to take one additional test cylinder during cold weather concreting and cure on job site under same conditions as the concrete it represents.
- .10 Testing firm is to report results of tests immediately to the Contractor. The Contractor is responsible for ensuring that the concrete meets the requirements of the specifications. Report adverse test results to the Engineer immediately.

## Part 2 Products

### 2.1 MATERIALS

- .1 Cement: Normal – Type GU and Sulphate Resistant – Type HS Portland Type, to CSA-A3000-13 “Cementitious Materials Compendium”
- .2 Supplementary Cementing Material
  - .1 Concrete may contain up to 15% fly ash. Fly ash to be type F or C.
- .3 Fine and Coarse Aggregates: conforming to CSA A23.1-09 (R2014) -“Concrete Materials and Methods of Concrete Construction”. The fine and coarse aggregate for concrete slabs, toppings and sidewalks shall contain a maximum of 0.4% low density particles as determined by CSA Test A23.2-4A “Low Density Granular Material in Aggregate”.
- .4 Water: clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material. Water to CSA A23.1-09 (R2014).
- .5 Admixtures
  - .1 Air-entraining admixtures are to conform to the requirements of ASTM C260. The admixture is to be of uniform consistency and quality within each container and from shipment to shipment.
  - .2 Water-reducing admixtures are to conform to the requirements of ASTM C494, Type A or D. The admixture is to be of uniform consistency and quality within each container and from shipment to shipment.
  - .3 Superplasticizers, if approved by the Engineer, (high-range water reducers) are to conform to the requirements of ASTM C494, Type F or G.
- .6 Accessories
  - .1 Curing Compounds: shall conform to the requirements of the latest issue of ASTM Standard C309 and CSA A23.1/ A23.2 -09 (R2014).
  - .2 Void Form: 150 thick cardboard honeycomb form suitable for project conditions. Top sheet to be 10mm OSB or plywood. Cover and wrap edges with 0.15 mm poly vapour barrier.
  - .3 Joint Sealant: non-staining, non-sagging, grey polyurethane base.
  - .4 Embedded Dowels: 2 component epoxy adhesive, complete with non-abrasive fillers conforming to ASTM c881, Type IV – Grade 3.
  - .5 Non-Shrink Grout: Pre-mixed compound consisting of non metallic aggregate, cement, water reducing and plasticizing agents. Pre-mixed in strict accordance with manufacturer’s instructions to obtain compressive strength of 16 mpa in 24 hours and 50 mpa in 28 days.

### 2.2 MIXES

- .1 Mechanical mix concrete in accordance with the requirements of CSA A23.1-09 (R2014).
- .2 Submit proposed mix design to Consultant two weeks prior to commencement of work. Provide certification that mix proportions selected will produce concrete of specified quality and that strength will comply with CSA A23.1 – 09 (R2014).

- .3 Each load of ready-mixed or transit-mixed concrete delivered to the project site shall be accompanied by duplicate delivery slips providing the following information:
  - .1 Name of ready-mix batch plant
  - .2 Serial number of ticket
  - .3 Date and truck number
  - .4 Name of contractor
  - .5 Specific designation of project
  - .6 Specific class of concrete
  - .7 Amount of concrete in cubic metres
  - .8 Time of loading or first mixing of aggregate, cement and water
- .4 Use accelerating admixtures in cold weather only when approved by Consultant.
- .5 Use set-retarding admixtures during hot weather only when approved by the Consultant.
- .6 Use of plasticizers only when approved by Consultant.
- .7 Do not use calcium chloride or admixtures containing calcium chloride.
- .8 Use all admixtures in strict accordance with the manufacturer's recommendations.
- .9 Documentation indicating the compatibility of the water reducing admixture, the air entraining admixture, the superplasticizing admixture (if any), the cement, the silica fume (if any) and the fly ash (if any) is to be submitted with the mix design for review by the Engineer.

### Part 3 Execution

#### 3.1 PREPARATION

- .1 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- .2 Verify that all items to be embedded in concrete are in place.
- .3 Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.
- .4 During concreting operations:
  - .1 Development of cold joints not allowed.
  - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .5 Pumping of concrete is permitted after approval of equipment and mix supplier.
- .6 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .7 Remove all wood scraps and debris from the formed areas in which concrete will be placed.
- .8 Thoroughly clean the forms to ensure proper placement and bonding of concrete.
- .9 Thoroughly wet the forms, except in freezing weather, or oil them; remove all standing water.
- .10 Thoroughly clean all transporting and handling equipment.

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**3.2 DISCREPANCIES**

- .1 In the event of discrepancy, immediately notify the Consultant.
- .2 Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

**3.3 PLACING CONCRETE**

- .1 Place concrete in accordance with requirements of CSA A23.1-09 (R2014) and as indicated on Drawings.
- .2 Notify Consultant and Inspection and Testing Firm a minimum of 24 hours prior to commencement of concreting operations.
- .3 Do not place concrete against frozen ground, frozen concrete or frosted forms.
- .4 Ensure all anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause undue hardship in placing concrete.
- .5 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- .6 Ensure reinforcement, inserts, embedded parts, formed joints and fitments are not disturbed during concrete placement.
- .7 Prepare previously placed concrete by cleaning with steel brush.
- .8 Do not place concrete older than 2 hours from batch time.
- .9 Do not add water after batching unless in strict accordance with CSA A23.1, Clause 5.2.4.3.2 and such that concrete conforms with the specified mix design parameters.
- .10 Pour concrete continuously between predetermined construction and control joints. All construction joints subject to approval of the Consultant.
- .11 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Contractor can place the planned casting without stopping.
- .12 Convey concrete to the place of final deposit by methods which will prevent the segregation or loss of material.
- .13 Equipment to be such that when concreting has once started, the depositing of concrete is to proceed at a rate and sequence such that concrete is at all times sufficiently plastic to ensure proper bonding of successive layers or panels.
- .14 Conveying and placing equipment to be free of hardened concrete and foreign material. Clean at frequent intervals.
- .15 Concrete to be deposited as close as practicable to final position. Avoid segregation due to re-handling or flowing. Place in horizontal lifts to maintain a level surface.
- .16 Vertical height of free fall of concrete not to exceed maximum required for good practice. If segregation occurs, chutes and spouts to be used.
- .17 Consolidate thoroughly and uniformly by tamping, hand tools, vibrators and finishing machines. Secure dense, homogeneous structure, close bond with reinforcement and smooth formed surfaces. Use internal vibrators wherever practicable. External-type vibrators only where satisfactory surfaces cannot be obtained with internal type.
- .18 Internal vibrators applied at the point of deposit in the areas of freshly placed concrete. Allow to sink in the concrete until penetrated into the previous layer of concrete. Withdraw immediately at the same speed at which they sank. Move about 300 mm to a

new location and then repeat process. Extreme care to be taken not to disturb the reinforcing steel or the forms.

- .19 Saw cut slabs on grade as indicated on Drawings. Saw cut control joints within 24 hours after finishing. Vacuum clean saw cut prior to installation of sealant.
- .20 Excessive honeycomb or embedded debris in concrete is not acceptable. Remove and replace defective concrete. Excessive honeycomb is when eraser end of a pencil fits into cavity.

### 3.4 CURING

- .1 Cure and protect concrete in accordance with CSA-A23.1.
- .2 Initial curing: Keep concrete surfaces continuously moist and cure at a minimum temperature of 10°C for three days or for the time required to obtain 35% of the required 28 day strength.
- .3 Final curing: Immediately following initial curing and before the concrete has dried, maintain curing to ensure required strengths and durability are obtained. Moist cure the following concrete at a minimum temperature of 10°C for the times noted or for the time required to obtain 70% of the 28 day strength.
  - .1 Foundation concrete exposed to sulphate attack to be continuously moist cured for a minimum of seven days.
  - .2 Exterior exposed concrete to be continuously moist cured for a minimum of seven days.
- .4 Protect concrete from sudden temperature changes as noted in CSA-A23.
- .5 Acceptable curing methods:
  - .1 Ponding or continuous sprinkling.
  - .2 Absorptive mat or fabric kept continuously wet.
  - .3 Continuous steam vapour mist bath not exceeding 70°C.
  - .4 Curing compounds approved by the Engineer for type and rate of application.
  - .5 Waterproof paper or plastic film.
  - .6 Watertight forms left in place. Wood forms are not considered watertight unless coated or sealed to prevent moisture absorption.
  - .7 Other moisture-retaining method approved by the Engineer.
- .6 Where curing compounds are approved, apply in two applications at right angles to each other.
- .7 Do not use curing compounds on concrete surfaces to receive topping, hardener or other type of bonded finish unless approved by the Engineer. Confirm that the coatings and curing compound are compatible.
- .8 Protect freshly placed and consolidated concrete against damage or defacement from curing methods or adverse weather conditions.
- .9 Exterior concrete to be protected and allowed to air dry for 30 days prior to application of de-icing chemicals.
- .10 Exposed concrete walking surfaces not to receive an integral hardener: Coat with curing compound of type that provides permanent seal.
- .11 Do not use water curing during freezing weather.
- .12 During hot weather, begin curing process immediately after finishing. Use continuous water or absorptive mats.

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**3.5 PROTECTION**

- .1 Hot Weather Protection
  - .1 When the air temperature is at or above 27 degrees C, hot weather requirements shall be applicable.
  - .2 Time of initial mixing to complete discharge shall not exceed one hour and fifteen minutes and concrete placed shall not exceed 30 degrees C.
  - .3 Concrete forming surfaces and reinforcing steel shall be sprinkled with cool water just prior to placing concrete. Standing water or puddles shall be removed prior to concrete placement.
  - .4 Special wind protection shall be provided as directed by the Consultant.
  - .5 Walls shall be kept continuously damp for twenty-four (24) hours by normal curing procedures as outlined by this Specification. Slabs cured by the applications of sealing, shall have curing compound applied immediately after finishing of the slab but before evaporation of surface moisture.
  - .6 The use of water reducing agents shall be subject to the approval of the Consultant when hot weather conditions prevail.
- .2 Cold Weather Protection
  - .1 Concrete shall be placed within an insulated and heated hoarding. At the time of placing and during curing, concrete surfaces shall be protected from direct exposure to combustion gases or drying from heaters. The hoarding shall be of sufficient size so as to ensure perimeter sections of the concrete structure are properly heated and cured.
  - .2 After the curing period, the heat shall be turned off and the hoarding left in place for at least 24 hours.

**3.6 CONSTRUCTION JOINTS**

- .1 The location and detail of all construction joints not detailed on the structural drawings shall be approved by the Consultant.
- .2 Where fresh concrete is to be placed against concrete which has set or has partially set, the surface of the set or partially set concrete shall be roughened, cleaned of all laitance, and thoroughly soaked with water prior to the placement of fresh concrete.
- .3 In general the construction joints in floor and roof systems shall be located at the 1/3 points of the spans of slabs, beams and girders. Proper key and dowels or extensions of reinforcing shall be provided at all construction joints.
- .4 Concrete placed in wall and column forms shall be struck off flush with the underside of the floor and roof systems.

**3.7 DEFECTIVE CONCRETE**

- .1 Concrete not meeting the requirements of the Specifications and drawings shall be considered defective concrete.
- .2 Concrete not conforming to the lines, details and grade specified herein or as shown on the drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Consultant. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified in the Formwork Section of these Specifications.
- .3 Concrete not properly placed resulting in excessive honeycombing and all honeycombing and other defects in critical areas of stress, shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Consultant.

- .4 Concrete of insufficient strength or improper consistency shall be, as required by the Consultant, subject to one or more of the following:
  - .1 Changes in mix proportions for the remainder of the work.
  - .2 Cores drilled and tested from the areas in questions as directed by the Consultant and in accordance with CSA A23.2-14. The test results shall be indicative of the in-place concrete.
  - .3 Load testing of the structural elements in accordance with CSA A23.3-14.
  - .4 The changes in the mix proportions and the testing shall be at the Contractor's expense.
- .5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Consultant.

### **3.8 PATCHING CONCRETE**

- .1 After the removal of the forms concrete surfaces may be subject to inspection by the Consultant.
- .2 All exposed metal form ties, nails, wires, shall be removed, fins broken off and all loose concrete removed.
- .3 Form tie pockets shall be thoroughly wetted and patched with patching concrete followed by proper curing.
- .4 Redundant dowel holes, honeycombed and other defective surfaces shall be chipped away to a depth of not less than 25 mm with the edges perpendicular to the surface, thoroughly wetted and patched with non-shrink grout followed by proper curing.
- .5 Non-shrink grout shall be thoroughly compacted into place and finished in such a manner as to match the adjoining concrete. The design mix of the non-shrink grout shall be approved by the Engineer.

**END OF SECTION**



**Part 1 General**

**1.1 WORK INCLUDED**

- .1 Structural steel framing members, structural steel support members, welds, washers, nuts, shims, anchor plates and bolts.
- .2 Baseplates, connectors and bearing plates.

**1.2 RELATED SECTIONS**

- .1 Section 033000 Cast-in-Place Concrete

**1.3 REFERENCES**

- .1 ASTM A36/A36M-14 - Standard Specification for Carbon Structural Steel.
- .2 ASTM A193/193M-15a – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
- .3 ASTM A307-14 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .4 ASTM A325-14 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .5 ASTM A325M-14 - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength.
- .6 ASTM A490M-14a - Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints.
- .7 CISC - Handbook of Steel Construction, Tenth Edition.
- .8 CISC/CPMA 1-73a – A Quick-drying One-coat Paint for Use on Structural Steel.
- .9 CISC/CPMA 2-75 – A Quick-drying Primer for Use on Structural Steel.
- .10 CSA-G40.20-13/G40.21-13 - General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .11 CSA-S16-14 - Design of Steel Structures.
- .12 CSA-S136-12 UP3 – North American Specifications for the Design of Cold-Formed Steel Structural Members.
- .13 CSA-W47.1-09 - Certification of Companies for Fusion Welding of Steel.
- .14 CSA-W48-14 - Filler Metals and Allied Materials for Metal Arc Welding.
- .15 CSA-W55.3-08 (R2013)- Certification of Companies for Resistance Welding of Steel and Aluminum.
- .16 CSA-W59-13 UP4 - Welded Steel Construction (Metal Arc Welding).
- .17 MPI (Master Painters Institute) – Architectural Painting Specifications Manual and Maintenance Repainting Manual.
  - .1 MPI # 18 – Primer, Zinc Rich, Organic
  - .2 MPI # 19 – Primer, Zinc Rich, Inorganic
  - .3 MPI # 76 – Primer, Alkyd, Quick Dry, for Metal
  - .4 MPI #79 – Primer, Alkyd, Anti-Corrosive for Metal
- .18 SSPC (The Society for Protective Coatings) - Steel Structures Painting Manual.
  - .1 SSPC SP 6/NACE NO. 3 – Commercial Blast Cleaning
  - .2 SSPC Paint 15 – Steel Joist Shop Primer/Metal Building Primer
  - .3 SSPC Paint 20 – Zinc-Rich Coating (Type 1Inorganic and Type 2 Organic)

- .5 Master Painters Institute
  - .1 MPI INT 5.1 98, Structural Steel and Metal Fabrications.
  - .2 MPI EXT 5.1 98, Structural Steel and Metal Fabrications.
- .6 The Society for Protective Coatings (SSPC)
  - .1 SSPC SP 6/NACE No. 3 00, Commercial Blast Cleaning.

#### **1.4 DESIGN REQUIREMENTS**

- .1 Design details and connections in accordance with requirements of CAN/CSA S16 and CAN/CSA S136 with CSA S136.1 to resist forces, moments, shears.
- .2 Shear connections:
  - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
  - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
  - .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Saskatchewan, Canada for non- standard connections, upon request.

#### **1.5 SHOP DRAWINGS**

- .1 Submit shop drawings clearly indicate sizes, spacing and locations of structural members, connections, attachments, anchorages, framed openings and size and type of fasteners and welds.
- .2 Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds.
- .3 Show all welds, both shop and field, by the currently recommended symbols of the Canadian Welding Bureau.
- .4 The shop drawings shall be reviewed by a qualified Professional Engineer registered in the Province of Saskatchewan.
- .5 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

#### **1.6 QUALITY ASSURANCE**

- .1 Structural steel fabricator to be certified as a Division 2 Company under CSA W47.1-92 - "Certification of Companies for Fusion Welding of Steel Structures", or CSA Standard W55.3 "Resistance Welding Qualification Code for Fabricators of Structural Members" or both, as applicable.
- .2 Design to strictly adhere to all codes and standards as enumerated under Section 1.2 References.
- .3 In the event of conflict between pertinent codes, standards and/or regulations, most stringent shall govern.
- .4 Provide structural steel Fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated, upon request.

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**1.7 INSPECTION AND TESTING**

- .1 Materials and workmanship subject to inspection on behalf of Owner.
- .2 Report failures of material to fit together properly to Consultant. No corrective measures permitted unless approved by Consultant in writing.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Standard Rolled Sections: new material conforming to CSA G40.21 - 98, Grade 350W.
- .2 Hollow Structural Sections: new material conforming to CSA G40.21 - 98, Grade 350W, Class C.
- .3 Plates, Angles and Miscellaneous Steel: new material conforming to CSA G40.21 - 98, Grade 300W.
- .4 Anchor Bolts: new material conforming to CSA G40.21 - 98, Grade 300W.
- .5 Bolts, Nuts and Washers: high strength type recommended for structural steel joints, conforming to requirements of ASTM A325M-83c.
- .6 Paint for primer shall meet requirements of one of the following:
  - .1 CISC/CPMA Standard 1-73a, quick drying one coat paint for use on structural steel.
- .7 Welding Materials: Type required for materials being welded.
- .8 Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 48 MPa at 28 days.
- .9 Shop and Touch-Up Primer: MPI #76, quick-dry alkyd primer and compatible with topcoat.
- .10 Primer: As specified in Section [09 91 10].
- .11 Touch-Up Primer for Galvanized Surfaces: MPI #18, organic zinc-rich primer.

**2.2 FABRICATION**

- .1 Fabricate structural steel members in accordance with building design drawings and all requirements of CAN/CSA S16 14. Welding to conform to CSA W59 - 13 "Welded Steel Construction". Verify all dimensions prior to fabrication.
- .2 No cutting of openings in structural members except as shown on structural drawings. Reinforce openings to maintain required design strength as per consultant's instructions.
- .3 Accurately cut and mill column ends to assure full contact of bearing surfaces.
- .4 All bolted connections to be slip-resistant (friction type) connections.
- .5 All structural members to be connected for loads shown on drawings or 1/2 the depth of the connected member whichever is greater.
- .6 Tolerances of all structural steel shall be maintained strictly in accordance with CAN/CSA S16 - 14.

**2.3 PAINTING**

- .1 All steel in contact with concrete and all faying surfaces of high strength bolted slip-resistant connections shall not be primed.
- .2 All other structural steel shall be prepared in accordance with SSPC Standard SP6

- "Commercial Blast Cleaning". Remove all scale and rust.
- .3 Apply shop primer to all steel surfaces not in contact with concrete including bottom of bottom flange of steel beams.
  - .4 Apply paint under cover on dry surfaces when surface and air temperatures are above 5 degrees C.
  - .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
  - .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.
  - .7 For steel exposed to the weather: use acrylic enamel Base Painting Systems.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- . Verify existing conditions before starting work.

#### **3.2 ERECTION**

- .1 Erect structural steel in accordance with building design drawings and all requirements of CSA S16 -01.
- .2 Make adequate provision for all erection loads, and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection. Leave such bracing in place as long as required for safety and integrity of the
- .3 As erection progresses, securely bolt work to take care of full design loads and to provide structural integrity as required.
- .4 Use high tensile bolts for field connections unless otherwise noted on building design drawings.
- .5 Set all base plates which are shop welded to columns to proper elevation on steel shims. Maximum tolerance from stated elevations to be + 2 mm.
- .6 Tolerance of all structural steel shall be maintained strictly in accordance with CSA S16- 01.
- .7 After erection, clean with mechanical brush and touch up shop primer to all welds, abrasions, bolted connections, and all other surfaces not shop primed, except surfaces to be in contact with concrete.
- .8 Obtain written permission of Consultant prior to altering or field cutting of structural members.
- .9 Continuously seal members by continuous welds where indicated. Grind smooth.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Work Included**

- .1 Interior access ladder to crawlspace.
- .2 Access stair in crawlspace over piping.
- .3 Steel grating to air intake well.
- .4 Sump pit covers

### **1.2 Related Sections**

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 09 91 23 - Interior Painting.

### **1.3 References**

- .1 American Society for Testing and Materials International, (ASTM)
  - a) ASTM A53/A53M-02, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - b) ASTM A167-Specification for Stainless and Heat-Resisting Chrome-Nickel Steel Plate, Sheet, and Strip.
  - c) ASTM A269-02, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - d) ASTM A307-02, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - e) ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Tubing
- .2 Canadian General Standards Board (CGSB)
  - a) CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
  - b) CAN/CGSB-1.181-92, Ready-Mixed, Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
  - a) CAN/CSA-G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel.
  - b) CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - c) CAN/CSA-S16.1-01, Limit States Design of Steel Structures.
  - d) CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
  - e) CSA W59-1989(R2001), Welded Steel Construction (Metal Arc Welding) (Imperial Version).
- .4 The Environmental Choice Program
  - a) CCD-047a-98, Paints, Surface Coatings.
  - b) CCD-048-98, Surface Coatings - Recycled Water-borne.

## **1.4 SUBMITTALS**

- .1 Shop Drawings
  - a) Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - b) Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - c) Submit shop drawing bearing stamp of a qualified professional engineer registered in Canada Province of Saskatchewan.

## **1.5 QUALITY ASSURANCE**

- .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 31 19.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - a) Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Protection:
  - a) Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.
  - b) Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

## **2. Products**

### **2.1 MATERIALS**

- .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 350W. Miscellaneous bars, plates and sections, Grade 250.
- .2 Steel tubing: to ASTM A500, Grade 345W, Class C or H.
- .3 Steel pipe: to ASTM A53/A53M Grade B, Schedule 40.
- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series.
- .6 Bolts and anchor bolts: to ASTM A307.

- .7 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

## **2.2 FABRICATION**

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured. The quality of fabrications will be subject to Construction Manager's approval.
- .2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

## **2.3 FINISHES**

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m<sup>2</sup> to CAN/CSA-G164.
- .2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.
- .3 Shop coat primer: to CAN/CGSB-1.40.
- .4 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

## **2.4 ISOLATION COATING**

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

## **2.5 SHOP PAINTING**

- .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .3 Clean surfaces to be field welded; do not paint.

## **2.6 ANGLE LINTELS**

- .1 Steel angles: prime painted, sizes indicated for openings. Provide 150 mm minimum bearing at ends.
- .2 Weld or bolt back-to-back angles to profiles as indicated.
- .3 Finish: shop painted.

## **2.7 PIPE RAILINGS**

- .1 Steel pipe: outside diameter indicated, formed to shapes and sizes as indicated.
- .2 Galvanize or shop as indicated.

## **2.8 ACCESS LADDERS**

- .1 Stringers: Size and profile indicated. Round off exposed ends.
- .2 Steel Rungs: 20 mm diameter, welded to stringers.
- .3 Brackets: sizes and shapes as indicated, weld to stringers at 1200 mm on centre, complete with fixing anchors.
- .4 Hot dip galvanize after fabrication.

## **2.9 SUMP PIT COVERS**

- .1 Frame: steel angle 50 x 50 x 6, with 6 mm steel bar concrete anchors at 400 mm on centre welded to frame. Mitre and weld frame corners.
- .2 Cover: 6 mm checker plate. Provide cover in two pieces with lift rings for each piece. Coordinate with Division 22 and provide openings and cut-outs in cover for mechanical piping.
- .3 Sleeve: 600 diameter steel galvanised culvert section as indicated. Length of culvert to be determined by the elevation of the weeping tile entering the sump. Bottom of pit to be 900 below the invert elevation.

## **2.10 INTAKE AIR WELL**

- .1 Galvanized metal grating equal to 38 x 5 AMICO 19-W-4 grating.

# **3. Execution**

## **3.1 ERECTION**

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Construction Manager such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Provide components for building by other sections in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CAN/CSA-S16.1, or weld.
- .7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

## **3.2 PIPE RAILINGS**

- .1 Install pipe railings to stairs as indicated.



### **3.3 ACCESS LADDERS**

- .1 Install access ladders in locations as indicated.

### **3.4 SUMP PIT COVERS**

- .1 Install sumps and covers in locations as indicated.
- .2 Provide lifting rings.

### **3.5 ACCESS STAIR**

- .1 Install steel channel access stair complete with checker plate landing and pipe handrail at location indicated in crawlspace over existing piping.

### **3.6 INTAKE AIR WELL**

- .1 Install access ladders in locations as indicated.
- .2 Cover shall be removable in sections that are manageable to handle without special equipment.

### **3.7 CLEANING**

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

**END OF SECTION**



## **1. GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Cold applied asphalt bitumen dampproofing.

### **1.2 RELATED SECTIONS**

- .1 Section 03 30 00 – Cast-In-Place Concrete: Concrete surfaces.
- .2 Section 07 21 13 - Board Insulation: Perimeter and horizontal insulation protective cover.
- .3 Section 31 23 23 - Backfilling.

### **1.3 REFERENCES**

- .1 ASTM D41-05 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- .2 ASTM D449-03(2008) - Asphalt Used in Dampproofing and Waterproofing.
- .3 ASTM D1227-95(2007) - Emulsified Asphalt Used as a Protective Coating for Roofing.
- .4 ASTM D1187-97(2002)e1 - Test Method for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
- .5 ASTM D2822-05 - Asphalt Roof Cement, Asbestos Containing.
- .6 ASTM D4479-07 - Asphalt Roof Coatings - Asbestos-Free
- .7 ASTM D4586-07 - Asphalt Roof Cement, Asbestos-Free
- .8 CGSB-37-GP-9Ma-83 - Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .9 CAN/CSA-A123.4-04 (R2008) - Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems
- .10 NRCA (National Roofing Contractors Association - USA) - Roofing and Waterproofing Manual.

### **1.4 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide properties of primer, bitumen, and mastics.

### **1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.

- .2 Installation Data: Manufacturer's special installation requirements indicating special procedures and perimeter conditions requiring special attention.

## **1.6 QUALITY ASSURANCE**

- .1 Perform Work in accordance with NRCA Waterproofing Manual.
- .2 Applicator Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

## **1.7 ENVIRONMENTAL REQUIREMENTS**

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain ambient temperatures above 5 degrees C for 24 hours before and during application until membrane has cured.

## **2. PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Bakor; Product: 700-01.

### **2.2 ASPHALTIC MATERIALS**

- .1 Asphalt: CAN/CGSB-37.2-M88.
  - .1 Water-Based Emulsified Asphalt: Cold-applied, asbestos-free, fibered non-fibered, emulsified-asphalt compound for exterior concrete surfaces below grade.

## **3. EXECUTION**

### **3.1 EXAMINATION**

- .1 Section 01 70 00: Verification of existing conditions before starting work.
- .2 Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- .3 Verify items which penetrate surfaces to receive dampproofing are securely installed.

### **3.2 PREPARATION**

- .1 Protect adjacent surfaces not designated to receive dampproofing.
- .2 Clean and prepare surfaces to receive dampproofing to manufacturer's written instructions.
- .3 Do not apply dampproofing to surfaces unacceptable to manufacturer or applicator.
- .4 Apply mastic to seal penetrations, small cracks, or minor honeycomb in substrate.

### 3.3 APPLICATION

- .1 Prime surfaces to manufacturer's instructions.
- .2 Apply bitumen dampproofing to manufacturer's instructions.
- .3 Apply bitumen in two (2) coats, continuous and uniform, at a rate of 0.5 to 1.5 L/sq m per coat.
- .4 Apply from floor elevation to bottom of grade beams.
- .5 Seal items projecting through dampproofing surface with mastic. Seal watertight.
- .6 Immediately backfill against dampproofing to protect from damage.
- .7 Apply sheet of waterproofing membrane from surface of existing grade beams to face of new retaining walls to ensure positive seal between new and existing.
- .8 Do not backfill wall until waterproofing and dampproofing is reviewed by Consultant.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 The requirements for the application of water repellents for underground exterior surfaces, as indicated.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM D2369-03, Test Method for Volatile Content of Coatings.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB 37-GP-37M-77, Application of Hot Asphalt for Dampproofing or Waterproofing.
  - .2 CAN/CGSB 37-GP-6Ma-83, Asphalt, Cutback, Unfilled, for Dampproofing.

**1.3 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 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's for water repellent.
- .2 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

**1.4 QUALITY ASSURANCE**

- .1 To ensure system compatibility all products must be from a single-source manufacturer.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 31 19.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Storage and Protection:
  - .1 Deliver, handle, store and protect materials of this section in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Protect products from freezing.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Divert unused waterproofing material from landfill to official hazardous material collections site approved by Construction Manager.
- .3 Do not dispose of unused waterproofing materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

**1.7 DELIVERY STORAGE AND HANDLING**

- .1 Deliver materials in original unopened containers or packaging clearly labelled with manufacturer's name, brand name, instructions for use, and all identifying numbers.
- .2 Store materials in a clean dry area protected from water and direct sunlight.
- .3 Store all adhesives at temperatures between 15<sup>o</sup> C and 26<sup>o</sup> C.

**1.8 WARRANTY**

- .1 For waterproof assembly including membrane, flashing, the 12 months warranty period is extended to 10 years.
- .2 Provide warranty under provisions of Section 01 78 00 - Closeout Submittals.
- .3 Warranty: include coverage for labour and materials.

**1.9 SITE CONDITIONS**

- .1 Site Environmental Requirements:
  - .1 Maintain substrate temperature at water repellent installation area in accordance with water repellent manufacturer's printed instructions.
  - .2 Apply coating during dry weather. Allow surfaces to dry minimum of 3 days after rainfall or cleaning before applying further coats.
  - .3 Protect plants and vegetation which might be damaged by water repellents.
  - .4 Protect surfaces not intended to have application of water repellents.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Standard of acceptance: membrane system based on Hydrotech Membrane Cor., 10951 parkway Boulevard, Ville D'Anjou, Quebec.
- .2 Membrane: hot, fluid applied, rubberized asphalt MM 6125.
- .3 Surface conditioner: for concrete surfaces meeting CGSB 37-GP9M: Hydrotec #56170.
- .4 Reinforcing:
  - .1 1.5mm (60-mil) thick, uncured neoprene reinforcing sheet, Flex Flash UN®
  - .2 1.2mm (47-mil) thick, butyl/ EPDM reinforcing sheet, Elastosheet® 6147.



- .3 1.6mm (63-mil) thick, butyl/ EPDM reinforcing sheet, Elastosheet® 6146
- .4 Spunbonded polyester fabric reinforcing sheet, Reemay 2014.
- .5 Adhesives/Sealants:
  - .1 Membrane manufacturers standard splicing cement, binding adhesive, and lap sealant.
- .6 Protection Course-Verticle Application:
  - .1 STYROFOAM® Brand insulation over separation sheet.
  - .2 Flexible hollow core polypropylene board, Hydroshield®.
- .7 Prefabricated Drainage Course, where indicated:
  - .1 Composite three dimensional, crushproof drainage core and filter fabric, Hydrodrain® 300, 400, 700 series.
- .8 Insulation:
  - .1 Extruded Polystyrene rigid insulation board, STYROFOAM® Roofmate®.
- .9 Filter fabric sheet, where required:
  - .1 Water permeable polymer fabric: Fabroc 400.

### **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 PREPARATION**

- .1 Prepare and clean substrate surfaces in accordance with water repellent manufacturer's printed instructions.

#### **3.3 APPLICATION**

- .1 Apply waterproof membrane in accordance with manufacturer's printed instructions.

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

- .1 After water repellent has dried, spray coated surfaces with water to verify coating coverage. Allow Engineer to witness tests.

#### **3.5 CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED WORK**

- .1 Section 07 92 00 Sealants
- .2 Division 23 - Insulation for mechanical work

**1.2 REFERENCES**

- .1 ASTM C578-09e1 – Rigid, Cellular Polystyrene Thermal Insulation.
- .2 ASTM C591-09 – Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- .3 ASTM C1289-08e1 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- .4 ASTM E84-09c – Test Method for Surface Burning Characteristics of Building Materials.
- .5 ASTM E96/E96M-05 – Test Methods for Water Vapor Transmission of Materials.
- .6 CAN/ULC-S102-07 – Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .7 CAN/ULC-S701-05 - Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .8 CAN/ULC-S704-03 – Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

**Part 2 Products**

**2.1 INSULATION**

- .1 Insulation for below grade: polystyrene, extruded-expanded type conforming to CAN/ULC-S701, type 3 or 4, thickness as indicated, thermal resistant not less than RSI 0.87/25mm (R5/in).

**2.2 ADHESIVE**

- .1 Adhesive: as recommended by manufacturer.

**2.3 ACCESSORIES**

- .1 Insulation fasteners: cadmium coated screws, anchors and washers of sizes and type required to securely fasten rigid board to various substrates such as concrete, wood and masonry.
- .2 Protective Boards: Cementitious smooth surface, 12 mm thick; Finex Multi-Purpose Fibre Cement Panels.

**Part 3 Execution**

**1.1 INSTALLATION - FOUNDATION PERIMETER**

- .1 Apply adhesive in three (3) continuous beads per board length.

- .2 Install extruded polystyrene insulation boards on foundation grade beam perimeter, horizontally.
  - .1 Place boards in a method to maximize contact bedding.
  - .2 Butt edges and ends tight to adjacent board and to protrusions.
- .3 Install stud strips simultaneously with insulation board, fitting into pre-slotting, so that boards are held solidly in place.
- .4 Cut and fit insulation tight to protrusions or interruptions to the insulation plane.
- .5 Immediately following application of board insulation, place protective boards over exposed insulation surfaces, fastening with stainless steel screws at 600 mm on center both ways to boards exposed above grade
  - .1 Install boards vertically for a distance of 1200 below grade as indicated.
  - .2 Butt board joints tight; stagger from insulation joints.

### 3.2 EXAMINATION

- .1 Examine substrates and immediately inform Consultant in writing of defects.
- .2 Prior to commencement of work ensure substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

### END OF SECTION

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 31 23 33 – Excavation, Trenching and Backfill

**1.2 REFERENCES**

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

**1.3 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:
    - .1 Product characteristics.
    - .2 Performance criteria.
    - .3 Limitations.
- .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .4 Quality assurance submittals:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction in accordance with Construction Manager's Health and Safety Plan.
- .2 Mock-Ups:
  - .1 Submit mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .2 Mock-up may be part of finished work.
  - .3 Mock-up will be used to judge workmanship, substrate preparation, and material application.
  - .4 Locate where indicated.
  - .5 Allow 24 hours for inspection of mock-up by Consultant before proceeding with vapour barrier work.
- .3 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## Part 2 Products

### 2.1 CRAWL SPACE REINFORCED VAPOUR RETARDER

- .1 Two layer fire retardant laminated multi-axially orientated, high density polyethylene .
- .2 Standard of acceptance: Permalon® PLY X-200 FR, or approved equivalent.
- .3 Physical characteristics:
  - .1 Weight: 25.1 Kg/100M<sup>2</sup>
  - .2 Thickness: 0.33mm
  - .3 3" Load @ yield: 80N to ASTM D-882
  - .4 3" Load @ break: 156N / 18.3 MPa to ASTM D-882
  - .5 3" Elongation @ break: 350% to ASTM D-882
  - .6 Tongue Tear: 70N to ASTM D-2261
  - .7 Trapezoidal Tear: 93.4N to ASTM D-4533
  - .8 PPT Resistance: 178N to ASTM D-2582
  - .9 Dart Impact: 1.8 Kg to ASTM D-1709
  - .10 Puncture strength: 8.90 MPa to ASTM D-4833
  - .11 Permeance: 1.551 NG/(PA.S.M<sup>2</sup>) to ASTM E-96
  - .12 Fire Retardancy: 20 flame spread, 100 smoke development

### 2.2 ACCESSORIES CRAWL SPACE VAPOUR RETARDER

- .1 Double sided asphaltic mastic tape..
- .2 Standard of acceptance: Fab Tape™ as manufactured by Griffolyn, a division of Reef Industries Inc., or approved equivalent.
- .3 Physical Characteristics:
  - .1 Thickness: 0.9mm
  - .2 Width: 38mm
  - .3 Specific Gravity: 1.4
  - .4 Solubility in Water: Insoluble
  - .5 3" Peel: 84.5 N
  - .6 3" Shear: 138 N
  - .7 Tested temperature range: 10<sup>o</sup>-35<sup>o</sup>C
- .4 Walkway mats to be of Pressure-Sensitive rubber roll material equal to that provided by Carlisle.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Use sheets of largest practical size to minimize joints.
- .3 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

### **3.2 INSTALLATION OF CRAWL SPACE VAPOUR RETARDER**

- .1 Install retarder to crawl entire crawl space floor and side slopes in accordance with manufacturer's instructions. Mechanically fasted to grade beams with continuous metal termination strip bolted to concrete as detailed. Lap joints minimum 150mm, and seal with continuous double sided tape. Must be removable.
- .2 Seal to all piles and penetrations through vapour retarder with compatible tape.
- .3 Ensure that at locations above drainage tile that openings are left to allow for any surface water to drain thru.
- .4 Cover the entire surface crawlspace with 50mm of sand bed and provide walk mats as indicated on the drawings.

### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**





**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Fireproof fire stopping materials and accessories.

**1.2 RELATED WORK**

- .1 Section 01 30 00 – Gypsum Board Assemblies: Gypsum wallboard fireproofing.
- .2 Section 05 12 23 – Structural Steel: Building structural substrate surfaces.
- .3 Division 23 – Heating, Ventilating and Air-Conditioning (HVAC): Mechanical work requiring firestopping.
- .4 Division 26 – Electrical: Electrical work requiring firestopping.

**1.3 REFERENCES**

- .1 ASTM E84-09c – Test Method for Surface Burning Characteristics of Building Materials.
- .2 ASTM E119-09c – Method for Fire Tests of Building Construction and Materials.
- .3 ASTM E814-09 – Test Method for Fire Tests of Through-Penetration Fire Stops.
- .4 ASTM E1966-07 – Test Method for Fire-Resistive Joint Systems.
- .5 CAN/ULC-S101-07 – Fire Endurance Tests of Building Construction and Materials.
- .6 CAN/ULC-S102-07 – Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .7 CAN/ULC-S115-05 – Fire Tests of Firestop Systems.
- .8 FM (Factory Mutual) – FM 4991, Approval of Firestop Contractors.
- .9 FCIA (Firestop Contractors International Association) – Manual of Practice.
- .10 NFPA 251 – Fire Tests of Building Construction and Materials.
- .11 OPL (Omega Point Laboratories).
- .12 UL 263 – Fire Tests of Building Construction and Materials (ASTM E119, NFPA 251).
- .13 UL 1479 – Fire Tests of Through-Penetration Firestops. (ASTM E814).
- .14 UL 1709 – Rapid Rise Fire Tests of Protection Materials for Structural Steel.
- .15 UL 2079 – Tests for Fire Resistance of Building Joint Systems.
- .16 ULC (Underwriters Laboratories of Canada) – List of Equipment and Materials for:
  - .1 Building Materials.
  - .2 Fire Resistance.
  - .3 Firestop Systems and Components..
- .17 WHI (Intertek/Warnock Hershey).

**1.4 DEFINITIONS**

- .1 Firestopping (Fire-safing): A sealing or stuffing material or assembly placed in spaces between building materials to arrest the movement of smoke, heat, gases, or fire through wall or floor openings.

**1.5 SYSTEM DESCRIPTION**

- .1 Firestopping systems installed to resist spread of fire and passage of smoke and other gases at penetrations through fire resistance rated wall and floor assemblies, materials and components.

**1.6 PERFORMANCE REQUIREMENTS**

- .1 Materials, accessories and application procedures listed by ULC, or tested to CAN/ULC-S115 to comply with building code requirements.
- .2 Firestopping Materials: CAN/ULC-S101 to achieve a fire rating as noted. All floors are 1 hour. Basement to Crawlspace shall be 2 hours.

**1.7 ADMINISTRATIVE REQUIREMENTS**

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.

**1.8 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on product characteristics, performance and limitation criteria.
- .3 System Design Listings: Submit system design listings, including illustrations from a qualified testing and inspection agency that is applicable for each firestop configuration.

**1.9 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special preparation and installation requirements.
- .3 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

**1.10 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .2 Contractor Qualifications: Company specializing in performing the work of this section and as follows:
  - .1 FM approved in accordance with FM standard 4991 – Approval of Firestop Contractors.
  - .2 Licensed by the province or local authority where applicable.
  - .3 Successfully completed not less than three (3) comparable scale projects.
- .3 Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems manufacturer.

**1.11 REGULATORY REQUIREMENTS**

- .1 Conform to applicable code for fire resistance ratings and surface burning characteristics.
- .2 Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

**1.12 DELIVERY, STORAGE AND PROTECTION**

- .1 Section 01 61 00: Transport, handle, store and protect products.

- .2 Deliver firestopping products in original, unopened containers with labels intact and legible, identifying product and manufacturer.
- .3 Store and handle firestopping materials to manufacturer's instructions.

### **1.13 ENVIRONMENTAL REQUIREMENTS**

- .1 Section 01 35 43: Environmental conditions affecting products on site.
- .2 Do not apply materials when temperature of substrate material and ambient air is below 15 degrees C.
- .3 Maintain this minimum temperature before, during and for three (3) days after installation of materials.
- .4 Provide ventilation to manufacturer's instructions in areas to receive solvent cured materials.

## **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.
  - .2 Firestop system rating: 60 minutes, 90 minutes as required.
- .2 Service penetration assemblies: certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.
- .3 Service penetration firestop components: certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.
- .4 Fire-resistance rating of installed fire-stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 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.

### **3.3 INSPECTION**

- .1 Notify Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

### **3.4 SCHEDULE**

- .1 Install firestops and smoke seals at:
  - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - .2 Top of fire-resistance rated masonry and gypsum board partitions.
  - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
  - .6 Openings and sleeves installed for future use through fire separations.
  - .7 Around mechanical and electrical assemblies penetrating fire separations.
  - .8 Rigid ducts: greater than 129 cm<sup>2</sup>: 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.

### **3.5 CLEAN UP**

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

**END OF SECTION**

**1. General**

**1.1 SECTION INCLUDES**

- .1 Materials, preparation and application for caulking and sealants.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 61 00 - Basic Product Requirements.

**1.3 REFERENCES**

- .1 ASTM C509-06 – Elastomeric Cellular Performed Gasket and Sealing Material.
- .2 ASTM C834-10 – Latex Sealants.
- .3 ASTM C919-12 – Use of Sealants in Acoustical Applications.
- .4 ASTM C920-14 – Elastomeric Joint Sealants.
- .5 ASTM C1184-13 – Structural Silicone Sealants.
- .6 ASTM C1193-13 – Guide for Use of Joint Sealants
- .7 ASTM C1311-10 – Solvent Release Sealants.
- .8 ASTM C1330-02(2013) – Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- .9 ASTM C1401-09a – Guide for Structural Sealant Glazing.
- .10 ASTM E330-02 – Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .11 CGSB-19-GP-5M-1984 – Sealing Compound, One Component, Acrylic Base, Solvent Curing.
- .12 CGSB-19-GP-14M-1984 – Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .13 CAN/CGSB-19.13-M87 – Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .14 CAN/CGSB-19.17-M90 – One Component Acrylic Emulsion Base Sealing Compound.
- .15 CAN/CGSB-19.22-M89 – Mildew-Resistant Sealing Compound for Tubs and Tiles.
- .16 CAN/CGSB-19.24-M90 – Multi-component, Chemical Curing Sealing Compound.
- .17 SWRI (Sealant, Waterproofing and Restoration Institute) – Sealant and Caulking Guide Specification.

**1.4 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's product to describe.
  - a) Caulking compound.

- b) Primers.
- c) Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .3 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Submit duplicate samples of each type of material and colour.
- .5 Cured samples of exposed sealants for each color where required to match adjacent material.
- .6 Submit manufacturer's instructions in accordance with Section 01 33 00 - Submittal Procedures.
  - a) Include installation instructions for each product used.

### 1.5 QUALITY ASSURANCE/MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock-up to show location, size, shape and depth of joint s complete with back-up material, primer, caulking and sealant.
- .3 Mock-up will be used:
  - a) To judge workmanship, substrate preparation, operation of equipment and material application.
  - b) To determine adhesion capabilities of sealant.
- .4 Locate where directed where indicated
- .5 Allow 48 hours for inspection of mock-up by Consultant before proceeding with sealant work.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may remain as part of finished Work.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Basic Product Requirements.
- .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

### 1.7 PROJECT CONDITIONS

- .1 Environmental Limitations:
  - a) Do not proceed with installation of joint sealants under following conditions:
    - i) When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
    - ii) When joint substrates are wet.
- .2 Joint-Width Conditions:
  - a) Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

- .3 Joint-Substrate Conditions:
  - a) Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

## **1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .3 Ventilate area of work as directed by Consultant by use of approved portable supply and exhaust fans.

## **2. Products**

### **2.1 MATERIALS**

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.
- .3 Sealants will allow for a minimum 25% movement in joint width.

### **2.2 SEALANT MATERIAL DESIGNATIONS**

- .1 Polysulfide Two Part.
  - a) Non-Sag to CAN/CGSB-19.24, Type 2, Class B, colour to be selected from manufacturer's complete range.
  - b) Acceptable material: Sonneborn Polysulfide Sealant by BASF Building Systems.
- .2 Urethanes Two Part.
  - a) Self-Leveling to CAN/CGSB-19.24, Type 1, Class B, colour to be selected from manufacturer's complete range.
  - b) Acceptable material: Sonneborn SL 2 by BASF Building Systems, Tremco THC 900.
- .3 Urethanes Two Part.
  - a) Non-Sag to CAN/CGSB-19.24, Type 2, Class B, colour to be selected from manufacturer's complete range.
  - b) Acceptable material: Sonneborn NP 2 by BASF Building Systems, Tremco Dymeric 240.
- .4 Urethanes One Part.
  - a) Self-Leveling to CAN/CGSB-19.13, Type 1, colour to be selected from manufacturer's complete range

- b) Acceptable material: Sonneborn SL 1 by BASF Building Systems, Tremco Vulkem 45SSL.
- .5 Urethanes One Part.
  - a) Non-Sag to CAN/CGSB-19.13, Type 2, MCG-2-25 MCG-2-40, colour to be selected from manufacturer's complete range
  - b) Acceptable material: Sonneborn NP 1 by BASF Building Systems, Tremco Dymeric FC.
- .6 Silicones One Part.
  - a) Neutral Cure: To CAN/CGSB-19.13 .
    - i) Acceptable material: Sonneborn Omniseal 50 by BASF Building Systems; Dow Corning 795 Building Sealant; Tremco Spectrum 2.
  - b) Acetoxy Cure: to CAN/CGSB –19.13\_.
    - i) Mildew-resistant: Acceptable material: Sonneborn Omniplus by BASF Building Systems; Dow Corning Tub, Tile, & Ceramic Silicone Sealant, Tremco Tremsil 600 clear.t
    - ii) Glazing : Acceptable material (Dow Corning Silicone Glazing Sealant); Tremco Glazing Sealant.
    - iii) Vision Wall: Acceptable material (Dow Corning 1199 Clear); Tremco Tremsil 600 clear.
- .7 Acrylics One Part.
  - a) To CGSB 19-GP-5M.
  - b) Acceptable material: Sonneborn Sonolac by BASF Building Systems; Tremco Mono 555 by Tremco.
- .8 Acrylic Latex One Part.
  - a) To CAN/CGSB-19.17.
  - b) Acceptable material: Sonneborn Sonolac by BASF Building Systems; Tremflex 834 by Tremco.
- .9 Acoustical Sealant.
  - a) To ASTM C919.
  - b) Acceptable material: Tremco Accoustical Sealant; GH #2210 Accoustical Sealant.
- .10 Butyl.
  - a) To CGSB 19-GP-14M.
  - b) Acceptable material: Tremco Butyl Sealant.
- .11 Semi-rigid Epoxy / Polyurea
  - a) Acceptable material: Sonneborn Epolith P/G, TF-100, Masterfil 300i.
- .12 Preformed Compressible and Non-Compressible back-up materials.
  - a) Polyethylene, Urethane, Neoprene or Vinyl Foam.
    - i) Extruded closed cell foam backer rod.



- ii) Acceptable material: Closed-cell backer rod and soft backer rod by BASF Building Systems or Tremco.
  - iii) Size: oversize 30 to 50 %.
- b) Neoprene or Butyl Rubber.
  - i) Round solid rod, Shore A hardness 70.
- c) High Density Foam.
  - i) Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m<sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.
- d) Bond Breaker Tape.
  - i) Polyethylene bond breaker tape which will not bond to sealant.

## 2.3 SEALANT SELECTION

- .1 Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block, precast masonry): Sealant type: Sonneborn NP 1, NP 2, Sonlastic 150 VLM, TX 1.
- .2 Expansion and control joints in exterior surfaces of poured-in-place concrete walls: Sealant type: Sonneborn NP 1, NP 2, Sonolastic 150 VLM, TX 1.
- .3 Control and expansion joints in exterior surfaces of unit masonry walls: Sealant type: Sonneborn NP 1, NP 2, Sonolastic 150 VLM, TX 1.
- .4 Coping joints and coping-to facade joints: Sealant type: Sonneborn NP 1, NP 2 Sonlastic 150 VLM, TX 1.
- .5 Horizontal surface joints: Sealant type: Sonneborn NP1, NP 2, Sonolastic 150 VLM, TX 1.
- .6 Exterior joints in horizontal wearing surfaces (as itemized): Sealant type: Sonneborn SL1, SL 2.
- .7 Seal interior perimeters of exterior openings as detailed on drawings: Sealant type: Sonneborn Sonolac, NP1, NP 2.
- .8 Control and expansion joints on the interior of exterior poured-in place concrete walls: Sealant type: Sonneborn NP 1, NP 2, Sonolastic 150 VLM, TX 1.
- .9 Control and expansion joints on the interior of exterior surfaces of unit masonry walls: Sealant type: Sonneborn NP 1, NP 2, Sonolastic 150 VLM, TX 1.
- .10 Interior control and expansion joints in floor surfaces: Sealant type: Sonneborn Epolith P/G, TF-100, Masterfil 300i.
- .11 Perimeters of interior frames, as detailed and itemized: Sealant type: Sonneborn Sonolac.
- .12 Interior masonry vertical control joints (block-to-block, block-to-concrete, and intersecting masonry walls): Sealant type: Sonneborn NP 1, NP 2 Sonolastic 150 VLM, TX 1.
- .13 Perimeter of bath fixtures (e.g. sinks, tubs, urinals, stools, waterclosets, basins, vanities): Sealant type: Sonneborn Omniplus; Dow Corning Tub, Tile & Ceramic Silicone Sealant.
- .14 Exposed interior control joints in drywall: Sealant type: Sonneborn Sonolac.
- .15 Joint at top of metal flooring cap (at coved base) and wall: Sealant type- Sonneborn Sonolac.

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**2.4 JOINT CLEANER**

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .2 Primer: as recommended by manufacturer.

**3. Execution**

**3.1 PROTECTION**

- .1 Protect installed Work of other trades from staining or contamination.

**3.2 SURFACE PREPARATION**

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

**3.3 PRIMING**

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

**3.4 BACKUP MATERIAL**

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

**3.5 MIXING**

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

**3.6 APPLICATION**

- .1 Sealant.
  - a) Apply sealant in accordance with manufacturer's written instructions.
  - b) Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - c) Apply sealant in continuous beads.
  - d) Apply sealant using gun with proper size nozzle.

- e) Use sufficient pressure to fill voids and joints solid.
  - f) Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
  - g) Seal around and over cavities in or behind surface elements to allow effective infection control.
  - h) Dry tool exposed surfaces before skinning begins to give slightly concave shape.
  - i) Remove excess compound promptly as work progresses and upon completion.
- .2 Curing.
- a) Cure sealants in accordance with sealant manufacturer's instructions.
  - b) Do not cover up sealants until proper curing has taken place.
- .3 Cleanup.
- a) Clean adjacent surfaces immediately and leave Work neat and clean.
  - b) Remove excess and droppings, using recommended cleaners as work progresses.
  - c) Remove masking tape after initial set of sealant.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 06 20 00 - Finish Carpentry.

**1.2 REFERENCES**

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC).
  - .1 Quality Standards for Architectural Woodwork 1998.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-71.19-M88, Adhesive, Contact, Sprayable.
  - .2 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .3 Canadian Standards Association (CSA International).
  - .1 CSA A440.2-98, Energy Performance of Windows and Other Fenestration Systems.
  - .2 CSA O115-M1982(R2001), Hardwood and Decorative Plywood.
  - .3 CAN/CSA O132.2 Series-90(R1998), Wood Flush Doors.
  - .4 CAN/CSA-Z808-96, A Sustainable Forest Management System: Guidance Document.
  - .5 CSA Certification Program for Windows and Doors 00.
- .4 Environmental Choice Program (ECP).
  - .1 CCD-045-92, Sealants and Caulking Compounds.
  - .2 CCD-046-92, Adhesives.

**1.3 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 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures . Indicate VOC's:
    - .1 For caulking materials during application and curing.
    - .2 For door materials and adhesives.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate door types and cutouts for lights and louvres, sizes, core construction, transom panel construction and cutouts.

**1.4 SAMPLES**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit one 300 x 300 mm corner sample of each type wood door.
- .3 Show door construction, core, glazing detail and faces.

- .4 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

## **1.5 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Wood fire rated doors: labelled and listed by an organization accredited by Standards Council of Canada.
  - .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
  - .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
  - .4 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 31 19.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Storage and Protection:
  - .1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
  - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
  - .3 Protect doors from scratches, handling marks and other damage.
  - .4 Store doors away from direct sunlight.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities, in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Divert unused adhesive material from landfill to official hazardous material collections site approved by Construction Manager.
- .3 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

## **Part 2 Products**

### **2.1 WOOD FLUSH DOORS**

- .1 Solid core: to CAN/CSA-O132.2.1.
  - .1 Construction:
    - .1 Solid particleboard core: stile and rail frame bonded to particleboard core with wood lock blocks, 7-ply construction. Top rail blocking for sliding track hardware and bottom rail blocking at kick plates.
  - .2 Face Panels: to be stained to match existing wood rails in corridors.

- .3 Face panels: maple / birch to match existing wood rails in corridors.
- .4 Adhesive: Type II (water resistant) for interior doors.

## **2.2 FABRICATION**

- .1 Vertical edge strips to match face veneer.
- .2 Prepare doors for sliding track hardware.

## **2.3 HARDWARE**

- .1 Provide and install Bypassing sliding track hardware equal to Crowdertrack CF-650, complete with flush pulls and fascia to conceal track.
- .2 Provide and install a surface mounted flush bolt on rear door (concealed) and a locking pin device to secure front panel into rear door.

## **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 INSTALLATION**

- .1 Unwrap and protect doors in accordance with CAN/CSA-O132.2 Series, Appendix A.
- .2 Install doors and hardware in accordance with manufacturer's printed instructions and CAN/CSA-O132.2 Series, Appendix A.
- .3 Adjust hardware for correct function.

### **3.3 ADJUSTMENT**

- .1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

### **3.4 CLEANING**

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Clean glass and glazing materials with approved non-abrasive cleaner.
- .4 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

**END OF SECTION**





**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Fire resistive rated and non-rated access door and frame units.

**1.2 RELATED SECTIONS**

- .1 Section 09 91 10 - Painting.
- .2 Division 23: Access doors in ductwork.

**1.3 REFERENCES**

- .1 ASTM A 36-93a - Standard Specification for Structural Steel.
- .2 ULC - Fire Resistance Directory.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
- .3 Coordinate the work with other work requiring access doors.

**1.5 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- .3 Shop Drawings: Indicate exact position of all access door units.

**1.6 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements and rough-in dimensions.

**1.7 CLOSEOUT SUBMITTALS**

- .1 Section 01 78 10: Closeout Submittals.
- .2 Record Documentation: Record actual locations of all access units.

**1.8 QUALITY ASSURANCE**

- .1 Provide access doors and frames from a single manufacturer.

**1.9 REGULATORY REQUIREMENTS**

- .1 Conform to applicable code for fire rated access doors.
- .2 Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.

**1.10 WASTE MANAGEMENT AND DISPOSAL**

- .1 Comply with Section 01 74 20 - Waste Management and Disposal.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Available Manufacturers: Or approved equal.
  - .1 Wall and Ceiling Access Doors:
    - .1 J.L. Industries.
    - .2 Larsen's Manufacturing Company.
    - .3 Milcor Inc.
  - .2 Floor Access Doors:
    - .1 Bilco Company.
    - .2 Milcor Inc.
    - .3 Maxam Metal Products Limited.

**2.2 MATERIALS**

- .1 Recycled Content: Products with maximum amount available of post-consumer recycled content and pre-consumer recycled content.
- .2 Sheet Steel: ASTM A36, commercial-quality, cold-rolled steel with baked-on, rust inhibitive primer.
- .3 Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- .4 Cold-Rolled Steel Sheets: ASTM A366, Commercial Steel (CS), or ASTM A620, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568. Electrolytic zinc-coated steel sheet, complying with ASTM A591, Class C coating, may be substituted at fabricator's option.
- .5 Electrolytic Zinc-Coated Steel Sheet: ASTM A591, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A568 for uncoated base metal.

**2.3 ACCESS DOORS**

- .1 Flush, Insulated, Fire-Rated Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
  - .1 Locations: Wall and ceiling surfaces.
  - .2 Fire-Resistance Rating: One hour for ceilings and one and one-half hours for walls.
  - .3 Temperature Rise Rating: 121 deg C at the end of 30 minutes.
  - .4 Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.91 mm.
  - .5 Frame: Minimum 1.5 mm-thick sheet metal with 25 mm wide, surface-mounted trim.
  - .6 Hinges: Continuous piano hinge.
  - .7 Automatic Closer: Spring type.
  - .8 Latch: Self-latching bolt operated by key with interior release.
- .2 Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
  - .1 Locations: Wall and ceiling surfaces.

- .2 Door: Minimum 1.5 mm thick sheet metal, set flush with exposed face flange of frame.
- .3 Frame: Minimum 1.5 mm thick sheet metal with 25-mm wide, surface-mounted trim.
- .4 Hinges: Continuous piano hinge.
- .5 Latch: Screwdriver-operated cam latch.
- .3 Flush Interior Access Doors and Frames with Exposed Trim:
  - .1 Location: Floor.
  - .2 Performance Characteristics:
    - .1 Cover: Reinforced to support a minimum live load of 150 psf (732 kg/m<sup>2</sup>) with a maximum deflection of 1/150th of span.
    - .3 Cover: Single leaf; 6.3 mm minimum thick aluminum, checkered pattern plate.
    - .4 Frame: 6.3 mm minimum thick extruded aluminum with strap anchors bolted to the exterior.
    - .5 Hinges: Continuous piano hinge.
    - .6 Lifting mechanisms: Cam-action hinges on torsion bars to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening.
    - .7 Latch: Removable exterior turn/lift handle, spring loaded.
    - .8 Hardware:
      - .1 Hinges: Cast steel cam-action hinges.
      - .2 Steel hold open arm that automatically locks the cover in the open position.
      - .3 Cover torsion bars.
      - .4 Type 316 stainless steel snap lock with fixed handle mounted on the underside of the cover.
      - .5 Hardware Finish: Zinc plated and chromate sealed.
      - .6 Frame Finish: Factory mill finish aluminum with bituminous coating applied to the exterior of the frame.

## 2.4 FABRICATION

- .1 General: Provide access door assemblies manufactured as integral units ready for installation.
- .2 Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- .3 Steel Doors and Frames: Weld, fill, and grind exposed welds smooth to assure square units that sit flush with adjacent surfaces when installed. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
  - .1 Exposed Flanges: Nominal 1 inch wide around perimeter of frame.
  - .2 Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction.
- .4 Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
  - .1 For keyed latches, furnish two keys per latch and key all latches alike.

**2.5 STEEL FINISHES**

- .1 Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
  - .1 Exteriors (SSPC Zone 1B): SSPC-SP6/NACE No. 3, "Commercial Blast Cleaning."
  - .2 Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- .2 Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA1, "Paint Application Specification No. 1," for shop painting.

**Part 3 EXECUTION**

**3.1 EXAMINATION**

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that rough openings for door and frame are correctly sized and located.

**3.2 INSTALLATION**

- .1 Install units to manufacturer instructions.
- .2 Install frames plumb and level in opening. Secure rigidly in place.
- .3 Position unit to provide convenient access to concealed work requiring access.

**3.3 ADJUSTING AND CLEANING**

- .1 Adjust and clean hardware and panels after installation for proper operation.
- .2 Clean and prepare doors for painting.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 07 90 00 Joint Sealers.

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.40-M89, Primer, Structural Steel, Oil Alkyd Type.
  - .2 CAN/CGSB-79.1-M91, Insect Screens.
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA-A440-M90, Windows.
  - .2 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CAN/CSA-Z91-M90, Safety Code for Window Cleaning Operations.
  - .4 CSA Z760-94, Life Cycle Assessment.
  - .5 CAN/CSA ISO 14040-97, Environmental Management - Life Cycle Cost Assessment - Principle and Framework.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate materials and details in scale full size for head, jamb and sill, profiles of components, interior and exterior trim junction between combination units elevations of unit, anchorage details, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.

**1.4 MAINTENANCE DATA**

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

**Part 2 Products**

**2.1 MATERIALS**

- .1 Materials: to CAN/CSA-A440 supplemented as follows:
- .2 All windows by same manufacturer.
- .3 Main frame: aluminum thermally broken.
- .4 Glass: insulating double-glazed units per section 08 80 00.
- .5 Isolation coating: alkali resistant bituminous paint.

## 2.2 WINDOW TYPE AND CLASSIFICATION

- .1 High performance window system shall be fabricated from thermally broken tubular aluminum sections with self-supporting framing, shop-fabricated, factory finished, vision glass infill, related flashings, anchorage and attachment devices.
- .2 Windows shall confirm to the following requirements of CAN/CSA-A440 Windows:
  - .1 Air infiltrations: fixed rating.
  - .2 Water infiltration: B7.
  - .3 Wind load resistance: C5.
  - .4 Wind loading: in accordance with NBC 2010.
  - .5 Condensation resistance temperature index for framing: minimum 78.
- .3 Acceptable product: Kawneer 518, double glazed, with a operating vent unit of 526 IsoPort (awning).

## 2.3 FABRICATION

- .1 Fabricate in accordance with CAN/CSA-A440 supplemented as follows:
- .2 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.
- .3 Face dimensions detailed are maximum permissible sizes.
- .4 Brace frames to maintain squareness and rigidity during shipment and installation.
- .5 Finish steel clips and reinforcement with shop coat primer to CAN/CGSB-1.40 380 g/m2 zinc coating to CAN/CSA-G164.
- .6 All glazing products shall be vented, pressure equalized and drained to the exterior.
- .7 Elastomeric air seal gasket shall be installed around full perimeter of glass and sealed at corners with silicone sealant.

## 2.4 ALUMINUM FINISHES

- .1 Exterior exposed aluminum surfaces:

Finish Architectural Class 1 anodic coating to AA-M12C22A31, dark bronze to match existing units.
- .2 Interior exposed aluminum surfaces: Architectural Class 1 anodic colour coating to AA-M12C22A31. Colour: dark bronze to match existing units.
- .3 Shop and touch-up primer for steel components: SSPC 25 Paint red oxide.
- .4 Touch-up primer for galvanized steel surfaces: SSPC 20 Paint zinc rich.
- .5 Concealed steel items: galvanized in accordance with ASTM A 123 to 600 gm/m2.

- .6 Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

## **2.5 ISOLATION COATING**

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

## **2.6 GLAZING**

- .1 Glaze windows in accordance with CAN/CSA-A440 and as specified in Section 08 80 00 - Glazing.

## **2.7 AIR BARRIER AND VAPOUR RETARDER**

- .1 Equip window frames with site installed air barrier and vapour retarder material for sealing to building air barrier and vapour retarder as follows:
  - .1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.
  - .2 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder from interior.

## **Part 3 Execution**

### **3.1 WINDOW INSTALLATION**

- .1 Install in accordance with CAN/CSA-A440.
- .2 Arrange components to prevent abrupt variation in colour.

### **3.2 SEALANT**

- .1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill up stand and window-frame. Caulk butt joints in continuous sills.
- .2 Apply sealant in accordance with Section 07 90 00 - Joint Sealers. Conceal sealant within window units except where exposed use is permitted by Consultant.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Aluminum Windows Section 08 50 00

**1.2 REFERENCES**

- .1 ANSI/ASTM E330-02 Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- .2 ASTM C542-94 (1999) Specification for Lock-Strip Gaskets.
- .3 ASTM D2240-026 Test Method for Rubber Property - Durometer Hardness.
- .4 ASTM E84-01 Test Method for Surface Burning Characteristics of Building Materials.
- .5 CAN/CGSB-12.1 M90 Tempered or Laminated Safety Glass.
- .6 CAN/CGSB-12.3-M91, Clear Float Glass.
- .7 CAN/CGSB-12.4-M91 Heat Absorbing Glass.
- .8 CAN/CGSB-12.8-M90 Insulating Glass Units.
- .9 CAN/CGSB-12.11-M90 Wired Safety Glass.
- .10 Flat Glass Manufacturers Association (FGMA) Glazing Manual 1997.

**1.3 PERFORMANCE REQUIREMENTS**

- .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
- .2 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure according to NBC 2010, for location of this project.
- .3 Limit glass deflection to flexural limit of glass maximum of L/200, with full recovery of glazing materials.

**1.4 SAMPLES**

- .1 Submit samples in accordance with Section 01 33 00, if requested by Consultant.
- .2 Submit duplicate 300 x 300mm size samples of glass.

**1.5 CLOSEOUT SUBMITTALS**

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

**1.6 SHOP DRAWINGS**

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

## 1.7 QUALITY ASSURANCE

- .1 Perform work in accordance with GMAC for glazing installation methods.
- .2 Maintain one copy of standard document on site.

## 1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Install glazing when ambient temperature is 10°C minimum. Maintain ventilated environment for 24 hours after application.
- .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

## Part 2 Products

### 2.1 MATERIALS: FLAT GLASS

- .1 Float glass: to CAN/CGSB-12.3, Glazing quality, 6 mm thick.
- .2 Safety glass: to CAN/CGSB-12.1, 6mm thick.
  - .1 Type 2 - tempered.
- .3 Wired glass: to CAN/CGSB-12.11, 6mm thick.
  - .1 Type 1 – polished both sides
- .4 Low emissivity (LOW E) glass as indicated.

### 2.2 MATERIALS: SEALED INSULATING GLASS

- .1 To exterior windows:
  - .1 6mm grey heat strengthened
  - .2 6mm Comfort E2 (3) heat strengthened
  - .3 Argon gas.
  - .4 EdgeTech super spacer
  - .5  $U = 0.137$
  - .6  $SC = 0.307$
  - .7 T. Vis.. = 28%

### 2.3 ACCESSORIES

- .1 Setting blocks: Neoprene Shore A durometer hardness to ASTM D2240, to suit glazing method, glass lightweight and area.
- .2 Spacer shims: Neoprene, 50 - 60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face. Note that special shims are required for high performance sealed units.
- .3 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, colour as selected.
- .4 Glazing clips: manufacturer's standard type.
- .5 Lock-strip gaskets: to ASTM C542.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

**3.2 PREPARATION**

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

**3.4 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)**

- .1 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .2 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .3 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .4 Place glazing tape on free perimeter of glazing in same manner described in 3.6.3.
- .5 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .6 Knife trim protruding tape.

**3.6 CLEANING**

- .1 Remove glazing materials from finish surfaces.
- .2 Remove labels after work is complete.
- .3 Clean glass and mirrors.

**3.7 PROTECTION OF FINISHED WORK**

- .1 After installation, mark light with an "X" by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedure.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.

**1.2 REFERENCES**

- .1 Unless otherwise indicated, execute all works in accordance with the National Building Code, current edition, and local bylaws and regulations.
- .2 In addition, execute all works in accordance with all applicable codes or standards, current editions, including, namely, the following, but not restricted to:
  - .1 National Research Council Canada (NRCC):
    - .1 National Fire Prevention Code (NFPC).
  - .2 Government of Canada - Human Resources and Skills Development Canada.
    - .1 CI 311 (M): Standard for Record Storage.
    - .2 Directive 2009-01: Fire Protection for Information technology Facilities and Equipment.
  - .3 Underwriter Laboratory of Canada (ULC).
    - .1 CAN/ULC-S504, Standard for Dry Chemical Fire Extinguishers.
    - .2 CAN/ULC-S508, Standard for the Rating and Fire Testing of Fire Extinguishers.
    - .3 CAN/ULC-S554, Standard for Water-Based Agent Fire Extinguishers.
  - .4 National Fire Protection Association (NFPA).
    - .1 NFPA 10, Standard for Portable Fire Extinguishers.
  - .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

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

- .2 Technical Specifications:
  - .1 Submit technical specifications and documentation from manufacturer. Shop drawings must provide the following information: product characteristics, performance criterion, dimensions, constraints, and finish.
  - .2 Submit two copies of Materials Safety Data Sheets required as per WHMIS (Workplace Hazardous Materials Information System), and in accordance with Section 01 33 00.
- .3 Submit required shop drawings.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Specs sheets and operation and maintenance literature, which will be appended to the manual mentioned in the Section 01 78 00 - Closeout Submittals.

#### **1.5 QUALITY CONTROL**

- .1 Qualifications:
  - .1 Experienced person or company that specializes in the installation of portable fire extinguishers, with references to support claim.
- .2 Health and Safety:
  - .1 Take necessary measures to ensure health and safety on construction site, in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Submit the following documents in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Test reports.
    - .1 Instructions: submit installation instructions provided by manufacturer.

#### **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Sort waste in order to re-use and recycle in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect packaging materials and send to appropriate recycling facilities.
- .3 Collect and sort plastic, paper and corrugated cardboard wrappings, and dispose them in appropriate designated bins in conformity with the Waste Management Plan.
- .4 Sort, flatten and place metal banding in designated area for recycling in conformity with the Waste Management Plan.
- .5 Manipulate and eliminate hazardous materials in accordance with the Canadian Environmental Protection Act, Transportation of Dangerous Goods Act, and provincial and municipal regulations.
- .6 Transport unused metal elements to a recycling facility approved by the Departmental Representative.

## **1.7 TRANSPORT, STORAGE AND HANDLING**

- .1 Conditioning, Transport, Handling and Unloading:
  - .1 Transport, handle and deliver materials and equipment as per manufacturers written instructions.
  - .2 Deliver materials and equipment in good condition to the construction site and in their closed original packaging which must bear the manufacturer's name, address and ULC approval.
- .2 Storage and Protection:
  - .1 Store materials and equipment as per manufacturers' recommendations, in a clean, dry, and well ventilated place.
  - .2 Replace all defective materials and equipment with new materials and equipment.

## **Part 2 Products**

### **2.1 MULTIPURPOSE DRY CHEMICALS EXTINGUISHERS (EP-01)**

- .1 Multipurpose dry chemicals portable fire extinguishers: permanent pressure type, refillable, equipped with flexible hose with closing valve and pressure gauge.
- .2 Characteristics:
  - .1 Approval: CAN/ULC-S504.
  - .2 Fire Classes: A, B and C.
  - .3 Minimum ULC Class: 4-A: 80-B:C.
  - .4 Minimum capacity: 4.54 kg (10 lb).
  - .5 Activation: permanent pressure.
  - .6 Acceptable products:
    - .1 Light and ordinary hazards: Ansul, AA10S Model; Amerex, B456 Model; Pyrochem, PC10SAB+1 Model.

### **2.2 LIQUID FIRE SUPPRESSANT EXTINGUISHER (EP-02)**

- .1 Liquid fire suppressant portable (aqueous solution) fire extinguisher for kitchen, rechargeable, stainless steel cylinder, permanent pressure type, refillable, equipped with flexible hose with closing valve and pressure gauge.
- .2 Characteristics:
  - .1 Approval: CAN/ULC-S554.
  - .2 Fire Classes: A and K.
  - .3 Minimum ULC Class: 2-A: K.
  - .4 Minimum capacity: 6 L (1.6 US gal).
  - .5 Activation: permanent pressure.

- .6 Acceptable products: Ansul, K-Guard - K01-2 Model; Amerex, B260 Model; Pyrochem, KS 6000 Model.

## **2.3 EXTINGUISHER BRACKETS**

- .1 Brackets as recommended by extinguishers manufacturer.

## **2.4 FIRE CABINETS**

- .1 Recessed, pre-fabricated 1.6 mm thick steel cabinets, equipped with a 2.5 mm steel door opening up to 180° and equipped with a lock.
- .2 Cabinets to have same equivalent fire rating as wall where cabinets are installed.
- .3 Finish.
  - .1 Box: finished with primer;
  - .2 Door and frame: stainless steel, satin finish No. 4.
- .4 Acceptable Products:
  - .1 Guardian, 2902 (multipurpose dry chemical) and 2912 (liquid fire suppressant) Models;
  - .2 Larsen, DEC2409-R (multipurpose dry chemical) and DEC2712-P (liquid fire suppressant) Models;
  - .3 Potter Roemer, DC-1704 (multipurpose dry chemical) and DC-1754 (liquid fire suppressant) Models.

## **2.5 LABELLING**

- .1 Extinguishers must be labelled in accordance with NFPA 10 Standard.
- .2 Attach, stick or affix label on extinguishers with bilingual inscription, showing year, month and day of installation. Space must be provided to indicate periodic inspection dates.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install or assemble extinguishers on brackets or in cabinets, as specified, while complying with NFPA 10 Standard.
- .2 Ensure that all portable extinguishers are filled before installing.



**3.3 FIELD QUALITY CONTROL**

- .1 Field quality control from manufacturer:
  - .1 The manufacturer must state his recommendations regarding the operation of the products and carry out periodical visits to verify that implementation is achieved as per recommendations.

**3.4 CLEANING**

- .1 Clean up as per section 01 74 11 - Cleaning.

**END OF SECTION**



**Part 1 General**

**1.1 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in the Province of Saskatchewan, Canada.
- .3 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Points of operation on performance curves.
  - .3 Manufacturer to certify current model production.
  - .4 Certification of compliance to applicable codes.
- .5 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.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .4 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.
  - .5 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.
- .6 Approvals:
  - .1 Submit 4 copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
  - .2 Make changes as required and re-submit as directed by Consultant.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 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".
  - .3 (Signature of Contractor) (Date).
  - .4 Submit to Consultant for approval and make corrections as directed.
  - .5 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .6 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

## 1.2 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.3 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 Sprinkler heads.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
- .2 Do verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

**Part 3 Execution**

**3.1 PAINTING REPAIRS AND RESTORATION**

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

**3.2 CLEANING**

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

**3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - 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 - 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.

**3.4 DEMONSTRATION**

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

**3.5 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.

**1.2 REFERENCES**

- .1 Unless otherwise indicated, the works will be done in accordance with the in force edition of the "National Building Code of Canada".
- .2 Furthermore, the Works will be done in accordance to any other code or standard having jurisdiction, notably including, but not limited to:
  - .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA).
    - .1 NFPA 101-2010, "Life Safety Code".
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM E2174-2010, Standard Practice for On-site Inspection of Installed Fire Stops.
  - .3 Underwriters Laboratories of Canada (ULC).
    - .1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
    - .2 CAN/ULC-S102, Seventh Edition Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies.
    - .3 CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
- .3 Tests:
  - .1 In accordance with CAN/ULC-S101 and CAN/ULC-S102.
  - .2 Submit test reports issued by recognized independent laboratories certifying that firestop products, materials and equipments comply with specified physical characteristics and performance criterion.

- .4 Certificates:
  - .1 Submit signed manufacturer documents, certifying that products, materials, and equipments comply with specified physical characteristics and performance criterion.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer installation instructions, including particular information regarding handling, installation, and cleaning.
- .6 Manufacturer's Field Services:
  - .1 Submit manufacturer's written reports within three days after executing field services regarding compliance of Work, as specified in FIELD QUALITY CONTROL of PART 3.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Closeout Submittals: submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance Data:
  - .1 Maintenance data to include:
    - .1 Product description, including manufacturer's name, type, model, year of manufacture, and specifications;
    - .2 Detailed instructions regarding operation, maintenance, and upkeep;
    - .3 List of recommended spare parts.

#### **1.5 WORK DESCRIPTION**

- .1 Provide staff as well as materials, equipment and services necessary for the installation of firestop and smoke control around mechanical services that penetrate through fire resistant building elements.

#### **1.6 QUALITY ASSURANCE**

- .1 Works must be carried out by a qualified person, approved by firestop systems manufacturer, employing skilled, certified, and experienced personnel in the installation of firestop systems and smoke control installations.
- .2 Works must comply with manufacturer's written specifications and be considered of high quality according to best industry practice.
- .3 Site Meetings: Manufacturer's Field Services specified in FIELD QUALITY CONTROL of PART 3 should include site visits as follows:
  - .1 Once, after product delivery and storage on site as well as preparatory work and other preliminary work is completed, but before the start of installation work;
  - .2 Once during works progress at 60% of completion;
  - .3 Once works are completed and clean up done.



## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, Shipping, Handling, and Unloading.
  - .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
  - .2 Deliver materials to site in original factory packaging, labelled ULC with manufacturer's name and address.
- .2 Storage and Protection:
  - .1 Store and handle materials in accordance with manufacturer's written instructions in a clean, dry, and well ventilated area.
  - .2 Replace defective or damaged materials by new materials.

## **Part 2 PRODUCT**

### **2.1 GENERAL**

- .1 All installed firestop system products must be officially "cUL", "ULC" and "FM" approved and must be labelled as such.

### **2.2 MATERIALS**

- .1 Firestop and Smoke Barrier Systems:
  - .1 Efficient, asbestos-free flame, smoke and gas barrier materials and systems, in accordance with CAN/ULC-S115. Dimensions should not exceed those of the penetrations or access points that they are intended for.
  - .2 Assembly of firestop and smoke control systems: ULC certified in accordance with CAN/ULC-S115.
  - .3 Fire resistance rating of installed firestop systems must not be less than fire resistance rating of floor and surrounding walls and in accordance with architectural drawings.
  - .4 Acceptable products: 3M, FD-150 model + for steel, cast iron and, copper pipes and CP-25WB model + for plastic pipes; HILTI.
- .2 Firestop systems for penetrations made by utility services: tested in accordance with CAN/ULC-S115.
- .3 Firestop system elements for penetrations made by utility services: certified by a test laboratory in accordance with CAN/ULC-S115.
- .4 Fire resistance rating of installed firestop systems must comply to the NBC.
- .5 Firestop and smoke barrier systems installed on access points of hidden equipments and cables, for example: elastomer seals.
- .6 Firestop and smoke barrier systems installed around penetrations made by pipes, ducts or other mechanical materials needing acoustic and shock-absorbent insulation: elastomer seals.

- .7 Firestop Devices:
  - .1 Ultrafast firestop devices for plastic pipes, made of intumescent material that dilates when exposed to temperatures of 149°C and more. Material may dilate up to 25 times its original volume to seal openings created by plastic pipes.
  - .2 Devices should be certified to CAN/ULC-S115, according to tests performed at a differential pressure of 50 Pa (0.2 in. of water) with a one or two-hour fire resistance rating.
  - .3 Acceptable products: 3M, Fire Strap model up to NPS 3; Fire Stop model for NPS 4 and more; HILTI.
- .8 Primers: In compliance with manufacturer's recommendations regarding materials, supports and intended use.
- .9 Water (if applicable): Clean drinking water free of excessive amounts of harmful substances.
- .10 Mineral Wool: Rock and slag fibres agglomerated by a heat resistant binder. Maximum service temperature of 1,035°C. Practically pH- neutral.
- .11 Safety restraints, supports and anchoring: According to manufacturer's recommendations. Shall be compatible with implemented systems, tested and deemed acceptable by competent authorities.
- .12 Sealing materials for vertical joints: Product must not collapse in accordance with ULC assembly tests.

## **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 PREPARITORY WORK**

- .1 Examine size and condition of gaps to be filled in order to determine required material thickness and installation method.
  - .1 Make sure surfaces are clean, dry, and not frozen.
- .2 Prepare surfaces that will be in contact with firestop and smoke barrier systems in accordance with manufacturer's instructions.
- .3 Ensure integrity of insulation around pipes and ducts that penetrate fire resistant partitions as well as the vapor barrier.
- .4 Cover adjacent surfaces to protect them from drips and splashes, and clean away stains and undesirable deposit, once works are completed.

### **3.3 INSTALLATION**

- .1 Install firestop and smoke barrier systems as well as their components in accordance with manufacturer's instructions regarding tested and approved systems.

- .2 Seal gaps and spaces around pipes or devices which fully or partially penetrate fire resistant partitions and seal openings destined for later use, as well as their joints, in order to preserve continuity and integrity of smoke and fire protection systems.
- .3 If necessary, install temporary safety restraints until initial curing is completed and materials have acquired sufficient strength.
- .4 Shape apparent surfaces or even out with a trowel until achieving a smooth finish.
- .5 Quickly remove excess product as works progress and once completed.

### **3.4 WORK SCHEDULING**

- .1 Install only after submittals have been reviewed by Departmental Representative.
- .2 Implement floor firestop systems before installing interior partitions.
- .3 Bonding to metal support: Firestop protection must be implemented before spraying of fireproof coating in order to ensure required bonding.
- .4 Insulation of mechanical pipes: consisting of approved firestop system.
  - .1 Pipe insulation shall be installed before firestop protection.

### **3.5 FIELD QUALITY CONTROL**

- .1 Inspections: Before dissimulating or covering materials or firestop systems, advise Departmental Representative that works are ready for inspection.
- .2 Manufacturer's field services:
  - .1 Obtain manufacturer's written report confirming that works comply with specified criterion regarding product handling, installation and application as well as protection and cleaning of Works before submitting report, in accordance with SUBMITTALS, of PART 1.
  - .2 Manufacturer must provide recommendations regarding use of products and conduct periodic visits to verify if implementation is as recommended.
  - .3 Site visits shall be in accordance with QUALITY ASSURANCE, of PART 1.

### **3.6 SITE CONDITIONS**

- .1 Application and drying of stopfire and smoke barrier materials must be in accordance with manufacturer recommendations regarding temperature, relative humidity and moisture content of background layers.
- .2 Protect all works against potential damages and deterioration caused by other trades and protect other trade installations against dirt and potential damage originating from works.
- .3 Once completed, correct all imperfections and leave workplace in impeccable condition.

### **3.7 VERIFICATION**

- .1 Verify all stopfire surfaces to be sealed. Provide a written report stating conditions that are non-compliant or deemed unacceptable by the Contractor, before starting Works.
- .2 Delay works until surface conditions are acceptable.

### **3.8 MIX**

- .1 Mix materials in strict compliance with manufacturer's instructions.
- .2 Components must be well prepared and mixed by qualified personnel.

### **3.9 COATING MATURATION**

- .1 Allow coatings to mature according to manufacturer's recommendations.
- .2 Do not cover materials before maturation is completed.

### **3.10 INSPECTION OF WORK**

- .1 Inform Departmental Representative when works are ready for inspection. Works shall not yet be covered by fireproof shield, control material or all other services penetrating fire resistant partitions.
- .2 Inspect penetrations in firestop systems in accordance with ASTM E2174.

### **3.11 CLEANING**

- .1 Once implementation and performance monitoring finished, remove extra materials, rubbish, and tools from site.
- .2 Take off temporary safety restraints once initial setting is complete.

### **3.12 TESTS**

- .1 Perform smoke penetration simulation tests.
- .2 If joint finishing, gaps or openings described in this section show clear smoke emission during tests, correct all defects and start smoke test again at no additional costs to the Departmental Representative.
- .3 Smoke simulation product must not be toxic neither staining and must provide fog density of  $80 \text{ mg/m}^3$  ( $0.00008 \text{ oz/ft}^3$ ) with acceptable air concentration levels of 50 ppm.
- .4 Create smoke at a rate of 4 seconds/ $2.8 \text{ m}^3$  (4 seconds/ $100 \text{ ft}^3$ ) and maintain fog density until inspection is completed.

### **3.13 FIRESTOP SYSTEM LOCATION**

- .1 Ensure firestop and smoke barrier protection to building elements that are fire resistant, including the following places:
  - .1 Penetrations through partitions, masonry walls, concrete, and gypsum that are fire resistant.
  - .2 Penetrations through floor slab, ceiling, and roof that are fire resistant.
  - .3 Access openings and penetrations made in fire resistant partitions for further use.
  - .4 Around pipes and other mechanical and electrical material that penetrate fire resistant partitions.

- .5 Rigid conduits with sections above  $129 \text{ cm}^2$  ( $20 \text{ in}^2$ ): Fire protection by means of a fire resistant joint located between angle bracket and fire resistant partition as well as between angle bracket and conduit on each side of the fire resistant partition.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedure.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 01 91 13 - General Commissioning Requirements.
- .7 Section 23 05 19.01 - Thermometers and Pressure gauges – Piping Systems.
- .8 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .9 Section 23 05 53.01 - Mechanical and Network Equipment Identification.
- .10 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 Unless other notices, execute all works in accordance with the current valid edition of the National Building Code of Canada and local bylaws and regulations.
- .2 Moreover, execute all work in conformity with all applicable codes or standards, current editions, including namely the following, but not restricted to:
  - .1 National Research Council Canada (NRC).
    - .1 National Fire Code of Canada (NFC).
    - .2 National Plumbing Code of Canada (NPC).
  - .2 American Society for Testing and Material (ASTM).
    - .1 ASTM A-47M, Standard Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A-53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - .3 ASTM A-135, Standard Specification for Electric-Resistance-Welded Steel Pipe.
  - .3 Canadian Standard Association (CSA) / CSA International.
    - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
    - .2 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
    - .3 CAN/CSA B64.10-01, Manual for the Selection and Installation of Backflow Prevention Devices.
  - .4 Government of Canada – Treasury Board.
    - .1 Chapter 3-4: Standard for Fire Alarm Systems.
  - .5 Government of Canada - Human Resources and Skills Development Canada.
    - .1 FC 311 (M): Standard for Record Storage.
    - .2 FC 403: Standard for Sprinkler Systems.

- .6 National Fire Protection Association (NFPA).
  - .1 NFPA 13, Installation of Sprinkler Systems.
  - .2 NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
  - .3 NFPA 170, Standard for Fire Safety and Emergency Symbols.
  - .4 NFPA 291, Fire Flow Testing and Marking of Hydrants.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .8 Underwriter's Laboratories of Canada (ULC).
  - .1 CAN/ULC S543, Internal Lug Quick Connect Coupling for Fire Hose.

### 1.3 SUBMITTALS

- .1 Product Data.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Submit one (1) copy of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .2 Shop Drawings.
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures and in accordance with NFPA 13 Standard.
    - .1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Saskatchewan.
  - .2 Submit installation drawings as required in NFPA 13 Standard for execution drawings.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Submit all required documents and items after completion of work for incorporation into manual such as specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance Data Sheets.
  - .1 Maintenance data sheets must include the following elements:
    - .1 Technical data from catalogs and product literature, including the model number, type and size for the items mentioned below.
      - .1 Piping and fittings;
      - .2 Sprinklers;
      - .3 Valves, including gate valves, check valves and globe valves;
      - .4 Pipes hangers and suspension;
      - .5 Couplings;
      - .6 Monitoring switches.



- .2 Relevant details concerning operation, maintenance and servicing.
- .3 A list of recommended spare parts.
- .3 Provide a copy of NFPA 25 "Inspection, Testing, and Maintenance of Water Based Fire Protection Systems" and incorporate it into the "Operation and maintenance Manual".

#### 1.5 SKETCHES

- .1 Submit diagram complying with requirements.
- .2 Submitted diagram must include following items:
  - .1 A key localisation plan at 1: 500 scale;
  - .2 A plan for the basement and crawl space affected by fire protection work, showing the zone covered by the system, localisation of isolating valves, flow detectors and drainage test pipes.
- .3 Once approved, provide two laminated copies of the diagram, plasticized, glued on plywood and inserted in a solid wooden frame.
- .4 Install one diagram in the alarm valve room and deliver the other one to the Departmental Representative.
- .5 When there is more than one zone control per floor, install diagram near zone controls of each floor to clearly show the protected areas.

#### 1.6 QUALITY CONTROL

- .1 Qualifications:
  - .1 Experienced person or company that specializes in the installation of wet pipe sprinkler systems, with references to support claim.
- .2 Health and Safety:
  - .1 Take necessary measures to ensure health and safety on construction site, in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Submit the following documents in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Test reports.
    - .1 Submit test reports issued by recognized independent laboratories, certifying that automatic wet pipe sprinkler systems comply with requirements regarding physical characteristics and performance criteria.
    - .2 Submit documents signed by manufacturer certifying that products, materials and equipments meet requirements regarding physical characteristics and performance criteria.
    - .3 Instructions: Submit installation instructions provided by manufacturer.
    - .4 Manufacturer on-site checks: Submit required report.

#### 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Sort waste in order to re-use and recycle in conformity with section 01 74 21 - Waste Management Plan.
- .2 Collect packaging materials and send to appropriate recycling facilities.

- .3 Collect and sort plastic, paper and corrugated cardboard wrappings and dispose them in appropriate designated bins in conformity with the Waste Management Plan.
- .4 Sort metal banding, flatten and place in designated area for recycling in conformity with the Waste Management Plan.
- .5 Manipulate and eliminate hazardous materials in conformity with the Canadian Environmental Protection Act, Transportation of Dangerous Goods Act, and provincial and municipal regulations.
- .6 Transport unused metal elements to a recycling facility approved by the Departmental Representative.

## **1.8 SPARE PARTS AND MAINTENANCE**

- .1 Provide extra material spare parts for maintenance as required by section 01 78 00 - Closeout Submittals.
- .2 Provide spare sprinklers and tools as required by NFPA 13 Standard.

## **1.9 TRANSPORT, STORAGE AND HANDLING**

- .1 Conditioning, Transport, Handling and Unloading:
  - .1 Transport, store and handle materials and equipment as per manufacturers written instructions.
  - .2 Deliver materials and equipment to the project site in good condition and in their original packaging which must bear the manufacturer's name, make, and ULC approval.
- .2 Storage and Protection:
  - .1 Store materials and equipment inside as per manufacturers' instruction, in a dry, well ventilated, and clean area.
  - .2 Replace defective or damaged materials and equipment by new materials and equipment.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 All products used in fire safety installations must be "cUL" or "ULC" listed and must be labelled as such.
- .2 Provide accessories that can withstand the normal pressure exerted in the fire protection network.

### **2.2 PIPES AND FITTINGS**

- .1 Pipes:
  - .1 Pipes 50 mm or less:
    - .1 Black steel, schedule 40, grooved or threaded, complying with NFPA 13 and ASTM A-53 or ASTM A-135 Standards.
  - .2 Pipes 65 mm and over:
    - .1 Black steel, schedule 10, grooved or threaded, complying with NFPA 13 and ASTM A-53 or ASTM A-135 Standards.

- .3 Acceptable products: Allied; Bull Moose.
- .2 Fittings and couplings as per NFPA 13 Standard:
  - .1 Fittings and couplings up to 50 mm:
    - .1 Couplings and fittings, rigid type, from the same manufacturer.
    - .2 Grooved-end pipe couplings in conformity with CSA B242 and ANSI/API Spec 5L Standards.
    - .3 Grooved-end fittings in conformity with ASTM A-536, grade 65-45-12 Standard.
  - .2 Fittings and couplings NPS 65 mm and over:
    - .1 Couplings and fittings, rigid type, from the same manufacturer.
    - .2 Grooved-end pipe couplings, in conformity with CSA B242 and ANSI B-3620 (API-5L) Standards.
    - .3 Grooved-end fittings in conformity with ASTM-A-536, grade 65-45-12.
  - .3 Acceptable products:
    - .1 Fittings: Victaulic, Firelock; Gruvlock, Rigidilite 7400 Series.
    - .2 Couplings: Victaulic, Vic-plus and "Flushseal"; Gruvlock.

## 2.3 AUXILIARY VALVES

- .1 All valves to be listed for fire protection service.
- .2 Acceptable Products:
  - .1 Valves, 50 mm and less, threaded ends:
    - .1 Bronze gate valves, with outside screw and yoke (OS&Y):
      - .1 Acceptable products: Maximum service pressure of 1.2 MPa (175 psi); Nibco T-104-0.
    - .2 Bronze ball valves:
      - .1 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi); Victaulic S/728 Firelock with monitoring switch; Victaulic S/722 Firelock; Anvil F171N; Nibco KT-505-W-8.
  - .2 Gate valves, NPS 65 mm and over, grooved ends:
    - .1 Ductile iron gate valve with outside screw and yoke (OS&Y), bronze trim.
      - .1 Acceptable products, maximum service pressure of 1.2 MPa (175 psi); Victaulic 771H.
  - .3 Butterfly valves, NPS 2½ and over, with monitoring switch:
    - .1 Ductile iron butterfly valves, with indicating yoke, grooved ends.
      - .1 Acceptable products, maximum service pressure of 1.2 MPa (175 psi); Nibco GD1765-8N.

- .4 Swing check valves with composite material disc:
  - .1 Flanged ends:
    - .1 Acceptable products, maximum service pressure of 1.2 MPa (175 psi): Nibco F908W.
  - .2 Grooved ends:
    - .1 Acceptable products, maximum service pressure of 1.2 MPa (175 psi): Globe CV-1-S.
  - .3 Quiet type, adapted for flanged ends:
    - .1 Acceptable products, maximum service pressure of 1.7 MPa (250 psi): Rite, 212 Model.
- .5 Ball drip:
  - .1 Acceptable products, maximum service pressure of 1.7 MPa (250 psi): Victaulic S/748, Viking B-1.

## 2.4 SPRINKLER HEADS

- .1 General Requirements: Sprinkler heads complying with NFPA 13 Standard, and approved for fire protection service.
- .2 For tender, provide an additional amount of each type of sprinkler, equivalent to 2% of the number of sprinklers of each type provided, including installation.
- .3 Sprinkler guard for sprinkler exposed to mechanical shock, with zinc coated steel rod.
  - .1 Guards must be approved for sprinkler head.
  - .2 Acceptable products: Viking; Tyco; Victaulic.
- .4 Upright Sprinkler:
  - .1 Upright sprinkler, quick-response, with frangible bulb, "K" factor of 80.6 L/min/(Bar)<sup>1/2</sup> (5.6 US gal/min/(psi)<sup>1/2</sup>):
    - .1 Acceptable products:
      - .1 Quick-response sprinklers: Viking VK-300; Victaulic style V2704; Globe 5615.
  - .2 Temperature ratings: 68°C (155°F).
  - .3 Finish: Bronze.
  - .4 Maximum sprinkler coverage:
    - .1 Light hazard:
      - .1 Incombustible construction: 20.9 m<sup>2</sup> (225 ft<sup>2</sup>).
    - .2 Ordinary hazard: 12.1 m<sup>2</sup> (130 ft<sup>2</sup>).

- .5 Pendant Sprinkler:
  - .1 Adjustable standard type pendant sprinklers, quick response, with frangible bulb, "K" factor of 80.6 L/min/(Bar)<sup>1/2</sup> (5.6 gal US/min/(psi)<sup>1/2</sup>). Chromed finish plate.
    - .1 Acceptable products:
      - .1 Quick response sprinklers: Viking VK-302 with escutcheon E-1; Victaulic V2708 Model; Tyco, TY3231 or TY3221 Model.
  - .2 Temperature rating: 68°C (155°F), 141°C (286°F) as required.
  - .3 Finish: Chrome; corrosion-resistant coatings: White polyester or according to the indications of the plans.
  - .4 Maximum sprinkler coverage:
    - .1 Light hazard:
      - .1 Incombustible construction: 20.9 m<sup>2</sup> (225 ft<sup>2</sup>).
    - .2 Ordinary hazard: 12.1 m<sup>2</sup> (130 ft<sup>2</sup>).

## 2.5 PIPE HANGERS

- .1 Hangers for fire protection service, in conformity with NFPA 13 Standard.
- .2 Refer to Sections 23 05 29, Hangers and Supports for HVAC Piping and Equipment.

## 2.6 MONITORING SWITCHES

- .1 General: Switches approved for fire protection service, complying with NFPA 13 Standard.
- .2 Valves:
  - .1 Mechanically attached to valve body, with normally open and normally closed contacts, with monitoring capability.
  - .2 Add monitoring contacts on non-supervised valves, as indicated on site.
  - .3 Acceptable products:
    - .1 OS&Y valves: System Sensor, OSY2A Model.
    - .2 Pluggable valves: System Sensor, PSP1A Model.
- .3 Flow Switch:
  - .1 Designed to ensure monitoring of the system.
    - .1 Acceptable products: System Sensor, WFDxxA Series; Potter, VSR.

## 2.7 TEST AND DRAIN VALVE

- .1 Combined valve for test and drain, including a 3-position ball valve, two (2) flow indicators, pressure gauge outputs, and a label plate indicating orifice diameter.
  - .1 Acceptable products: Victaulic S/720 TestMaster™ II ou S/747 Riser; Tyco, F350; Reliable Test and Drain System.

## 2.8 IDENTIFICATION

- .1 Indicating plates for test/drain valves: To NFPA 13 Standard.

- .2 Provide a hydraulic design information sign for each hydraulic calculation. It shall be permanently installed at the base of riser and shall include the following information:
  - .1 Location of the design area.
  - .2 Discharge density over the design area.
  - .3 System flows and residual pressures requirements at the base of riser.
  - .4 Occupancy classification.
  - .5 Hose stream allowance included.
- .3 Fire protection equipment identification to NFPA 170, Standard for Fire Safety and Emergency Symbols.
- .4 Refer to Section 23 05 53.01 - Mechanical and Network Equipment Identification.

## **2.9 SPARE PARTS CABINETS**

- .1 Cabinet for maintenance material including special tools and spare sprinklers.
- .2 Cabinet installed nearby sprinkler systems alarm check valves.
- .3 There must be a minimum of one spare sprinkler for each type of sprinkler installed. The stock of spare sprinklers must comply with NFPA 13 Standard.
- .4 Cabinets must be constructed as per sprinkler system manufacturer's standards.
  - .1 Acceptable Products: Victaulic, SA1-000-0000 Style; Grinnell, F-740 Model.

## **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, inspect and perform acceptance tests in accordance with NFPA 13 and NFPA 25 Standards.
- .2 Execute installation in accordance with established standards and laws, regulations and current codes, and standards requirements.
- .3 Proper operation and installation coordination of the system, including automatic sprinkler system, system's monitoring points as well as the systems commissioning, are all under the fire protection Contractor's responsibility.
- .4 Clearly identify main shut-off valves, drain valves, by-pass valves, and all auxiliary valves.
- .5 Install sprinkler system test drains to open drains.
- .6 Install hydraulic calculations nameplate at alarm valve.
- .7 Slope all pipe to ensure proper air venting and provide approved automatic air vents, as required by NFPA 13.

### 3.3 TESTS AND VERIFICATIONS

- .1 Carry out the following tests on the sprinkler system, complying with NFPA 13 and NFPA 25 Standards:
  - .1 Execute complete hydrostatic testing on the automatic sprinkler systems piping and appurtenances at a pressure of 1,380 kPa (200 psi) for 2 hours.
  - .2 Complete a flow test through the test connection of each zones in order to confirm flow switches operation. The alarm signals must be transmitted to the alarm panel within one minute maximum, starting at test connection opening and during test flow.
  - .3 Complete a flow test through the test connections fully opened to ensure that no pressure build-up occurs in the drainage piping, that could affect the proper operation of the system.
- .2 Conduct tests in presence of the representative of the authority having jurisdiction or the Departmental Representative and supply test certificates, as required by NFPA 13 and CAN/CSA B64.10-01 Standards.

### 3.4 TRAINING

- .1 Contractor shall organize a 2-hour training session for the building's operation and maintenance staff, in presence of the Departmental Representative.
- .2 Staff training shall cover normal sprinkler system operation, emergency procedure, and system maintenance, as per NFPA 25 Standard.

### 3.5 REPORT AND CERTIFICATE

- .1 Provide both inspection report and inspection attestation to the Departmental Representative at the end of the project, in addition to the properly completed and signed materials and tests certificate. Record all tests results in a notebook appended to the report.

### 3.6 CLEANING

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

**END OF SECTION**





**Part 1 General**

**1.1 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in the Province of Saskatchewan, Canada.
- .3 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .5 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.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .4 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.

- .5 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.
- .6 Approvals:
  - .1 Submit 4 copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
  - .2 Make changes as required and re-submit as directed by Consultant.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Consultant for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

## **1.2 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.3 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .3 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 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse, and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## Part 2 Products

### 2.1 MATERIALS

- .1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
- .2 Do verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

## Part 3 Execution

### 3.1 PAINTING REPAIRS AND RESTORATION

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

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

**3.4 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 Sump Pump Systems.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Instruction duration time requirements as specified in appropriate sections.

**3.5 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for plumbing pumps.
  - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29.06 - Health and Safety Requirements.
  - .3 Section 01 45 00 - Quality Control.
  - .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .5 Section 01 78 00 - Closeout Submittals.
  - .6 Section 01 91 13 - General Commissioning (Cx) Requirements.

**1.2 REFERENCES**

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

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Coordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.
- .3 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
  - .2 Submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.
- .4 Shop Drawings.
  - .1 Submit shop drawings to indicate:
    - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
    - .2 Wiring and schematic diagrams.
    - .3 Dimensions and recommended installation.
    - .4 Pump performance and efficiency curves.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Instructions: submit manufacturer's installation instructions.
- .7 Manufacturers' Field Reports: manufacturers' field reports specified.

- .8 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:

- .1 Manufacturers name, type, model year, capacity and serial number.
- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list with names and addresses.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
  - .2 Construction requirements: in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
  - .3 Verification: contractor's verification in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

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

- .1 Store and manage hazardous materials in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
- .2 Waste Management and Disposal:
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 47 19 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .5 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
  - .6 Fold up metal and plastic banding, flatten and place in designated area for recycling.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Materials and resources in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

#### **2.2 SUMP PUMP**

- .1 Capacity: as indicated on the drawings.

- .2 Configuration: duplex, base-mounted:
  - .1 Self priming centrifugal, gray iron case, copper alloy C93700 impeller, stainless steel shaft.
  - .2 Column and cast iron parts protected with baked epoxy paint.
  - .3 Non-corrosive cone type strainer
- .3 Motor: as indicated, rated for continuous duty, built-in overload protection, drip-proof.
- .4 Control: refer to equipment schedule.

### **Part 3 Execution**

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

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

#### **3.2 INSTALLATION**

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

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

- .1 Site Tests/Inspection:
  - .1 Check power supply.
  - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust impeller shaft stuffing boxes, packing glands.
- .6 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Low-emitting materials.

### 3.4 START-UP

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
  - .2 Procedures:
    - .1 Check power supply.
    - .2 Check starter O/L heater sizes.
    - .3 Start pumps, check impeller rotation.
    - .4 Check for safe and proper operation.
    - .5 Check settings, operation of operating, limit, safety controls.
    - .6 over-temperature, audible/visual alarms, other protective devices.
    - .7 Test operation of hands-on-auto switch.
    - .8 Check base for free-floating, no obstructions under base.
    - .9 Run-in pumps for 12 continuous hours.
    - .10 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
    - .11 Adjust alignment of piping and conduit to ensure full flexibility.
    - .12 Eliminate causes of cavitation, flashing, air entrainment.
    - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
    - .14 Verify lubricating oil levels.

### 3.5 PV - STORM WATER PUMPS

- .1 Application tolerances:
  - .1 Flow: plus 10%; minus 0%.
  - .2 Pressure: plus 10%; Minus 5%.
- .2 PV Procedures:
  - .1 Fill sump at rate slower than capacity of pump #1.
  - .2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to down water level.
  - .3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.
  - .4 Record levels at which pumps start and stop - water level rising and water level falling.
  - .5 Verify operation of alternator.
  - .6 Adjust water level controls as necessary.
  - .7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.



- .8 Record levels at pump starts and stops - water level rising and falling.
- .9 Check operation of alternator.
- .10 Adjust level controls as necessary.
- .11 Check level at which high water level alarm starts and stops. Adjust as necessary.
- .3 Check removability of pumps for servicing without interfering with installation or operation of other equipment.
- .4 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

### 3.6 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.
- .2 Include:
  - .1 PV results on approved PV Report Forms.
  - .2 Product Information report forms.
  - .3 Pump performance curves (family of curves) with final point of actual performance.

### 3.7 TRAINING

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 11 - Cleaning.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 01 91 13 - General Commissioning (Cx) Requirements.
- .6 Section 23 05 05 - Installation of Pipework.

**1.2 REFERENCES**

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "National Plumbing Code of Canada".
- .2 Furthermore, the works will be done in accordance with any other code or standard having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
    - .1 ANSI/ASME B16.15 2006, Cast Bronze Threaded Fittings, Classes 125 and 250.
    - .2 ANSI/ASME B16.18 2001, Cast Copper Alloy Solder Joint Pressure Fittings.
    - .3 ANSI/ASME B16.22 2001, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
    - .4 ANSI/ASME B16.24 2001, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Classes 150, 300, 400, 600, 900, 1500, and 2500.
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A182, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
    - .2 ASTM A268/A268M, Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service.
    - .3 ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
    - .4 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .5 ASTM A312/A312M, Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes.
    - .6 ASTM A403, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
    - .7 ASTM B32, Standard Specification for Solder Metal.

- .8 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .9 ASTM F492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .10 ASTM B283/B283M, Standard Specification for Copper and Copper-Alloy Die Forging (Hot-Pressed).
- .3 American National Standards Institute/American Water Works Association (ANSI/AWWA).
  - .1 ANSI/AWWA C111-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA B242-M1980 (R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Manufacturer's Standardization Society of the Valves, and Fittings Industry (MSS).
  - .1 MSS-SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .2 MSS-SP-71-1997, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-80-2003, Bronze Gate, Globe, Angle and Check Valves.
- .6 National Sanitation Foundation (NSF).
  - .1 NSF 61, Drinking Water System Components.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.4 HEALTH AND SAFETY

- .1 Take necessary measures to ensure health and safety on construction site in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling, in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **1.6 QUALITY ASSURANCE**

- .1 All components used in the potable water distribution must follow NSF 61 Standard.

## **Part 2 Products**

### **2.1 PIPING**

- .1 Domestic hot, cold and recirculation systems, within building.
  - .1 Above ground:
    - .1 50 mm and less: Copper tube, hard drawn, type "L", according to ASTM B88M and NSF/ANSI-61 Standards.
    - .2 65 mm and above: Schedule 10, 304L stainless steel according to ASTM and NSF/ANSI-61 Standards.
  - .2 Below ground:
    - .1 Soft copper, type "K" (ASTM B88M), full length without joints underground.

### **2.2 FITTINGS**

- .1 Copper Pipe:
  - .1 Bronze pipe flanges and flanged fittings, Classes 150 and 300 according to ANSI/ASME B16.24 Standard.
  - .2 Cast bronze threaded fittings, Classes 125 and 250, according to ANSI/ASME B16.15 Standard.
  - .3 Welded cast copper according to ANSI/ASME B16.18 Standard.
  - .4 Forged copper and copper alloys to be welded according to ANSI/ASME B16.22 Standard.
- .2 Stainless Steel:
  - .1 6e mm and above: Schedule 10, welded, according to ASTM A403, grade WP-304L, and ANSI B16.9 Standards.
  - .2 Cast stainless steel flanges, Class 150, according to ASTM A182, grade F304L, and ANSI B16.5 Standards.
  - .3 Union: Class 3000, forged stainless steel, according to ASTM A182, grade F304L Standard.

## 2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111/A21.11.
- .2 Bolts, Nuts, Hex Head, and Washers: to ASTM A307, heavy series.
- .3 Solder: tin/copper 95/5.
- .4 Teflon Tape: for threaded joints.
- .5 Grooved Couplings: Designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric Connections between Dissimilar Metals: dielectric fitting, complete with thermoplastic liner.

## 2.4 SWING CHECK VALVES

- .1 50 mm and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 50 mm and under, screwed:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .3 65 mm and over, flanged:
  - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap.

## 2.5 BALL VALVES

- .1 65 mm and under, screwed:
  - .1 Class 150.
  - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.
- .2 65 mm and under, soldered:
  - .1 To ANSI/ASME B16.18, Class 150.
  - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper.

## 2.6 BUTTERFLY VALVES

- .1 65 mm and over, tapped lug:
  - .1 To MSS-SP-67, Class 125/150. Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner. Lever operated, NPS 6 and over, gear operated.

**Part 3 Execution**

**3.1 APPLICATION**

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

**3.2 INSTALLATION**

- .1 Install in accordance with National Plumbing Code of Canada and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI Standards.
- .4 Install piping close to walls and ceilings to reduce overcrowding of space. Group piping and install parallel to walls.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions, unless otherwise indicated.

**3.3 VALVES**

- .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings upon completion.

**3.4 PRESSURE TESTS**

- .1 Conform to requirements of Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .2 Test Pressure: greater than one time maximum system operating pressure or 860 kPa during 2 hours.

**3.5 PRE-START-UP INSPECTIONS**

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.

**3.6 FLUSHING AND CLEANING**

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

**3.7 DISINFECTION**

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction approval of Departmental Representative.

- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative.

### 3.8 START-UP

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up Procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
- .4 Rectify start-up deficiencies.

### 3.9 PERFORMANCE VERIFICATION

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet design criterion.
  - .2 TAB hvac in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Verify compliance with safety and health requirements.
  - .4 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements Reports, using report forms and schematics as specified in the same section.
  - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.



**3.10 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 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**1.2 CODES AND REFERENCE STANDARDS**

- .1 Unless otherwise indicated, all of the works will be done in accordance with the in force edition of the "National Plumbing Code of Canada".
- .2 Furthermore, the works will be done in accordance to any other code or standard having jurisdiction, notably including but not limited to:
  - .1 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300;
  - .2 ANSI/ASME B16.4, Gray Iron Threaded Fittings, Classes 125 and 250;
  - .3 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings;
  - .4 CAN/CSA B158.1, Cast Brass Solder Joints Drainage, Waste, and Vent Fittings;
  - .5 ASTM B32, Specification for Solder Metal;
  - .6 ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless;
  - .7 ASTM B306, Specification for Copper Drainage Tube (DWV);
  - .8 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings;
  - .9 ASTM C1277, Standard Specification for Shielded Coupling Joining Hubless Cast Iron Soil Pipe and Fitting;
  - .10 CAN/CSA B70, Cast Iron Soil Pipe, Fittings, and Means of Joining;
  - .11 CAN/CSA B125, Plumbing Fittings;
  - .12 CAN/CSA B602, Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe;
  - .13 CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies;
  - .14 CAN/ULC S102.2, Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies;
  - .15 NPC, National Plumbing Code;
  - .16 MSS-SP-67, Butterfly Valves;
  - .17 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends;
  - .18 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends;
  - .19 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves;

- .20 ISO 9000, Quality Management System;
- .21 ISO 14001, Environmental Management System;
- .22 UPC-IAPMO, Uniform Plumbing Code.

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

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit required specifications sheets and manufacturer documentation regarding adhesives. Specifications sheets must show products characteristics, performances criteria, dimensions, limits, and finishes.

### **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.
- .3 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

### **1.5 QUALITY CONTROL**

- .1 An ISO 9000 Quality Control Certificate for gray cast iron parts must be provided on demand.
- .2 An ISO 140001 Environmental Control Certificate for gray cast iron parts must be provided on demand.
- .3 Ferrous matters used for gray cast iron parts production to be installed must be subject to a radiation detection test, complying with CSA B70, article 4.1.1 Standard. Documentation must be provided on demand, according with this article.
- .4 The manufacturer of previous parts must have all certificates and approvals, in order to know its exact origin and the links between product and certificate.
- .5 All assembled parts, such as gray cast iron piping and fittings must come from the same manufacturer to ease the responsibility and warranty.
- .6 All products and materials to be installed, such as stainless steel sheath couplings (MJ joint), must come from the same manufacturer to ease the responsibility and warranty.

### **1.6 MAINTENANCE SHEETS**

- .1 Supply the maintenance sheets required and add them to the "Exploitation and Maintenance Manual".

- .2 The maintenance files must contain or indicate the following:
  - .1 A description of the appliances, including the manufacturer's name, the type, model, year of manufacture and the power, supply or output.
  - .2 The pertinent details regarding the exploitation, servicing and maintenance.
  - .3 A list of recommended spare parts.

## **Part 2 Products**

### **2.1 COPPER PIPES AND CONNECTED FITTINGS**

- .1 The drainage pipes for sanitary water, sump pumps, storm water and ventilation, of a nominal diameter less than 75 mm, made to be installed above ground, as well as the connected fittings, will be of DWV type and in accordance with the ASTM B306 Standard.
  - .1 Fittings.
    - .1 Fittings in cast brass: in accordance with CAN/CSA-B125 and CAN/CSA B158.1 Standards.
    - .2 Fittings in forged copper: in accordance with the CAN/CSA-B125 Standard.
  - .2 Soft solder: lead/tin 50/50, in accordance with the ASTM B32 Standard, of 50A type.

### **2.2 CAST IRON PIPES AND CONNECTED FITTINGS**

- .1 Sanitary waste, rain water and ventilation piping, to be installed underground and related couplings, must be made from Class 4000 gray cast iron, united or interlock ends, complying with CAN/CSA-B70 Standard, and have a bituminous coating.
  - .1 Acceptable products: Bibby-Ste-Croix.
- .2 Sanitary waste, rain water and ventilation piping 75 mm and over, to be installed above ground and related couplings, must be made from Class 4000 gray cast iron, complying with CAN/CSA-B70 Standard, and have a bituminous coating.
  - .1 Acceptable products: Bibby-Ste-Croix.
- .3 Contractor may use cast iron piping instead of previously described DWV copper, for indoors piping under 75 mm.
- .4 Trademark, size, and CSA and ASTM signs must be stamped on the whole length of piping, in accordance with CAN/CSA B70 Standard.
- .5 Fitting must have notches to ensure positioning.

- .6 Couplings.
  - .1 Standard pipefittings and united ends gray cast iron fittings (MJ), under and above ground and piping up to 100 mm.
    - .1 Mechanical joints with neoprene trim reinforced with 0.2 mm (0.008 in) stainless steel sheath and equipped with T-304 stainless steel clamp. Joints must comply with CAN/CSA B70-M, CSA B602 and CAN/ULC S102 or CAN/ULC S102.2 Standards.
      - .1 Acceptable products: Bibby-Ste-Croix, 2000 Series, manufactured by Tyler or approved equivalent.
    - .2 Fittings for united ends gray cast iron piping (MJ) and above ground DWV copper pipes.
      - .1 Mechanical joints with neoprene trim reinforced with 0.2 mm (0.008 in) stainless steel sheath and equipped with T-304 stainless steel clamp. Joints must comply with CAN/CSA B70-M, CSA B602 and CAN/ULC S102 or CAN/ULC S102.2 Standards.
        - .1 Acceptable products: Bibby-Ste-Croix, 2400 series, manufactured by ANACO or approved equivalent.
      - .2 Threaded cast iron fittings meant to receive male brass adaptor. Use approved jointing compound or 100% Teflon ribbon.
    - .3 Fittings for united ends (MJ) gray cast iron piping under and above ground, up to 250 mm.
      - .1 Mechanical joints with neoprene trim reinforced with 0.4 mm (0.016 in) stainless steel corrugated sheath and equipped with T-304 stainless steel clamp with hex head bolt  $\frac{3}{8}$  in., tightened at 80 lb/in. Joints must comply with CAN/CSA B70-M, CSA B602, ASTM C1277, UPC-IAPMO, FM and CAN/ULC S102 or CAN/ULC S102.2 Standards.
        - .1 Acceptable products: Bibby-Ste-Croix, Husky SD-4000, manufactured by ANACO or approved equivalent.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Unless otherwise indicated, install the piping and elements in accordance with the requirements of the National Plumbing Code and of the local competent authorities.
- .2 Install the piping to be buried on a clean, washed sand bed, of a 150 mm (6 in) thickness, wrought in a way that marries the shape of fittings and female end pieces of jointing pipes. Respect the slope, the lines and the levels indicated. Backfill with a layer of 150 mm (6 in) of washed-out sand.
- .3 Install the above-ground piping parallel to the walls and ceilings and near them, to reduce as less as possible the effective space of rooms. Respect the slope and levels indicated.
- .4 Carry out tests in accordance with National Plumbing Code and local authorities having jurisdiction.

- .5 Lay a copper drainage piping of 32 mm, to link to the nearest floor drain, the drainage fittings (with deep water guard trap) the drip pans for coils, the air inlets and outlets and the drip bowls of air ducts.

### 3.2 VENTS

- .1 Extend vents without size diminution up to 450 mm (18 in) below roof level and increase size from this point using conic fitting, to at least NPS 4.

### 3.3 TESTS

- .1 Every opening and piping outlet of the entire installation must be perfectly sealed as well as the sanitary waste and rain water drainage installations, including upward vents, connections, horizontal drains and main ducts. Piping must be filled with water up to the highest level for at least two (2) hours. If it is not possible to test the whole installation at once, it can be divided in sections, individually tested as described before. However, water level in column must be at least 3 m (10 ft) over the tested section.
- .2 Piping must be tested up to the roof.
- .3 Tests must comply with the National Plumbing Code and be carried out in presence of the plumbing inspector or the Departmental Representative.

### 3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts.
  - .1 Ensure accessibility and that inspection cover is correctly located.
  - .2 Open, cover with linseed oil and re-seal, airtight.
  - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Affix applicable label (storm, sanitary, vent, pump discharge, etc.) c/w directional arrows at every floor or 4.5 m (15 ft) (whichever is less).

### 3.5 CLEANING

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

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**1.2 CODES AND REFERENCE STANDARDS**

- .1 Unless otherwise indicated, all of the works will be done in accordance with the in force edition of the "National Plumbing Code of Canada".
- .2 Furthermore, the works will be done in accordance to any other code or standard having jurisdiction, notably including but not limited to:
  - .1 American Society for Testing and Materials International (ASTM).
    - .1 ASTM D2235, Specification for Solvent Cement for Acrylonitrille-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
    - .2 ASTM D2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Pipe and Fittings.
    - .3 ASTM F439, Standard Specification for Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe Fitting, Schedule 80.
    - .4 ASTM F441, Standard Specification for Chlorinated Poly(Vinyl-Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.Canadian Standards Association (CSA International).
  - .2 Canadian Standards Association (CSA International).
    - .1 CAN/CSA-B181.1, ABS Drain, Waste, and Vent Pipe and Pipe Fittings.
    - .2 CAN/CSA-B181.2, PVC Drain, Waste, and Vent Pipe and Pipe Fittings.
    - .3 CAN/CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
    - .4 CAN/CSA-B182.2, PVC Sewer Pipe and Fittings (PSM Type).
  - .3 National Research Council Canada (NRC).
    - .1 National Plumbing Code of Canada.
  - .4 Underwriters Laboratories of Canada (ULC).
    - .1 CAN/ULC-S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit required specifications sheets and manufacturer documentation regarding adhesives. Specifications sheets must show products characteristics, performances criteria, dimensions, limits, and finishes.

#### **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.
- .3 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

#### **1.5 QUALITY CONTROL**

- .1 An ISO 9000 Quality Control Certificate for gray cast iron parts must be provided on demand.
- .2 An ISO 140001 Environmental Control Certificate for gray cast iron parts must be provided on demand.
- .3 Ferrous matters used for gray cast iron parts production to be installed must be subject to a radiation detection test, complying with CSA B70, article 4.1.1 standard. Documentation must be provided on demand, according with this article.
- .4 The manufacturer of previous parts must have all certificates and approvals, in order to know its exact origin and the links between product and certificate.
- .5 All assembled parts, such as gray cast iron piping and fittings must come from the same manufacturer to ease the responsibility and warranty.

#### **1.6 MAINTENANCE SHEETS**

- .1 Supply the maintenance sheets required and add them to the "Operation and Maintenance Manual".
- .2 The maintenance files must contain or indicate the following:
  - .1 A description of the appliances, including the manufacturer's name, the type, model, year of manufacture and the power, supply or output.
  - .2 The pertinent details regarding the exploitation, servicing and maintenance.
  - .3 A list of recommended spare parts.

### **Part 2 Products**

#### **2.1 PIPES AND CONNECTED FITTINGS**

- .1 Above ground for incombustible or combustible construction - PVC piping and fittings, DWV type, with a maximum flame propagation of 15.
  - .1 Sanitary drainage piping, exhaust, and ventilation conforming to:
    - .1 CAN/CSA-B181.2;
    - .2 CAN/ULC-S102.2.
  - .2 Acceptable products: IPEX; System 15.

- .2 Above ground in a return air ventilation plenum:
  - .1 PVC piping and fittings, DWV type, with a maximum flame propagation of 0 and smoke production of 35, conforming to:
    - .1 CAN/CSA-B181.2;
    - .2 CAN/ULC-S102.2.
  - .2 Acceptable products: IPEX; System XFR.
- .3 Underground:
  - .1 DWV Sanitary drainage piping, exhaust, and ventilation conforming to:
    - .1 CAN/CSA-B181.2 (for PVC DWV, 50 mm to 600 mm);
    - .2 CAN/CSA-B182.1 (for plastic DWV piping);
    - .3 CAN/CSA-B182.2 (for PVC DWV piping, DR28 type, 100 mm to 150 mm, AND DR35 type, 200 mm and up).
  - .2 Acceptable products: IPEX.
- .4 Drainage Pumps Discharge Piping:
  - .1 CPVC pipe, Schedule 40 for piping and Schedule 80 for fittings, for a minimum operation of 860 kPa at 23°C, with a maximum flame propagation of 10 and smoke production of 25, in accordance with ASTM F441, ASTM F439 and CAN/ULC S102.2 Standards.
  - .2 Acceptable products: IPEX Corzan.

## **2.2 JOINTS**

- .1 Solvent weld for PVC: Complying with ASTM D2564 Standard.
- .2 Solvent weld for ABS: Complying with ASTM D2235 Standard.
- .3 Acceptable Products: IPEX: ABS-DWV, PVC-DWV.

## **2.3 FIRESTOP SYSTEM**

- .1 Firestop products and units complying with ULC, with a fire rating of 2 hours.
- .2 Acceptable Products: 3M Canada; Hilti; IPEX.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Unless otherwise indicated, install the piping and elements in accordance with the requirements of the National Plumbing Code, and of the local competent authorities.
- .2 Install the piping to be buried on a clean, washed sand bed, of a 150 mm (6 in) thickness, wrought in a way that marries the shape of fittings. Respect the slope, the lines, and the levels indicated. Backfill with washed-out sand.
- .3 Install the above-ground piping parallel to the walls and ceilings and nearby, to reduce as less as possible the effective space of rooms. Respect the slope and levels indicated.
- .4 Apply a primer prior to solvent on male and female pipe joints.

- .5 Install a plastic drain from condensate pan and freshair louvres to nearest floor drain.

### 3.2 RESTRICTIONS

- .1 Restrictions of use according to the NBC for incombustible buildings.

Product	General Usage	Air Plenum	Vertical Service Shaft	High-rise Building	Below Ground Installion	Within Wall Construction Void	Within Concrete Slab
System 15 DWV	P*	N	N	N	P	P	P
System XFR DWV	P	P	N	P	P	P	P

\* N for diameters of 20 and 24 in.

P = Permitted

N = Not permitted

- .2 Do not use plastic drain line for hot discharge.

### 3.3 FIRE STOP

- .1 Install fire stops on pipe where it goes through a rated fire separation.  
.2 Pipe must be installed perpendicularly when crossing a fire rated partition.  
.3 Install as mentioned in Section 21 05 14 and by manufacturer's recommendations.

### 3.4 TESTS

- .1 Proceed with tests in accordance with the requirement of the "National Plumbing Code" and of the local competent authorities.  
.2 Proceed whit pressure testing of pipe before backfilling.  
.3 Every opening and piping outlet of the entire installation must be perfectly sealed as well as the sanitary waist and rain water drainage installations, including upward vents, connections, horizontal drains, and main ducts. Piping must be filled with water up to the highest level, for at least two (2) hours. If it is not possible to test the whole installation at once, it can be divided in sections, individually tested as described before. However, water level in column must be at least 3 m (10 ft) over the tested section.  
.4 Piping must be tested up to the roof.  
.5 Tests must comply with the National Plumbing Code and be carried out in presence of the plumbing inspector or the Departmental Representative.

### 3.5 PERFORMANCE VERIFICATION

- .1 Cleanouts.  
.1 Ensure accessibility and that access doors are correctly located.  
.2 Verify that cleanout rods can probe as far as the next cleanout, at least.  
.2 Test to ensure traps are fully and permanently primed.

- .3 Storm water drainage.
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

### **3.6 VENTS**

- .1 Extend vents without size diminution up to 450 mm (18 in) below roof level and increase size from this point using conic fitting, to at least 100 mm.

### **3.7 CLEANING**

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

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

**1.2 CODES AND REFERENCE STANDARDS**

- .1 Unless otherwise indicated, the works will be done in accordance with the in force edition of the "National Plumbing Code of Canada".
- .2 Furthermore, the Works will be done in accordance to any other code or standard having jurisdiction, notably including, but not limited to:
  - .1 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A126-95 (2001), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
    - .2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
    - .3 ASTM B32, Standard Specification for Solder Metal.
    - .4 ASTM B370, Standard Specification for Copper Sheet and Strip for Building Construction.
  - .2 American Water Works Association (AWWA).
    - .1 AWWA C700-02, Cold Water Meters - Displacement Type, Bronze Main Case.
    - .2 AWWA C701-02 Cold Water Meters - Turbine Type for Customer Service.
    - .3 AWWA C702-1-01, Cold Water Meters - Compound Type.
  - .3 Canadian Standards Association (CSA International).
    - .1 CSA-B64-01, Backflow Preventers and Vacuum Breakers.
    - .2 CSA-B79-94 (R2000), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
    - .3 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.
  - .4 CAN3-B79, Floor Drains and Trench Drains.
  - .5 PDI - WH201, Water Hammer Arrestors.
  - .6 National Plumbing Code of Canada.
  - .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).

### 1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
  - .2 Indicate dimensions, construction details and materials for specified items.
- .3 Shop Drawings.
  - .1 Submit shop drawings to indicate materials, finishes, dimensions, construction, and assembly details.
- .4 Instructions: Submit manufacturer's installation instructions.
- .5 Closeout Submittals: Submit product data and maintenance sheets for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .5 Fold up metal and plastic banding, flatten, and place in designated area for recycling.

## Part 2 Products

### 2.1 FLOOR DRAINS

- .1 Floor Drains: To CSA B79 Standard.
- .2 Type AS (general duty): Cast iron body 8¾ NPS, round, adjustable head, sediment basket, nickel bronze adjustable strainer 6 NPS, integral sewage pan, clamping collar, and trap primer adapter.
  - .1 Acceptable products:
    - .1 Concrete floors: Zurn ZZN-415-A6-P; Watts FD100-C-5-1; Jay R. Smith, 2005-AHD.
- .3 Type AS-1 (with sediment bucket): Cast iron body NPS 15, heavy duty hinged lacquered cast iron grate with stainless steel covering 289 x 289 mm (11<sup>3</sup>/<sub>8</sub> x 11<sup>3</sup>/<sub>8</sub> in.), 254 mm (10 in.) sediment bucket, integral sewage pan and clamping collar, and trap primer adapter.
  - .1 Acceptable products: Zurn, ZXSS610-H-Y-OLF-P.



- .4 Type ASE (combination funnel floor drain): Cast iron body NPS 8¾, round, adjustable head, sediment basket, nickel-bronze adjustable head strainer with integral funnel NPS 6, integral sewage pan, clamping collar, and trap primer adapter.
  - .1 Acceptable products: Zurn, ZZN-415-BFM-A6-P; Watts, FD100-C-5-1; Jay R. Smith, Fig. 2005-A.

## 2.2 CLEANOUTS

- .1 Cleanout Plugs: Heavy cast iron male ferrule with brass screws and threaded brass plug, and neoprene gasket.
  - .1 Acceptable products: Zurn, Z-1445; Watts, CO460; Jay R. Smith, 4510.
- .2 Access Covers.
  - .1 Wall access: Face or wall type, polished nickel bronze or stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
    - .1 Acceptable products: Zurn, ZANB-1460; Watts, CO460-S-3; Jay R. Smith, 4375.
  - .2 Floor access: Round FUSOTEC 300 cast iron body and frame with adjustable secured nickel bronze top. Cover adjusted to finish.
    - .1 Cover for unfinished concrete floors: nickel bronze, round, gasket, vandal-proof screws.
      - .1 Acceptable products: Zurn, ZX-161245, Watts, CO200-RX-1-34G, Jay R. Smith, 4220.
    - .2 Finished floors ceramic tile or linoleum: Nickel bronze, with built in depression to incorporate the finish, gasket, vandal-proof screws.
      - .1 Acceptable products: Zurn, ZN-1320, Watts-Drainage HY-725; Jay R. Smith, 5509QTNB.

## 2.3 WALL MOUNTED FROST PROOF HOSE BIBS

- .1 Type RAE: Recessed in wall, chrome plate rough cast bronze box and hinged cover, bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.
  - .1 Zurn, ZN-1320; Watts, HY-725; Jay R. Smith, Fig. 5509QTNB.

## 2.4 WATER HAMMER ARRESTORS

- .1 Stainless steel construction, bellows type: To PDI-WH201 Standard.
  - .1 Acceptable products: Zurn, Z-1700; Watts-Drainage, SG Serie or P.P.P. Inc.; Jay R. Smith, 5000 Series.

## 2.5 BACKFLOW PREVENTERS

- .1 Backflow prevention devices complying with CAN/CSA B64.4 Series, for domestic water connected on floor drains. Contractor must obtain a test certificate for every device.

- .2 The backflow preventers will be selected to CAN/CSA B64 Series or more restrictive indications.
- .3 DAR-1: Reduced pressure double check valve backflow prevention devices 6 mm to 250 mm.
  - .1 High risk: Trap primer and heating systems.
  - .2 Bronze or cast iron body with epoxy coating, double check valves, internal relief valve, test coks, and two shut off valves for pressures up to 1,120 kPa and 43°C water.
  - .3 Built-in strainer and air gap.
  - .4 Acceptable products: Watts, 009 and 909 Series; Zurn Wilkins, 375, Conbraco 40-200 Series.
- .4 DAR-2: Double-check valve backflow prevention devices NPS 6 mm to NPS 250 mm.
  - .1 Low to moderate risk: Main water shut-off and dishwasher.
  - .2 Bronze or cast iron body with epoxy coating, double check valves, internal relief valve, test coks, and two shut-off valves for pressures up to 1,120 kPa and 43°C water.
  - .3 Built-in strainer.
  - .4 Acceptable products: Watts, 007 (12 mm to 75 mm) and 709 (75 mm to 250 mm) Series; Conbraco 100 and 110 Series; Zurn Wilkins, 350.

## 2.6 VACUUM BREAKERS

- .1 Vacuum Breakers: To CSA-B64 Series.
- .2 Atmospheric type vacuum breaker for water heaters.
  - .1 Acceptable products: Watts, No. 288A; Zurn Wilkins, 30; Conbraco, 38-100/200.
- .3 Atmospheric vacuum breaker for flexible hoses.
  - .1 Acceptable products: Watts, No. 8; Zurn Wilkins, BFP-8; Conbraco, 38-304.

## 2.7 BACKWATER VALVES

- .1 Above Ground:
  - .1 For copper and cast iron: Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded or bolted cover; no hub connections.
    - .1 Acceptable products: Zurn, Z-1090.
  - .2 For PVC piping: Body, seat and revolving flapper: Same material as the piping.
    - .1 Acceptable products: IPEX.
- .2 Floor Access:
  - .1 For copper and cast iron: Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded or bolted cover; no hub connections.
    - .1 Access piping with cover.
    - .2 Cast iron access box with gasket.

.3 Acceptable products: Zurn, Z-1095-15.

.2 For PVC piping: Body, seat and revolving flapper: Same material as the piping.

.1 Acceptable products: IPEX.

## **2.8 INTERIOR HOSE BIBS**

.1 Type RAI: Bronze valve with bronze construction complete with integral backflow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

.2 Acceptable Products: Watts, SC8-4 Series.

## **2.9 DRAINAGE VALVES**

.1 Valves shall be 20 mm, unless otherwise specified, bronze construction, hose thread spout with cap mounted on a chain.

.2 Acceptable Products: Toyo-R/W, 5046; Newman Hattersley, 1969 CAP; Milwaukee.

## **2.10 WATER MAKE-UP ASSEMBLY FOR HEATING AND COOLING CIRCUITS**

.1 Make-up assembly complete with:

.1 Backflow preventer, pressure gauge on inlet and outlet, pressure relief valve on low pressure side and gate valves on inlet and outlet.

.1 Acceptable products: Watts, 009 Series; Zurn Wilkins, 375; Combraco, 40-400.200.

.2 Strainer.

.3 Pressure reducing valve to CSA B359 Standard.

.1 Acceptable products: Watts, U5B-GG; Zurn Wilkins, 600-G; Combraco, 36G.

.4 Check valve.

.5 Safety valve on low pressure side.

.1 Acceptable products: Watts, 174A; Zurn Wilkins, P-100; Combraco, 10-600.

.6 Install water make-up assembly between two ball valves.

.7 Install water make-up assembly with a by-pass and valve.

.8 Install a pressure gauge on the low pressure side of make-up assembly.

## **2.11 WATER METER**

.1 Supply and install shut-off valves, unions, strainer, etc., required for the installation of the water meter.

.2 Water meter: To AWWA C701 Standard.

.3 Characteristics: Water flow of 12.62 L/sec at 13.79 kPa pressure drop, flanged connections 75 mm, temperature correction.

.4 Accessories: Programmable pulse output.

- .1 Acceptable products: Sensus Omni C<sup>2</sup> -3".

## 2.12 STRAINERS

- .1 Y Type: Pressure rating of 860 kPa, with monel, bronze or stainless steel removable screen.
- .2 50 mm and under:
  - .1 Bronze body to ASTM-B-62 Standard or cast iron to ASTM A-278M Standard, Class 30, purge cap.
  - .2 Screwed ends.
  - .3 Stainless steel removable screen with 0.8 mm (0.032 in.) perforations.
  - .4 Purge plug to be adapted to the diameter of strainer, with ball valve and brass cap.
  - .5 Acceptable products: Conbraco, 59-00X-06; Zurn Wilkins, S Series.
- .3 65 mm and over:
  - .1 Cast iron to ASTM A-278M, class 30, purge cap.
  - .2 Flanged ends.
  - .3 stainless steel removable screen with 3,2 mm (0.125 in.) perforations.
  - .4 Purge plug to be adapted to the diameter of strainer, with ball valve and brass cap.
  - .5 Acceptable products: Conbraco FC-1; Zurn Wilkins, FS Series.

## 2.13 PRIMER

- .1 Automatic Trap Primer System:
  - .1 Normally closed solenoid valve, with programmable timer. 120/1/60 electrical supply with transformer.
  - .2 Acceptable products: Proto/Primer, 990-BT.
- .2 Connect floor drains and open drains to automatic primer system as follow:
  - .1 Above ground: Rigid copper, complying with requirements.
  - .2 Underground: One-piece flexible aluminum hose, with inner and outer polyethylene coating.
    - .1 Acceptable products: XPA from "IPEX" or equivalent.
    - .2 Provide dielectric connection for underground to aboveground passage, complying with requirements.

## Part 3 Execution

### 3.1 INSTALLATION

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

### **3.2 CLEANOUT**

- .1 Install cleanouts at base of soil and waste stacks (drain connectors and down pipes) at code required locations and as indicated.
- .2 Install cleanouts flush with the finished wall or floor, unless it is floor-mounted, with a maintenance access from beneath the floor.
- .3 Size of cleanouts, mounted over main collectors and sanitary waste columns must be equal to the size of canalisation, but never over 100 mm.

### **3.3 WATER HAMMER ARRESTORS**

- .1 Install on fixtures or group of fixture supply branches, upstream of all quick-close valves.

### **3.4 BACKWATER VALVES**

- .1 Install in main sewer lines where indicated.

### **3.5 PRIMER DEVICES**

- .1 Install device on all floor drains (AS), at all open drain connectors and as indicated on plans, and as prescribed by prescriptions of the "National Plumbing Code of Canada".
- .2 Install primer devices in accessible locations.

### **3.6 COMMISSIONING**

- .1 For the current article, "verify" a characteristic or "ensure" a component's state or operation also means to demonstrate to the Departmental Representative.
- .2 Carry out commissioning only once every failure detected during start up has been corrected.
- .3 Verify visit doors' dimensions as well as their location towards elements to visit.

### **3.7 TESTING AND ADJUSTING**

- .1 General.
  - .1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Floor Drains.
  - .1 Verify operation of trap seal primer.
  - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .3 Check operations of flushing features.
  - .4 Check security, accessibility, and removability of strainer.
  - .5 Clean out baskets.
- .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 Cleanouts.
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .6 Water Hammer Arrestors.
  - .1 Verify proper installation of correct type of water hammer arrester.
- .7 Commissioning Reports.
  - .1 In accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.
- .8 Training.
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 All sections defined in the section list are an integral part of this section.

**1.2 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .4 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.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .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 instructions for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .3 Maintenance data to include:
    - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required, and task time.
  - .4 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is completed.

- .2 Equipment performance verification test results.
- .3 Special performance data as specified elsewhere in Contract documents.
- .4 Testing, adjusting and balancing (TAB) reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .6 Site records:
  - .1 Keep a copy of drawings on Work site. Identify "As Built" drawings and indicate, as Work goes along, all changes that are made during the execution of the Works to materials, mechanical equipment, control/regulation systems, and to low voltage control wiring.
  - .2 Use different colour permanent ink for each service.
  - .3 Make drawings available for reference purposes and inspection.
- .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 (½ in.) high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit drawings to Departmental Representative 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 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

### 1.4 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals:
  - .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.



**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

- .1 Not Used.

**Part 3 Execution**

**3.1 PAINTING REPAIRS AND RESTORATION**

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

**3.2 CLEANING**

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

**3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - 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 - 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.

**3.4 DEMONSTRATION**

- .1 Departmental Representative 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 each appropriate section.

**3.5 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

.1 Section Includes:

.1 Use of mechanical systems during construction.

**1.2 USE OF SYSTEMS**

.1 Use of existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.3 There is no possibility of damage.

.4 Supply ventilation systems are protected by MERV 11 filters, inspected daily, changed every 2 weeks or more frequently as required.

.5 Return systems have approved filters over openings, inlets, outlets.

.6 Systems will be:

.1 Operated as per manufacturer's recommendations and instructions.

.2 Operated by Contractor.

.3 Monitored continuously by Contractor.

.7 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.

.8 Refurbish entire system before static completion; clean internally and externally, restore to existing condition, replace filters in air systems.

.2 Filters specified in this Section are over and above those specified in other Sections of this project.

.3 Exhaust systems are not included in approvals for temporary heating ventilation.

**Part 2 Products**

.1 Not Used.

**Part 3 Execution**

.1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 23 05 00 - Common Work Results for HVAC.
- .5 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2 REFERENCE**

- .1 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 Canadian General Standards Board (CGSB).
    - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

**1.3 SUBMITTALS**

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

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

- .1 Not Used.

**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 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

### 3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, and maintenance, and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components (whichever is greater) without interrupting operation of other system, equipment, and components of network. Fitted out space has to be of dimensions as indicated on drawings or as recommended by manufacturer, the most raised value must be retained.

### 3.4 PIPEWORK INSTALLATION

- .1 Install piping as recommended by the applicable standards.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI Standards.
- .6 Install exposed piping, equipment, rectangular cleanouts, and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, to maximize headroom, and to conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible or as indicated.
- .11 Ream pipes, remove scale, and other foreign material before assembly. Clean also when Work is completed.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves.
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position or vertical upward, unless otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use gate or ball valves at branch take-offs for isolating purposes, except where specified.
  - .7 Install butterfly valves on chilled water and related condenser water systems only.

- .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .9 Install ball valves for glycol service.
- .15 Check Valves:
  - .1 Install silent check valves on discharge of pumps, in vertical pipes with downward flow and as indicated.
  - .2 Install swing check valves in horizontal lines and as indicated.

### 3.5 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies and elsewhere, as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation.
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181 Standard.
- .6 Sealing.
  - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere: Provide space for firestopping. Maintain required fire rating integrity.
  - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### 3.6 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
  - .1 Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve.
  - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

### 3.7 PREPARATION FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 21 05 14 – Firestop systems and smoke control.

- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### **3.8 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in 23 Division.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.9 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pework: test as specified in relevant of 23 Division.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant of 23 Division.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

### **3.10 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval 10 days minimum prior to commencement of Work.
- .3 Be responsible for damage to existing plant by this Work.
- .4 Ensure daily clean-up of existing areas.
- .5 Take water samples of existing piping prior to commencing work.

### **3.11 CLEANING**

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

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 78 00 - Closeout Submittals.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
  - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two (2) copies of the material safety data sheets as required by the Workplace Hazardous Materials Information System (WHMIS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Closeout Submittals.
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 Motors: High efficiency, in accordance with local Hydro company Standards and to ASHRAE 90.1 Standard.

**2.2 MOTORS**

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors 373 W (½ HP) and larger: EEMAC Class B, 3-phase, 600 V, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, unless otherwise indicated.
- .3 Motors connected to variable frequency drives must be of "Inverter Duty" or "Inverted Ready" type and conform to NEMA MG-1, part 31 Standard.
- .4 Thermistors are required on all motors that are 2 HP or greater.

**2.3 BELT DRIVES**

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys, unless otherwise indicated.
- .3 For motors under 7.5 kW (10 HP): Standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW (10 HP) and over: Sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

**2.4 DRIVE GUARDS**

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives.
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.

- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Securely fasten in place.
  - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  - .2 Net free area of guard: Not less than 80% of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.

### **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 Fasten securely in place.
- .2 All equipment and elements have to be removable for servicing, easily returned into, and fixed in position.

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

- .1 Site Tests: Conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - 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 - 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 CLEANING**

- .1 Execute all cleaning work in accordance with section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 23 05 05 - Installation Pipework.

**1.2 REFERENCES**

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "National Building Code of Canada".
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME).
    - .1 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
    - .2 ANSI/ASME B16.3, Malleable Iron Threaded Fittings.
    - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
    - .4 ANSI/ASME B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
    - .5 ANSI/ASME B16.25, Buttwelding Ends.
    - .6 ANSI/ASME B18.2.1, Square and Hex Bolts and Screws (inches series).
    - .7 ANSI/ASME B18.2.2, Square and Hex Nuts (inches series).
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
    - .3 ASTM A105/A105M, Standard Specification for Carbon Steel Forgings, for Piping Applications.
    - .4 ASTM A126, Specification for Grey Iron Castings for Valves, Flanges and Pipe Fittings.
    - .5 ASTM A216/216, Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
    - .6 ASTM A278/A278M, Standard Specification for Grey Iron Castings for Pressure - Containing Parts for Temperatures up to 650°F (350°C).
    - .7 ASTM A351/A351M, Standard Specification for Steel Castings, Austenitic, for Pressure-Containing Parts.
    - .8 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

### 1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data Sheets:
  - .1 Data sheets must include the following:
    - .1 Manufacturer's name, model number, type of fluid, as well as rated temperature and pressure of the proposed network and the equipment.
    - .2 Movement type; axial, lateral or angular compensation and maximum movement for each case.
    - .3 Element diameter and nominal dimension as well as construction details of relevant assemblies.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance Data Sheet:
  - .1 Maintenance data sheet must include the following:
    - .1 Equipment description, including the manufacturer's name, type, model, year, capacity, head, and flow rate.
    - .2 Pertinent details related to maintenance.
    - .3 Supply spare parts.

### 1.5 WASTE MANAGEMENT

- .1 Sort out and recycle wastes in accordant with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## Part 2 Products

### 2.1 FLEXIBLES METAL FITTINGS

- .1 Usage: According to movement.
- .2 Fittings must be of minimal length according to manufacturer's recommendations regarding movement.
- .3 Inner pipe: Flexible stainless steel corrugated pipe.
- .4 Exterior lining: Stainless steel mesh.
- .5 End component, size and type: As indicated on drawings.
- .6 Flexible fittings must be designed to support respective operating pressure and temperature of 1,034 kPa and 93°C.
  - .1 Operation conditions must comply with network requirements.
- .7 Fittings must absorb lateral movements of 150 mm. Ratio between the length of the flexible portion and fitting diameter must not be less than 6. Flexible pipe length must not be greater than 600 mm.

- .8 Tips: suitable for pipes.
- .9 Acceptable Products:
  - .1 50 mm and under: Connectall, Style-19 or Style-A1 Series.
  - .2 Over 50 mm: Connectall, Style-A1 Series.

## **2.2 FLEXIBLE POLYMER FITTINGS**

- .1 EPDM flexible fittings, equipped with enamel painted ductile iron flanges, retaining rings and a reinforcing ring, designed for a rated operation pressure of 1,725 kPa.
- .2 Fittings must absorb longitudinal movements in tension or compression of 19 mm.
- .3 Use: Chiller and cooling tower pipes.
- .4 Acceptable Products: Mason Industries, SFDEJ.

## **2.3 SLIP TYPE EXPANSION JOINTS**

- .1 Application: for axial pipe movement, as indicated.
- .2 Repacking: under full line pressure.
- .3 Body and packing housings: Class 150, 1 MPa carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe with raised face slip-on flanges to match pipe or threaded ends.
- .4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B hard chrome plated.
- .5 Anchor base: construction steel, welded to body.
- .6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.
- .7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.
- .8 Packings rings: 6 minimum graphite impregnated asbestos.
- .9 Thermal plastic packing: Teflon or graphite impregnated asbestos slug supplied loose.
- .10 Lubricating fittings: pet coks with grease nipple.
- .11 Plunger body and plunger:
  - Plunger body: heavy wall carbon steel welded body.
  - Plunger: carbon steel with hex head for use with socket wrench.
- .12 Lubricant: to manufacturer's recommendations.
- .13 Lubricant gun: complete with hose assembly.
- .14 Drip connection: 20 MPa forged steel to ASTM A105/A105M. Include half coupling with drain plug.

## **2.4 ANCHORING AND PIPE GUIDES**

- .1 Anchoring: According to Section 23 05 29.

- .2 Pipe guide components: Galvanised steel.
- .3 Acceptable Products: Anvil, Figure 255.

**Part 3 EXÉCUTION**

**3.1 INSTALLATION**

- .1 Expansion joints must be installed under cold tension conditions as indicated by manufacturer. Tension value shall be documented.
- .2 Flexible fittings and expansion joints shall be installed according to manufacturer's instructions.
- .3 Anchoring and pipe guides shall be installed as indicated. Anchoring must absorb an axial movement of 150%.

**3.2 CLEANING**

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

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 23 05 00 - Common Work Results for HVAC.
- .6 Section 21 13 13 - Wet Pipe Sprinkler Systems.
- .7 Section 23 21 13.02 - Hydronic Systems Steel.
- .8 Section 23 22 13 - Steam and Condensate Heating Piping.

**1.2 REFERENCES**

- .1 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
    - .1 ANSI/ASME B31, Power Piping.
    - .2 ANSI/ASME B31.3, Process Piping.
  - .2 ANSI/ASME Boiler and Pressure Vessel Code-2007:
    - .1 Section I: Power Boilers.
    - .2 Section V: Nondestructive Examination.
    - .3 Section IX: Welding and Brazing Qualifications.
  - .3 American National Standards Institute/American Water Works Association (ANSI/AWWA).
    - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
  - .4 American Welding Society (AWS).
    - .1 AWS B3.0, Welding Procedures and Performance Qualifications.
    - .2 AWS C1.1, Recommended Practices for Resistance Welding.
    - .3 AWS Z49.1, Safety Welding, Cutting and Allied Process.
    - .4 AWS W1, Welding Inspection Handbook.
  - .5 Canadian Standards Association (CSA International).
    - .1 CSA W47.2-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.
    - .2 CSA W48 Series, Filler Metals and Allied Materials for Metal Arc Welding.
    - .3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.
    - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.

- .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
- .6 CSA W178.2-2008, Certification of Welding Inspectors.
- .6 Canadian General Standards Board (ONGC/CGSB).
- .1 CAN/CGSB 48.2, Spot Radiography of Welded Butt Joints in Ferrous Materials.

### **1.3 QUALIFICATIONS OF WELDERS**

- .1 Welding qualifications in accordance with CSA B51 Standard.
- .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
- .3 Submit welder's qualifications to Departmental Representative.
- .4 Each welder to possess identification symbol issued by authority having jurisdiction.
- .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2 Standard.

### **1.4 QUALIFICATION OF INSPECTORS**

- .1 Inspectors qualified to CSA W178.2 Standard.

### **1.5 WELDING METHODS**

- .1 Registration of welding procedures in accordance with CSA B51 Standard.
- .2 Copy of welding procedures available on site for reference purposes.
- .3 Safety in welding, cutting, and allied processes in accordance with CSA-W117.2 Standard.

## **Part 2 Products**

### **2.1 ELECTRODES**

- .1 Electrodes: In accordance with CSA W48 Series.

## **Part 3 Execution**

### **3.1 QUALITY OF WORK**

- .1 Welding: In accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX, and ANSI/AWWA C206 Standards, using procedures conforming to AWS B3.0 and C1.1 Standards, and applicable requirements of provincial authority having jurisdiction.

### **3.2 INSTALLATION REQUIREMENTS**

- .1 Identify each weld with welder's identification symbol.
- .2 Backing Rings:
  - .1 Where used, fit to minimize gaps between ring and pipe bore.

- .2 Do not install at orifice flanges.
- .3 Fittings:
  - .1 50 mm and smaller: Install welding type sockets.
  - .2 Branch connections: Install welding tees or forged branch outlet fittings.

### 3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable Codes and Standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested, and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures. Repair or replace defects as required by Codes and as specified in this section.

### 3.4 SPECIALIST EXAMINATIONS AND TESTS

- .1 General:
  - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 Standards, and approved by Departmental Representative.
  - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 Standard, and requirements of authority having jurisdiction.
  - .3 Inspect and test 100% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle" tests) and spot gamma ray radiographic (hereinafter referred to as "radiography" tests).
- .2 Hydrostatically test welds to ANSI/ASME B31.1 Standard.
- .3 Visual Examinations: Include entire circumference of weld externally and wherever possible internally.
- .4 Failure of Visual Examinations:
  - .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic tests.

### 3.5 DEFECTS CAUSING REJECTION

- .1 General.
  - .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code Standards.
- .2 Chilled water systems below 1,000 kPa (145 psi):
  - .1 Undercutting greater than 0.8 mm (0.031 in.) adjacent to cover bead on outside of pipe.
  - .2 Undercutting greater than 0.8 mm (0.031 in.) adjacent to root bead on inside of pipe.

- .3 Undercutting greater than 0.8 mm (0.031 in.) at combination of internal and external surfaces.
- .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm (1½ in.) in 1,500 mm (59 in.) length of weld depth of such defects being greater than 0.8 mm (0.031 in.).
- .5 Repair cracks and defects in excess of 0.8 mm (0.031 in.) in depth.
- .6 Repair defects whose depth cannot be determined accurately on basis of visual examination.

### **3.6 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

### **3.7 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 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 23 05 53.01 - Mechanical and Network Identification.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
  - .1 Pressure gauges;
  - .2 Stop valve;
  - .3 Thermometers;
  - .4 Thermometric wells.

**1.4 HEALTH AND SAFETY**

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect, separate and place in designated containers for recycling paper, plastic, corrugated cardboard packaging Steel, Metal and Plastic in accordance with Waste Management Plan.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- .4 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

**Part 2 Products**

**2.1 GENERAL**

- .1 Design point to be at mid point of scale or range.

## 2.2 DIRECT READING THERMOMETERS

- .1 Industrial digital thermometers, with 12 mm height LCD screen, accuracy of 1% and a solar battery.
- .2 The thermometers will be of rigid rectangular type with aluminum frame and adjustable angle.
- .3 These thermometers will have a combined grading (°C and °F).
- .4 Scale : -40°C to 150°C (-40°F to 302°F).
- .5 Acceptable products: Trerice n° SX9 Solar Therm; Weiss no. DVU35.

## 2.3 THERMOMETER WELLS

- .1 In the case of an assembling inside a copper or plastic pipe, use copper or bronze wells.
- .2 In the case of an assembling inside a steel duct, wells in brass or stainless steel.
- .3 Acceptable products: Trerice.

## 2.4 MANOMETERS

- .1 Manometers with 90 mm diameter, dial filled with liquid, in accordance with ANSI/ASME B40.100, standards, class 1A, accurate to 1%.
  - .1 Polished stainless steel casing and ring, stainless steel mechanism with adjustable needle.
  - .2 Graduated scale in order to operate in a third of the range.
  - .3 Manometers built to resist to a minimum pressure of 5,500 kPa (800 lb/in²).
  - .4 Threaded joint ¼ in made of copper or bronze for copper or plastic piping and made of brass or stainless steel for steel piping.
  - .5 5-year warranty.
  - .6 Acceptable products: Trerice, 700 series.
- .2 The following characteristics or elements must be considered for every installed thermometer and manometer:
  - .1 U-bend, if on a steam network.
  - .2 Shock absorber if the network undergoes pressure pulsations.
  - .3 Separating membrane if the network contains corrosive fluids.
  - .4 Bronze globe valve with drainage joint at every manometer.

## Part 3 Execution

### 3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

### 3.2 THERMOMETERS

- .1 Always set the thermometers in thermometric wells fitted with a heat conducting material.
- .2 Install the thermometers at the described places as well as at the entrance and the exit of the following appliances:
  - .1 Heating and cooling coils;
  - .2 Boilers;
  - .3 Heat exchangers;
  - .4 Chillers.
- .3 Use extensions for thermometers fixed on insulated piping.
- .4 Provide and install the thermometric wells necessary for the balancing and adjusting of networks.

### 3.3 PRESSURE GAUGES

- .1 Install in following locations:
  - .1 Upstream and downstream of the pumps;
  - .2 Upstream and downstream of pressure reducers;
  - .3 Upstream and downstream of regulation valves;
  - .4 At the entrance and the exit, water side, of the cooling and heating coil, heat exchangers and chillers;
  - .5 At the expansion tank;
  - .6 At every location indicated.
- .2 Use extensions on insulated piping.
- .3 Use extensions where pressure gauges are located use for balancing purposes.

### 3.4 NAMEPLATES

- .1 Install engraved Lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Network Identification, identifying medium.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 23 05 00 - Common Work Results for HVAC.

**1.2 REFERENCES**

- .1 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A125-1996(R2001), Specification for Steel Springs, Helical, Heat-Treated.
    - .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .3 ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.
  - .2 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS).
    - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
    - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
    - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
  - .3 Underwriter's Laboratories of Canada (ULC).
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
  - .1 Bases, hangers, and supports;
  - .2 Connections to equipment and structure;
  - .3 Structural assemblies.
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .4 Instructions:
  - .1 Submit manufacturer's installation instructions.
- .5 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 in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

### **Part 2 Products**

#### **2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements.
  - .1 Construct pipe hanger and support to manufacturer's recommendations using manufacturer's regular production components, parts, and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1 Standard.
  - .3 Design hangers and supports to support piping, air ducts, systems and mechanical equipments under operating conditions allow free expansion and contraction of supported elements, to prevent excessive stress from being introduced into piping or connected equipments.
  - .4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58 Standard.

#### **2.2 GENERAL**

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

#### **2.3 PIPE HANGERS**

- .1 Finishes.
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Use electro-plating galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are copper plated epoxy coated.

#### **2.4 INSULATION PROTECTION SHIELDS**

- .1 For protection shells, use high density insulation with continuous vapour-barrier for cold coolants.

- .2 Horizontal suspension for saddles and shells for insulated pipes, with the following characteristics:
  - .1 Stiff copper piping, greater than 150 mm: Protection shell.
  - .2 Ferrous metal pipes, greater than 150 mm:
    - .1 On stirrups: Protection shell;
    - .2 On rollers: protection shells.

## **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 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.
- .2 Anchorage components for hangers mounted on concrete structure.
  - .1 Attach elements (plates and stirrup) using at least four (4) concrete inserts, one at each corner.

### **3.3 SPACING BETWEEN SUPPORTS AND SUSPENSIONS**

- .1 Follow the requirements of the National Plumbing Code of Canada for plumbing piping network.
- .2 Install supports/suspension at each 1.5 m for 12 mm NPS or smaller copper piping.
- .3 Install a support/suspension at a maximum of 300 mm from each elbow.
- .4 Install supports at base of vertical piping, at the high point of each floor.

- .5 In addition to the above required supports, install supports and suspensions on the straight lengths of the piping as described in the tables below:

HEATING, COOLING AND PLUMBING PIPING						
MAXIMUM SPACING FOR HORIZONTAL PIPING, IN METERS						
Ø PIPING (NPS)	Ø ROD mm	STEEL	COPPER	ASBESTOS CEMENT	ABS PVC	CPVC
Up to ½	10	2.1	1.5	---	0.9	0.8
¾	10	2.1	1.5	---	1.0	0.9
1	10	2.1	1.8	---	1.1	1.0
1¼	10	2.1	2.1	2.0	1.2	1.2
1½	10	2.7	2.4	2.0	1.3	1.3
2	10	3.0	2.4	2.0	1.5	1.4
2½	13	3.4	2.7	2.0	---	1.7
3	13	3.6	3.0	2.0	1.9	1.8

### 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.
- .4 Beam Clamps.
- .1 Hammer jaw firmly against underside of beam.

**3.7 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - 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 - 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 Dispose of construction materials surplus, waste, tools, and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 61 00 - Common Product Requirements.
- .5 Section 01 74 11 - Cleaning.
- .6 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**1.2 REFERENCES**

- .1 National Fire Protection Association (NFPA).
  - .1 NFPA 13-2009, Standard for the Installation of Sprinkler Systems.
- .2 National Building Code of Canada (NBC) - 2010.

**1.3 SUBMITTALS**

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include performance criteria, and limitations.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Provide shop drawings for the whole installation, complete with performance and product data.
  - .2 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance criterion and physical properties.
  - .2 Manufacturer's field reports: manufacturer's field reports specified.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, Shipping, Handling, and Unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition waste management and disposal: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 1.6 USE OF VIBRATION AND SEISMIC CONTROL EQUIPMENT

- .1 Install vibration control equipments to the following table:

Equipment	Power (HP) and Others	RPM	Location of Equipment											
			Ground Base			Base - Size								
						Up to 6 m			6 to 9 m			9 to 12 m		
			Base	Isolator	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)	Base	Isolateur	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)
Chillers, Other Cooling Equipments and Air Compressors														
Reciprocating	All	All	A	2	6	A	4	20	A	4	40	A	4	65
Centrifugal, screw type vis, Scroll	All	All	A	1	6	A	4	20	A	4	40	A	4	40
Absorption	All	All	A	1	6	A	4	20	A	4	40	A	4	40
Centrifugal Pumps														
Single piece	≤ 7,5	All	B	2	6	C	3	20	C	3	20	C	3	20
	≥ 10	All	C	3	20	C	3	20	C	3	40	C	3	40
Vertical in line	5 à 25	All	A	3	20	A	3	40	A	3	40	A	3	40
	≥ 30	All	A	3	40	A	3	40	A	3	40	A	3	65
Horizontal, end suction type	≤ 40	All	C	3	20	C	3	20	C	3	40	C	3	40
	50 à 125	All	C	3	20	C	3	20	C	3	40	C	3	65
	≥ 150	All	C	3	20	C	3	40	C	3	65	C	3	90
Ventilation Unit	All	All	A	1.1	-	A	1.1	-	A	1.1	-	A	1.1	-
Axial Fans														
Diameter to 560 mm	All	All	A	2	5	A	3	20	A	3	20	C	3	20



Equipment	Power (HP) and Others	RPM	Location of Equipment											
			Ground Base			Base - Size								
						Up to 6 m			6 to 9 m			9 to 12 m		
			Base	Isolator	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)	Base	Isolateur	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)
Diameter 600 mm and more	S.P. ≤ 500 Pa	Up to 300	B	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	B	3	20	B	3	40	C	3	65	C	3	65
		501 and more	B	3	20	B	3	40	B	3	40	B	3	40
	S.P. ≥ 501 Pa	Up to 300	C	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	C	3	40	C	3	40	C	3	65	C	3	65
		501 and more	C	3	20	C	3	40	C	3	40	C	3	65
Centrifugal Fans														
Diameter up to 560 mm	All	All	B	2	5	B	3	20	B	3	20	C	3	40
Diameter 600 mm and more	≤ 40	Up to 300	B	3	65	B	3	90	B	3	90	B	3	90
		301 to 500	B	3	40	B	3	40	B	3	65	B	3	65
		501 and more	B	3	20	B	3	20	B	3	20	B	3	40
	≥ 50	Up to 300	C	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	C	3	40	C	3	40	C	3	65	C	3	65
		501 and more	C	3	25	C	3	40	C	3	40	C	3	65
Condensing Units	All	All	A	1	5	A	4	20	A	4	40	A/D	4	40

Equipment	Power (HP) and Others	RPM	Location of Equipment											
			Ground Base			Base - Size								
						Up to 6 m			6 to 9 m			9 to 12 m		
			Base	Isolator	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)	Base	Isolateur	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)
Package Units														
All	10	All	A	3	20	A	3	20	A	3	20	A	3	20
	≥ 15 Pa S.P ≤ 1,000 Pa	Up to 300	A	3	20	A	3	90	A	3	90	C	3	90
		301 to 500	A	3	20	A	3	65	A	3	65	A	3	65
		501 and more plus	A	3	20	A	3	40	A	3	40	A	3	40
	≥ 15 Pa S.P. > 1,000 Pa	Up to 300	B	3	20	C	3	90	C	3	90	C	3	90
		301 to 500	B	3	20	C	3	40	C	3	65	C	3	65
		501 and more	B	3	20	C	3	40	C	3	40	C	3	65
	Stand Alone Rooftop Units	All	All	A/D	1	5	D	3	20	See note 17 in: notes for Table 48: Selection Guide for Vibration Isolation, in 2007 ASHRAE Handbook HVAC Applications, Chapter 47.				
Small Fans and Fan Powered Terminal Boxes														
	≤ 285 L/s	All	A	3	15	A	3	15	A	3	15	A	3	15
	> 285 L/s	All	A	3	20	A	3	20	A	3	20	A	3	20

Base Types:

- No base, isolators attached to equipment.
- Base or structural steel rail (2.9).
- Inertia base, concrete (2.10).
- Roof curb isolation rails (2.11).

Isolators Types:

- Elastomeric pads (2.2).
- 1.1 Elastomeric pads, rubber/steel/rubber (2.2, EP4).
- Elastomeric mounts or suspension (2.3, 2.6).
- Floor springs or suspension (2.6).
- Spring mounts (2.5).
- Horizontal strain restraints (2.8).

## Part 2 Products

### 2.1 GENERAL

- Size and shape of bases type and performance of vibration isolation as indicated.
- All products must conform to anti-seismic standards.

## 2.2 ELASTOMERIC PADS

- .1 Type EP1 - Neoprene waffle or ribbed; 12 mm minimum thick; 50 durometer; maximum loading 621 kPa (90 psi).
  - .1 Acceptable products: Vibro-Acoustics, type R, Vibra-Sil; Ingenia "Amber/Booth".
- .2 Type EP2 - Rubber waffle or ribbed; 12 mm minimum thick; 30 durometer natural rubber; maximum loading 345 kPa (50 psi).
  - .1 Acceptable products: Vibro-Acoustics, type R, Vibra-Sil; Ingenia "Amber/Booth".
- .3 Type EP3 - Neoprene-steel-neoprene; 12 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 621 kPa (90 psi).
  - .1 Acceptable products: Vibro-Acoustics, type NSN, Vibra-Sil; Ingenia "Amber/Booth".
- .4 Type EP4 - Rubber-steel-rubber; 12 mm minimum thick rubber bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 345 kPa (50 psi).
  - .1 Acceptable products: Vibro-Acoustics, type RSR, Vibra-Sil; Ingenia "Amber/Booth".

## 2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - Colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.
  - .1 Acceptable products: Vibro-Acoustics, type MD, Vibra-Sil; Ingenia "Amber/Booth".

## 2.4 SPRINGS

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

## 2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
  - .1 Type M2 - Stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
    - .1 Acceptable products: Vibro-Acoustics, type SL, Vibra-Sil; Ingenia "Amber/Booth".
  - .2 Type M4 - Restrained stable open spring: supported on bonded 12 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
    - .1 Acceptable products: Vibro-Acoustics, type CSR or CT, Vibra-Sil; Ingenia "Amber/Booth".

- .3 Type M5 - Enclosed spring mounts with snubbers for isolation up to 950 kg (2,090 pounds) maximum.
  - .1 Acceptable products: Vibro-Acoustics, type SWSR, Vibra-Sil; Ingenia "Amber/Booth".
- .2 Performance: minimum damping efficiency: 95%.

## 2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
  - .1 Type H1 - Neoprene - In-shear, moulded with rod isolation bushing which passes through hanger box.
    - .1 Acceptable products: Vibro-Acoustics, type HD, Vibra-Sil; Ingenia "Amber/Booth".
  - .2 Type H2 - Stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
    - .1 Acceptable products: Vibro-Acoustics, type SH, Vibra-Sil; Ingenia "Amber/Booth".
  - .3 Type H3 - Stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
    - .1 Acceptable products: Vibro-Acoustics, type SHR, Vibra-Sil; Ingenia "Amber/Booth".
  - .4 Type H4 - Stable spring, elastomeric element with precompression washer and nut with deflection indicator.
    - .1 Acceptable products: Vibro-Acoustics, Vibra-Sil; Ingenia "Amber/Booth".
- .2 Performance: minimum damping efficiency: 95%.

## 2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic Barriers: Between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.
  - .1 Acceptable products: Vibro-Acoustics, Vibra-Sil; Ingenia "Amber/Booth".

## 2.8 HORIZONTAL THRUST RESTRAINT

- .1 Type L1: Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.
- .3 Acceptable Products: Vibro-Acoustics, type HSC; Vibra-Sil; Ingenia "Amber/Booth".

## 2.9 STRUCTURAL BASES

### .1 Types:

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2,400 mm on smallest dimension, split for field welding on sizes over 2,400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.1 Acceptable products: Vibro-Acoustics, type S, Vibra-Sil; Ingenia "Amber/Booth".

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.1 Acceptable products: Vibro-Acoustics, type SS; Vibra-Sil; Ingenia "Amber/Booth".

.3 Bases to clear housekeeping pads by 25 mm minimum.

## 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 vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to 100 mm: First 3 points of support. 125 mm to 200 mm: First 4 points of support. 250 mm and over: First 6 points of support.

.2 First point of support: Static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.6 Place ventilation units on elastomeric pads with 4 mm static flexion, with a maximum distance of 2,400 mm between centers.

**3.3 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA).
  - .1 NFPA 13-2007, Standard for the Installation of Sprinkler Systems.

**1.3 SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality Control.
- .2 Health and Safety:
  - .1 Apply pertinent safety rules in accordance with Section 01 35 29.06 - Health and Safety.

**1.5 DELIVERY, STORAGE, AND HANDLING**

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

## 1.6 IDENTIFICATION

- .1 Mechanical and network identification must be in accordance with Client's identification system.

## Part 2 Products

### 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

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

### 2.2 SYSTEM NAMEPLATES

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

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

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



- .3 Indicate the number and the type of system as well as the service and the area it serves.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS).
  - .1 Use arrangement of Main identifier/Source identifier/Destination identifier.
  - .2 Equipment in Mechanical Room:
    - .1 Main identifier: size #9.
    - .2 Source and Destination identifiers: size #6.
    - .3 Terminal cabinets, control panels: size #5.
  - .3 Equipment elsewhere: sizes as appropriate.

## 2.3 EXISTING IDENTIFICATION SYSTEMS

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

## 2.4 FIRE PROTECTION PIPING SYSTEMS

- .1 Identification.
  - .1 Sprinkler systems: in accordance with NFPA 13 Standard.

## 2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 Standard, except where specified otherwise.
- .2 Pictograms.
  - .1 In accordance with Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .3 Legend.
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3 Standard.

Exterior pipe or insulation diameter	Letters height
(mm)	(mm)
30	13
50	19
150	32
250	63
Larger than 250	88

- .4 Arrows showing direction of flow.
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

- .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
- .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking.
  - .1 Height: To full circumference of pipe or insulation.
  - .2 Length: To accommodate pictogram, full length of legend, and arrows.
- .6 Materials for background colour marking, legend, arrows.
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C (300°F) and intermittent temperature of 200 degrees C (390°F).
- .7 Colours and Legends.
  - .1 Where not listed, obtain direction from Departmental Representative.
  - .2 Colours for legends, arrows: to following table:

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

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
<i>Add design temperature</i>		
<i>Add design temperature and pressure</i>		
Chilled Water Supply	Green	CH. WTR. SUPPLY
Chilled Water Return	Green	CH. WTR. RETURN
Hot Water Supply	Yellow	HEATING SUPPLY
Hot Water Return	Yellow	HEATING RETURN
Steam	Yellow	STEAM
Gravity Condensate	Yellow	GR. CONDENSATE
Pressure Condensate	Yellow	PR. CONDENSATE
Safety Valve	Yellow	SAFETY VALVE
Domestic Hot Water	Green	DOM. HOT WTR
Domestic Chilled Water	Green	DOM. CH. WTR
Sewage	Green	SEWAGE
Storm Water	Green	STORM
Sanitary	Green	SAN

Contents	Background colour marking	Legend
<i>Add design temperature</i>		
<i>Add design temperature and pressure</i>		
Ventilation (Sanitary)	Green	VENT. SAN
Refrigeration Liquid	Yellow	REF. LIQUID
Refrigeration Steam Return	Yellow	REF. RETURN
Compressed Air (<700 kPa)	Green	COMP. AIR ... kPa
Compressed Air (>700 kPa)	Yellow	COMP. AIR ... kPa
Water - Fire Protection	Red	FIRE
Water - Sprinklers	Red	SPRINKLERS
Air - Process	Green	AIR PROCESS

## 2.6 IDENTIFICATION DUCTWORK SYSTEMS

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

## 2.7 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

## 2.8 CONTROLS COMPONENTS IDENTIFICATION

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

## 2.9 LANGUAGE

- .1 Inscriptions used for system identification must be written in French and English.
- .2 French and English identification must be written on the same identification plate, label, etc.

## 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 EXECUTION

- .1 Start network and equipment identification work only when painting work is done.

### 3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 Standard, except as specified otherwise.
- .2 Provide ULC or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.
- .4 Materials for background color, lettering and arrow markings:
  - .1 Affix the tape to dry and clean surfaces prepared for this purpose. Roll the tape around the pipe with an overlap equivalent to at least one pipe diameter.

### 3.4 NAMEPLATES

- .1 Locations.
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Stand-offs.
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection.
  - .1 Do not paint, insulate or cover.
- .4 Submit a nameplate list for approval before engraving.
- .5 The following systems are to be identified:
  - .1 Pumps;
  - .2 Chillers;
  - .3 Cooling tower;
  - .4 Heat exchangers;
  - .5 Humidifiers;
  - .6 Fans;
  - .7 Coils.

### 3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 Affix identification tags on the following pipe and ductwork locations:
  - .1 On long straight runs in open areas, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
  - .2 To each change in direction.
  - .3 At least once in each small room through which piping or ductwork passes.
  - .4 On both sides of visual obstruction or where run is difficult to follow.

- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
- .10 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.
- .2 Mark the piping with a stencil once the last paint layer has been applied.

### **3.6 VALVES, CONTROLLERS**

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

### **3.7 CLEANING**

- .1 In accordance with section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Division 23 - Heating, Ventilation and Air-Conditioning (HVAC).
- .2 Division 26 - Electrical.

**1.2 SUMMARY**

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for air systems and hydronic systems.
- .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.

**1.3 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel to perform TAB to Departmental Representative 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-1-2002.
  - .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.

#### **1.4 PURPOSE OF TAB**

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

#### **1.5 EXCEPTIONS**

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

#### **1.6 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.

#### **1.7 PRE-TAB REVIEW**

- .1 Review Contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design, and installation pertinent to success of TAB.
- .2 Review specified Standards and report to Departmental Representative 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.

#### **1.8 START-UP**

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

#### **1.9 OPERATION OF SYSTEMS DURING TAB**

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

#### **1.10 START OF TAB**

- .1 Notify Departmental Representative 7 days prior to start of TAB.



- .2 Start TAB when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weatherstripping, sealing, and caulking.
  - .3 Pressure, leakage, other tests specified elsewhere in Specifications.
  - .4 Provisions for TAB installed and operational.
  - .5 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 and 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 Hydronics systems:
      - .1 Liquid systems flushed, filled, vented.
      - .2 Correct pump rotation.
      - .3 Strainers in place, baskets clean.
      - .4 Isolating and balancing valves installed, open.
      - .5 Calibrated balancing valves installed, at factory settings.
      - .6 Water treatment systems complete, operational.

#### **1.11 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 Air systems: plus or minus 10%.
  - .2 Hydronic systems: plus or minus 5%.

#### **1.12 ACCURACY TOLERANCES**

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

#### **1.13 INSTRUMENTS**

- .1 Prior to TAB, submit to Departmental Representative 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 3 months of TAB. Provide certificate of calibration to Departmental Representative.

#### **1.14 SUBMITTALS**

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

#### **1.15 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Departmental Representative, 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.

#### **1.16 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 6 copies of TAB Report to Departmental Representative for verification and approval, in both official languages, in "D-ring" binders, complete with index tabs.

#### **1.17 VERIFICATION**

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

#### **1.18 SETTINGS**

- .1 After TAB is completed to satisfaction of Departmental Representative, 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.

**1.19 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

**1.20 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of this section or TAB Standards of AABC, NEBB, SMACNA or ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified in contractual documents.
- .3 Qualifications: Personnel performing TAB qualified to Standards of AABC or NEBB.
- .4 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 and controlled device.
- .5 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

**1.21 HYDRONIC SYSTEMS**

- .1 For the needs for this section, the hydronic systems include the cooling and heating systems using the following fluids: water and glycol.
- .2 The operations of TAB must be carried out in accordance with the strictest requirements stated in the present section or the Standards and the relevant reference documents of the AABC of the SMACNA or the ASHRAE.
- .3 Carry out the test, the adjustment and the balancing of the systems, the apparatus, the elements and the regulation and control devices.
- .4 The persons charged to carry out the operations of TAB must be members in good standing and be entitled to provide the services prescribed, according to Standards of the AABC.
- .5 The TAB operations of the systems must be carried out under the direction of a recognized supervisor entitled to provide the services prescribed according to Standards of the AABC.
- .6 The readings to be done will carry in particular on followings, according to systems, the apparatus, the elements or the control devices and regulation concerned: the static pressure, the flow rate, the pressure drop, the temperature, the density, the number of revolutions, the power, the voltage, levels of noise and vibration.
- .7 The points of measurement, in the case of the apparatus, will be located at the following places, according to the case:
  - .1 At the entry and the exit side of the heat exchangers (primary and secondary sides), cooling coils, condensers, cooling tower, pumps, pressure regulators, control valves and regulation and any other apparatus causing conditions changes;
  - .2 At the regulators and the regulation control devices.
- .8 The points of measurement, in the case of the systems, will be located at the following places, according to the case: on the supply and the return of the primary and secondary loops (supply lines of the final elements of the hydronic systems, connections of admission of the auxiliary water circuits).

**1.22 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: As for air systems specified in this section.
  - .2 Quality assurance: As for air systems specified in this section.
- .2 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter and summer design conditions, at all times.
- .3 Measure equipments' noise level, as prescript in 23 and 26 Divisions.
- .4 Measure ambient noise level.

**Part 2 Products**

- .1 Not Used.

**Part 3 Execution**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 23 31 13.01 - Metal Ducts - Low pressure to 500 Pa.

**1.2 SUMMARY**

- .1 Materials and methods for pressure testing ducts over 5m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

**1.3 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
  - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

**1.4 SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
    - .1 Submit proposed report form and test report format to Departmental Representative for approval at least 1 month before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
    - .2 Prepare report of results and submit to Departmental Representative within 48 hours of completion of tests. Include:
      - .1 Schematic of entire system.
      - .2 Schematic of section under test showing test site.
      - .3 Required and achieved static pressures.
      - .4 Orifice differential pressure at test sites.
      - .5 Permissible and actual leakage flow rate (L/s) for test sites.
      - .6 Witnessed certification of results.
    - .3 Include test reports in final TAB report.

- .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 Manufacturer's field reports specified.

## **1.5 CO-ORDINATION**

- .1 Schedule time required into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Test each system independently and subsequently, where interlocked with other systems, in unison with those systems.

## **1.6 TERM REVIEW**

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

## **Part 2 Products**

### **2.1 TESTING INSTRUMENTS**

- .1 Test apparatus to include:
  - .1 Fan capable of producing required static pressure.
  - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
  - .3 Flow measuring instrument compatible with the orifice plate.
  - .4 Calibration curves for orifice plates used.
  - .5 Flexible duct for connecting to ductwork under test.
  - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: Accurate to within  $\pm 3\%$  of flow rate and pressure.
- .3 Submit details of test instruments to be used to Departmental Representative at least 1 month before anticipated start date.
- .4 Test instruments: Calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.

## **2.2 EQUIPMENT LEAKAGE TOLERANCES**

- .1 Equipment and system components such as duct heating leakage: 1%.

## **Part 3 Execution**

### **3.1 TEST PROCEDURES**

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include: Fittings, branch ducts, and tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

### **3.2 SITE TOLERANCES**

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: Not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
  - .1 Small duct systems up to 250 Pa: Leakage 2%.
  - .2 Large low pressure duct systems up to 500 Pa: Leakage 2%.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

### **3.3 TESTING**

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

### **3.4 FIELD QUALITY CONTROL**

- .1 Quality Control
  - .1 Departmental Representative to witness tests and to verify reported results.
  - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

### **3.5 CLEANING**

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

**1.2 CODES AND REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
  - .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International (ASTM).
  - .1 ASTM B209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB).
  - .1 CGSB 51-GP-52Ma-89, Vapor Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC), National Insulation Standards (C1999).
- .5 Underwriters Laboratories of Canada.
  - .1 CAN/ULC-S102-M88 (C2000), Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-01, Thermal Insulation Polyotrene, Boards and Pipe Covering.

### 1.3 DEFINITIONS

- .1 For the present section the following definitions apply:
  - .1 Concealed elements: Insulated piping, ductwork and mechanical equipment located above suspended ceilings or in inaccessible construction spaces.
  - .2 Visible elements: Elements that are not concealed (as per the definition above).
  - .3 Insulation: Includes the insulating material, accessories for fixing and jackets.
  - .4 Ductwork: Overall duct network including the ducts, the joints and all related accessories.
- .2 Insulation thickness is the thickness needed to cover every component of the insulated element, including reinforcements, angles, T-joints, flanges, etc.

### 1.4 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.
- .3 Manufacturers' Instructions.
  - .1 Provide manufacture's written duct insulation jointing recommendations and special handling criteria, installation sequence, and cleaning procedures.

### 1.5 QUALIFICATIONS

- .1 Installation: A specialist in performing work specified in this section, having at least 3 years of experience with this type and size of project and member of TIAC.
- .2 Work must be completed by skilled insulation workers.

### 1.6 QUALITY ASSURANCE

- .1 The mechanical quality insulation standards manual of the Thermal Insulation Association of Canada (TIAC), as well as its authorized amendments, must be used as the standard reference and is part of the specifications of this project.
- .2 The Contractor responsible for the thermal insulation installation must keep a copy of this quality standard manual as a reference on the jobsite.

### 1.7 WASTES MANAGEMENT

- .1 Sort out and recycle wastes in accordant with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 FIRE AND SMOKE RATING**

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

**2.2 INSULATION**

- .1 Thermal conductivity coefficient (coefficient "K") must not exceed the prescribed value at mean temperatures of 24°C (75°F), in accordance with ASTM C335 Standard.
- .2 Type **D-1 insulation**: rigid panels made of mineral fibres in accordance with ASTM C612 Standard, with a factory installed vapour barrier envelop in accordance with CGSB 51-GP-52Ma Standard.
  - .1 Thermal conductivity coefficient "K" no greater than 0,035 W/m•°C (0.234 BTU-in/h•ft<sup>2</sup>•°F) at mean temperatures of 24°C (75°F).
  - .2 Temperature limit: 120°C (250°F).
  - .3 Acceptable product: Manson AK Board FSK.
- .3 Type **D-2 insulation**: Bat made of mineral fibres in accordance with ASTM C553 Standard, with factory installed vapour barrier envelop in accordance with CGSB 51-GP-52Ma Standard.
  - .1 Mineral fibers: In accordance with ASTM-C553 Standard.
  - .2 Vapour barrier: In accordance with CGSB 51-GP-52Ma Standard.
  - .3 Thermal conductivity coefficient "K" no greater than 0,035 W/m•°C (0.234 BTU-in/h•ft<sup>2</sup>•°F) at mean temperature of 24°C (75°F).
  - .4 Temperature limit: 120°C (250°F).
  - .5 Density: (1.5 lb/ft<sup>3</sup>).
  - .6 Acceptable product: Manson Alley Wrap FSK.
- .4 Type **D-3 insulation**: Rigid ducts made of mineral fibres, with factory installed vapour barrier envelop.
  - .1 Mineral fibers: In accordance with ASTM-C547 Standard.
  - .2 Vapour barrier: In accordance with CGSB 51-GP-52Ma Standard.
  - .3 Thermal conductivity coefficient "K" no greater than 0.037 W/m•°C (0.26 BTU-in/h•ft<sup>2</sup>•°F) at mean temperature of 38°C (100°F).
  - .4 Density: 40 kg/m<sup>3</sup> (2.5 lb/ft<sup>3</sup>).
  - .5 Temperature limit: 454°C (850°F).
  - .6 Acceptable products: Knauf KwikFlex Pipe & Tank with FSK liner.

## 2.3 JACKETS

- .1 Canvas.
  - .1 To utilize to the exposed elements 220 gm/m<sup>2</sup> cotton ULC approved, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921 Standard.
  - .2 Acceptable products: S. Fatall Thermocanvas.
  - .3 Lagging adhesive: Compatible with insulation.

## 2.4 GLUES, TAPES AND ATTACHMENTS

- .1 Tapes: Self-adhesive aluminum, of 100 mm in width, approved by the ULC for the following characteristics: Flame spread index inferior to 25 and a fumigant property index of at most 50.
- .2 Quick set contact glue.
- .3 Sealing Glue for Overlaps: Quick set glue used to seal the joints and the overlaps of the vapour barriers.
- .4 Glues for jackets in canvas web.
  - .1 Washable glue used to stick the jacketing on the insulating material.
- .5 Pegs.
  - .1 Pegs to weld to the duct once the insulation is set, of a 4 mm (0.157 in.) diameter, with a 35 mm (1.378 in.) head diameter, of an appropriate length to the thickness of the insulator.
  - .2 Pegs to weld on the duct before the insulation is set, of a 2 mm (0.079 in.) diameter, of an appropriate length to the thickness of the insulator, equipped with a nylon square holding small plate of 32 mm (1.259 in.) side.

## Part 3 Execution

### 3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems completed, witnessed, and certified.
- .2 Ensure surfaces are clean, dry, and free from foreign material.

### 3.2 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 (3 in.).
- .4 If there are elevated joints, cover them by overlapping sections or with a flexible insulating material with an integrated vapour barrier.
- .5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.

- .6 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.
- .7 Fasteners: Install at 300 mm (12 in.) on centre in horizontal and vertical directions, minimum two rows each side.

### 3.3 DUCTWORK INSULATION SCHEDULE

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

	NETWORKS AND EQUIPMENTS	THICKNESS OF INSULATION mm (in.)	TYPE OF INSULATION
.1	The networks of rectangular exposed supply conditioning air ducts	25 (1)	D-1
.2	The networks of hidden rectangular supply conditioning air ducts whose greatest dimension does not exceed 1,000 mm (39 in.)	25 (1)	D-1
.3	The networks of hidden rectangular supply conditioning air ducts whose greatest dimension does exceed 1,000 mm (39 in.)	25 (1)	D-1
.4	The networks of round and oval exposed supply and return conditioning air ducts	25 (1)	D-2
.5	The networks of round and oval hidden supply and return conditioning air ducts	25 (1)	D-2
.6	The hidden and exposed air exhaust ducts on a 5 m (16 ft.) length starting from the roof or from exterior wall, to the main pipe and the branch lines	50 (2)	D-1
.7	The fresh air ducts on a 5 m (16 ft.) length, starting from the louvers to the heating coils	75 (3)	D-1

### 3.4 FINISHING

- .1 Visible ducts located inside the building: Canvas jacket.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 23 05 00 - Common Work Results for HVAC.
- .5 Section 23 05 05 - Installation Pipework.
- .6 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipments.
- .7 Section 23 21 13.02 - Hydronic Systems Steel.

**1.2 REFERENCES**

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the National Building Code.
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
    - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
    - .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal 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 C533, Calcium Silicate Block and Pipe Thermal Insulation.
    - .6 ASTM C547, Mineral Fiber Pipe Insulation.
    - .7 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .8 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .9 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .10 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

- .3 Manufacturer's Trade Associations.
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .4 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings.
  - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.
- .5 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .6 Canadian General Standards Board (CGSB).
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53-95, Poly(Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

### 1.3 DEFINITIONS

- .1 Thickness of insulation is that required to cover all the components of the element to insulate including reinforcements, angle iron, flanges, bolts, etc.

### 1.4 SUBMITTALS

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Assurance.
  - .1 Installer: Specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to TIAC Standards.

### 1.5 DELIVERY, STORAGE AND HANDLING

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



- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.

## 1.6 WORK FORCE QUALIFICATION

- .1 Installer: Specialist in performing Work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to TIAC Standards.
- .2 Work to be executed by workforce specialized in thermal insulation.

## 1.7 QUALITY ASSURANCE

- .1 Thermal Insulation Association of Canada (TIAC) manuals, standards, additions, and addendums, are to be used as reference documents and are an integral part of the specifications of the present work.
- .2 Insulation Contractor will keep a copy of the standards on site for reference.

## Part 2 Products

### 2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102 Standard.
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### 2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335 Standard.
- .2 TIAC Code **C-1**: Rigid mineral fibre board, unfaced, without factory applied vapour retarder jacket.
  - .1 Mineral fibre: To ASTM C547 Standard.
  - .2 Maximum "K" factor: of 0,037W/m•°C (0.26 Btu-po/h•pi<sup>2</sup>•°F) at an average temperature of 38°C (100°F).
  - .3 Density: 40 kg/m<sup>3</sup> (2.5 lb/ft<sup>3</sup>).
  - .4 Temperature limits: 454°C (850°F).
  - .5 Acceptable products: Knauf KwikFlex Pipe & Tank.
- .3 TIAC Code **C-4**: Rigid mineral fibre board faced with factory applied vapour retarder jacket.
  - .1 Mineral fibre: ASTM C612.
  - .2 Jacket: to CGSB 51-GP-52MA.

- .3 Maximum "k" factor: ASTM C612.
- .4 TIAC Code **A.6**: flexible unicellular tubular elastomer.
  - .1 Insulation: ASTM C534.
  - .2 Maximum "k" factor: 0,039 W/m°C at 24°C medium temperature.
  - .3 Certified by manufacturer free of potential stress corrosion cracking corrodants.
  - .4 Acceptable product: Armaflex AP.

## 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.
  - .3 Acceptable products: Fattal Thermocanvas.
- .2 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: corrugated.
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

## 2.4 INSULATING CEMENT

- .1 Finishing insulating cement.
  - .1 To ASTM C449/C449M Standard.
- .2 Hydraulic cement or air drying on mineral fiber insulation to ASTM C449 Standard.

## 2.5 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact Adhesive: Quick setting.
- .3 Canvas Adhesive: Washable.
- .4 Tie Wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation with expanded metal lath on other face of insulation.
- .7 Fasteners: 4 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

**Part 3 Execution**

**3.1 PRE-INSTALLATION REQUIREMENT**

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

**3.2 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
  - .1 Hot equipment: To TIAC Code 1503-H.
- .2 Apply materials in accordance with manufacturers' instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers and supports outside vapour retarder jacket.
- .5 Supports and Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

**3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: At expansion joints, valves, chilled water pumps, flash tank, flanges and unions at equipment.
- .2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

**3.4 EQUIPMENT INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges, and fittings, unless otherwise specified.
- .2 Hot Equipment:
  - .1 **C-1** type insulation with mechanical fastenings, wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
    - .1 Insulation thickness.

SERVICE	THICKNESS OF INSULATION
Heat exchangers	50 mm (2 in)
Flash tank	50 mm (2 in)

.3 Cold Equipment :

- .1 **C-4** type insulation with mechanical fastenings, wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

- .1 Insulation thickness.

SERVICE	THICKNESS OF INSULATION
Chillers (except factory insulated)	50 mm (2 in)
Pumps and any other cold equipment	50 mm (2 in)

.4 Finishes:

- .1 Indoors:

- .1 Equipment installed in mechanical rooms and the crawl space: hot equipment – Canvas or aluminum if indicated on drawings; Cold equipment: aluminum.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Thermal insulation for piping and piping accessories in commercial type applications.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 23 05 00 - Common Work Results for HVAC.
- .5 Section 23 05 05 - Installation Pipework.
- .6 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipments.
- .7 Section 23 21 13.02 - Hydronic Systems Steel.

**1.3 REFERENCES**

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the National Building Code of Canada.
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
    - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings, Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM B209M-01, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
    - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
    - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
    - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
    - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

- .3 Manufacturers' Trade Associations.
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .4 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings.
  - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.
- .5 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .6 Canadian General Standards Board (CGSB).
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

#### 1.4 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - Insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - Will mean "not concealed" as specified.

#### 1.5 SUBMITTALS

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Assurance.
  - .1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.

## Part 2 Products

### 2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102 Standard.
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### 2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335 Standard.
- .2 Insulation type **P-1**: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547 Standards.
  - .2 Vapour retardant to CGSB 51GP-52Ma Standard.
  - .3 Maximum "k" factor: of 0.033 W/m°C at an average temperature of 24°C.
  - .4 Temperature limits: -29°C à 454°C.
  - .5 Acceptable products: Manson Alley-K, Knauf, Johns-Manville.
    - .1 Acceptable products: Manson Alley-K.
- .3 Insulation type **P-2**: Mineral fibre blanket faced with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547 Standards.
  - .2 Vapour retardant to CGSB 51GP-52Ma Standard.
  - .3 Maximum "k" factor: of 0.035 W/m°C at an average temperature of 24°C.
  - .4 Temperature limits: -29°C à 120°C.
  - .5 Density: 24 kg/m<sup>3</sup> (1.5 lb/ft<sup>3</sup>).
  - .6 Acceptable products: Manson Alley Wrap FSK.

- .4 Insulation type **P-3**: Flexible unicellular tubular elastomer.
  - .1 Jacket to CAN/CGSB-51.40 Standard.
  - .2 Maximum "k" factor: of 0.039 W/m°C at an average temperature of 24°C.
  - .3 Temperature limits: -57°C à 105°C.
  - .4 Insulation jacket certified by manufacturer as to not cause constraint corrosion fissures.
  - .5 Acceptable products: Armaflex AP.

## 2.3 INSULATION SECUREMENTS

- .1 Tape: self-adhesive, aluminum reinforced, 50 mm wide minimum.
  - .1 Acceptable products: Tape Fattal Insultape made by S. Fattal Canvas Inc.
- .2 Vapour Retarder Lap Adhesive.
  - .1 Water based, fire retardant type, compatible with insulation.
  - .2 Acceptable products: Foster 87-75 without asbestos fiber, with a coverage density of 6 m<sup>2</sup>/L.
- .3 Indoor Vapour Retarder Finish.
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Acceptable products: Foster 30-36 without asbestos fiber, with a coverage density of 1.25 m<sup>2</sup>/L.

## 2.4 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.
  - .3 Acceptable products: Fattal Thermocanvas.

## 2.5 PRE-FABRICATED REMOVABLE INSULATION COVERS

- .1 Glass fibre inner and outer face, mineral fibre insulation, Kevlar cotton stitching, and glass fibre straps with stainless steel buckles, suitable for 425°C metal surface temperature.
- .2 Standard of acceptance: Spirax Sarco.

## Part 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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



### 3.2 PRE-INSTALLATION REQUIREMENT

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

### 3.3 INSTALLATION

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

### 3.4 PIPING INSULATION SCHEDULES

- .1 Unless otherwise specify, the insulation of the piping include the insulation of the valve, filters, and accessories.
- .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, and fittings.
- .3 Insulate the piping and equipment as indicated in the following table:

SYSTEMS AND EQUIPMENTS	FLUID TEMPERATURE °C	INSULATION TYPE
.1 Potable cold water	4 (39)	P-1
.2 Potable hot water	60 (140)	P-1
.3 Recirculation potable hot water	60 (140)	P-1
.4 Exposed storm drainage, thickness of insulation 25 mm	--	P-1
.5 Hidden storm drainage, thickness of insulation 40 mm	--	P-1
.6 Exposed vent pipe on a 5 m length starting from the roof, on main and branch pipe	--	P-1
.7 Hidden vent pipe on a 5 m length starting from the roof, on main and branch pipe, thickness of insulation 25 mm.	--	P-1
.8 On body of roof drain, thickness of insulation 50 mm	--	P-2
.9 Drainage piping of HVAC units and air plenum, thickness of insulation 25 mm.	--	P-1
.10 Cold water make up	4 (39)	P-1
.11 Hot water heating systems	83 (181)	P-1

SYSTEMS AND EQUIPMENTS	FLUID TEMPERATURE °C	INSULATION TYPE
.12 Glycol heating systems	83 (181)	P-1
.13 Low pressure steam heating systems up to 103 kPa	118 (244)	P-1
.14 Low pressure condensate and pump condensate	118 (244)	P-1
.15 High pressure stem heating systems more than 103 kPa.	170 (338)	P-1
.16 Refrigerant piping suction side, thickness of insulation 19 mm.	--	P-3
.17 Drainage of evaporator in coolers	less than 5 (41)	P-3

.4 Thickness of the P-1 and P-3 insulation types.

FLUID TEMPERATURE °C	NOMINAL DIMENSION OF THE PIPING (NPS)			
	1 and less	1¼ to 2	2½ to 4	5 and more
	THICKNESS (mm)			
151-240	64		76	89
121-150	51	64		76
96-120	38		51	
50-95	25		38	
14-49	25		38	
5-13	25	38		
5	25	38		

### 3.5 FINISHES

- .1 Exposed Indoors: Canvas.
- .2 Concealed, indoors: Canvas on valves, fittings. No further finish.
- .3 Installation: Appropriate to TIAC.

### 3.6 REMOVABLE, PRE-FABRICATED, INSULATION COVERS

- .1 Application: At expansion joints, valves, flanges and unions at equipment.
- .2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings, and finishes: same as system.
  - .2 Jacket: Canvas.

**3.7 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 21 05 01 - Common Work Results - Mechanical.
- .2 Section 22 42 01 - Plumbing Specialties and Accessories.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Section 23 08 02 - Cleaning and Start-up for Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American National Standard Institute/American Society of Mechanical Engineers (ANSI/ASME).
  - .1 ANSI/ASME B31.1-2010, Power Piping.

**1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests.
  - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1 Pump operation.
    - .2 Heat exchangers and chiller operation.
    - .3 Pressure bypass open/closed.
    - .4 Control pressure failure.
    - .5 Maximum heating demand.
    - .6 Maximum cooling demand.
    - .7 Chiller failure.
    - .8 Cooling tower fan failure.
    - .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

## 1.5 HYDRONIC SYSTEM CAPACITY TEST

- .1 Perform hydronic system capacity tests after:
  - .1 TAB has been completed.
  - .2 Verification of operating, limit, safety controls.
  - .3 Verification of primary and secondary pump flow rates.
  - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system's capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system's capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating System Capacity Test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Reducing space temperature by turning off heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
- .7 Chilled water system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Adding heat from building heating system or;
    - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater than OAT. RAT to be at least 23°C minimum.
  - .2 Test procedures:
    - .1 Open fully cooling coil control valves.
    - .2 Set thermostats on associated AHU's for maximum cooling.
    - .3 Set AHU's for design maximum air flow rates.
    - .4 Set load or demand limiters on chillers to 100%.
    - .5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

## **1.6 CONDENSER WATER AND HUMIDIFICATION SYSTEMS**

- .1 In addition to procedures specified above, perform following:
  - .1 Add chemicals as required.
  - .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
  - .4 Inject inhibitor into cooling tower sump.

## **1.7 GLYCOL SYSTEMS**

- .1 Test to prove concentration will prevent freezing to minus 40°C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

## **1.8 STEAM SYSTEMS**

- .1 Performance verification:
  - .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
  - .2 Verify operation of components of steam system including:
    - .1 Steam traps by:
      - .1 Measuring temperature of condensate return and/or;
      - .2 Using audio-sensing devices;
      - .3 Use of other approved methods.
    - .2 Flash tanks.
    - .3 Thermostatic vents.
  - .3 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.
  - .4 Adjust piping system as required to eliminate water hammer.
- .2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

## **1.9 WET PIPE SPRINKLER SYSTEM**

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.

## **1.10 SANITARY AND STORM DRAINAGE SYSTEMS**

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.

- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: refer to Section 22 42 01 - Plumbing Specialties and Accessories.

**1.11 REPORTS**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

**Part 2 Products**

- .1 Not Used.

**Part 3 Execution**

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Section 23 05 00 - Common Work Results for HVAC.

**1.2 REFERENCES**

- .1 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American Society for Testing and Materials International (ASTM).
    - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
  - .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

**Part 2 Products**

**2.1 CLEANING SOLUTIONS**

- .1 Tri-sodium Phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium Carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming Detergent: 0.01 kg per 100 L water in system.

**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 CLEANING HYDRONIC AND STEAM SYSTEMS**

- .1 Timing: Systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
  - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Scope:
  - .1 Clean only the new hydronic piping and the condensate piping.
- .5 Cleaning Procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1 Cleaning procedures, flow rates, elapsed time.
    - .2 Chemicals and concentrations used.
    - .3 Inhibitors and concentrations.
    - .4 Specific requirements for completion of work.
    - .5 Special precautions for protecting piping system materials and components.
    - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .6 Conditions at Time of Cleaning of Systems:
  - .1 Systems: Free from construction debris, dirt and other foreign material.
  - .2 Control valves: Operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers: Clean prior to initial fill.
  - .4 Install temporary filters on pumps not equipped with permanent filters.
  - .5 Install pressure gauges on strainers to detect plugging.
- .7 Report on Completion of Cleaning:
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .8 Hydronic Systems:
  - .1 Fill system with water, ensure air is vented from system.

- .2 Use water meter to record volume of water in system to  $\pm 0.5\%$ .
- .3 Add chemicals under direct supervision of chemical treatment supplier.
- .4 Closed loop systems: Circulate system cleaner at 60°C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
- .5 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
- .6 Add chemical solution to system.
- .7 Establish circulation, raise temperature slowly to maximum design 82°C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .9 Glycol Systems:
  - .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to minus 40°C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.
- .10 Steam Systems: In addition to general requirements as specified above, perform following:
  - .1 Remove internal components of steam traps until flushing and warm-up have been completed.
  - .2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.
  - .3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.
  - .4 Water hammer: Determine source and eliminate cause.

### 3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
  - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
  - .8 Repeat with water at design temperature.

- .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .10 Bring system up to design temperature and pressure slowly.
- .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .12 Adjust pipe supports, hangers, springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .16 Check operation of drain valves.
- .17 Adjust valve stem packings as systems settle down.
- .18 Fully open balancing valves (except those that are factory-set).
- .19 Check operation of over-temperature protection devices on circulating pumps.
- .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### 3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 01 91 13 - General Commissioning (Cx) Requirements.
- .7 Section 23 05 05 - Installation Pipework.
- .8 Section 23 05 17 - Pipe Welding.
- .9 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .10 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .11 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2 REFERENCE**

- .1 Unless otherwise indicated, all of the works will be done in accordance with the in force edition of the National Building Code of Canada.
- .2 Furthermore, the works will be done in accordance to any other code or standard having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 American Society of Mechanical Engineers (ASME).
    - .1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
    - .2 ASME B16.3-98, Malleable Iron Threaded Fittings.
    - .3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
    - .4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
    - .5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
    - .6 ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).
  - .2 American Water Works Association (AWWA).
    - .1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .3 American Society for Testing and Materials International, (ASTM).
    - .1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
    - .3 ASTM A536-84(1999)e1, Standard Specification for Ductile Iron Castings.
    - .4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.

- .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67-02, Butterfly Valves.
  - .2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

### 1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:
    - .1 Product data from manufacturer must specify servicing requirements.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling, in accordance with Waste Management Plan.
  - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## Part 2 Products

### 2.1 BLACK STEEL PIPE

- .1 Steel Pipe for Heating and Cooling: Complying with ASTM A53/A53M Standard, Grade B, Schedule 40.

- .2 Acceptable Products: Douglas Barwick.

## **2.2 PIPE JOINTS FOR BLACK STEEL**

- .1 50 mm and under: Screwed fittings with PTFE tape or lead-free pipe dope in accordance to ASTM-47M Standard, Grade 32510.
- .2 65 mm and over: Welding fittings and flanges to CSA W47.1 and CSA W47.1S1 Standards, Roll grooved: Standard or rigid coupling to CSA B242 Standard.
- .3 Orifice Flanges: Raised face, slip-on raised face.
- .4 Flange Gaskets: In accordance to ANSI/AWWA C111/A 21.11 Standard.
- .5 Pipe Thread: Taper.
- .6 Bolts and Nuts: In accordance to ASME B18.2.1 and ANSI/ASME B18.2.2 Standards.

## **2.3 FITTINGS FOR BLACK STEEL**

- .1 Screwed Fittings: Malleable iron, to ASME B16.3 Standard, Class 150.
- .2 Pipe Flanges and Flanged Fittings:
  - .1 Cast iron: To ASME B16.1 Standard, Class 150.
  - .2 Steel: To ANSI/ASME B16.5 Standard.
- .3 Butt-Welding Fittings: Steel Schedule 40, to ANSI/ASME B16.9 Standard.
- .4 Roll grooved: Standard rigid coupling, cast iron as per ASTM A47/A47M and ductile iron as per ASTM A536.

## **2.4 STAINLESS STEEL PIPE**

- .1 Use stainless steel pipe on cooling tower circuit, between the chiller and the cooling tower.
- .2 Stainless steel pipe, schedule 10, 304/304L finish, as per ASTM A312 and NSF/ANSI-61.
- .3 Connections:
  - .1 Butt-Welding fittings: stainless steel, schedule 10, 304/304L finish, as per ASTM A403, WP grade and ANSI B16.9;
  - .2 Stainless steel, flanged ends, 150 class, as per ASTM A182 and ASME/ANSI B16.5, 304/304L finish.

## **2.5 VALVES**

- .1 Connections:
  - .1 50 mm and smaller: Screwed ends.
  - .2 65 mm and larger: Flanged ends.

- .2 Butterfly Valves:
  - .1 65 mm and over: Flangeless model with flaps and lugs.
    - .1 In accordance with MSS-SP-67 Standard, Class 150, category 1 MPa, type EHG, iron-steel cast body, stainless steel gate, stainless steel stem, replaceable EPDM rubber seat lever and locking handle gear drives for valves with diameters of 150 mm and over.
    - .2 Acceptable products: Keystone, AR2 Model; Anvil, Nos. L5271 and L5272 for 200 mm and over; Milwaukee, No. ML224E; Romatec, ABZ Series, Fig. 102.
- .3 Balancing, for TAB:
  - .1 Sizes: Calibrated balancing valves angle body ("Y"), as specified this section.
  - .2 50 mm and under:
    - .1 Bronze/Copper body die casting, screw ends, Teflon seat and copper gate, screw-on threaded bonnet, that can support an effective maximum pressure of 1.7 MPa and a maximum temperature of 121°C.
    - .2 Flow control: At least four complete wheel revolutions, digital display type with mechanical memory, hidden and secure.
  - .3 65 mm or over.
    - .1 Iron cast body with epoxy resin based coating, internal devices and bonnet made of dezincification-resistant copper and zinc alloy, Class 125 with flanged ends according to ANSI; that can support an effective maximum pressure of 1.7 MPa and a maximum temperature of 121°C.
    - .2 Flow control: At least eight complete wheel revolutions with adjusting rings and mechanical memory, hidden and secure.
  - .4 Applicable products:
    - .1 Balancing valve: Tour and Anderson; Armstrong CBV.
- .4 Drain Fittings.
  - .1 20 mm plug and faucet, for flexible pipe connexion, body integrated or provided separately.
- .5 Ball Valves:
  - .1 Faucets: 50 mm or less, to screw.
    - .1 In accordance with ASTM B62 Standard, category 4 MPa, bronze body cast, TFE seal, sturdy massive chrome gate (rotating), Teflon seat and lever-handle.
    - .2 Acceptable products: Anvil, F 171 N; Milwaukee, No. BA-100; Jenkins, No. 201J; Toyo-R/W, No. 5044 A/MAS B-3; Kitz, No. 58.



## **2.6 CHECK VALVES**

- .1 50 mm or less, screw on.
  - .1 In accordance with MSS-SP-80, type 3, Class 125, category 860 kPa, bronze cast body, bronze hinged disc, screw-on threaded bonnet, and adjustable seat.
  - .2 Acceptable products: Crane, No. 37; Nibco, T 413 B; Jenkins, No. 4092J; Milwaukee, No. 509-T; Toyo-R/W, No. 236; Kitz, No. 22.
- .2 65 mm or more, flangeless.
  - .1 In accordance with MSS-SP-71 Standard, Class 125, category 860 kPa, iron cast body, Buna-N seat, 304 stainless steel hinged disc, flangeless.
  - .2 Acceptable products: Prince, R Series; Check Rite, 200 Series; Moygro, W12A-I6V (seat: viton).

## **Part 3 Execution**

### **3.1 PIPING INSTALLATION**

- .1 Install pipe work in accordance with Section 23 05 05 - Installation of Pipe Work.

### **3.2 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated. Sizing of valves to flow rate, not pipe diameter.
- .2 Remove hand wheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

### **3.3 CLEANING, FLUSHING AND START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

### **3.4 TESTING**

- .1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.

### **3.5 BALANCING**

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

### **3.6 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management.
- .3 Section 01 35 29.06 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 23 08 01 - Performance Verification - Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME-04, Boiler and Pressure Vessel Code.
- .2 American Society for Testing and Materials, (ASTM).
  - .1 ASTM A47/A47M-99, Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A278M-01, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
  - .3 ASTM A516/A516M-96(e1), Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .4 ASTM A536-84(1999)e1, Specification for Ductile Iron Castings.
  - .5 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International).
  - .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements.
  - .1 In accordance with section 01 35 29.06 - Health and Safety Requirements.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## Part 2 Products

### 2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Horizontal and vertical steel pressurized diaphragm type expansion tank.
- .2 Capacity: As indicated in the Expansion Tank Table.
- .3 Diaphragm: Sealed in EPDM suitable for 115°C operating temperature.
- .4 Working Pressure: 860 kPa with ASME stamp and certification.
- .5 Air precharged: Initial fill pressure of system.
- .6 Saddles for horizontal installation.
- .7 Supports: Provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

### 2.2 AUTOMATIC AIR VENT

- .1 Bleed tap with float, standard type: Body in bronze or iron with 3 mm joint designed for nominal work pressure of 860 kPa (125 psi), to be used for water system only.
  - .1 Usage:
    - .1 At the joints of convectors, fan coils, and other terminal heating or cooling equipment.
    - .2 On piping diameter less than 50 mm.
    - .3 At other locations indicated.
  - .2 Acceptable products: Watts, FV-4M1; Bell & Gossett; Armstrong.
- .2 Air vent with float, industrial type: body in iron with 12 mm joint designed for nominal work pressure of 860 kPa (125 psi).
  - .1 Float: designed for working temperature of 115°C (239°F).
  - .2 Usage:
    - .1 At the joints of convectors, fan coils, and other terminal heating equipment using glycol water.
    - .2 On piping diameter less than 50 mm with water-glycol mixer.
    - .3 On piping diameter greater than 65 mm with any fluids.
    - .4 At other locations indicated.
  - .3 Acceptable products: Amtrol, 747; Bell & Gossett.
- .3 Install a bronze ball valve at every air vent.

### 2.3 PIPING MOUNTED AIR SEPARATORS

- .1 Working Pressure: 860 kPa (125 psi).
- .2 Working Temperature: 177°C (350°F).
- .3 Dimensions: Same as pipe diameter.
- .4 Acceptable Products: Spirotherm; Bell & Gossett; Rolairtrol; Armstrong.

## 2.4 STRAINER

- .1 Inclined (Y) strainer, body tested for gauge pressure of 860 kPa (125 psi) with removable strainer made of monel, bronze or stainless steel.
- .2 Piping up to 50 mm:
  - .1 Body: Bronze in accordance with ASTM B-62 Standards, or iron in accordance with ASTM A278M, Class 30 Standards.
  - .2 Joints: Threaded.
  - .3 Filter: stainless steel with 0.8 mm ( $\frac{1}{32}$  in.) holes.
  - .4 Strainer joint: NPS fit with filter, ball valve and cap.
  - .5 Acceptable products: Armstrong, F4SC - A1SC; Conbraco, 59-00X-06; Zurn Wilkins, series S; Newman, Hattersley T807; Mueller, 351M.
- .3 Piping for greater than 65 mm:
  - .1 Body: made of iron in accordance with ASTM A278M, Class 30 Standards.
  - .2 Joint: Flanged.
  - .3 Filter: Stainless steel with 3.2 mm holes.
  - .4 Bleed tap joint: NPS fit with filter, globe valve, and cap.
  - .5 Acceptable products: Armstrong, F4SC - A1SC; Conbraco, 59-00X-06; Zurn Wilkins, S Series; Newman, Hattersley T807; Mueller, 351M; Watson-McDaniel, WCSY Series.
- .4 Filter diameters from 50 mm to 300 mm: "T" type, cast iron body in accordance with ASTM A536.

## 2.5 LOW PRESSURE RELIEF AND SAFETY VALVE

- .1 Install the relief valve, in accordance with the requirements and as indicated to protect the network against overpressure.
- .2 Valve with spring, made of bronze, with high flow capabilities and maximum opening capabilities for pressure relief as per indications, in accordance with ASME Code requirements.
- .3 Material:
  - .1 Body made of forged copper alloy.
  - .2 Valve housing made of bronze or cast iron.
  - .3 Spring made of cadmium plated steel.
  - .4 Internal pieces made of bronze and brass.
- .4 Relief valve adjusted to 35 kPa (5 psi) or 105% of maximal working pressure, whichever is most stringent. Relief valve adjustment and capacity determined in order to prevent the fluid pressure to increase over system elements working pressure while preventing valves from opening erratically.
- .5 Relief valve discharge towards the closest drain.
- .6 Discharge toward glycol tank for the glycol water network.

- .7 Low pressure check valve on the supply pipes.
- .8 Removable filter.
- .9 Acceptable Products: Kunkle; Armstrong; Conbraco.

## **2.6 SUCTION STRAINER**

- .1 Body: Made of cast iron with threaded flange.
- .2 Strainer: Built-in, with 1.19 mm mesh, disposable, low pressure loss, with NPS 1 bleed nipple.
- .3 Separator with permanent magnet.
- .4 Full length straightening vanes.
- .5 Manometer port.
- .6 Adjustable support footing.

## **2.7 ETHYLENE GLYCOL FLUID**

- .1 Supply and install a 50% ethylene glycol (Dowtherm) and 50% distilled water mix with rust inhibitors in sufficient quantity for the glycol heating circuits.
- .2 Minimal alkalinity of 10.0 ml.
- .3 Calculate the volume required by the modifications on the glycol circuits and add the required glycol quantity.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Install parts and accessories as per piping diagrams and manufacturers' recommendations.
- .2 Discharge piping will be directed to nearest floor drain.
- .3 Allow for adequate space required for maintenance and repairs. If there is insufficient space that is different from what is shown on the drawings, the Departmental Representative must be contacted before final installation.
- .4 If access space can't be achieved, consult Departmental Representative for clarifications and directives.
- .5 Installation to be as per manufacturer's drawings.
- .6 Ensure that all openings required for maintenance and hook up of equipment and operating weight are as indicated in shop drawings.
- .7 If additional parts are shipped loose, check with manufacturer for installation requirements.

### **3.2 STRAINER FILTERS**

- .1 Install filters in horizontal or downwards flow pipes.
- .2 Provide clearance to remove the filter.
- .3 Install a filter upstream to every pump and control valves (except at radiators), and elsewhere indicated.

### **3.3 AIR VENT**

- .1 Install air vent on piping and for equipment, upstream at high points, before each fluid drop, and where specifically indicated.
- .2 Air vent must comply with indications and have an isolation valve.
- .3 Install a ball valve upstream to any industrial bleed tap and send the discharge to the closest floor drain.

### **3.4 EXPANSION TANKS**

- .1 Adjust expansion tank pressure as indicated.
- .2 Install expansion tanks where indicated, in accordance with manufacturer's recommendations.
- .3 Install a lockshield type valve on the expansion tank inlet.

### **3.5 SAFETY VALVES**

- .1 Install the relief valves where indicated.
- .2 Send the discharge pipe to the closest floor drain.

### **3.6 SUCTION STRAINER**

- .1 Install a suction strainer on suction pipe side of the pump if the diameter is greater than NPS 2.

### **3.7 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification - Mechanical Piping Systems.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 91 13 - General Commissioning (Cx) Requirements.
- .4 Section 23 05 00 - Common Work Results for HVAC.
- .5 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

**1.2 REFERENCES**

- .1 Unless otherwise indicated, work will be performed in accordance with the applicable edition of the National Building Code of Canada.
- .2 In addition, perform work complying with any other standard having jurisdiction, including:
  - .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
    - .1 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, 250, and 800.
    - .2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
    - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.
    - .4 ANSI/ASME B16.9, Factory-Made Wrought Steel Butt Welding Fittings.
    - .5 ANSI/ASME B18.2.1, Square and Hex Bolts and Screws.
    - .6 ANSI/ASME B18.2.2, Square and Hex Nuts.
  - .2 American National Standards Institute/American Water Works Association (ANSI/AWWA).
    - .1 ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
  - .3 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
    - .1 Standard 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .4 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A47M, Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A48/A48M, Standard Specification for Gray Iron Castings.
    - .3 ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
    - .4 ASTM A536, Specification for Ductile Iron Castings.
    - .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

- .6 ASTM E202, Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .5 Canadian Standards Association (CSA International).
  - .1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.
  - .2 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
  - .3 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .6 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .7 National Electrical Manufacturers Association (NEMA).
  - .1 NEMA MG 1, Motors and Generators.

### 1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Shop Drawings to show:
    - .1 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
    - .2 Wiring diagrams.
    - .3 Recommended dimensions and installation mode.
    - .4 Pump performance curves.
    - .5 Final in field location of the controllers, pipes, valves, and fittings that are shipped separately by the manufacturer.
- .3 Data Sheets:
  - .1 Submit required data sheets and manufacturer's specification document for the proposed equipment.
- .4 Certificates:
  - .1 Submit signed documents by the manufacturer, certifying that the product, material and equipments comply with the required characteristics and performance criteria.
- .5 Instructions:
  - .1 Submit manufacturer's installation instructions.
- .6 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .7 Submit, for verification, the pump curves showing the duty point.

## 1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance Data Sheet:
  - .1 Maintenance data sheet must include the following:
    - .1 Equipment description, including the manufacturer's name, type, model, year, capacity, head, and flow rate.
    - .2 Pertinent details related to maintenance.
    - .3 Supply spare parts.

## Part 2 Produits

### 2.1 SINGLE SUCTION CENTRIFUGAL PUMP

- .1 Base: common fabricated steel with drip rim and tapping for drain connection.
- .2 Volute: cast iron radially split, end suction, flanged suction and discharge, with drain plug and vent cock, suction and discharge pressure gauge tapings.
- .3 Impeller: cast stainless steel enclosed type, balanced to ANSI/HI 9.6.4-2009 balance grade G6.3 keyed drive with locking nut or screw.
- .4 Shaft: stainless steel with two point support, machined shoulders for ball bearing mounting.
- .5 Seal assembly: internally-flushed mechanical seal with ceramic seal seat and carbon seal ring suitable for continuous operation at 107°C. A replaceable stainless steel shaft sleeve shall completely cover the wetted area under the seal.
- .6 Coupling: flexible self-aligning.
- .7 Motor: NEMA MG 1, squirrel cage induction, 1,725 r/min. Continuous duty, drip proof, ball bearing, maximum temperature rise 50°C.
- .8 Capacity: as indicated.
- .9 Design pressure: 1200 kPa.
- .10 Acceptable products: Bell & Gossett, Armstrong.

### 2.2 SUCTION GUIDE

- .1 Angular suction guide with the following specifications:
  - .1 Designed with a combination of guide/cylindrical orifice strainer, straightening vanes, start-up strainer, permanent magnet, and an adjustable support.
  - .2 Combination guide/cylindrical orifice strainer designed to withstand an equal differential pressure to the maximum pump head at zero flow. The sum of the perforated area must be equal to five times the cross section of the pump suction opening.
  - .3 The length of the straightening vanes must be at least twice the diameter of the pump suction opening.

- .4 The straightening vanes must be made of strong cast iron, with flanged connection and have a combination guide/strainer with 4.76 mm perforations made of carbon steel to protect the pump.
- .2 The full length of the straightening vanes must provide a laminar flow at the pump suction port.
- .3 The permanent magnet is located in the flow of the fluid to protect the mechanical joints of the pump. It must be removable to allow cleaning.
- .4 The start-up strainer must have a 16 mesh bronze screen that will be removed after the system start-up. A support pipe will eliminate strain on the device and the pump connection. All interior parts must be replaceable.
- .5 Maximum pressure loss 13.8 kPa (2 psi).
- .6 Characteristics: As indicated on drawings.
- .7 Acceptable Products: Bell & Gossett, Armstrong; Grundfos.

## 2.3 FLEXIBLE FITTINGS

- .1 Internal Pipe: Flexible made of braided stainless steel.
- .2 Exterior braiding consisting of a stainless steel mesh.
- .3 Diameters and End Types: As indicated on drawings.
- .4 Flexible fittings must be designed for 1,034 kPa (150 psi) working pressure at 93°C (199°F).
  - .1 The operating conditions must meet the piping network requirements.
- .5 Fittings must be able to absorb 150 mm (6 in.) of lateral displacement; the ratio of the length of the flexible part to the fitting diameter must be greater than six. The length of the flexible part must be no greater than 600 mm (24 in.).
- .6 Acceptable Products:
  - .1 50 mm or less:
    - .1 Flexi-Tube, type TSN; Railmex, type R-BSN.
  - .2 65 mm and greater:
    - .1 Flexi-Tube, type PSF; Railmex, type BSF.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 In accordance with CAN/CSA-B214 Standard.
- .2 Base mounted type: Supply templates for anchor bolt placement. Include anchor bolts with sleeves. Place level, shim unit and grout. Align coupling in accordance with manufacturer's recommended tolerance. Check oil level and lubricate. After run-in, tighten glands.
- .3 Install the support elements or suspension for the body of the pumps did not support the piping or equipments. Refer to details and instructions of the manufacturer.
- .4 Pipe drain tapping to floor drain.
- .5 Install volute venting pet cock in accessible location.

- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

### 3.2 **START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) requirements.
  - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
  - .1 Before starting pump, check that cooling water and heating water system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours minimum.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.
  - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  - .10 Rectify alignment of piping and conduit to ensure true flexibility.
  - .11 Eliminate cavitation, flashing, and air entrainment.
  - .12 Adjust pump shaft seals, stuffing boxes, glands.
  - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
  - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
  - .15 Verify lubricating oil levels.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management.
- .3 Section 01 35 29.06 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 01 91 13 - General Commissioning (Cx) requirements.
- .6 Section 23 05 00 - Common Work Results for HVAC.
- .7 Section 23 05 05 - Installation of Pipework.
- .8 Section 23 08 01 - Performance Verification - Mechanical Piping Systems.
- .9 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI/ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
  - .2 ANSI/ASME B16.25-97, Buttwelding Ends.
  - .3 ANSI/ASME B16.3-98, Malleable Iron Threaded Fittings.
  - .4 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .5 ANSI/ASME B16.9-01, Factory-Made Wrought Steel Buttwelding Fittings.
  - .6 ANSI B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
  - .7 ANSI/ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).
- .2 American Water Works Association (AWWA).
  - .1 AWWA C111-2000, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM A126-95(2001), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
  - .1 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .2 MSS-SP-71-97, Gray Iron Swing Check Valves, Flanged and Threaded Ends.

- .3 MSS-SP-80-97, Bronze Gate, Globe, Angle and Check Valves.
- .4 MSS-SP-85-94, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

### 1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, and include following:
  - .1 Special servicing requirements.

### 1.4 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### 1.6 EXTRA MATERIALS

- .1 Provide following spare parts:
  - .1 Valve seats: One for every ten valves, each size. Minimum one.
  - .2 Discs: One for every ten valves, each size. Minimum one.
  - .3 Stem packing: One for every ten valves, each size. Minimum one.
  - .4 Valve handles: Two of each size.
  - .5 Gaskets for flanges: One for every ten flanges.

## Part 2 Products

### 2.1 PIPE

- .1 Steel Pipe: To ASTM A53/A53M, Grade B, as follows:
  - .1 Schedule 40.
    - .1 Saturated steam piping.
  - .2 Schedule 80.
    - .1 Condensate piping.
    - .2 Steam vent piping.

### 2.2 PIPING CLASSIFICATION

- .1 Class 300 Piping:
  - .1 Steam piping: 860 kPa (125 psi).



- .2 Class 150 Piping:
  - .1 Steam piping: 55 kPa (8 psi).
  - .2 Condensate piping.
  - .3 Steam vents piping.

## 2.3 PIPE JOINTS

- .1 50 mm and Under: Screwed fittings with PTFE tape.
- .2 65 mm and Over: Welding fittings and flanges to CSA W48.
- .3 Flanges: Plain or raised face. Flange gaskets to AWWA C111.
- .4 Pipe Thread: Taper.
- .5 Bolts and Nuts: Carbon steel, to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.
- .6 Buttwelding Ends: To ANSI/ASME B16.25 as indicated.

## 2.4 FITTINGS

- .1 Pipe Flanges: Cast-iron to ANSI/ASME B16.5.
- .2 Buttwelding Fittings: Steel to ANSI/ASME B16.9.
- .3 Unions: Malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3 and ASTM A47M.
- .4 Class 250-300 joints:
  - .1 Steel flanges for pipes: Class 250, to ANSI/ASME B16.1.
  - .2 Ductile iron pipe threads: Class 300, to ANSI/ASME B16.3.
- .5 Other Piping:
  - .1 Ductile iron for pipes: Class 125, to ANSA/ASME B16.1.
  - .2 Ductile iron pipe threads: Class 150, to ANSI/ASME B16.3.

## 2.5 GATE VALVES, CLASS 125-150

- .1 Gate Valves: With diameter equal or smaller than 50 mm, screwed connections:
  - .1 Rising stem, to standard MSS-SP-80, type 2, Class 125, category 800 kPa, bronze body, single piece wedge.
  - .2 Acceptable products: Crane No. 428; Nibco No. T-111; Milwaukee No. 148; Newman Hattersley T607; Toyo-R/W No. 293; Kitz No. 24.
- .2 Gate Valves: With diameter equal or greater than 65 mm, to be installed in mechanical rooms, with flanges.
  - .1 Rising stem, conform to MSS-SP-70, Class 125, category 860 kPa, cast iron body to ASTM A126, Class B bronze internal parts, flat seal face flange, bolted bonnet, single piece wedge.
  - .2 Acceptable products: Crane No. 465 1/2; Nibco No. F-617-O; Milwaukee No. F-2885; Newman Hattersley 504; Toyo-R/W No. 421A; Kitz No. 72.

## 2.6 GLOBE VALVES, CLASS 125-150

- .1 Globe Valves: With diameter equal or smaller than 50 mm, screwed connections.
  - .1 Conform to MSS-SP-80, Type 2, Class 150, category 1,034 kPa, bronze body, single piece wedge, screw-in bonnet, composite material wedge, replaceable.
  - .2 Protected adjustment mechanism: As indicated.
  - .3 Acceptable products: Crane No. 7; Nibco No. T-235-Y; Milwaukee No. 590-T; Newman Hattersley 13; Toyo-R/W No. 221; Kitz No. 09.
- .2 Globe Valves: With diameter equal or greater than 65 mm, with flanges.
  - .1 Conform to MSS-SP-85, Class 125, category 860 kPa, cast iron body, bronze internal parts, rising stem, bolted bonnet, bronze wedge and seat ring, flat seal face flange.
  - .2 Acceptable products: Crane No. 351; Nibco No. F-718-B; Milwaukee No. F-2981; Newman Hattersley 731; Toyo-R/W No. 400A; Kitz No. 76.

## 2.7 LIFT CHECK VALVE - CLASS 125-150

- .1 Check valves with diameter equal or smaller than 50 mm, screwed type.
  - .1 Conform to MSS-SP-80, Class 125, category 860 kPa, bronze body, bronze lift check, screw-in bonnet, reparable seat.
  - .2 Acceptable products: Crane No. 37; Nibco No. T-413; Milwaukee No. 509-T; Newman Hattersley A60; Toyo-R/W No. 236; Kitz No. 22.
- .2 Check valve with diameter equal or greater than 65 mm, with flanges.
  - .1 Conform to MSS-SP-71, Type 1, Class 125, category 860 kPa, bronze body, reparable or replaceable seat, bronze lift check, bolted bonnet, flat seal face flange.
  - .2 Acceptable products: Crane No. 373; Nibco No. F-918-B; Milwaukee No. F-2974; Newman Hattersley 651; Toyo-R/W No. 435A; Kitz No. 78.

## 2.8 SILENT TYPE CHECK VALVE - CLASS 125-150

- .1 Check valves with diameter equal or smaller than 50 mm, screwed type.
  - .1 Conform to ASTM B62, Class 125, category 860 kPa, bronze body, brass seat and check valve, stainless steel spring (heavy duty for installation on downstream flow vertical pipes).
  - .2 Acceptable products: Singer No. 475; Nibco No. T-480; Milwaukee, 1400 Series; Mueller, 91BP.

## 2.9 GATE VALVES - CLASS 250-300

- .1 Gate Valves: With diameter equal or smaller than 50 mm, screwed connections:
  - .1 Rising stem, to standard MSS-SP-80, Type 2, Class 300, category 2,068 kPa, bronze body, single piece wedge, stainless steel seat.
  - .2 Acceptable products: Crane No. 634E; Nibco No. T-174-SS; Milwaukee No. 1184.

- .2 Gate Valves: With diameter equal or greater than 65 mm, with flanges.
  - .1 Rising stem, conform to MSS-SP-70, Class 250, category 1,723 kPa, cast iron body to ASTM A126, Class B bronze internal parts, flat seal face flange, bolted bonnet, single piece wedge.
  - .2 Acceptable products: Crane No. 7 1/2E; Nibco No. F-667-O; Milwaukee No. F-2894.

## **2.10 GLOBE VALVES - CLASS 250-300**

- .1 Globe Valves: With diameter equal or smaller than 50 mm, screwed connections.
  - .1 Conform to MSS-SP-80, Type 2, Class 300, category 2068 kPa, bronze body, single piece wedge, screw-in bonnet, stainless steel wedge, and seat.
  - .2 Protected adjustment mechanism: as indicated.
  - .3 Acceptable products: Crane No. 382P; Nibco No. T-276-AP; Milwaukee No. 593A.
- .2 Globe Valves: With diameter equal or greater than 65 mm, with flanges.
  - .1 Conform to MSS-SP-85, Class 250, category 1,720 kPa, cast iron body, bronze internal parts, rising stem, bolted bonnet, bronze wedge and seat ring, and flat seal face flange.
  - .2 Acceptable products: Crane No. 21E; Nibco No. F-768-B; Milwaukee No. F-2983.

## **2.11 LIFT CHECK VALVE - CLASS 250-300**

- .1 Check valves with diameter equal or smaller than 50 mm, screwed type:
  - .1 Conform to MSS-SP-80, Class 300, category 2068 kPa, bronze body, bronze lift check, screw-in bonnet, reparable seat.
  - .2 Acceptable products: Crane No. 76E; Nibco No. T-473-B; Milwaukee No. 517-T.
- .2 Check valve with diameter equal or greater than 65 mm, with flanges.
  - .1 Conform to MSS-SP-71, Type 1, Class 250, category 1,720 kPa, cast iron body, reparable or replaceable seat, bronze lift check, bolted bonnet, and flat seal face flange.
  - .2 Acceptable products: Crane No. 39E; Nibco No. F-968-B; Milwaukee No. F-2970.

## **Part 3 Execution**

### **3.1 PIPING**

- .1 Connect branch lines into top of mains.
- .2 Unless otherwise specified, connect piping in conformity with manufacturer's requirements.
- .3 Install concealed piping as close as possible to building structural elements, in order to technical spaces to use as little space as possible, and keep maximum free space underneath. Install apparent piping parallel to walls. Group pipes as much as possible.
- .4 Unless otherwise specified, install piping with descending slope 25 mm per 6 m in the direction of flow.
- .5 Make provision for thermal expansion.

- .6 Drip Pocket: Line size.
- .7 Make provision sufficient for insulation, and provide access for maintenance to equipments, valves, and joints.
- .8 Before installation, barb both ends, remove scories and dust, inside and outside. Clean also when installation is finished.
- .9 Use connecting joints to ANSI Standards.
- .10 For main piping, joints with base-plate are allowed if the diameter of the connecting pipe is equal or smaller than half the main pipe. Before welding the base-plate, make the hole on the main pipe with a saw or a drill and barb the sides of the hole to keep the connection its full inside diameter.

### **3.2 VALVES**

- .1 Unless otherwise specified, install valves with stem up, or at 45° with horizontal position.
- .2 Install stop valves (gates) at each branch, to isolate each equipment, and all other indicated places.
- .3 Install globe valves on bypass to control valves.
- .4 Install handwheel with chain operators for valves installed at more than 3 m above floor.
- .5 Install bypass globe valves for all gate valves with diameter equal or greater than NPS 8.

### **3.3 TESTING**

- .1 Test system in accordance with Section 21 05 01 - Mechanical - Common Work Results.
- .2 Test Pressure: 1½ times maximum system operating pressure or 860 kPa, whichever is greater.

### **3.4 CLEANING, FLUSHING, START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **3.5 PERFORMANCE VERIFICATION (PV)**

- .1 General:
  - .1 In accordance with Section 23 08 01 - Performance Verification - Mechanical Piping Systems, supplemented as specified herein.
- .2 Timing, only after:
  - .1 Pressure tests successfully completed.
  - .2 Flushing as specified has been completed.
  - .3 Water treatment system has been commissioned.
- .3 PV Procedures:
  - .1 Verify complete drainage of condensate from steam coils.
  - .2 Verify proper operation of system components, including, but not limited to:
    - .1 Steam traps - Verify no blow-by.

- .2 Flash tanks.
- .3 Thermostatic vents.
- .3 Monitor operation of provisions for controlled pipe movement, including expansion joints, loops, guides, and anchors.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 35 29.06 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 23 08 01 - Performance Verification - Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American Society for Mechanical Engineers (ASME International).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A126-95(2001), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM A167-99, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
  - .3 ASTM A216/A216M-2003, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.
  - .4 ASTM A240/A240M-04, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .5 ASTM A276-03, Standard Specification for Stainless Steel Bars and Shapes.
  - .6 ASTM A278/A278M-01, Standard Specification for Gray Iron Castings for Pressure - Containing Parts for Temperatures up to 650 Degrees F (350 degrees C).
  - .7 ASTM A351/A351M-03, Standard Specification for Steel Castings, Austenitic, Austenitic- Ferritic (Duplex) for Pressure-Containing Parts.
  - .8 ASTM A564/A564M-02a, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
  - .9 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

**1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4 HEALTH AND SAFETY**

- .1 Apply, safety rules in accordance with Section 01 35 29.06 - Health and Safety Requirements.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate wastes in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Cast Steel: To ASTM A216/A216M.
- .2 Cast Iron: To ASTM A278, Class 300.
- .3 Bronze: To ASTM B62.
- .4 Stainless Steel: To ASTM A351/A351M.

### **2.2 FLOAT AND THERMOSTATIC STEAM TRAPS**

- .1 Application: For modulating steam service on humidifier, heat exchangers.
- .2 Materials: Body - cast iron or cast-steel; valve - chrome or stainless steel with stainless steel seat; float and mechanisms - stainless steel; air vent - phosphor bronze thermostatic type.
- .3 Capacity: As indicated.

### **2.3 SAFETY AND RELIEF VALVES**

- .1 Application: Installed as required and where indicated, to protect the network from overpressure.
- .2 Valve with a bronze control spring, high flow and maximum opening for pressure relief as indicated, in accordance with ASME Requirements.
- .3 Material: forged copper alloy body, cast bronze or malleable iron housing, steel cadmium plated steel, and internal pieces made of bronze and brass.
- .4 Relief valve discharge channeled out via a discharge elbow.
- .5 Acceptable Products: Kunkle; Armstrong; Sarco; Conbraco.

### **2.4 DRIP PAN ELBOWS**

- .1 Application: On discharge of steam safety relief valves as indicated.
- .2 Cast iron or steel with screwed or flanged inlet and threaded drain connections.

### **2.5 VACUUM BREAKERS 0.85-68 KPA**

- .1 Application: on inlets to heat exchangers and as indicated.
- .2 Materials: body and cap - lead-free brass; spring - stainless steel; stem and seat - lead-free brass.
- .3 Capacity: as indicated.



**2.6 PIPE LINE STRAINERS UP TO 50 MM**

- .1 Application: Ahead of condensate pumps, steam traps, control valves and elsewhere as indicated.
- .2 Screen: With angled body (Y), 300-lb Class and removable strainer made of monel, bronze or stainless steel.
- .3 Body: Bronze in accordance with ASTM B62 Standard or cast iron in accordance with ASTM A278M Standard, Class 30.
- .4 Fittings: Threaded.
- .5 Screen: Made of stainless steel with 0.8 mm ( $1/32$  in.) perforations.
- .6 Discharge Connection: NPS adapted to the screen with globe valve and cap.
- .7 Acceptable Products: Armstrong F4SC - A1SC; Conbraco 59-00X-06; Zurn Wilkins, S Series. Newman Hattersley T807; Mueller 351M; Watson-McDaniel, WCSY Series; Hoffman ITT.

**2.7 PIPE LINE STRAINERS 65 MM AND OVER**

- .1 Application: ahead of condensate pumps, steam traps, control valves, as indicated.
- .2 Working pressure: 860 kPa.
- .3 Body: cast iron.
- .4 Connections: flanged.
- .5 Blowdown connection: 32 mm complete with gate valve and cap.
- .6 Screen: stainless steel with 3.2 mm perforations.

**2.8 FLASH TANKS**

- .1 Location: as indicated.
- .2 Tank: vertical type with flanged drop tube connections.
- .3 Size: 150 mm diameter x 900 mm long.
- .4 Construction: to ASME code.
- .5 Maximum working pressure: 860 kPa.
- .6 Connections: 50 mm and under, screwed; 65 mm and over, flanged.
- .7 Finish: prime coated.
- .8 Supports: vertical legs for vertical tank.

**Part 3 Execution**

**3.1 GENERAL**

- .1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Maintain proper clearance around equipment to permit maintenance.

**3.2 STRAINERS**

- .1 Install as indicated.
- .2 Ensure clearance for removal of basket.
- .3 Install valved blowdown as indicated.

**3.3 SAFETY RELIEF VALVE**

- .1 Pipe to atmosphere independent of other vents and in accordance with applicable Code.
- .2 Support discharge pipe against reaction forces and to take up thermal movement.
- .3 Drain pipe from drip pan elbow to terminate over floor drain.

**3.4 STEAM TRAPS**

- .1 Install unions on inlet and outlet.

**3.5 FLASH TANKS**

- .1 Pipe arrangement as indicated.

**3.6 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification - Mechanical Piping Systems.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 23 05 00 - Common Work Results for HVAC.
- .4 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME Boiler and Pressure Vessel Code, Section VII-2001.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance material to include:
  - .1 Log sheets as recommended by manufacturers.
  - .2 Brochures and bulletins related to installed water treatment.
  - .3 Instruction manuals, including full description of treatment methods used the goals of the operation, chemical test to be carried out, sampling and chemical; values to be maintained.
  - .4 Written instructions for sensing and cleaning.

**1.4 TRAINING OF OPERATION AND MAINTENANCE PERSONNEL**

- .1 For two days running, give to operation and maintenance personnel, training regarding operation, maintenance and chemical test procedures.
- .2 Courses to be both theoretical and practice and using current installed equipment.

**1.5 SERVICES**

- .1 Hot water heating system only shall be equipped with a chemical treatment system.
- .2 Because of the small amount of make-up water involved, chemicals shall be added by hand.
- .3 See more details in a further clause of this specification.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Waste Management and Disposal.
- .2 Unused metal and wiring materials are to be diverted from landfill to a metal recycling facility as approved by the Departmental Representative.

- .3 Dispose of unused water treatment chemicals at official hazardous material collections site approved by the Departmental Representative.
- .4 Do not dispose of unused water treatment chemicals into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .6 Dispose of corrugated cardboard polystyrene plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

## **Part 2 Products**

### **2.1 MANUFACTURER**

- .1 Equipment, chemicals, and service by one supplier.

### **2.2 SHIPPING/FEEDING CHEMICAL CONTAINERS**

- .1 High density moulded polyethylene, with liquid level graduations, cover.
- .2 No agitation required, premixed solution used.

### **2.3 POT FEEDER**

- .1 To feed corrosion inhibitors, provide a pot feeder for each and every heating and water cooling closed circuits.
- .2 Carbon steel construction.
- .3 Carbon steel 12 mm piping.
- .4 In and out Connections: 12 mm NPT.
- .5 Vent: 3 mm.
- .6 Maximum Operating Pressure: 1,050 kPa (150 psi).
- .7 Capacity: 9 liters.
- .8 Drain Connections: 12 mm NPT.

### **2.4 CARTRIDGE FILTER**

- .1 Filtration system for 5% of total flow complete with:
  - .1 304 stainless steel filter housing with nickel plated brass head. Maximum operating pressure of 860 kPa (125 psi). Maximum temperature of 12°C (250°F).
  - .2 Cartridge with 30 microns.
  - .3 Two pressure gauges.
  - .4 Two shut-off valves and one balancing valve.
  - .5 Supply five replacement filters for each installation.
  - .6 Acceptable products: Magnor FCFH or equivalent.

## 2.5 COOLING TOWER FILTRATION SYSTEM

- .1 Purpose.
  - .1 The removal of specific unwanted solids from a cooling tower sump or remote basin shall be accomplished with a packaged system, featuring a centrifugal-action vortex separator. Solids removal efficiency is principally predicated on the difference in specific gravity between the liquid and the solids. Fluid viscosity must be 100 SSU or less.
  - .2 Equipment for this purpose shall be a LAKOS TPX/TPI Tower-Clean Separator Package as manufactured by Claude Laval Corporation.
- .2 Performance.
  - .1 In a single pass through the separator system, given solids with a specific gravity of 2.6 and water at 1.0, performance is predictably 98% of 74 microns and larger. Additionally, particles finer in size, heavier by specific gravity and some lighter by specific gravity will also be removed, resulting in an appreciable aggregate removal of particles (up to 75%) as fine as 5 microns.
  - .2 In a recirculating system, 98% performance is predictable to as fine as 40 microns (given solids with a specific gravity of 2.6), with correspondingly higher aggregate performance percentages (up to 90%) of solids as fine as 5 microns.
  - .3 PLUS System shall remove 90% of all solids down to 0.35 microns in size (recirculating system) without restricting flow thru the system. Maximum flow thru the PLUS system is 50 GPM per cartridge.
  - .4 Separator performance must be supported by published independent test results from a recognized and identified agency. Standard test protocol of upstream injection, downstream capture and separator purge recovery is allowed with the 50-200 mesh particles to enable effective, repeatable results. Single pass test performance must be not less than 95% removal. Model tested must be of the same design series as specified unit.
- .3 Manufacturer.
  - .1 The separator system shall be manufactured by LAKOS Filtration Systems, a division of Claude Laval Corporation in Fresno, California USA. Specific model designation is: TPX-0100-SRV-575.
- .4 Liquid-Solids Separator.
  - .1 A tangential inlet and mutually tangential internal accelerating slots shall be employed to promote the proper velocity necessary for the removal of the separable solids. The internal accelerating slots shall be spiral-cut (larger system with HTH/HTX Series only) for optimal flow transfer, laminar action and particle influence into the separation barrel. The separator's internal vortex shall allow this process to occur without wear to the accelerating slots.
  - .2 Separated particle matter shall spiral downward along the perimeter of the inner separation barrel, in a manner which does not promote wear of the separation barrel, and into the solids collection chamber, located below the vortex deflector stool.

- .3 To insure maximum particle removal characteristics, the larger systems featuring the HTH/HTX Series Separator shall incorporate a vortex-induced pressure relief line (Vortube), drawing specific pressure and fluid from the separator's solids collection chamber via the outlet flow's vortex/venturi effect, thereby efficiently encouraging solids into the collection chamber without requiring a continuous underflow or excessive system fluid loss.
- .4 System fluid shall exit the separator by following the center vortex in the separation barrel and spiral upward to the separator outlet.
- .5 The separator shall feature the following access capabilities for either inspection or the removal of unusual solids/debris:  

A hand-hole port at the collection chamber (4" and larger HTX Series Separators only). Separators without hand-hole port are not acceptable since they don't provide access and ease of maintenance.
- .6 The separator shall be of unishell construction with SA-36, SA-53B or equivalent quality carbon steel, minimum thickness of .25 inches (6.35 mm). Maximum operating pressure shall be 150 psi (10.3 bar), unless specified otherwise.
- .7 Paint coating shall be oil-based enamel, spray-on, gloss black.
- .8 Inlet shall be 75 mm (125# ANSI FLANGED) & outlet shall be 50 mm (GROOVED).
- .9 Purge outlet shall be threaded with screw-on flange, size: 20 mm.
- .10 The separator shall operate within a flow range of: 100 gpm (23 m<sup>3</sup>/hr).
- .11 Pressure loss shall be between 3-12 psi (.2-.8 bar), remaining constant, varying only when the flow rate changes.
- .5 Purging & Solids Handling.
  - .1 Separated solids shall be continuously purged under controlled flow into a 304 stainless steel Solids Recovery Vessel equipped with one 25-micron fiberfelt solids collection bag. Solids collection capacity: 360 cubic inches (6 liters). Excess liquid shall pass through the bag and return to system flow via piping connected to the system pump's suction line. The system shall include an air/pressure relief line for the vessel. System also includes manual isolation valves for use when servicing the collection bag; sight glasses for verification of flow through the vessel; annunciator for indicating when the collector bag needs cleaning/replacement; flow control orifice to minimize fluid volume/velocity through the vessel and collector bag.
- .6 Strainer.
  - .1 Provided with system to protect system pump from damage or fouling by larger solids or debris.
  - .2 Cast-iron housing; manual-cleaning; 1/8-inch (3.2 mm) minimum mesh rating; stainless steel basket.
- .7 Pump.
  - .1 End-suction, single stage; TEFC motor; cast iron housing; iron or bronze impeller; bronze shaft sleeve; Viton/Silicon Carbide mechanical shaft seal; flooded suction required. A self priming pump may be used in sump applications that do not allow for flooded suction.

- .8 Piping.
  - .1 Schedule 40 galvanized carbon steel; reinforced rubber hose to solids recovery vessel and PLUS System.
- .9 Electrical Control.
  - .1 IEC starter with overload module; HOA selector switch; NEMA-4X enclosure; re-set/disconnect/trip switch; 120 volt, single phase control voltage; UL Listed panel.
- .10 Valves.
  - .1 Ball valves on purge line for isolation of solids-handling/purging equipment. Optional inlet/outlet butterfly valve kit is available.
- .11 Skid Plate.
  - .1 Stainless steel, 3/16-inch (5 mm) minimum thickness on system up to TPX/TPI-1100.
- .12 PLUS System.
  - .1 Stainless steel housing with pleated, cleanable, cartridge filter. Unit is mounted on separate stainless steel 3/16-inch (5mm) skid plate. TPX/TPI-0065 thru 0400 systems have (1) cartridge; TPX/TPI-0525 and larger systems have (2) cartridges.
- .13 Basin Cleaning - Hydroboosters/Eductors.
  - .1 Placement of the separator package's inlet and outlet within the basin shall be strategically determined and supplemented where necessary with specific agitation devices known as hydroboosters or eductors. Each hydrobooster/eductor shall be capable of increasing its input flow 20 psi or more, to six times greater output flow without excessive wear to the hydrobooster/eductor, thereby providing the proper directed turbulence to prevent troublesome solids accumulation and induce separable solids to the separator pump suction.

## 2.6 MATERIAL FOR ANALYSIS

- .1 Each system related to this Section to be supplied with necessary analysis material for testing its performance.
- .2 Analysis material to be supplied in a small case and shall include appropriate reactors used and also specialized or supplemental material required.

## 2.7 50% ETHYLENE GLYCOL MIX

- .1 Supply and install a mix of clean demineralized water and ethylene glycol at 50% concentration per volume. The mix must be pre-mixed at the factory and shipped by truck for use.
- .2 Acceptable Products: Dowtherm SR-1 mixed with distilled water at 50%.

## **2.8 REAGENTS**

- .1 Supply enough reagents to combat tarter, mud, and corrosion of pipe for one year. Reagents must be compatible with all materials in contact of HVAC water systems.

## **2.9 CHEMICAL PRODUCTS**

- .1 Supply the following chemicals for start-up and operation of system for the period preceding take-over by Owner.
- .2 Heating and Glycol Systems:
  - .1 Closed circuits inhibitor products supplied by Contractor.
- .3 Supply all required reagents for laboratory tests.
- .4 Supply all necessary chemicals for cleanings each and every hydraulic networks.

## **2.10 WATER TREATMENT FOR OPEN TYPE CIRCUIT COOLING TOWER**

- .1 Refer to the section 23 65 10 - Cooling towers for the water treatment on the open circuit of the cooling tower.

## **Part 3 Execution**

### **3.1 BASE CRITERION**

- .1 General:
  - .1 The goods for the installation of water treatment systems are to prevent:
    - .1 Rust, limestone, and scale formation.
    - .2 Corrosion.
  - .2 Water quantities:
    - .1 Meter water volume of each circuit to determine concentration of chemicals before proceeding to revering and cleaning of same.
  - .3 Electrical installations to conform with Division 26.
  - .4 Identification of control panels: White ebonite nameplates, black lettering.
- .2 Particular requirements:
  - .1 HVAC treatment system must be:
    - .1 Conforming to standards of chemical products disposal in public sewer system and environment.
    - .2 Easy handling.
    - .3 No danger to operating and maintenance staff.
    - .4 No danger for equipment on building materials (especially roofing materials).
    - .5 Not to maintain life of micro-organism.
    - .6 Langelier Index equal or greater than zero (no corrosive water with sub-zero Langelier Index).



- .7 No acid shall be used for water treatment.
- .3 General characteristics of circuits and apparatus to be protected.
  - .1 Piping:
    - .1 See Section 23 22 13 - Steam and Condensate Heating Piping.
  - .2 Pumps:
    - .1 See Section 23 21 23 - Pumps - Hydronic Systems.
  - .3 Make-up water:
    - .1 Hot water heating networks - Chemical treatment.
  - .4 Base criterion:
    - .1 Heating water networks:
      - .1 Maximum corrosion rates for all welded surfaces:
        - .1 Steel or iron surfaces: maximum penetration of 0.0127 mm/gr.
        - .2 Copper surfaces: maximum penetration of 0.00254 mm/gr.

### 3.2 POT FEEDER

- .1 Install pot feeder in by-pass with network circulation pump. The inhibitor is poured in the feeder and introduced in the network by the water flowing in the feeder.

### 3.3 CLEANING OF MECHANICAL SYSTEM, ALL NETWORKS, INCLUDING GLYCOL/WATER NETWORKS

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by the Departmental Representative.
- .2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials must be safe to handle and use.
- .3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 35 29.06 - Health and Safety Requirements.
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Section 23 44 00 - HVAC Air Filtration.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International (ASTM).
  - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association (NFPA).
  - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2<sup>nd</sup> Edition 1995 and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1<sup>st</sup> Edition.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1<sup>st</sup> Edition.

**1.3 SUBMITTALS**

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

#### 1.4 QUALITY ASSURANCE

- .1 Certification of Ratings.
  - .1 Catalogue or published ratings are those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to Codes and Standards.
- .2 Health and Safety:
  - .1 Apply pertinent safety rules in accordance with section 01 35 29.06 - Health and Safety Requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal.
  - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .2 Collect and separate packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .3 Separate for reuse and recycling and place in designated containers waste in accordance with Waste Management Plan.
  - .4 Place materials defined as hazardous or toxic in designated containers.
  - .5 Fold up metal banding, flatten and place in designated area for recycling.

#### 1.6 CLEANLINESS OF DUCTWORK

- .1 Contractor must take all necessary dispositions to ensure the cleanliness of ductwork during fabrication, shipping and storage, and during installation leading up to final work approval.
  - .1 After fabrication and during shipping, the ductwork must be protected from dust by sealing the extremities of the ducts with polyethylene film.
  - .2 During storage, the ductwork must be protected by polyethylene cover to protect from dust and weather.
  - .3 During installation on site, the ductwork must be protected from dust by sealing open extremities of the ducts with a new polyethylene film.
- .2 Ductwork must be clean and free of dust and debris before HVAC start-up. Dust on the interior surface of duct must be less than 0.75 mg/100 cm<sup>2</sup>, as per NADCA Vacuum Test.

## Part 2 Products

### 2.1 SEAL CLASSIFICATION

- .1 Seal classification for ductwork is to be determined by the following table:

Maximum Pressure	Seal Classification
500 Pa	A (SMACNA)
750 Pa	A (SMACNA)

- .2 Seal Classification:

- .1 Class A: Longitudinal seams, transverse joints and connections made airtight with sealing product or tape embedded in sealing product.
- .2 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

### 2.2 SEALANT

- .1 Transverse Joints:

- .1 Rectangular or round ducts with slotted or "S" joints.
- .1 Tube applied sealant.
- .1 Acceptable products: Mulco-Butyle; Ductmate 5511M.
- .2 "T" joints and flanged joints.
- .1 Waterproof tape.
- .1 Acceptable products: Ductmate 440 Gasket tape.

- .2 Longitudinal Joints:

- .1 Round duct.
- .1 Tube applied sealant of sealant product.
- .1 Acceptable products: Mulco-Butyle; Ductmate 5511M.
- .2 Rectangular duct.
- .1 Tube sealant.
- .1 Acceptable products: Mulco-Butyle; Ductmate No. 5511M.

- .3 Miscellaneous:

- .1 For installation temperature higher than -7°C (19.4°F).
- .1 Sealing product: sealing product for air duct, water based, ULC certified, with fire spread factor smaller than 26 and smoke density rating lower than 51, usable within -7°C (19.4°F) to 93°C (199.4°F) temperature range.
- .1 Acceptable products: Duro Dyne DWN.

## 2.3 TAPE

- .1 Tape: Polyvinyl treated, open weave fiberglass tape, 50 mm wide.
  - .1 Acceptable products: Duro Dyne FT-2.

## 2.4 FITTINGS

- .1 Fabrication: According to SMACNA.
- .2 Rounded Elbows:
  - .1 Rectangular ducts: Elbows bend radius equal to one times the width of the duct.
  - .2 Ducts round: Elbows bend radius equal to 1.5 times the diameter of the pipe "Standard manufacturers."
- .3 90° Elbows: Rectangular Ducts:
  - .1 Ducts whose largest dimension is less than or equal to 400 mm equipped with baffles elbows single thickness.
  - .2 Ducts whose largest dimension is greater than 400 mm equipped with baffles elbows double thickness.
- .4 Bypass Fittings:
  - .1 Main and branch ducts, rectangular:
    - .1 Lateral entry at 90°: With damper in the branch closest to the main duct.
    - .2 Lateral entry to 45°: Radius of curvature equal to one time the width of the duct with damper in the branch closest to the main duct.
  - .2 Ducts, main, and branch, round: Entering the main duct with conical fitting.
- .5 Transition Elements:
  - .1 Divergent elements: Transition angle of up to 20°.
  - .2 Elements converging transition angle exceeding 30°.
- .6 Offsets: 90° bends or elbows rounded, as indicated.
- .7 Deflectors for obstacles to keep the same effective area. The angles of maximum transition must be the same as in the case of regular transformations.

## 2.5 FIRE STOPPING

- .1 Angle restraints must be installed around the sleeves on each side of fire separations.
- .2 Fire stopping material and installation must not distort duct.

## 2.6 GALVANIZED STEEL

- .1 Lock Forming Quality: To ASTM A653/A653M, Z90 zinc coating.
- .2 Design Criteria: Pressure of 500 Pa.
- .3 Thickness, Manufacturing and Reinforcement: To ASHRAE and SMACNA recommendations.

- .4 Joints.
  - .1 Complying with ASHRAE and SMACNA for following usage:
    - .1 Ducts, with greater dimension up to 3 ft 11 in.
    - .2 Acceptable products: Ductmate Canada.
  - .2 Prefab trade marked flanged joints for air ducts, for following usage.
    - .1 Ducts, with greater dimension up to 3 ft 11 in.
    - .2 Acceptable products: Ductmate Canada.
- .5 Circular and Oval Ducts.
  - .1 Ducts: Factory manufactured, spiral, with assorted fittings and special parts, in accordance with SMACNA.
  - .2 Transverse joints for ducts up to 36 in diameter: Interlocked type, use sealing product and tape for tightness.
  - .3 Transverse joints for ducts over 36 in diameter: Vanstone.
  - .4 Acceptable products: Spiro Metal Canada Inc.; Ductmate Canada.

## 2.7 HANGERS

- .1 Hanging Straps: Used for ducts with greater dimension up to 20 in. Same material as suspended duct, one gauge thicker than suspended duct material.
- .2 Hangers Configuration: In accordance with ASHRAE and SMACNA recommendations.
- .3 Angles and hanger rods; angles made from galvanized steel, retained by galvanized steel rods, in accordance with ASHRAE and SMACNA recommendations and following table:

DUCT SIZE mm	ANGLES SIZE mm	RODS SIZE mm
Up to 750	25 x 25 x 3	6
From 751 to 1,050	40 x 40 x 3	6
From 1,051 to 1,500	40 x 40 x 3	10
From 1,501 to 2,100	50 x 50 x 3	10
From 2,101 to 2,400	50 x 50 x 5	10
Over 2,400	50 x 50 x 6	10

- .4 Hanger Attachment Devices.
  - .1 Attachment for concrete works; prefab concrete anchorage.
    - .1 Acceptable products: Myatt, fig. 485.
  - .2 Steel beam attachment: prefab concrete clamps.
    - .1 Acceptable products: Anvil fig. 61 or 86 for U-bolts and Anvil fig. 60 support plates.

- .3 Steel beam attachment: prefab clamps.
- .1 Acceptable products: Anvil fig. 60.

### Part 3 Execution

#### 3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, and SMACNA, as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .4 Support risers in accordance with ASHRAE and SMACNA, as indicated.
- .5 Install breakaway joints in ductwork on sides of fire separation.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining, as indicated.

#### 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 ASHRAE and SMACNA recommendations, as follows:

Duct Size (mm)	Spacing (mm)
To 1,500	3,000
1,501 and over	2,500

#### 3.3 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.
- .3 Seal every opening in air ducts (i.e.: openings for instruments, dampers liking parts, coils, etc.), using sealing product or neoprene or silicone trim. Equipment installed within the duct must be allowed to move freely as required.

#### 3.4 LEAKAGE TESTS

- .1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.



- .6 Test section minimum of 30 m long with not less than three (3) branch takeoffs and two (2) 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.
- .3 National Fire Protection Association (NFPA).
  - .1 NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B-2009, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 Underwriter's Laboratories of Canada (ULC).
  - .1 CAN/ULC-S110-M86(R2001), Fire Tests for Air Ducts.
  - .2 UL 181-1996, Factory Made Air Ducts and Connectors

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data.
  - .1 Submit manufacturer's printed product literature, specifications, and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
  - .2 Submit Material Safety Data Sheets (MSDS).
- .3 Test Reports: Submit independent laboratory test reports in order to certify that the products and materials satisfy the performance criteria.
  - .1 Technical data provided by the manufacturer must be reliable and confirmed by tests performed by the manufacturer or by independent laboratories in order to certify their compliance to the standards.
- .4 Certificates: Submit documents signed by the manufacturer in order to certify that the products and materials satisfy the performance criteria.

- .5 Instructions: Submit manufacturer's installation instructions.
- .6 On-field Manufacturer Inspection: Submit reports for these inspections.
- .7 Closeout Submittals: Submit maintenance data sheets and join them to the manual mentioned in section 01 78 00 - Closeout Submittals.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Apply required measures in accordance with section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling, in accordance with Waste Management Plan.
  - .4 Divert unused metal materials from landfill to recycling facility as approved by Departmental Representative.

### **Part 2 Products**

#### **2.1 GENERAL**

- .1 Accessories to be manufactured in accordance with SMACNA - HVAC Duct Construction Standards.

#### **2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: Galvanized sheet metal frame 1.3 mm (0.05 in) thick with fabric clenched by means of double locked seams.
- .2 Material.
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, density of 1.3 kg/m<sup>2</sup>.
  - .2 Asbestos fibre cloth, treated with acrylic resin, incombustibles, meeting environment protection standards requirements, rated for temperature up to 900°F, complying with ASTM AAAA category, with 0.92kg/m<sup>2</sup> (0.189 lb/ft<sup>2</sup>), ULC listed (S109).

#### **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 (1 in) thick rigid glass fibre insulation.
- .3 Gaskets: Neoprene, 20 mm x 10 mm.
- .4 Hardware.
  - .1 Doors, up to 300 mm x 300 mm: Two locks, Duro Dyne SL-1, with chain.
  - .2 Doors, up to 301 mm x 450 mm: Four locks, Duro Dyne SL-1, with chain.
  - .3 Doors, from 451 to 1,000 mm height: One continuous piano type hinge and at least two locks, Duro Dyne SL-1.
  - .4 Doors, over 1,000 mm height: One continue piano type hinge and three handles operable from both inside and outside.
  - .5 Door holder: Device to keep doors in open position.

## **2.4 TURNING VANES**

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

## **2.5 INSTRUMENT TEST**

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

## **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 Flexible Connections.
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
  - .2 Length of connection: 150 mm (6 in).
  - .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 Door Duct.
  - .1 Size:
    - .1 610 x 1,520 mm for person size entry.
    - .2 460 x 460 mm for handhole.
    - .3 300 x 200 mm for viewing.
    - .4 As indicated.
  - .2 Locations:
    - .1 Fire and smoke and control dampers.
    - .2 Devices requiring maintenance.
    - .3 Required by Code.
    - .4 Reheat coils, one on each side.
    - .5 Elsewhere as indicated.
  - .3 Handhole location:
    - .1 Located to give access to the smoke evacuation dampers and fire dampers.
    - .2 Located to give access to balancing dampers.
    - .3 Located to give access to devices requiring periodical maintenance.
    - .4 Located as required by standards.
    - .5 Located to give access to both sides of a coil.
    - .6 Located where 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 Inlets and outlets of other fan systems.
      - .2 Main and sub-main ducts.
      - .3 As indicated.
    - .2 For temperature readings:
      - .1 At outside air intakes.
      - .2 On mixing boxes as approved by the Departmental Representative.

- .3 At inlet and outlet of coils.
- .4 Downstream of junctions of two converging air streams of different temperatures.
- .5 As indicated.
- .4 Turning vanes.
  - .1 Install in accordance with recommendations of SMACNA and as indicated.

### 3.3 **CLEANING**

- .1 Once installation work is completed, clear the job site of all surplus material, waste, tools and safety barriers.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 - Waste Management and Disposal.

**1.2 REFERENCES**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible - 1985.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Data Sheet:
  - .1 Submit required product data sheets and manufacturer's specifications in accordance with section 01 33 00 - Submittals. Provide product characteristics, performance criteria and restrictions.
    - .1 Submit two data sheet copies required by the Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .2 Quality Assurance: Submit the following documents in accordance with section 01 33 00 - Submittals:
  - .1 Certificates: Submit documents signed by the manufacturer in order to certify that the products and materials satisfy required performance criteria.
  - .2 Instructions: Submit manufacturer's installation instructions:
    - .1 Departmental Representative will provide one copy of the installation instruction prepared by the manufacturer.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Apply required measures in accordance with section 01 35 29.06 - Health and Safety Requirements.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Wastes Management and Disposal:
  - .1 Sort wastes in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal, sort to be reused and recycled.

**Part 2 Products**

**2.1 GENERAL**

- .1 Dampers to be manufactured according to SMACNA Standards.

**2.2 SPLITTER DAMPERS**

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Double thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: Piano hinge.
- .6 Folded leading edge.

**2.3 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 250 mm (10 in).
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

**2.4 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed Blade: Configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum Blade Height: 100 mm.
- .4 Bearings: Pin in bronze bushings, self-lubricating.
- .5 Linkage: Shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

**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 recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Install balancing dampers at all places where air balancing is required and as indicated.
- .3 Install multi-bladed dampers of opposite blade type in all secondary ducts that are greater than 250 mm (10 in) in height and in all the main ducts.
- .4 Install single blade dampers in the secondary ducts that are less than 250 mm in height.
- .5 Install dampers as close as possible to the main ducts when installed in the secondary ducts.
- .6 Install controls for damper in accessible and visible locations.
- .7 Properly fix dampers, including the control shaft in order to prevent vibration.
- .8 Only install turning vanes in "Wye" or "Tee" shaped ductwork.

### 3.3 CLEANING

- .1 Once installation and performance tests are completed, clear the job site of all excess materials, waste, tools, and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM).
  - .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Data Sheet:
  - .1 Submit required product data sheets and manufacturer's specifications in accordance with section 01 33 00 - Submittals Procedures. Provide product characteristics, performance criteria, and restrictions.
  - .2 Submit two data sheet copies required by the Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .2 Quality Assurance: Submit the following documents in accordance with section 01 33 00 - Submittals Procedures:
  - .1 Certificates: Submit documents signed by the manufacturer in order to certify that the products and materials satisfy required performance criteria.
  - .2 Instructions: Submit manufacturer's installation instructions:

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Apply required measures in accordance with section 01 35 29.06 - Health and Safety Requirements.
- .2 Certificate:
  - .1 Technical data taken from catalogs and from manufacturers' documentation must be reliable, based on results of tests carried out by manufacturers themselves or on their behalf by independent laboratories and certify the compliance with the requirements of Codes and Standards.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packaging, Shipping, Handling and Unloading.
  - .1 Transport and store material in accordance with manufacturer's instructions.
- .2 Wastes Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal; sort waste to reused and recycled.

## Part 2 Products

### 2.1 MULTI-LEAF DAMPERS

- .1 The damper type is opposite or parallel blade, as indicated.
- .2 Flanged connection type damper, only if one of the dimensions is less than or equal to 500 mm or if the mechanism is not accessible for maintenance (removal and replacement of linkages).
- .3 The dampers without thermal insulation for air mixing, and with thermal insulation for the fresh air and exhaust dampers.
- .4 Materials:
  - .1 Uninsulated damper.
    - .1 Chassis and blades are made of aluminum extrusions, 2.05 mm (0.08 in) thick. "Air-Foil" type blades, with a width of 125 to 155 mm. Chassis made from aluminum channels, with reinforcing mullions and grooves to insert the vinyl lining. Typical dimensions of the frame are 25 x 100 x 25 mm on four (4) sides. The swivel stems are made of hexagonal aluminum extrusion 12 mm, set in the blade. The Celcon double-sealed bearings for the inner part are inserted into the chassis so there is no rotation. The rods are designed to avoid friction, metal on metal or metal on bearings. The shutters are designed for minimum resistance to airflow. Vinyl liners are fitted in the grooves of the chassis for this purpose.
  - .2 Insulated damper.
    - .1 Chassis and blades are made from aluminum extrusion 2.05 mm thick. "Air-Foil" type blades, with a width of 125 to 155 mm and are aluminum extruded with insulated cavities with 22 mm thick polyurethane foam with thermal barrier. The extruded aluminum frames are 100 mm deep with three (3) insulated sides with polystyrene foam with an R-factor 5.0. The Tamco double-sealed bearings with Celcon inner pads attached to the hexagonal shaft, pivot on an outside pad of polycarbonate inserted into the chassis. The parts of the mechanism are installed in a chassis out of the airflow.
- .5 Dimensions:
  - .1 Blades width: Between 125 mm and 155 mm; length: Maximum 1,200 mm length.
  - .2 Module maximum size of 1,200 mm wide by 2,400 mm high.

- .3 Registers of multiple blades must be fitted with stiffeners and transverse coupling rods.
- .4 The dampers must be of sufficient size so it does not restrict the useful area of the duct. The installation of such inserted registers is not acceptable if one dimension is less than or equal to 500 mm or if the mechanism is not accessible for maintenance.
- .6 Performance:
  - .1 Maximum allowable leak: 50 L/s.m<sup>2</sup> for a static pressure of 1.0 kPa.
  - .2 Temperature range for the insulated registers: From -40°C to 68°C.
  - .3 Temperature range for the uninsulated registers: From -40°C to 100°C.
  - .4 Maximum speed: 5 m/s at the face.

## **2.2 BACKDRAFT DAMPERS**

- .1 Automatic dampers, operating by gravity, made of aluminum, with multiple blades nylon rollings and a spring return.

## **2.3 EXHAUST DAMPERS**

- .1 Automatic, made of aluminum or steel, with multiple blades, ball bearings, and counterweight, adjusted to open for a static pressure of 25 Pa, as indicated.

## **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 dampers with thermal insulation on fresh air intakes and exhausts.
- .2 Install dampers registers where indicated.
- .3 Install dampers registers in accordance with recommendations of SMACNA and the manufacturer's instructions.
- .4 Install dampers registers so the blades are horizontal.
- .5 Install dampers registers on tilted or vertical conduits so the blades are horizontal.
- .6 Seal the joints of multiple dampers registers modules using a non-transparent sealant silicone, that is recognized by UL, and respecting the standards of NFPA 90A.
- .7 At the start-up of the system, ensure that dampers registers are working properly.
- .8 Install an access door near each dampers register.
- .9 Ensure dampers are visible and easily accessible.

**3.3 CLEANING**

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittals Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - General Requirements about Products.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 78 00 - Closeout Submittals.

**1.2 CODES AND REFERENCES**

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA).
  - .1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC).
  - .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
  - .2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two Material Safety Data Sheets (MSDS) copies in accordance with Section 01 33 00 - Submittals Procedures.
  - .2 Indicate the following:
    - .1 Fire dampers;
    - .2 Smoke dampers;
    - .3 Fire stop flaps;
    - .4 Operators;
    - .5 Fusible links;
    - .6 Design details of break-away joints.

- .2 Quality Assurance: Submit the following in accordance with Section 01 33 00 - Submittal Procedures:
  - .1 Certificate: Submit catalogued or published ratings obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency demonstrating adherence to Codes and Standards.
  - .2 Instructions: Submit manufacturer's installation instructions.
    - .1 Departmental Representative will provide one installation instruction copy prepared by the system manufacturer.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety: Apply pertinent measures in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Certificates:
  - .1 Technical data provided by manufacturer's documentation must be reliable and based on tests performed by an independent certified laboratory or by the manufacturer itself, in order to demonstrate material compliance with the applicable standard.

#### **1.5 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide following:
    - .1 Six fusible links of each type.

#### **1.6 TRANSPORT, STORAGE, AND HANDLING**

- .1 Packaging, Shipping, Handling, and Unloading:
  - .1 Transport, store and handle products and material in accordance with Section 01 61 00 - General Requirements about Products.
  - .2 Transport and store products and materials in accordance with manufacturer's instructions.

### **Part 2 Products**

#### **2.1 FIRE DAMPERS**

- .1 Fire dampers: Arrangement type listed and bear label of ULC and UL meet requirements of Fire Commissioner of Canada (FCC), CFFM, and ANSI/NFPA 90A, and authorities having jurisdiction. Fire damper assemblies fire tested, in accordance with CAN4-S112.

- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: Offset, round or square; multi-blade hinged or interlocking type; guillotine type; sized to maintain full duct cross section, as indicated.
- .4 Fusible link activated, with counterweight to close and lock in closed position, when the mechanism is activated, or using a total closure antagonist spring command for many blades type or horizontally mounted enrolment closure device for vertical air duct.
- .5 Fire dampers must be as defined by SMACNA, (Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems), for high pressure tightness.
  - .1 Wall-trough air transfer: Type A;
  - .2 Rectangular ducts: Type B;
  - .3 Circular ducts: Type C;
  - .4 Oval ducts: Type C.
- .6 Fire dampers factory-mounted within a sleeve, minimum thickness of the sleeve must meet recommendation from SMACNA and UL 555 Standards.
- .7 Fire dampers made with a galvanized steel frame installed so that it does not interrupt the continuity of the duct in which it is installed.
- .8 Penetration hole frames/sleeves made of stainless steel with angle beams fixed on each side of the wall or floor. When the floor/ceiling or ceiling/roof assembly have a degree of fire resistance, conduits must conform to penetrating hole ULC Standards.
- .9 Dampers designed and built so that they do not reduce the size of duct or opening in which they are installed.
- .10 Holding Angles: To be installed on the sleeve's periphery, on each side of the fireproof separation.
  - .1 Sleeve with greater dimension up to 1,200 mm: folded galvanized steel, 1.5 mm (0.06 in) minimal thickness.
  - .2 Sleeve with greater dimension over 1,200 mm: folded galvanized steel, minimal dimensions 40 x 40 x 3 mm.
- .11 Protection Time: In accordance to City Building Codes, but no less than 1.5 hr.
- .12 Acceptable Products: Controlled Air Manufacturing Ltd.; Nailor; Penn Ventilator Canada Ltd.; Ruskin (Kerr-Hant); AMI.

### **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 equipments complying with ANSI/NFPA 90A standards, according with ULC approval requirements and following the "Basic Fire Damper Installation Details" from SMACNA.
- .2 Complete works without altering the fire resistance level of casing within which equipments are mounted.
- .3 Install fire dampers in ductwork each time it goes through a fire resistant partition.
  - .1 Floors that separate two levels.
  - .2 Technical shaft partitions.
  - .3 Technical room partitions.
  - .4 Fire stopper suspended ceilings.
  - .5 As indicated on drawings.
  - .6 Fire stopper partitions indicated in architectural documents.
  - .7 Where required by the Quebec Construction Code or Municipality.
  - .8 Every where else required, but not mentioned in this list.
- .4 If needed, wait for approval from the authority having jurisdiction, before hiding any components.
- .5 Install one access door next to each damper.
- .6 Coordinate work with those installing fire/smoke stopper materials.
- .7 Install the devices where the access doors, the fuse links and servo-motors are visible and easily accessible.
- .8 Install approved isolation joints on each side of the fire stopper partition.
- .9 Mounting: Follow the "Basic Fire Damper Installation Details" from the "Fire, Smoke and Radiation Damper, Installation Guide for HVAC Systems" section provided by SMACNA.
  - .1 Partition mounted: "Case 2: Vertical Fire Damper Installation".
  - .2 Floor mounted: "Case 3: Horizontal Fire Damper Installation".
  - .3 Wall air transfer mounted: "Case 7: Vertical Fire Damper Installation".
  - .4 Any other mounting not listed at Articles 9.1, 9.2 and 9.3 or not accepted.

### 3.3 CLEANING

- .1 In accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Section 01 78 00 - Closeout Submittals.
- .7 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .8 Section 23 05 48 - Vibration and Seismic Control for HVAC Piping and Equipment.
- .9 Section 23 33 00 - Air Duct Accessories.

**1.2 REFERENCES**

- .1 Air Conditioning and Mechanical Contractors Association (AMCA).
  - .1 AMCA Publication 99-2003, Standards Handbook.
  - .2 AMCA 300-2005, Reverberant Room Method for Sound Testing of Fans.
  - .3 AMCA 301-2005, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National standard Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB 1.181-99, Zinc-Rich Epoxy Coating.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Data Sheet (DS).

**1.3 SYSTEM DESCRIPTION**

- .1 Performance Requirements.
  - .1 Technical data provided by the manufacturer documentation must be reliable, confirmed by tests performed by the manufacturer itself, or by independent laboratories certifying compliance to the applicable standards.
  - .2 Equipment characteristics: Flow rate, static pressure, mechanical power in bhp, efficiency, rotation speed in rpm, model, dimensions, and sound level, as indicated.
  - .3 Fans: Statically and dynamically balanced, built in accordance with AMCA 99 Standards.

- .4 Sound level: In accordance with AMCA 301 Standards; tests in accordance with AMCA 300 Standards. Equipment must wear the AMCA tag certifying their sound level.
- .5 Equipment performance characteristics: based on tests made in accordance with ANSI/AMCA 210 Standards. Equipment must wear the AMCA tag, except for helical fans with diameters smaller than 300 mm.

#### 1.4 SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide the following data:
  - .1 Fan curves with operating point, break horse power (bhp), mechanical horse power (hp), and the efficiency.
  - .2 Sound level, in dBA, at the operating point.
- .4 Shop drawing must show the following:
  - .1 Details of the motor, the pulley, the bearings, and the shaft.
  - .2 Minimum possible efficiency.
- .5 Quality Assurance Submittals: Submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: Submit manufacturer's installation instructions.
- .6 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### 1.5 QUALITY ASSURANCE

- .1 Health and Safety: Apply pertinent safety rules in accordance with 01 35 29.06 - Health and Safety Requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling, and Unloading:
  - .1 Deliver, store, and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store, and handle in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Product**

### **2.1 FANS - GENERAL**

- .1 Motors.
  - .1 As prescribed in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, and in this section.
  - .2 Power as indicated.
- .2 Accessories and other Elements: as requested.
- .3 Primer of color chosen from those available by the manufacturer to be factory applied on the parts before assembly.
- .4 Scroll casing drains, as indicated.
- .5 Lubrication system with extra length tube when the bearings are not easily accessible.
- .6 Vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Control for HVAC Piping and Equipment.
- .7 Flexible Connections: In accordance with Section 23 33 00 - Air Duct Accessories.

### **2.2 CENTRIFUGAL FANS**

- .1 Wheels:
  - .1 Made of aluminum or steel, welded.
  - .2 Maximum speed not over 50% of critical speed.
  - .3 Aerodynamic blade for diameters 464 mm and over and blade inclined toward the back for diameters of 419 mm or less, as indicated.
- .2 The HVAC systems fans' ball bearings shall be designed for intensive use and shall have a certified average lifespan of 200,000 hours, as in AFBMA L-50. The ball bearings' characteristics and specifications shall be based on the fans' technical sheet maximum speed and power. Bearings shall be equipped with copper lubrication tubes so that the nozzle is oiled at only one point inside the bearing.
- .3 Bearings: Heavy duty, split pillow-block or flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.
- .4 Housing:
  - .1 Volute with inlet cones: Fabricated steel for wheels 300 mm or greater, aluminum or steel for smaller wheels, braced, and with welded supports. Adaptable outlet for fans with wheels up to 675 mm diameter, and fixed outlets for bigger wheels.
  - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

- .3 Provide bolted airtight doors, with handles.
- .5 Variable Volume Control Devices:
  - .1 Provided and mounted by the regulation specialist.
  - .2 Fans for HVAC units shall come with variable frequency drives. Distance control and programming by the regulation specialist. Electrical cables shall be made of EMT type galvanized steel. Frequency drives shall be equipped with a communication interface (BACnet MS/TP) compatible with the existing building controls (Delta).
    - .1 Every variable frequency drive shall accept the following control signals from an external controller:
      - .1 Frequency drive start/stop (SB);
      - .2 Speed modulation (SA).

## **2.3 CABINET FANS, GENERAL PURPOSE**

- .1 Fan Characteristics and Construction: As centrifugal fans.
- .2 Single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, and other accessories.
- .3 Fabricate casing of zinc coated or phosphate treated steel of 18 gauge, reinforced and braced for rigidity. Provide removable panels for access to interior. Uncoated, steel parts shall be painted over with corrosion resistant paint to CGSB 1-GP-181M.

## **2.4 IN-LINE CENTRIFUGAL FANS**

- .1 Fan Characteristics and Construction: As centrifugal fans.
- .2 Provide AMCA Arrangements 1 or 9, as indicated, with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

## **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 FANS INSTALLATION**

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads, and flexible connections, in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and panel to provide easy access for maintenance.



**3.3 ANCHOR BOLTS AND TEMPLATES**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified as indicated in Section 23 05 48.

**3.4 QUALITY ASSURANCE**

- .1 Commissioning:
  - .1 As per Section 01 91 00.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Section 01 78 00 - Closeout Submittals.

**1.2 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.

**1.3 SUBMITTALS**

- .1 Product Data.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .2 Indicate following:
    - .1 Capacity;
    - .2 Throw and terminal velocity;
    - .3 Noise criteria;
    - .4 Pressure drop;
    - .5 Neck velocity.
- .2 Quality Assurance: Submit the following in accordance with section 01 33 00 - Submittal Procedures.
  - .1 Certificate: Submit catalogued or published ratings obtained from tests carried out by the manufacturer or those ordered by the manufacturer from an independent testing agency demonstrating adherence to codes and standards.
  - .2 Instructions: Submit manufacturer's installation instructions.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety: Apply pertinent measures in accordance to Section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Packing, Shipping, Handling, and Unloading.
  - .1 Deliver, store, and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal.
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **1.6 MAINTENANCE**

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

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Standard products meeting requirements regarding following items: air flow, pressure loss, air terminal velocity, range, noise level and velocity at maximum narrowing point (clamp).
- .2 Casing.
  - .1 Steel casing: primed stamped steel, cold rolled with apparent joints welded and miter joints at the angles.
  - .2 Aluminum casing: extruded aluminum, satin finish, with mechanical fasteners and miter joints at the angles.
  - .3 Sealing trim surrounding casing.
  - .4 Assembling frame, coated for casing mounted within coated wall or partition, or made from plaster plates, as prescript.
  - .5 Hidden attach system.
- .3 Hidden manual operation device for volumetric registers.
- .4 Diffuseurs, registers, grilles, and Pod unit shall be with vandalproof screw.
- .5 Acceptable products: E.H. Price; Titus; Nailor.
- .6 Characteristics: See table on drawing.

## **2.2 MANUFACTURED UNITS**

- .1 Grilles, registers, and diffusers of same generic type, products of one manufacturer.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head cadmium plated screws in countersunk holes, where fastenings are visible.
- .3 Bolt diffusers and grids located in the gymnasium and other playing rooms. Install a security chain for each grid and diffuser.
- .4 Paint the back of the grilles, diffusers and registers flat black as to minimise visibility of metallic components.
- .5 For double-deflection grids, make sure the blades are set to the required orientation.
- .6 Install balancing dampers with each grid and diffuser.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 REFERENCES**

- .1 Unless otherwise specified, execute all work in accordance with the current edition of the "National Building Code of Canada."
- .2 In addition, execute the work in accordance with any code or any other standard having jurisdiction, according to the current edition, including, but not limited to:
  - .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA).
    - .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).
  - .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .5 Society of Automotive Engineers (SAE).

**1.3 SUBMITTALS**

- .1 Submit all documents and samples required in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings and Data Sheets:
  - .1 Shop drawings and specifications must include the following:
    - .1 The pressure drop;
    - .2 The front surface;
    - .3 The free surface.
- .3 Certificates:
  - .1 Submit documents signed by manufacturer certifying that products, materials and equipment meet the requirements as to the physical characteristics and performance criteria.
- .4 Instructions:
  - .1 Submit installation instructions provided by the manufacturer.
- .5 Test Reports:
  - .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

**1.4 TECHNICAL DATA RELIABILITY**

- .1 Technical data from catalogs and manufacturers' literature should be reliable, based on results of tests carried out by the manufacturers themselves or on their behalf by independent laboratories and to certify that allowed the compliance of the requirements of Codes and Standards.

**Part 2 Products**

**2.1 BIRD SCREEN**

- .1 Aluminum screen, removable for cleaning.
- .2 Utility: for all vents (intake or exhaust).

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforcing brace and air intakes, vents and windbreaks gooseneck to make sure that they resist of wind surges. Refer to NBC to see the wind speeds in a particular region.
- .3 Secure items in the openings have been performed for this purpose. Seal all around to ensure a good seal.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers International (ASME)/Boiler and Pressure Vessel Code.
  - .1 BPVC-VIII B, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.
- .2 Canadian Standards Association (CSA) / CSA International.
  - .1 CSA B51, Code on the Boilers, and Pressure Piping Systems.

**1.3 SUBMITTALS**

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings must include the clearances recommended by the manufacturer to facilitate the removal of tubes and manipulation tools for cleaning them.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit all documents and items to deliver to the end of work and join to the "Operations and Maintenance Manual" in accordance with Section 01 78 00 - Closeout Submittals.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect and separate paper packaging, plastic, polystyrene and corrugated cardboard and place them in appropriate on-site bins for recycling in accordance with the Waste Management Plan.
- .3 Sort steel scrap and metal for reuse / recycling, and place in designated containers.

**Part 2 Products**

**2.1 TUBE-IN-SHELL HEAT EXCHANGER**

- .1 Tube-in-shell Heat Exchanger:
  - .1 Steam to glycol / water solution. Heating media in shell, multi pass design.
  - .2 Designed, constructed and tested in accordance with ASME Boiler and Pressure Vessel Code and provincial pressure vessel regulations.

- .3 Shell: steel 1 MPa working pressure. Inlets and outlets as required. Tappings for relief valve, gauge, drain, vacuum breaker.
- .4 Head: cast iron, inlet and outlet. Tapped connections for drain and vacuum breaker.
- .5 Tubes: 20 mm O.D. copper with steel tube support. Maximum tube velocity: 2 m/s.
- .6 Tube sheet: steel.
- .7 Fouling Resistance Coefficient: as indicated.
- .8 Capacity: as indicated.
  - .1 Working pressure: shell 1034 kPa, tubes 860 kPa.
- .9 Dimensions: as indicated.
- .10 Mounting supports: steel or cast iron saddles.
- .2 Acceptable Products: Bell & Gossett: capacity as indicated in table on drawing.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.
- .3 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

#### **3.2 APPURTENANCES**

- .1 Install with safety relief valve piped to drain, vacuum breaker, steam traps, hose bib drain valve.
- .2 Install thermometer wells with thermometers on inlet and outlet of secondary side.
- .3 Install pressure gauge on steam inlet.

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

- .1 Site Tests and Inspections:
  - .1 Perform tests as directed by Departmental Representative to ensure heat exchangers are functional.
- .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

#### **3.4 SYSTEM START-UP**

- .1 General: perform start-up operations in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

- .2 Check heater for cleanliness on primary and secondary sides.
- .3 Check installation, settings, operation of relief valves and safety valves.
- .4 Check installation, location, settings and operation of operating, limit and safety controls.
- .5 Check supports, seismic restraint systems.
- .6 General: perform performance verification in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .7 Timing: only after TAB of hydronic systems have been successfully completed.
- .8 Primary side:
  - .1 Measure flow rate, pressure drop, water temperature at heater inlet and outlet.
    - .1 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
  - .2 Control valve: verify proper operation without binding, slack in components. Measure steam pressure at control valve inlet.
  - .3 Secondary side:
    - .1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.
    - .2 Verify installation and operation of air elimination devices.
  - .4 Calculate heat transfer from primary and secondary sides.
  - .5 Simulate heating water temperature schedule and repeat above procedures.
  - .6 Verify settings, operation, safe discharge from safety valves and relief valves.
  - .7 Verify settings, operation of operating, limit and safety controls and alarms.

### 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 installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by heat exchanger installation.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

**1.2 REFERENCES**

- .1 Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
  - .1 AHRI 550/590-11, Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.
  - .2 AHRI 575, Method of Measuring Machinery Sound Within an Equipment Space.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section VIII.
  - .2 ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
  - .3 ANSI/ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .4 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
  - .5 ANSI/ASME B16.9, Factory Made Wrought Steel Buttwelding Fittings.
  - .6 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .7 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .8 ANSI/ASME B16.25, Buttwelding Ends.
  - .9 ANSI/ASME B18.2.1, Square and Hex Bolts and Screws.
  - .10 ANSI/ASME B18.2.2, Square and Hex Nuts.
- .3 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
  - .2 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .3 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - .4 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .5 ASTM B32, Standard Specification for Solder Metal.
  - .6 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
  - .7 ASTM B75, Specification for Seamless Copper Tube.

- .8 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA B52-99, Mechanical Refrigeration Code.
- .5 Environment Canada/Environmental Protection Services (EPS).
  - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

### **1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
  - .1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
  - .2 Wiring as assembled and schematically.
  - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
  - .4 Space requirements for operation and maintenance.
  - .5 Type of refrigerant used.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data to include:
  - .1 Dimensioned plan and elevation view, including required clearances, and location of all field piping and electrical connections.
  - .2 Summaries of all auxiliary utility requirements such as: electricity, water, air, etc. Summary shall indicate quality and quantity of each required utility.
  - .3 Diagram of control system indicating points for field interface and field connection. Diagram shall fully depict field and factory wiring.
  - .4 Manufacturer's certified performance data at full load plus IPLV or NPLV.
  - .5 Details on operation servicing and maintenance.
  - .6 Recommended spare parts list.

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and with Waste Reduction Workplan.

### **1.6 PREVENTIVE MAINTENANCE SERVICE**

- .1 Manufacturer's contract price should include a preventive maintenance contract for one year starting on the date of chiller commissioning.

- .2 Provide preventive maintenance contract costs for a period of one year starting on the provisional acceptance date. Detailed description of preventive maintenance contract must meet minimum requirements described in this section.

## **Part 2 Products**

### **2.1 ACCEPTABLE MANUFACTURERS**

- .1 Basis of Design - Daikin Applied® Magnitude Model WMC/WME, including the standard product features and all special features required per the plans and specifications.
- .2 Equal Products - Equipment manufactured by York may be acceptable as an equal. Naming these products as equal does not imply that their standard construction or configuration is acceptable or meets the specifications. Equipment proposed "as equal", must meet the specifications including all architectural, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications.

### **2.2 UNIT DESCRIPTION**

- .1 Provide and install as shown on the plans a factory assembled, charged, and tested water-cooled packaged centrifugal chiller. Chillers shall have no more than two oil-free, magnetic bearing, semi-hermetic centrifugal compressors (no exceptions). Each compressor shall have an integrated variable-frequency drive operating in concert with inlet guide vanes for optimized full and part load efficiency. On two-compressor units, the evaporator and condenser refrigerant sides and the expansion valve shall be common and the chiller shall be capable of running on one compressor with the other compressor or any of its auxiliaries inoperable or removed.
- .2 To ensure quick and trouble free start up and commissioning, each chiller shall pass a full battery of factory tests. These tests will include the verification of operating and compressor controls to ensure full unit functionality and manufacturing integrity. Any deviation from stringent factory quality standards shall be remedied prior to shipment.

### **2.3 DESIGN REQUIREMENTS**

- .1 General: Provide a complete water-cooled, semi-hermetic oil-free centrifugal compressor water chiller as specified herein. The unit shall be provided according to standards indicated in Section 1.2. In general, unit shall consist of one or two magnetic bearing, completely oil-free centrifugal compressors, refrigerant, condenser and evaporator, and control systems including integrated variable frequency drive, operating controls and equipment protection controls. Chillers shall be charged with refrigerant HFC-134a. If manufacturer offers a chiller using any HCFC refrigerant that is subject to phase out by the Montreal Protocol or the U.S. Clean Air Act, manufacturer shall provide, in writing, documentation signed by an officer of the company assuring refrigerant availability and price schedule for a 20-year period.

- .2 The entire chiller system, including all pressure vessels, shall remain above atmospheric pressure during all operating conditions and during shut down to ensure that non-condensables and moisture do not contaminate the refrigerant and chiller system. If any portion of the chiller system is below atmospheric pressure during either operation or shut down, the manufacturer shall include, at no charge:
  - .1 Purge System:
    - .1 A complete purge system capable of removing non-condensables and moisture during operation and shut-down. The system shall consist of an air cooled condensing unit, purge condensing tank, pumpout compressor, and control system.
    - .2 A dedicated condensing unit shall be provided with the purge system to provide a cooling source whether or not the chiller is running. The condensing unit shall provide a low purge coil temperature to result in a maximum loss of 0.1 pounds of refrigerant per pound of purged air.
    - .3 The purge system shall be connected to a 100% reclaim device.
    - .4 A 20-year purge maintenance agreement that provides parts, labor, and all preventative maintenance required by the manufacturer's operating and maintenance instructions.
  - .2 Annual Oil/Refrigerant Analysis:
    - .1 The manufacturer shall also include at no charge for a period of 20 years an annual oil and refrigerant analysis report to identify chiller contamination due to vacuum leaks.
    - .2 If the analysis identifies water, acid, or other contaminant levels higher than specified by the manufacturer, the oil and/or refrigerant must be replaced or returned to the manufacturer's original specification at no cost to the owner.
  - .3 Shell Pressurization System:
    - .1 The manufacturer shall include a factory-installed and wired system that will enable service personnel to readily elevate the vessel pressure during shutdown to facilitate leak testing.
    - .2 A shell pressurization system shall be provided to keep air out of the chiller when the unit is not in service. Electric blanket or hot water circulation system are both acceptable.

## 2.4 PERFORMANCE

- .1 See the chiller schedule on the drawings.

## 2.5 ELECTRICAL CONNECTION

- .1 Chiller must be supplied by a single 575 V, 3 phase, 60 Hz connection. The disconnect switch shall be provided with the chiller.

## 2.6 DIMENSIONS

- .1 Chiller, including all its components must fit inside a volume of 4,350 mm long x 1 200 mm wide x 2,150 mm high.



## 2.7 ACOUSTICAL PERFORMANCE

- .1 Chiller acoustical performance levels must not exceed levels indicated in the chiller schedule on the drawings.

## 2.8 COMPRESSOR AND MOTOR

- .1 The unit shall utilize magnetic bearing, oil-free, semi-hermetic centrifugal compressors. The levitated shaft position shall be digitally controlled and shall be monitored by X-axis position sensor, Y-axis position sensor, and Z-axis position sensor. The compressor drive train shall be capable of coming to a controlled, safe stop in the event of a power failure by diverting stored power to the magnetic bearing controls system.
- .2 The motor shall be of the semi-hermetic type, of sufficient size to efficiently fulfill compressor horsepower requirements. It shall be liquid refrigerant cooled with internal thermal sensing devices in the stator windings. The motor shall be compatible with variable frequency drive operation.
- .3 If unit contains an atmospheric shaft seal, the manufacturer shall provide the following at no additional charge:
  - .1 20 year warranty and all preventive maintenance required to maintain the shaft seal including appropriate disposal of all oil lost through the shaft seal. Such disposal shall be done in a manner consistent with all Federal, state, and local laws pertaining to disposal and documentation of appropriate disposal shall be provided.
  - .2 Replacement and re-charging on a semi-annual basis, or more often if required, of all oil lost through the shaft seal.
  - .3 20 year refrigerant replacement warranty for any loss of refrigerant that can be directly attributable to the failure of the atmospheric shaft seal.
- .4 If the compressor drive motor is an open design the chiller manufacturer shall provide at no additional charge a self contained air conditioning system in the mechanical space sized to handle the maximum heat output the open drive motor. The energy required to operate this air conditioning system shall be added to the chiller power at all rating points for energy evaluation purposes.
- .5 If the compressor drive motor uses any form of antifriction bearings (roller, ball, etc) the chiller manufacturer shall provide the following at no additional charge:
  - .1 A 20 year motor bearing warranty and all preventative maintenance, including lubrication, required to maintain the bearings as specified in the manufacturer's operating and maintenance instructions.
  - .2 At start up a three axis vibration analysis and written report which establishes a baseline of motor bearing condition.
  - .3 An annual three axis vibration analysis and written report to indicate the trend of bearing wear.
- .6 The chiller shall be equipped with an integrated Variable Frequency Drive (VFD) to automatically regulate compressor speed in response to cooling load and the compressor pressure lift requirement. Movable inlet guide vanes and variable compressor speed acting together, shall provide unloading. The chiller controls shall coordinate compressor speed and guide vane position to optimize chiller efficiency.
- .7 Each compressor circuit shall be equipped with a 5% rated line reactor to help protect against incoming power surges and help reduce harmonic distortion.

- .8 The unit shall have a minimum of a 0.90 power factor at compressor full load.

## 2.9 EVAPORATOR AND CONDENSER

- .1 The evaporator and condenser shall be separate vessels of the shell-and-tube type, designed, constructed, tested and stamped according to the requirements of the ASME Code, Section VIII. Regardless of the operating pressure, the refrigerant side of each vessel will bear the ASME stamp indicating compliance with the code and indicating a test pressure of 1.1 times the working pressure, but not less than 690 kPa (100 psig). The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.
- .2 The evaporator shall be flooded type with 0,063 mm (0.025 in) wall copper internally and externally enhanced tubes rolled into carbon steel tubesheets. The water side shall be designed for a minimum of 1,035 kPa (150 psi). The refrigerant side shall be designed for a minimum of 1,380 kPa (200 psi). Provide intermediate tube supports at a maximum of 18 inch spacing. The heads shall be carbon steel and the tubesheets shall be carbon steel. Water connections shall be grooved suitable for Victaulic couplings. The evaporator shall have dished heads with valved drain and vent connections. The evaporator shall have left-hand connections when looking at the unit control panel.
- .3 The condenser shall have 0,063 mm (0.025 in) wall copper internally and externally enhanced tubes rolled into carbon steel. Water connections shall be grooved suitable for Victaulic couplings. The water side shall be designed for a minimum of 1035 kPa (150 psi) and the refrigerant side shall be designed for a minimum of 1 380 kPa (200 psi). Provide intermediate tube supports at a maximum of 457 mm (18 inch) spacing. The condenser shall have dished heads with valved drain and vent connections. The heads shall be carbon steel and the tubesheets shall be carbon steel. The condenser shall have left-hand connections when looking at the unit control panel.
- .4 Provide sufficient isolation valves and condenser volume to hold the full unit refrigerant charge in the condenser at 32.2°C (90°F) in accordance with ANSI ASHRAE 15.A during servicing or provide a storage tank sufficient to hold the charge of the largest unit being furnished.
- .5 An electronic expansion valve shall control refrigerant flow to the evaporator. Fixed orifice devices or float controls with hot gas bypass are not acceptable because of inefficient control at low load conditions. The liquid line shall have moisture indicating sight glass.
- .6 Re-seating type spring loaded pressure relief valves according to ASHRAE-15 safety code shall be furnished. The evaporator shall be provided with single or multiple valves. The condenser shall be provided with dual relief valves equipped with a transfer valve so one relief valve can be removed for testing or replacement without loss of refrigerant or removal of refrigerant from the condenser. Rupture disks are not acceptable. If rupture disks are required on negative pressure units to prevent air and moisture ingress, then factory mounted spring loaded pressure relief valves shall be provided in series with the rupture disks to contain the remaining refrigerant in the event of vessel over-pressurization. The space between the rupture disk and the relief valve shall include a suitable telltale indicator integrated into the chiller control system to alert the operator that a potential safety issue exists in the pressure relief system.
- .7 The evaporator vessel, including water heads, suction line, and any other component or part of a component subject to condensing moisture shall be insulated with UL recognized 20 mm closed cell insulation. All joints and seams shall be carefully sealed to form a vapor barrier.

- .8 Provide factory-mounted and wired, thermal-dispersion water flow switches on each vessel to prevent unit operation with no or low water flow. Paddle and pressure differential type switches are not acceptable due to high rates of failure and false indications from these types of flow indicators.

## 2.10 CONTROL SYSTEM

- .1 The unit shall have a microprocessor-based control system consisting of a 15-inch VGA touch-screen operator interface and a unit controller.
- .2 The touch-screen shall display the unit operating parameters, accept setpoint changes (multi-level password protected) and be capable of resetting faults and alarms. The following parameters shall be displayed on the home screen and also as trend curves on the trend screen:
  - .1 Entering and leaving chilled water temperatures;
  - .2 Entering and leaving condenser water temperatures;
  - .3 Evaporator saturated refrigerant pressure;
  - .4 Condenser saturated refrigerant pressure;
  - .5 Percent of 100% speed (per compressor);
  - .6 % of rated load amps for entire unit.
- .3 In addition to the trended items above, all other important real-time operating parameters shall also be shown on the touch-screen. These items shall be displayed on a chiller graphic showing each component. At a minimum, the following critical areas must be monitored:
  - .1 Compressor actual speed, maximum speed, percent speed;
  - .2 Liquid line temperature;
  - .3 Chilled water setpoint;
  - .4 Compressor and unit state and input and output digital and analog values.
- .4 A fault history shall be displayed using an easy to decipher, color coded set of messages that are date and time stamped. Time interval scale shall be user selectable as 20 mins, 2 hours, or 8 hours. The alarm history shall be downloadable from the unit's USB port. An operating and maintenance manual specific for the unit shall be viewable on the screen.
- .5 All setpoints shall be viewable and changeable (multi-level password protected) on the touch screen and include setpoint description and range of set values.
- .6 Automatic corrective action to reduce unnecessary cycling shall be accomplished through preemptive control of low evaporator or high discharge pressure conditions to keep the unit operating through abnormal transient conditions.
- .7 Chiller plant optimization software for multiple chillers shall be provided including automatic control of: at least two (2) chillers, evaporator and condenser pumps (primary and standby), up to 3 stages of cooling tower fan cycling control and a tower modulating bypass valve or cooling tower fan variable frequency drives.
- .8 The factory mounted controller(s) shall support operation on a BACnet® network via one of the data link / physical layers as specified by the successful Building Automation System (BAS) supplier: BACnet MS/TP master (Clause 9), BACnet IP (Annex J), or BACnet ISO 8802-3 (Ethernet).

- .9 All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.
- .10 The factory supplied VFD and controls should include the following:
  - .1 High short circuit panel rating of 35kA with a matching circuit breaker.
  - .2 Phase loss protection.
  - .3 Under/over voltage protection.
  - .4 Ground Fault Protection to reduce the arcing ground fault damage from line-to-ground fault currents less than those required for conductor protection.
- .11 Energy saving software logic shall at a minimum offer the following:
  - .1 User programmable compressor soft loading.
  - .2 Chilled water reset.
  - .3 Demand limit control.
  - .4 Staging options lead lag between multiple compressors on a single chiller or on multiple chillers.
  - .5 Plotting of historic trends for optimizing efficiency.

## **2.11 ACCESSORIES**

- .1 The following optional items shall be furnished:
  - .1 Provide neoprene waffle-type vibration isolators for each corner of the unit.
  - .2 Pumpout unit, with or without storage vessel.
  - .3 Refrigerant monitor.
  - .4 Harmonic filter(s) to work in conjunction with the line reactor to further minimize harmonic distortion. Filter is to be field installed wired between the line reactor and compressor by others.
  - .5 Standard Factory Run Test.

## **2.12 AHRI/ETL/CETL APPROVALQUALITY ASSURANCE**

- .1 Regulatory Requirements: Comply with the codes and standards in 1.2.
- .2 Chiller manufacturer must be ISO Certified.
- .3 The chiller shall be tested to job conditions at the manufacturer's plant.

## **2.13 DELIVERY AND HANDLING**

- .1 Chiller shall be delivered to the job site completely assembled and charged with refrigerant R134a and be shipped on skids with a weather resistant cover.
- .2 Comply with the manufacturer's instructions for rigging and transporting units. Leave protective covers in place until installation.

**2.14 GUARANTEE**

- .1 The chiller manufacturer's warranty shall cover parts and labor costs for the repair or replacement of defects in material or workmanship, and include refrigerant for the entire unit, for a period of one year from equipment startup or 18 months from shipment, whichever occurs first, and also include an additional extended warranty for four years on the compressor and drive train only. Warranty support shall be provided by company direct or factory authorized service permanently located near the job site.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Provide appropriate protection apparatus.
- .2 Install unit as indicated, to manufacturer's recommendations, and in accordance with EPS1/RA/2 Standard.
- .3 Adjust chiller alignment on foundations, or subbases as called for on drawings.
- .4 Arrange piping to allow for dismantling to permit head removal and tube cleaning.
- .5 Coordinate electrical installation with electrical contractor.
- .6 Coordinate controls with control contractor.
- .7 Provide all material required for a fully operational and functional chiller.
- .8 Ensure adequate clearances for servicing and maintenance.
- .9 Manufacturer to approve installation, to supervise start up and to instruct operators.
  - .1 Include 3 days per unit.

**3.2 PREVENTIVE MAINTENANCE SERVICE (BY MANUFACTURER)**

- .1 General:
  - .1 Chiller preventive maintenance Contractor must offer emergency service at all times (24/7). Contractor must be on chiller installation site within 2 hours after an emergency call has been made.
  - .2 Preventive maintenance includes: cleaning, calibration, lubrication and various mechanical adjustments necessary for proper chiller operation. It also includes all tasks described in this section, all tasks defined in chiller operation and maintenance manual and all other maintenance works required by the latest version of the Mechanical Refrigeration Code CSA-B52.
  - .3 During the contract period, Preventive maintenance Contractor must at least carry out the number of preventive visits indicated in this section, on a regular basis.
  - .4 Preventive maintenance Contractor must make sure all hired chiller (and compressor) maintenance personnel perform tasks with care, diligence and skill and work in close collaboration with PWGSC personnel. Maintenance staff must speak French currently.
  - .5 Preventive maintenance Contractor must contact Departmental Representative in order to plan each visit.

- .6 After each visit, Contractor must submit a written report to Departmental Representative describing work that was performed and relevant recommendations.
- .7 Use a standardised form for visit reports.
- .8 Preventive maintenance work must be performed from Monday to Friday between 7 a.m. and 4 p.m., except for legal holidays.
- .9 Maintenance contract must meet the following requirements:
  - .1 Inspection during operation (at least once a month):
    - .1 Record chiller operation flow, temperature and pressure values and compare values to set points. Correct deviations, if necessary.
    - .2 Verify and record voltage and current of the electric circuits.
    - .3 Adjust chiller control and security devices.
    - .4 Verify operation of all control and interlocking circuits.
    - .5 Verify expansion valve operation.
    - .6 In the presence of operator, check system log and discuss system operation.
  - .2 Annual inspection (must be performed between November 1<sup>st</sup> and March 31<sup>st</sup>):
    - .1 Verify control panel and main starter.
    - .2 Perform tightness test to check refrigerant leaks.
    - .3 Verify continuity of compressor motor windings.
    - .4 Subject compressor motor to grounding test.
    - .5 Verify compressor motor with megohmmetre.
    - .6 Verify operation and low temperature security breakpoints for chilled water and refrigerant, as well as condenser water high temperature.
    - .7 Verify adjustments and operation of security controls against compressor surcharge.
    - .8 Verify motor fuse.
    - .9 Verify evaporator and condenser pressure and temperature.
    - .10 Verify temperature sensors on water and refrigerant side. Recalibrate sensors if necessary.
    - .11 Verify operation of flow switches.
    - .12 Verify operation of expansion valve.
    - .13 Disassemble expansion valve and inspect internal components.
    - .14 Inspect unusual noise and vibrations.
    - .15 Verify indicator lights.
    - .16 Verify microprocessor operation.
    - .17 Verify refrigerant supply controls.

- .18 Amperage reading on compressor motor supports.
- .19 Verify contactor, auxiliary contacts and fuses.
- .20 Verify refrigerant level as well as its condition.
- .21 Communicate instructions regarding new operation procedures to operator.
- .22 Renew logbook.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 01 91 13 - General Commissioning (Cx) Requirements.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM).
  - .1 ASTM A48/A48M-03, Standard Specification for Gray Iron Castings.
  - .2 ASTM A123/A123M-2001, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A153/A153M-04, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .4 ASTM B117-2003, Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - .5 ASTM C67-2003, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
  - .6 ASTM D520-2000, Standard Specification for Zinc Dust Pigment.
- .2 Canadian Standard Association (CSA)/CSA International.
  - .1 CSA B52-1999(C2004), Refrigeration Standard.
- .3 Cooling Technology Institute (CTI).
  - .1 CTI-ATC-105-2000, Acceptance Test Code.
  - .2 CTI-STD-201-2004, Standard for the Certification of Commercial Water Cooling Tower Thermal Performance.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-88 (C2000), Surface Burning Characteristics of Building Materials and Assemblies.
- .6 National Electrical Manufacturers Association (NEMA).
  - .1 NEMA MG 1 2003, Motors and Generators.

**1.3 PERFORMANCE REQUIREMENTS**

- .1 Performance certified in accordance with CTI-STD-201.

## 1.4 SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate:
    - .1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
    - .2 Wiring as assembled and schematically.
    - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
    - .4 Weight and load distribution.
    - .5 Vibration and seismic control measures.
    - .6 Manufacturers recommended clearances.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Test reports:
    - .1 Submit certified test reports for cooling towers from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Include:
    - .1 Description of equipment giving manufacturers name, type, model year, and capacity.
    - .2 Start-up and commissioning procedures.
    - .3 Details of operation, servicing, and maintenance.
    - .4 Recommended spare parts list.

## **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: company or person specializing in cooling towers installations with five-year documented experience.
- .2 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial Regulations.
- .3 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Storage and Protection:
  - .1 Store materials in dry location.
  - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

## **1.7 WASTE MANAGEMENT AND DISPOSAL:**

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management.

## **1.8 MAINTENANCE**

- .1 Furnish spare parts data for each different item of equipment specified, after approval of detail drawings and not later than one month prior to date of occupancy.
- .2 Include with data complete list of parts and supplies, recommended spare parts list for one year of operation, and list of parts recommended by manufacturer to be replaced on routine basis.

## **1.9 PREVENTIVE MAINTENANCE SERVICE**

- .1 Manufacturer's contract price should include a preventive maintenance contract for one year starting on the date of cooling tower commissioning.
- .2 Provide preventive maintenance contract costs for a period of one year starting on the provisional acceptance date. Detailed description of preventive maintenance contract must meet minimum requirements described in this section.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Manufacturers: Subject to compliance with requirements, provide cooling towers manufactured by one of the following:
  - .1 EVAPCO Model UT-19-511.
  - .2 Approved Substitute.

**2.2 THERMAL PERFORMANCE**

- .1 The unit shall have a capacity of 1 318 kW and be capable to cool 47.32 L/s (750.00 GPM) of water entering at 35°C (95.00°F) leaving at 28.33°C (83.00°F) at a design wet bulb of 22.77°C (73.00°F).

**2.3 COOLING TOWER DIMENSIONS**

- .1 The unit shall have the following dimensions: 3,188 x 2,578 x 4,302 mm and have an operating weight of 3,828 kg.

**2.4 IBC COMPLIANCE**

- .1 The unit structure shall be designed, analyzed, and constructed in accordance with the latest edition of International Building Code (IBC) Regulations for seismic loads up to 1.0 g or wind loads up to 60 psf.

**2.5 COMPONENTS**

- .1 Description: Factory assembled and tested, induced draft counter flow cooling tower complete with fan, fill, louvers, accessories and rigging supports.
- .2 Materials of Construction.
  - .1 All cold water basin components including vertical supports, air inlet louver frames and panels up to rigging seam shall be constructed of Type 304 Stainless Steel. "Series 300" Stainless Steel will not be acceptable as equivalent to Type 304 Stainless Steel.
  - .2 Upper Casing, channels and angle supports shall be constructed of heavy gauge mill hot-dip galvanized steel. Fan cowl and guard shall be constructed of galvanized steel. All galvanized steel shall be coated with a minimum of 2.35 ounces of zinc per square foot area (G-235 designation). During fabrication, all galvanized steel panel edges shall be coated with a 95% pure zinc-rich compound.
- .3 Fan(s).
  - .1 Unit shall be provided with SUPER Low Sound Fan(s). Fan(s) shall be high efficiency axial propeller type with non-corrosive Fiber Reinforced Polyester (FRP) hub and blade construction. Fan(s) shall be heavy duty, one-piece molded and utilize a forward swept blade design for superior sound reduction. Each fan shall be statically balanced and installed in a closely fitted fan cowl with venturi air inlet for maximum fan efficiency.

- .4 Drift Eliminators.
  - .1 The eliminators shall be constructed entirely of Polyvinyl Chloride (PVC) in easily handled sections. Design shall incorporate three changes in air direction and limit the water carryover to a maximum of 0.001% of the recirculating water rate.
- .5 Water Distribution System.
  - .1 Spray nozzles shall be precision molded ABS, large orifice spray nozzles utilizing fluidic technology for superior water distribution over the fill media and to minimize water distribution system maintenance. Spray header and branches shall be Schedule 40 Polyvinyl Chloride (PVC) for corrosion resistance with steel connection to attach external piping. Branches shall have threaded end caps to facilitate debris removal.
- .6 Heat Transfer Media.
  - .1 Fill media shall be constructed of Polyvinyl Chloride (PVC) of cross-fluted design and suitable for inlet water temperatures up to 130°F. The bonded block fill shall be bottom supported and suitable as an internal working platform. Fill shall be self-extinguishing, have a flame spread of 5 under A.S.T.M. designation E-84-81a, and shall be resistant to rot, decay and biological attack.
- .7 Air Inlet Louvers.
  - .1 The air inlet louvers shall be constructed from UV inhibited polyvinyl chloride (PVC) and incorporate a framed interlocking design that allows for easy removal of louvers for access to the entire basin area for maintenance. The louvers shall have a minimum of two changes in air direction and shall be of a non-planar design to prevent splash-out, block direct sunlight and debris from entering the basin.
- .8 Electric water level control.
  - .1 The cooling tower will be supplied with an electronic water level control package, designed and manufactured exclusively for Evapco. The system consists of 3 (three) high/low water heavy duty stainless steel electrodes, mounted external to the unit in a vertical stand pipe, wrapped with electric heating cable and insulated to protect it from freezing. A slow operating, normally closed solenoid valve will be supplied with the cooling tower for the make-up water connection for field installation. The valve shall be installed in the chiller room - see the mechanical drawings.
- .9 Pan Strainer.
  - .1 Pan Strainer shall be all type 304 stainless steel construction with large area removable perforated screens.

## 2.6 MOTORS AND DRIVES

- .1 General requirements for motors are specified in Division 23 Section "Motors".
- .2 Fan Motor.
  - .1 Fan motor(s) shall be totally enclosed, ball bearing type electric motor(s) suitable for moist air service. Motor(s) are Premium Efficient, Class F insulated, 1.15 service factor design. Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.
  - .2 Fan motor: one (1), 15 HP at 600 V/3 ph/60 Hz.

- .3 Fan Drive.
  - .1 The fan drive shall be multigroove, solid back V-belt type with taper lock bushings designed for 150% of the motor nameplate horsepower. The belt material shall be neoprene reinforced with polyester cord and specifically designed for evaporative equipment service. Fan sheave shall be aluminum alloy construction. Belt adjustment shall be accomplished from the exterior of the unit.
- .4 Fan Shaft.
  - .1 Shaft shall be Solid, ground and polished steel. Exposed surface coated with rust preventative.
- .5 Fan Shaft Bearings.
  - .1 Fan Shaft Bearings shall be heavy-duty, self-aligning ball type bearings with extended lubrication lines to grease fittings located on access door frame. Bearings shall be designed for a minimum L-10 life of 75,000 hours.
- .6 Vibration Switch.
  - .1 Unit shall be provided with Vibration Cutout Switch, operating on 120 V feed, to protect the fan and drive assembly from damage in the event of excess vibration. Vibration switch shall be DPDT.

## 2.7 MAINTENANCE ACCESS

- .1 Fan Section.
  - .1 Access door shall be hinged and located in the upper casing for fan drive and water distribution system access. Swing away motor cover shall be hinged for motor access.
- .2 Basin Section.
  - .1 Framed removable louver panels shall be on all four sides of the unit for pan and sump access.
- .3 Internal Working Platform.
  - .1 Internal working platform shall provide for easy access to the fans, belts, motor, sheaves, bearings, all mechanical equipment and complete water distribution system. The fill shall be an acceptable means of accessing these components.
- .4 External Service Platform with Ladder.
  - .1 An OSHA approved external service platform shall be provided at the motor access door of the tower extending the full length of the of the access door. Each platform shall have at least a 36" walking surface. The platforms shall be galvanized steel grating, supported by galvanized steel framework attached to the tower and surrounded by a sturdy handrail, knee rail and kick plate system. Mounting channels shall be the same material as the casing section (galvanized or stainless steel). A vertical ladder shall be provided from the base of the unit to the platform.
  - .2 Safety cage(s) shall be provided on all vertical ladder(s) and ship mounted. Safety cage(s) shall begin approximately 7-8 feet above grade.

- .5 Motor Davit with Base.
  - .1 Unit shall be provided with mechanical jib-boom assembly which facilitates in removal of larger fan section components. Davit arm shall be constructed of aluminum and base shall be galvanized steel.
- .6 Sump sweeper piping.
  - .1 Cold water basin fitted with schedule 80 PVC sump sweeper piping complete with high-flow eductor nozzles to facilitate basin cleaning. This system contains one inlet connection and one outlet connection for hook-up for a filtration system.
- .7 Cold water basin heaters.
  - .1 The cold water basin will be furnished with electric heaters to prevent the water from freezing. The heaters are designed to maintain 4.4°C (40°F) water temperature at -17.7°C (0°F) ambient temperature. The electric water heaters are furnished with a thermostat and low water protection device to cycle the heater on when required. All components are enclosed in rugged, weather proof enclosures for outdoor use. Heater control package shall include contactor, transformer and disconnect switch. Required capacity: 1 electric heater 8 kW at 600 V/3 ph/60 Hz.

## 2.8 EVAPORATIVE COOLING WATER TREATMENT SYSTEM

- .1 Work Includes:
  - .1 Furnish all labor, materials, tools, equipment and services for condenser water treatment system as indicated, in accordance with provisions of the contract documents.
  - .2 Completely coordinate with work of all other trades.
  - .3 See Division 1 for General Requirements.
  - .4 Services of manufacturer's representative company to provide automatically controlled water treatment programs and equipment as specified herein.
  - .5 Provide treatment and supervision for the condenser water treatment program, designed to minimize corrosion, scale formation and biological growth in the following mechanical systems:
    - .1 Condenser Water Piping System.
- .2 Description of System.
  - .1 Purification Chamber with shielded cable by equipment manufacturer.
  - .2 Pulse Panel by equipment manufacturer.
  - .3 Conductivity controller and bleed valve as specified below.
- .3 Submittals.
  - .1 Piping diagrams of all factory mounted components (show all field piping required, if any).
  - .2 Conductivity control panel and wiring diagrams (show all field wiring required). Include bill of materials showing model number, manufacturer, physical layout drawings, panel and equipment catalog cuts.
- .4 Operation and maintenance manuals.
  - .1 Include testing procedures for each of the treated systems.

- .5 Laboratory make-up water sample analyses.
  - .1 Submit a copy of the project site make-up water analysis to document the water quality available at the project site. Make-up water test analysis to include at a minimum the analysis of the following compositions of the water:
  - .2 Calcium Hardness (as ppm  $\text{CaCO}_3$ );
  - .3 Total Hardness (as ppm  $\text{CaCO}_3$ );
  - .4 Total Alkalinity or m-Alkalinity (as ppm  $\text{CaCO}_3$ );
  - .5 pH;
  - .6 Silica (as  $\text{SiO}_2$ );
  - .7 Specific Conductivity (micro S/cm);
  - .8 Sulfate (as  $\text{SO}_4$ );
  - .9 Chloride (as  $\text{Cl}^-$ );
  - .10 Phosphate (as  $\text{PO}_4$ ).
- .6 Quality assurance.
  - .1 Obtain water samples from the site and furnish a laboratory analysis of the water. Supply with submittal.
  - .2 Review the make-up water analysis to ensure compatibility with the water treatment program.
  - .3 Propose water treatment methods and appropriate non chemical treatment required to minimize scale, corrosion and biological growth. Submit all of the above with shop drawings and other required submittals.
  - .4 Methods selected shall comply with all the requirements of the American Public Health Association (APHA), the Environmental Protection Agency (EPA) and local environmental agencies.
- .7 Performance criteria.
  - .1 Conductivity range of 300 to 5,000 micro S/cm.
  - .2 pH range of 6.5 to 9.0.
  - .3 Local environmental regulations may dictate the highest pH permitted for blowdown. The conductivity setting can be adjusted up or down to change the pH by the balancing of fresh make-up water.
  - .4 Total bacteria count (TBC) of less than 10,000 CFU's/ml.
  - .5 Keep condenser water system scale free and corrosion to levels acceptable by AWT guidelines.
- .8 Water treatment system acceptable products:
  - .1 Non-Chemical Water Treatment System.
    - .1 Purification chamber.
    - .2 Electrical Pulse Panel.
    - .3 Conductivity controller, motorized bleed valve and torodial probe.



- .2 Furnish a non-chemical Condenser Water Treatment System on the re-circulating water system of the cooling tower. System shall be capable of handling a maximum flow per minute recirculating water. System shall be Pulse~Pure ® by EVAPCO. System shall have a 12 month money back guarantee if the system fails perform as outlined below.
- .9 Electrical Requirements:
  - .1 The system shall have a maximum power draw.
  - .2 The system shall operate on a single 1 Ø input as standard.
  - .3 The system shall have a Total Harmonic Distortion (THD) of less than 15%.
  - .4 The system shall meet UL and cUL specifications for electrical components.
  - .5 The system shall have a shielded cable to minimize susceptibility to external electro-magnetic field interference.
  - .6 The system shall meet FCC requirements for electromagnetic emissions per Title47 CFR part 18 for Industrial, Scientific and Medical Equipment.
  - .7 The coil assemblies shall be enclosed in a NEMA 4 water resistant shell and be provided with indicator lights that signify the system is on and operational.
  - .8 All water sensors for conductivity shall be torodial type and factory mounted.
- .10 Construction Requirements:
  - .1 The Electrical Pulse Panel shall be a NEMA 4 enclosure. Panel shall be factory mounted to unit. The use of cooling fans to remove heat from the electrical pulse panel shall not be acceptable.
  - .2 The system shall have remote start-up and monitoring capabilities via a control relay wired from the pump or through the building management system using a MODBUS protocol.
  - .3 The Chamber shall contain two separate coil sections housing a minimum of four low frequency and two high frequency coils per chamber. Chamber shall be factory mounted by evaporative unit manufacturer.
    - .1 This single control panel per chamber shall have the capability of receiving input from local make-up and bleed water meters and activating a 120 volt contact.
- .11 Testing equipment: Furnish basic water test equipment for maintaining control of program standards in the condenser water systems. Test kits will include the following:
  - .1 Reagents and apparatus for determination of pH, total alkalinity, conductivity, chloride, calcium hardness, and total hardness.
  - .2 Apparatus for determination of microbiological colony population and biocide effectiveness.

## Part 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### **3.2 GENERAL**

- .1 Mount on structural supports and vibration isolators as indicated and to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.

### **3.3 FIELD QUALITY CONTROL**

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

### **3.4 ADJUSTING**

- .1 Lubricate bearings with oil or grease as recommended by manufacturer.
- .2 Tighten belts to manufacturer's specified tension.

### **3.5 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Wipe equipment clean, and remove traces of oil, dust, dirt, or paint spots.
- .3 Maintain system in clean condition until final acceptance.
- .4 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

### **3.6 PREVENTIVE MAINTENANCE SERVICE (PROVIDED BY MANUFACTURER)**

- .1 General:
  - .1 Cooling tower preventive maintenance Contractor must offer emergency service at all times (24/7). Contractor must be on site within 2 hours after an emergency call has been made.
  - .2 Preventive maintenance includes: cleaning, calibration, lubrication and various mechanical adjustments necessary for proper cooling tower operation. It also includes all tasks described in this section and all tasks defined in cooling tower operation and maintenance manual.
  - .3 During the contract period, Preventive maintenance Contractor must at least carry out the number of preventive visits indicated in this section, on a regular basis.

- .4 Preventive maintenance Contractor must make sure all hired cooling tower maintenance personnel perform tasks with care, diligence and skill and work in close collaboration with Departmental Representative. Maintenance staff must speak English currently.
- .5 Preventive maintenance Contractor must contact Departmental Representative in order to plan each visit.
- .6 After each visit, Contractor must submit a written report to Departmental Representative describing work that was performed and relevant recommendations.
- .7 Use a standardised form for visit reports.
- .8 Preventive maintenance work must be performed from Monday to Friday between 7 a.m. and 4 p.m., except for legal holidays.
- .9 Maintenance contract must meet the following requirements:
  - .1 Inspection during operation (at least once a month):
    - .1 Visually check cooling tower operation such as: water distribution, cleanliness of drip tray and basin, leaks, belt condition and vibrations.
    - .2 Verify and adjust belt-tension.
    - .3 Verify float valve operation. Adjust if necessary.
    - .4 Verify and log motor amperage.
    - .5 Lubricate bearing bushes.
    - .6 Report relevant shortfalls to Client.
  - .2 Annual inspection (must be performed between November 1<sup>st</sup> and March 31<sup>st</sup>):
    - .1 Take off protection mesh and doors for inspection.
    - .2 Fill tower. Operate pump and fan. Verify sprinklers. Adjust if necessary.
    - .3 Thoroughly clean tower supply system and basin strainer as well as cold and hot water basins.
    - .4 Perform a detailed inspection of the tower, including the following:
      - .1 Medium condition;
      - .2 Exterior casing (water leaks and corrosion);
      - .3 Access doors (accessories and restraints);
      - .4 Interior structure, medium support, casing and cell dividers;
      - .5 Verify condition of squirrel cage, tightness of lug bolts, shaft anchoring and fan blade angles, if applicable;
      - .6 Verify isolation spring tolerance.
    - .5 Verify belt and pulley alignments. Adjust if necessary.
    - .6 Verify and lubricate all bearings.
    - .7 If tower is equipped with gearbox: check bearings, change oil and check for leaks (when applicable).

- .8 Verify and log motor amperage.
- .9 Report relevant shortfalls to Client.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .7 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .8 Section 23 33 15 - Dampers - Operating.
- .9 Section 23 34 00 - Commercial Fan.

**1.2 REFERENCES**

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA).
  - .1 ANSI/NFPA-90A-2009, Standard for the Installation of Air Conditioning and Ventilating Systems, 2009 Edition.
- .2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE).
  - .1 ANSI/ASHRAE 90.1-2007, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .3 Air Conditioning and Refrigeration Institute (ARI).
- .4 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .5 Master Painters Institute (MPI).
  - .1 MPI-INT 5.3-2007, Galvanized Metal.
- .6 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

**1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Coils operating parameters;

**1.4 CLOSEOUT SUBMITTALS**

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

**1.5 QUALITY ASSURANCE**

- .1 Built-up air handling systems shall be provided by an accredited manufacturer complying with ISO-9001: 2000 Quality Control Program. Control procedures shall be documented to ensure uniform product quality.
- .2 The manufacturer shall have a local representative to provide the required assistance.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site packaging materials and route them to appropriate facilities for recycling.
- .3 Collect and separate paper packaging, plastic, polystyrene and corrugated cardboard and place them in appropriate on-site bins for recycling in accordance with the Waste Management Plan.
- .4 Sort steel scrap, metal and plastic for reuse/recycling and place in designated containers in accordance with the Waste Management Plan.
- .5 Route unused metal parts to a metal recycling facility approved by the Departmental Representative.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and address of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, to be included into operating manual.
- .3 Provide pulleys and belts for the air balancing tests. These equipments shall be provided later at the HVAC unit contractor's request. This equipment shall be included in the submittal price.

**1.8 INSTRUCTIONS FOR HANDLING**

- .1 Provide recommended for air handling unit, storage and installation of units on site.
- .2 Units shall be shipped without damage.
- .3 The units will be cleaned before shipment. All the openings of the units must be sealed with pieces of wood, metal or plastic to prevent the entry of moisture or dirt. The exposed pipe fittings must be protected by a cap or plastic stopper.
- .4 Vibration isolators shall be properly fastened.
- .5 Unpainted machined surfaces should be coated with an anti-rust finish.

**Part 2 Products**

**2.1 UNIT SF-1**

- .1 Modification of the existing unit.
  - .1 As indicated on the drawings.

- .2 Condensate/Drain pans.
  - .1 IAQ style drain pans shall be provided. Drain pans shall be fabricated from 16 gauge stainless steel. All drain connections shall be piped and trapped (in field, by Others) separately for proper drainage. Drain pans shall be sloped at a minimum of 1.5% with a threaded drain pipe connection ending through the side of structural base frame. Drain pipe shall be schedule 40, 32 mm (1 ¼ in) nominal, MPT stainless steel pipe. All drain pan corners shall be welded.
- .3 Coils.
  - .1 Coils - General Information (applicable to hydronic coils): Acceptable coils shall have AHRI Standard 410 certification and bear the AHRI symbol. Coils shall be submerged in water and tested to a minimum dry air/nitrogen pressure of 300 psig standard copper tube coils. Coils shall display a tag with the inspector's identification as proof of testing. Tubes shall have a nominal thickness of 0.5 mm (0.020 in) unless otherwise specified. Fins shall be made of 0.2 mm (0.0075 in) thick aluminum unless otherwise specified. Tubing, return bends, and headers shall be made of seamless UNS 12200 copper meeting ASTM B75 and ASTM B251 Standards. Coil return headers shall be equipped with factory-installed 1.2 in FPT air vent connections placed at the highest point available on the face of the header (except for evaporator coils). Casings and endplates shall be made of 16 gauge galvanized steel, meeting ASTM A527 Standard unless otherwise noted. Double flanged casings on the top and bottom of finned height shall be provided to allow for coil stacking. Piping, control valve and valve operator shall be supplied and installed by others.
  - .2 Hydronic Coils: Hydronic coils shall be designed to withstand 250 psig maximum operating pressure and a maximum water temperature of 149°C (300°F) for standard duty copper tube coils. Standard construction fluid MPT connections shall be made from red brass meeting ASTM B43 Standard or Schedule-40 steel pipe as a minimum. Provide intermediate drain pans on all stacked cooling coils. The intermediate pan shall drain to the main drain pan through a copper downspout.
    - .1 Coil tube caliber: 16 mm (5/8 in).
    - .2 Coil tube wall thickness: 0.5 mm (0.020 in).
    - .3 Fins to be 0.2 mm (0.0075 in) thick aluminum and be mechanically fastened to copper tubes.
- .4 Dampers.
  - .1 Replace all the existing dampers as indicated on the drawings. Dampers shall be designed for operating temperatures between -40°C (-40°F) and 100°C (212°F). Air leakage through a 1,219 mm x 1,219 mm (48 in x 48 in) damper shall not exceed 10.3 cfm/sq. ft. against 4 in. w.g. differential static pressure at standard air condition. Standard air leakage data to be rated in accordance with AMCA certified rating program. Outside air dampers shall be opposed blade motorized and exhaust air dampers shall be of parallel blade gravity backdraft type. For other dampers, see manufacturer's recommendations. Flat or formed metal blades are not acceptable.
  - .2 Damper construction shall be as follows: damper frame shall be of extruded aluminum or galvanized steel; damper blades shall be of extruded aluminum; dampers shall be of opposed blade type or parallel blades where indicated; damper blade ends shall be sealed with neoprene edge seals with bottom and top blade wiper seals.

## **2.2 ACCEPTABLE PRODUCTS**

- .1 Manufacturers specialized in the design and fabrication of the equipments described in this section with a minimum of ten (10) years of documented experience, and with available documentation.
- .2 Acceptable Products: McQuay; York; Venmar; Engineered Air; Trane.

## **Part 3 Execution**

### **3.1 DELIVERY**

- .1 Upon delivery of the equipment, the manufacturer's representative must be on site to inspect the machine before lifting. He must then make a report confirming that the lifting method was consistent with the manufacturer's recommendations. Finally, it must confirm that the unit is in perfect condition once established.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 The manufacturer must doing the start up and commissioning of the equipment it provides. The manufacturer must provide a report certifying that the equipment is operating in according to specifications and indicating the tests performed and test results during commissioning.

### **3.3 INSTALLATION**

- .1 Provide appropriate protection apparatus.
- .2 Fabricate to provide smooth air flow through components.
  - .1 Limit air leakage to 1% of rated air flow at 2.5 kPa suction pressure.
- .3 Apply sealer into seams prior to assembly.
  - .1 Secure toe angles on 300 mm centres for full length of casing.
- .4 Paint inside casing surfaces with zinc coating, mastic, corrosion resistant paint to CAN/CGSB 1.181, 0.075 mm minimum thickness when dry. Prime coat outside surfaces.

### **3.4 DRIP PAN**

- .1 Install deep deal P trap and trap seal primer on drain lines.
  - .1 Depth of water seal to be 1.5 minimum times static pressure at this point.

### **3.5 CLEANING**

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



- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Materials, equipment, components and installation methods associated with fan coils for air handling.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout submittal.
- .4 Section 01 91 13 - General Commissioning (Cx) requirements.
- .5 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .6 Section 23 34 00 - HVAC Fans.
- .7 Section 23 44 00 - HVAC Air Filtration.

**1.3 REFERENCES**

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "National Building Code".
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
  - .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI).
    - .1 AHRI 410, "Standard for forced circulation air heating and air cooling coils".
    - .2 AHRI 430, "Standard for performance rating of central station air handling units supply fans".
  - .2 Air Movement and Control Association (AMCA).
    - .1 AMCA 301, "Methods for calculating fan sound ratings from laboratory test data".
  - .3 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA).
    - .1 ANSI/NFPA-90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .4 American Society for Testing and Materials International (ASTM).
    - .1 ASTM-A653/A653M, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by Hot-Dip Process.
    - .2 ASTM-B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
    - .3 ASTM-C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
    - .4 ASTM-E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

- .5 ASTM-E795, Standard Practices for Mounting Test Specimens during Sound Absorption Tests.
- .5 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA).
  - .1 ANSI/AMCA 201, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- .6 Canadian Standards Association (CSA)/CSA International.
- .7 Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102, Standard Method of Test, surface burning characteristics of building materials and assembly.
- .8 General Standards Board of Canada (CGSB).
  - .1 CGSB-1-GP-181M, zinc-rich coating, organic and prepared.
- .9 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA, HVAC Duct Construction Standards.

#### 1.4 SUBMITTAL

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 The data sheets must include the following:
    - .1 Dimensions, construction details and materials manufacturing equipment and materials required.
- .3 Shop Drawings:
  - .1 The shop drawing must include the following:
    - .1 The construction materials, finishes, method of anchoring, the number of anchors, dimensions, construction details and assembly and equipment accessories.
    - .2 The operation curves of the fans, the operating coils parameters, the filters characteristics, noise levels in octave bands from 63 Hz to 8000 Hz at the inlet and outlet of the device as well as the sound radiating through the box, complete electrical data and drawings of the unit with item descriptions.
- .4 Certificates:
  - .1 Submit signed documents by the manufacturer certifying that the products, materials and equipment meet the requirements as to the physical characteristics and performance criteria.
- .5 Instructions:
  - .1 Submit installation instructions provided by the manufacturer.
- .6 On site inspection by the manufacturer:
  - .1 Submit inspection reports required.

## 1.5 CLOSEOUT SUBMITTALS

- .1 Submit all documents and items to deliver to the end of work and join to "Operations and Maintenance manual" in accordance with Section 01 78 00 - Closeout Submittal.
- .2 Data sheets:
- .3 The data sheets must include the following:
  - .1 A special equipment description, including the manufacturer's name, type, model, year of manufacture and all power, flow or capacity;
  - .2 The relevant details relating to the operation and maintenance of equipment;
  - .3 A list of recommended spare parts.
- .4 Materials / equipment maintenance/replacement:
  - .1 Provide a package of all the special tools required for maintenance of equipment, as recommended by the manufacturers.
    - .1 Provide a commercial grade grease gun and adapters to suit all types of fat and grease fittings used.
    - .2 Provide extension tubes for lubrication when the levels are not readily available.
    - .3 Provide pulleys and belts for the final balancing of air flow during testing. This equipment is provided later at the request of the contractor installing the unit. This equipment must be included in the submission.

## 1.6 DATA RELIABILITY

- .1 Data from catalogs and manufacturers' literature should be reliable, based on results of tests carried out by the manufacturers themselves or on their behalf by independent laboratories, and that allowed to certify the compliance of the requirements of codes and standards.
- .2 The air flows, the external static pressures and water flow rates should be used as selection criteria:
  - .1 Speed front of coils and filters, should be equal to the specified value.
  - .2 Fan Speed: not exceeding the specified value.
  - .3 Water loss pressure: a tolerance of 10% above or below the specified value.
- .3 The dimensions must be respected. The Contractor is responsible for any additional changes (including redevelopment plans) to adapt the devices in the mechanical room.

## 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .2 Remove from site packaging materials and route them to appropriate facilities for recycling.
- .3 Collect and separate paper packaging, plastic, polystyrene and corrugated cardboard and place them in appropriate on-site bins for recycling in accordance with the Waste Management Plan.
- .4 Route unused metal parts to a metal recycling facility approved by the DCC Representative.

- .5 Route paint products or unused coatings to approved collection site of hazardous materials approved by the DCC Representative.
- .6 It is prohibited to discharge coatings, paint products and sealants unused drains in a river, a lake, on the ground or any place where it could pose a risk to health or the environment.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Equipment factory assembled to form an air distribution unit that meets the indicated design criteria.
- .2 The fan coils should be cleaned at the factory before packaging made with a plastic membrane to completely coat each fan coil when delivery.
- .3 At the construction site or elsewhere, store fan coils in a clean space and protected against the weather and the risk associated with the construction site.
- .4 The design and assembly of the boxes must be made to withstand the maximum static pressure that the fan coils can meet at design condition.
- .5 The design and factory assembly of fan coils must be made to obtain the external connections to the fan coil box.
  - .1 All pipe fittings for the coils shall be extended to the outside of the box through flexible neoprene gaskets.
  - .2 Header coils shall be completely located inside the boxes.
  - .3 All connections must be the same side as the access doors, unless otherwise indicated on the plans.
- .6 Doors or access panels must be provided so that you can remove each of the internal mechanical components without compromising the structural integrity of the casing.
- .7 All fan/motor sets must be mounted on a supported base with vibration insulators.

### **2.2 FANS**

- .1 As specified in Section 23 34 00.

### **2.3 CASING**

- .1 Galvanized steel casing of 1.3 mm, coated with baked enamel paint. The interior is covered with sound insulation of 20 mm thick, coated with a protective layer against the microbial elements.
- .2 Acoustic Performance:
  - .1 The acoustical performance of fan coils must be approved by an independent laboratory.
- .3 Access doors: fans section and access sections with doors providing full access.
- .4 Access Panels:
  - .1 When space is limited, access panels must be provided instead of hinged doors. They must be of similar construction to the gates described above.

## 2.4 COILS

- .1 General:
  - .1 Flat corrugated fin coils: tubes with fins attached by mechanical means.
  - .2 All tubes and manifolds in non-ferrous metal: assembly by brazing.
  - .3 Coils tested at the factory, under air pressure and immersed.
- .2 Capacity: as indicated.
- .3 Characteristics: AHRI certified, according to data on the actual temperatures of the fluid at the inlet and outlet of the coil, and as air temperatures involved; shop drawings provided.
- .4 Coils casing:
  - .1 Installation: designed for bolting to other elements.
  - .2 Material: forged steel sheet of 1.6 mm (0.063 in, 16 gauge) thick galvanized.
  - .3 Supports tubes: allowing free expansion and contraction.
  - .4 Supports: "U" steel brackets rack, double angle or approved support.
  - .5 Locking plates: same material as the envelope, to prevent bypass air flow. Seal openings crossing pipes in the envelope as recommended by SMACNA.
- .5 Cold Water Coils with Cleaned Fins:
  - .1 Tubes: Copper, 10 mm or 16 mm.
  - .2 The minimum number of required rows: 4.
  - .3 Maximum number of fins per meter: 394/m (10/in).
  - .4 Fins: flat aluminum, 0.24 mm thick.
  - .5 Collectors: copper.
  - .6 Test pressure: 1.7 MPa (250 lb/in<sup>2</sup>).
  - .7 Operating pressure depending on operating temperature: 1.4 MPa (200 lb/in<sup>2</sup>).

## 2.5 DRIP PANS

- .1 A drip pan must be installed under cooling coils.
- .2 Drip pan in stainless steel with copper drainage fitting at the lower point of NPS ¾ diameter with uniform slope of at least 1%, with no obstacle for complete water elimination.
- .3 The pan must be excess at least 150 mm (6 in) in front the coil face.

## 2.6 FILTERS

- .1 The filters are inserted laterally through a hinged door on aluminum sliding profiles.
- .2 Filters: according to the requirements of Section 23 44 00.
- .3 Provide locking plate to prevent air bypass around the filters.

## **2.7 MOTOR AND ELECTRICAL CONNECTION**

- .1 The motor is silent type including a built-in overload relays and a junction box attached to the frame of the unit, all CSA approved. The motor is connected at the factory to the outside junction box.

## **2.8 ANTIVIBRATION DEVICES**

- .1 Vibration isolators on each assembly fan, in accordance with Section 23 05 48.
- .2 Flexibles connection, in accordance with Section 23 33 00.

## **2.9 ACCEPTABLE PRODUCTS:**

- .1 McQuay, Magic Aire; International Environmental.

## **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.
- .2 The manufacturer must doing the start up and commissioning of the equipment it provides. The manufacturer must provide a report certifying that the equipment is operating in according to specifications and indicating the tests performed and test results during commissioning.

### **3.2 FAN**

- .1 Supply and install the drive pulleys and belts necessary for final air flow balancing.
- .2 The suspension equipment must include four components: a ceiling flange, a superior collar, a inferior collar and an adjustable levelling anti-vibration devices.
- .3 Install flexible connection on fan outlet.
  - .1 Ensure that the fixing metal clamps are parallel and do not touch when the fans are running and when they are arrested.
  - .2 Ensure that the discharge of each fan and duct it is connected are aligned when the fan is running.

### **3.3 CONDENSATE PAN**

- .1 Install high deep "P" Trap with a siphon initiator on drains pipe.
- .2 The guard height must correspond to 1.5 time of static pressure at that location.



**3.4 TESTS**

- .1 Units assembled on site must be tested on site in the presence of Departmental Representative.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 Canada Green Building Council (CaGBC).
  - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum 2007).
  - .2 LEED Canada 2009 for Design and Construction-2010, LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.
  - .3 LEED Canada for Existing Buildings, Operations and Maintenance-2009, LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
- .2 Institute of Boiler and Radiator Manufacturers (IBR).
- .3 US Department of Commerce.
  - .1 CS 140-47, Commercial 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 finned tube radiation heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Indicate on drawings:
    - .1 Equipment, capacity, piping, and connections.
    - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
  - .3 Special enclosures.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**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 finned tube radiation heaters for incorporation into manual.

#### 1.4 DELIVERY, STORAGE AND HANDLING

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

#### Part 2 Products

##### 2.1 CAPACITY

- .1 As indicated, based on 93°C average water temperature, 11°C temperature drop and 18°C at entering air temperature.

##### 2.2 BASEBOARD RADIATION

- .1 Heating elements: 20 mm or 32 mm copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins, one tube end belled.
- .2 Enclosure: minimum 1.0 mm thick steel prefinished surface mounted with 1.0 mm thick back and top of one piece construction. Front panel removable. Run wall to wall unless otherwise indicated. Provide panel corners end caps. Assemble with stainless steel No.10 oval head sheet metal screws. Finish factory applied baked on enamel.
- .3 Element brackets: 1.2 mm thick galvanized steel to support front panel and element cradle. Space brackets 900 mm centres maximum.
- .4 Provide for noiseless expansion of components.

##### 2.3 FINNED TUBE RADIATION

- .1 Heating elements: 20 mm or 32 mm seamless copper tubing, 1.2 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100 x 100 mm nominal, 130 fins per metre suitable for sweat fittings.
- .2 Special enclosures: as indicated.
- .3 Dimensions for enclosures: measure site conditions. Do not scale from drawing.
- .4 Provide for noiseless expansion of components.

#### 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 finned tube radiation convector heater installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative

### 3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout and approved shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .6 Valves:
  - .1 Install valves with stems upright or horizontal unless approved otherwise.
  - .2 Install isolating ball valves on inlet and on outlet of each unit.
- .7 Venting:
  - .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
  - .2 Install automatic air vent on continuous finned tube radiation.
- .8 Clean finned tubes and comb straight.
- .9 Install flexible expansion compensators 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.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 Canada Green Building Council (CaGBC).
  - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum 2007).
  - .2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
  - .3 LEED Canada 2009 for Design and Construction-2010, LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.
  - .4 LEED Canada for Existing Buildings, Operations and Maintenance-2009, LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.

**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 humidifiers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports:
  - .1 Submit manufacturer's 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 humidifiers for incorporation into manual.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.

#### 1.5 DELIVERY, STORAGE AND HANDLING

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

### Part 2 Products

#### 2.1 PACKAGED, STEAM TO STEAM HEAT EXCHANGER HUMIDIFIER

- .1 Free standing, steam to steam heat exchanger humidifiers as shown on Drawings.
- .2 Components housed in factory fabricated UL/CSA listed enclosure cabinet with access panel and factory baked enamelled finish. Vapourizing chamber, cover fittings to be stainless steel with heli-arc welded seams.
- .3 Controls:
  - .1 Solid state panels with automatic fill and level sensing and self diagnosis controls. Numeric display of setpoint, measured humidity, high limit setpoint, air proving. Keypad control for setpoint adjustments.
  - .2 Low water cutoff and skimmer bleed-off functions. Solenoid valve on water, skimmer and drain lines.
  - .3 Return air duct mounted humidistat.
  - .4 Airflow proving switch.
  - .5 Adjustable flush cycle timer, surface skimmer with field adjustable flow control.
- .4 Duct distribution header complete with condensate drain and supply hose.
- .5 Capacity and model: as indicated on the drawings.



**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat as indicated.
- .4 Water service overflow drain: to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.
- .7 Install capped drain connection at low point in duct.

**3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit immediately to Departmental Representative.

- .2 Performance Verification (PV):
  - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
  - .2 Timing:
    - .1 After TAB of ducted air systems.
    - .2 At same time as PV of related air handling units.
  - .3 PV procedures:
    - .1 Steam to steam heat exchanger Humidifiers.
- .3 Start-up:
  - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
  - .2 Verify:
    - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
    - .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
    - .3 Visually check distribution manifold to ensure:
      - .1 Even distribution of vapour.
      - .2 Freedom from water deposits.
- .4 Commissioning Reports:
  - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
    - .1 PV results on approved PV Report Forms.
    - .2 Product Information Report Forms.

### 3.4 DEMONSTRATION

- .1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

### 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.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittal.
- .3 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .4 Section 25 05 01 - EMCS: General Requirements.

**1.2 DEFINITIONS**

- .1 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: Ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: Results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
  - .1 Outage of main power supply in excess of back-up power sources, provided that:
    - .1 Automatic initiation of back-up was accomplished.
    - .2 Automatic shut-down and re-start of components was as specified.
  - .2 Failure of communications link, provided that:
    - .1 Controller automatically and correctly operated in stand-alone mode.
    - .2 Failure was not due to failure of any specified EMCS equipment.
  - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
    - .1 System recorded said fault.
    - .2 Equipment defaulted to fail-safe mode.
    - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

**1.3 DESIGN REQUIREMENTS**

- .1 Confirm with Departmental Representative that Design Criteria and Design Intent are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.

**1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: Submit report to Departmental Representative.
  - .1 Include measurements, final settings and certified test results.

- .2 Bear signature of commissioning technician and supervisor.
- .3 Report format to be approved by the Departmental Representative before commissioning is started.
- .4 Revise "As-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative and to Consultant in accordance with Section 01 78 00 - Closeout Submittals.
- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review by the Engineer before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

#### **1.6 COMMISSIONING**

- .1 Do the system commissioning in accordance with section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .2 Complete commissioning under the supervision of the Departmental Representative and the Commissioning Manager.
- .3 Inform the Departmental Representative in writing, at least 14 days before the start of commissioning or before each test. In order to obtain approval submit the following information:
  - .1 Location and section of the system to be tested.
  - .2 Test procedures and anticipated results.
  - .3 Name of the persons who will perform the tests.
- .4 Correct deficiencies, re-test in until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform the tests in accordance with the requirements.

#### **1.7 COMPLETION OF COMMISSIONING**

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by the Departmental Representative.

#### **1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION**

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Provide sufficient instrumentation to verify and commission the installed system.
- .2 Instrumentation Accuracy Tolerances: Higher order of magnitude than equipment or system being tested.
- .3 An independent laboratory must certify testing materials compliance no more than two months before the tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: To conform to normal industry standards.

**Part 3 Execution**

**3.1 PROCEDURES**

- .1 Test each system independently and then in unison with other related systems.
- .2 Follow the Departmental Representative's start-up procedures for each system.
- .3 Follow the Departmental Representative's start-up procedures for integrated systems.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

**3.2 FIELD QUALITY CONTROL**

- .1 Pre-Installation Testing.
  - .1 General: Consists of field tests of equipment just prior to installation.
  - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
  - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's, including MCU's, LCU's, and TCU's.
  - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
  - .5 Additional instruments to include:
    - .1 DP transmitters.
    - .2 SP transmitters in supply duct - VAV.
    - .3 DP switches used for dirty filter indication.

- .6 Beyond the testing material, the Contractor must also provide the following: inclined tube manometer, digital micromanometer, milliammeter and a pressure gauge with a range of 0 Pa to 500 Pa, which can maintain a constant pressure at any value and with an output to the milliammeter.
- .7 After initial calibration, verify the zero value and the range by 10% increments (by increasing and decreasing values).
- .8 The Departmental Representative must write "Approved for Installation" on instruments having an accuracy of 0.5% or less in both directions.
- .9 Transmitters above 5% error will be rejected.
- .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
  - .1 General: Test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
  - .2 Include following activities:
    - .1 Test and calibrate field hardware including stand-alone capability of each controller.
    - .2 Test all analog-digital converters.
    - .3 Test and calibrate each AI using calibrated digital instruments.
    - .4 Test each DI to ensure proper settings and switching contacts.
    - .5 Test each DO to ensure proper operation and lag time.
    - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
    - .7 Test operating software.
    - .8 Test application software and provide samples of logs and commands.
    - .9 Verify each CDL including energy optimization programs.
    - .10 Debug software.
    - .11 Blow out static pressure stations with high air pressure at 700 kPa.
    - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final start-up testing.
  - .3 Final start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:
    - .1 Two technicians capable of calibrating the equipment and modifying the software on the field.
    - .2 A detailed daily program, indicating the elements to be tested and the available personnel.
    - .3 Acceptance by the Departmental Representative in writing, for every execution and application program.

- .4 Commissioning to commence during final start-up testing.
- .5 O&M personnel to assist in commissioning procedures as part of training.
- .6 Commissioning to be supervised by Departmental Representative.
- .7 Start-up of the security systems before any of the concerned areas are occupied.
- .8 Operate systems as long as necessary to commission entire project.
- .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: To demonstrate that EMCS functions in accordance with contract requirements.
  - .1 Prior to beginning, demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
    - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
  - .2 Test to last at least 30 consecutive 24 hour days.
  - .3 Tests to include:
    - .1 Demonstration of correct operation of monitored and controlled points.
    - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
  - .4 System will be accepted when:
    - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
    - .2 Requirements of Contract have been met.
  - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
  - .6 Correct defects when they occur and before resuming tests.
- .5 The Commissioning Manager must verify the results.

### 3.3 ADJUSTING

- .1 Final adjusting: Upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 05 01 - EMCS: General Requirements.

**1.2 DEFINITIONS**

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
  - .1 List name of trainer, and type of visual and audio aids to be used.
  - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of Phase 1 training program that training has been satisfactorily completed.

**1.4 QUALITY ASSURANCE**

- .1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Departmental Representative reserves right to approve instructors.

**1.5 INSTRUCTIONS**

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

**1.6 TIME FOR INSTRUCTION**

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

**1.7 TRAINING MATERIALS**

- .1 Provide equipment, visual and audio aids, and materials for classroom training.

- .2 Supply manual for each trainee, describing in detail data included in each training program.
  - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

## **1.8 TRAINING PROGRAM**

- .1 Training will be given in two parts over a six month period.
- .2 Two day training program to begin before the 30 day test period at time mutually agreeable to Contractor, Departmental Representative and PWGSC Commissioning Manager.
  - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
  - .2 Supplement with on-the-job training during 30 day test period.
  - .3 Include overview of system architecture, communications and other points touching the modified systems.
  - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

## **1.9 MONITORING OF TRAINING**

- .1 The Departmental Representative will monitor training program and may modify schedule and content.

### **Part 2 Products**

- .1 Not Used.

### **Part 3 Execution**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 25 05 02 - EMCS: Submittals and Review Process.
- .5 Section 25 05 54 - EMCS: Identification.
- .6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).
  - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 Canadian Standards Association (CSA International).
  - .1 CAN/CSA-Z234.1-FM89(C1995), Canadian Metric Practice Guide.
- .4 Consumer Electronics Association (CEA).
  - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .5 Departmental of Canada's Justice (Jus).
  - .1 Canadian Environmental Assessment Act (CEAA), 1997, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .6 Electrical and Electronic Manufacturers Association (EEMAC).
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .7 Health Canada - Workplace Hazardous Materials Informations System (WHMIS).
  - .1 Data Sheet (DS).
- .8 Transport Canada (TC).
  - .1 Transportation of Dangerous Good Act, 1992, c. 34.

**1.3 ACRONYMS AND ABBREVIATIONS**

- .1 Acronyms used in EMCS:
  - .1 AEL - Average Effectiveness Level.
  - .2 AI - Analog Input.

- .3 AIT - Agreement on International Trade.
- .4 AO - Analog Output.
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Center.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.

- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

## 1.4 DEFINITIONS

- .1 Point: May be logical or physical.
  - .1 Logical points: Values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
  - .2 Physical points: Inputs or outputs which have hardware connected to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: Composed of two parts, point identifier and point expansion.
  - .1 Point identifier: Comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25-character field for each point identifier. "System" is system that point is located on.
    - .1 Area descriptor: Building or part of building where point is located.
    - .2 System descriptor: System that point is located on.
    - .3 Point descriptor: Physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
  - .2 Point expansion: Comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32-character fields for each point expansion.
  - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
    - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: Points fall into following object types:
  - .1 AI (analog input).
  - .2 AO (analog output).
  - .3 DI (digital input).
  - .4 DO (digital output).
  - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: To ANSI/ISA S5.5.
  - .1 Printouts: To ANSI/IEEE 260.1.
  - .2 Refer also to Section 25 05 54 - EMCS: Identification.

## 1.5 SYSTEM DESCRIPTION

- .1 Since there is an existing EMCS system on site by Andover and Honeywell, it is required that the new system be supplied, installed, programmed, and commissioned by Andover or Honeywell.
- .2 Refer to control schematics for system architecture.
- .3 The above-mentioned sections aim at the supply and installation of a new system. Include what follows:
  - .1 Building Controllers.
  - .2 Control devices as listed in I/O point summary tables.
  - .3 Workstations.
  - .4 Data communications equipment necessary to effect EMCS data transmission system.
  - .5 Field control devices.
  - .6 Software/Hardware complete with full documentation.
  - .7 Complete operating and maintenance manuals.
  - .8 Training of personnel.
  - .9 Acceptance tests, technical support during commissioning, full documentation.
  - .10 Wiring interface co-ordination of equipment supplied by others.
  - .11 Miscellaneous work as specified in these sections and as indicated.
- .4 Design Requirements:
  - .1 Design and provide conduit and wiring linking elements of system.
  - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
  - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
  - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
  - .5 Metric references: In accordance with CAN/CSA Z234.1.
- .5 Language Operating Requirements:
  - .1 Provide passwords to use the system in English.
  - .2 Use non-linguistic symbols for displays on graphic terminals. Display other information in English.
  - .3 Operating system executive: Provide primary hardware-to-software interface.
  - .4 System manager software: System definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

- .5 Software has to include, in English:
  - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
  - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points.
  - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

## 1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Submit for Review:
  - .1 Equipment list and systems manufacturers within 48 hours after award of contract.
- .3 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process Label or listing of specified organization is acceptable evidence.
  - .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
  - .5 For materials whose compliance with organizational standards/ codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
  - .6 Permits and fees: In accordance with general conditions of contract.
  - .7 Submit an acceptance certificate provided by the competent authority to the Departmental Representative.
  - .8 Existing devices intended for re-use: Submit test report.

## 1.7 QUALITY ASSURANCE

- .1 Have local office within 50 km of project, staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems.
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7-year guarantee of availability of spare parts after obsolescence.

- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety:
  - .1 Apply pertinent safety rules in accordance to Section 01 35 29.06 - Health and Safety Requirements.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Material Delivery Schedule: Provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Waste Disposal and Management:
  - .1 Sort out wastes for re-use or recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Evacuate all wrapping material off the job site to the appropriate recycling facilities.
  - .3 Place wrapping material made of paper, plastic, polyester and corrugated cardboard in appropriate bins located on site for recycling, in accordance with the wastes management plan.
  - .4 Sort out the steel and plastic waste for re-use and drop them in designated bins, in accordance with the wastes management plan.
  - .5 Drop in designated bins the elements corresponding to the definition of hazardous and toxic wastes.
  - .6 Manipulate and dispose of the hazardous wastes in accordance with the municipality regulations.
  - .7 Identify the storing location for the salvaged material and protect it with a fence and a security system.
  - .8 Make sure that empty containers are sealed and safely stored.
  - .9 Bring the unused metallic elements to a recycling facility approved by the Engineer.
  - .10 Fold metal and plastics straps, flatten and place them in the designated area for recycling.

## **1.9 EXISTING CONTROL/REGULATION ELEMENTS**

- .1 As indicated, use existing controls conduits.
- .2 Reusable controls elements can be reused if they comply to the codes, the standards and the prescriptions that apply.
  - .1 It is forbidden to modify the initial design of an existing element without having a written approval from the Departmental Representative.
  - .2 If there is doubt about an element's reusability, provide new elements with the appropriate design criteria to this project.
- .3 The existing elements to be reused must be inspected within 30 days of contract award, but before the installation of new devices.
  - .1 Provide, within 40 days of contract award, the test reports listing each reused device, while indicating if it meets requirements or needs to be repaired. In the latter case, the Departmental Representative will take action on it.



- .2 If the Contractor fails to provide test reports, it is assumed that the Contractor accepts the existing devices.
- .4 Defective Elements:
  - .1 Provide, with the test reports, specifications or functional requirements that back the results.
  - .2 The Departmental Representative will request the repair or the replacement of the defective existing elements.
- .5 Before starting Work, submit in writing an authorization request to power down the control elements and put the material out of service.
- .6 The Contractor's responsibility concerning the control elements that must be integrated to the EMCS, starts after receiving the authorization from the Departmental Representative.
  - .1 The Contractor is responsible for the repaired elements requested by the Departmental Representative.
  - .2 The Contractor is responsible for extra repair costs due to negligence or abusive material usage.
  - .3 The Contractor's responsibility concerning existing control elements ends at the moment where the complete EMCS including all modified systems have been received with entire satisfaction from the Departmental Representative.
  - .4 Collect the existing control elements that will not be reused. Store them in an approved storage area, in order to dispose of them following the Owner's instructions.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Control Network Protocol and Data Communication Protocol: To CEA 709.1 and ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

### **2.2 ADAPTORS**

- .1 Provide adaptors between metric and imperial components.

### **2.3 ACCEPTABLE SYSTEMS**

- .1 For reasons of compatibility with the existing EMCS, the system will be provided, installed, wired, programmed, and commissioned by Andover or Honeywell.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: To manufacturer's recommendations.

### 3.2 PAINTING

- .1 Perform painting in accordance with the following requirements:
  - .1 Clean and retouch the surfaces that were scratched so that they have the same original finish.
  - .2 Where retouches are not sufficient, a complete reconditioning (primer coat and finishing coat) of the damaged surfaces is required.
  - .3 Clean and use a primer coating on visible elements like supports, equipment frames and any other fixing devices.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 05 01 - EMCS: General Requirements.
- .3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

**1.2 DEFINITIONS**

- .1 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements.

**1.3 DESIGN REQUIREMENTS**

- .1 Preliminary Design Review: To contain following Contractor and systems information.
  - .1 Location of local Contractor office.
  - .2 Description and location of installing and servicing technical staff.
  - .3 Location and qualifications of programming design and programming support staff.
  - .4 List of spare parts.
  - .5 Location of spare parts stock.
  - .6 Names of sub-contractors and site-specific key personnel.
  - .7 Sketch of site-specific system architecture.
  - .8 Specification sheets for each item, including memory provided, programming language, speed, type of data transmission.
  - .9 Descriptive brochures.
  - .10 Sample CDL and graphics (systems schematics).
  - .11 Response time for each type of command and report.
  - .12 Item-by-item statement of compliance.
  - .13 Proof of demonstrated ability of system to communicate utilizing BACnet.

**1.4 PRELIMINARY SHOP DRAWING REVIEW**

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
  - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
  - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
  - .3 Spare point capacity of each controller by number and type.

- .4 Controller locations.
- .5 Auxiliary control cabinet locations.
- .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
- .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
- .8 Dampers: Sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
- .9 Flow measuring stations: Complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model, and range of velocity transmitter.

## 1.5 DETAIL SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 30 working days after award of contract and before start of installation, and include following:
  - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  - .2 Wiring diagrams.
  - .3 Piping diagrams and hook-ups.
  - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
  - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    - .1 Sensing element type and location.
    - .2 Transmitter type and range.
    - .3 Associated field wiring schematics, schedules and terminations.
    - .4 The schematics and nomenclature for pneumatic material.
    - .5 Complete Point Name Lists.
    - .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
    - .7 Software and programming details associated with each point.
    - .8 Manufacturer's recommended installation instructions and procedures.
    - .9 Input and output signal levels and pressures where new system ties into existing control equipment.
  - .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
  - .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plan as specified.

- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .16 Provide and submit a complete control device network schematic showing links between the systems.
- .17 Provide and submit a 30-day report with graphic schematics showing trends.
- .18 System sequence descriptions and a list of materials.

#### 1.6 QUALITY ASSURANCE

- .1 Preliminary design review meeting: No later than 45 days before contract being awarded, summon a meeting in order to:
  - .1 Verify the preliminary design documents and resolve any issues.
  - .2 Resolve the differences between the requirements in the contract document and real item characteristics (example: Irregularities in the points list).
  - .3 Review the material interface requirements provided by others.
  - .4 Review the sequence of operation.
- .2 The Contractor's programmer must be present at this meeting.
- .3 The Departmental Representative has the right to review the sequence of operation and control logic before completion of programming, without any extra cost to the Departmental Representative.

#### Part 2 Products

- .1 Not Used.

#### Part 3 Execution

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .3 Section 25 05 01 - EMCS: General Requirements.
- .4 Section 25 05 02 - EMCS: Submittals and Review Process.

**1.2 DEFINITIONS**

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements. OWS - Operator Work Station.

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit Record Documents, "As-built" drawings, Operation and Maintenance Manual to Departmental Representative in English.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
  - .1 Binders to be  $\frac{2}{3}$  maximum full.
  - .2 Provide index to full volume in each binder.
  - .3 Identify contents of each manual on cover and spine.
  - .4 Provide Table of Contents in each manual.
  - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

**1.4 RECORD DOCUMENTS**

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
  - .1 Changes to contract documents as well as addenda and contract extras.
  - .2 Changes to interface wiring.
  - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
  - .4 Locations of obscure devices to be indicated on drawings.
  - .5 Listing of alarm messages.
  - .6 Panel/circuit breaker number for sources of normal/emergency power.
  - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.

- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 hard and 1 soft copy incorporating changes made during final review.

## 1.5 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests.
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.
  - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
  - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
  - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
  - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
  - .2 Operation of computer peripherals, input and output formats.
  - .3 Emergency, alarm and failure recovery.
  - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
  - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
  - .2 Detailed descriptions of program requirements and capabilities.



- .3 Data necessary to permit modification, relocation, reprogramming and to permit software modules to respond to changing system functional requirements without disrupting normal operation.
- .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device.
- .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
- .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: Document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller, and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System Configuration Document:
  - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
  - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with EMCS, including interfacing schematics, signal identification, timing diagrams, and fully commented source listing of applicable driver/handler.

**Part 2 Products**

- .1 Not Used.

**Part 3 Execution**

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 05 01 - EMCS: General Requirements.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19<sup>th</sup> Edition), Safety Standard for Electrical Installations.

**1.3 DEFINITIONS**

- .1 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements.

**1.4 SYSTEM DESCRIPTION**

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

**1.5 SUBMITTALS**

- .1 Submit required documents and samples specified in section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

**Part 2 Products**

**2.1 NAMEPLATES FOR TABLES**

- .1 Identify by Plastic laminate, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: Minimum 5 mm high, black.
- .4 Inscriptions: Machine engraved to identify function.

**2.2 NAMEPLATES FOR FIELD DEVICES**

- .1 Identify by plastic encased cards attached by chain plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: Minimum 5 mm high produced from laser printer in black.
- .4 Data to include: Point name and point address.
- .5 Companion Cabinet: Identify interior components using plastic enclosed cards with point name and point address.

### **2.3 NAMEPLATES FOR ROOM SENSORS**

- .1 Identify by stick-on labels using point identifier.
- .2 Location: As directed by Departmental Representative.
- .3 Letter Size: Minimum 5 mm high.

### **2.4 WARNING SIGNS**

- .1 Equipment including motors, starters under remote automatic control: Supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative.

### **2.5 WIRING IDENTIFICATION**

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets, and outlet boxes.
- .2 Colour Coding: To CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power Wiring: Identify circuit breaker panel/circuit breaker number inside each EMCS panel.

### **2.6 CONDUIT IDENTIFICATION**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings. Paint conduits every 2 metres if joints or box covers are not pre-painted.
- .3 Coding: Use fluorescent orange paint or 25 mm width tape and confirm colour with Departmental Representative during "Preliminary Design Review".

## **Part 3 Execution**

### **3.1 NAMEPLATES AND LABELS**

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

### **3.2 EXISTING PANELS**

- .1 Correct existing nameplates and legends to reflect changes made on system.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .3 Section 25 05 54 - EMCS: Identification.
- .4 Section 25 08 20 - EMCS: Warranty and Maintenance.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C2, National Electrical Safety Code.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 American National Standards Institute (ANSI)/National Fire Protection Association (NFPA).
  - .1 ANSI/NFPA 70, National Electrical Code.
- .4 Canadian Standards Association (CSA)/CSA International.
  - .1 CSA C22.1, Canadian Electrical Code, Part 1.
  - .2 CSA C22.2, Canadian Electrical Code, Part 2.
  - .3 CAN/CSA C22.3 No. 1, Networks.
  - .4 CAN/CSA C22.3 No. 7, Underground Networks.
  - .5 CSA 22.2 No. 45, Rigid Steel Conduits.

**1.3 SYSTEM DESCRIPTION**

- .1 Electrical:
  - .1 Provide power wiring from emergency panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
  - .2 Hard wiring between field control devices and EMCS field panels.
  - .3 Communication wiring between EMCS field panels and OWS, including main control centre.
  - .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .5 Refer to wiring diagrams included as part of flow diagrams. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by Departmental Representative before commencing Work.

- .2 Mechanical:
  - .1 Pipe taps required for EMCS equipment will be supplied and installed according to the applicable sections.
  - .2 Wells and control valves shall be supplied by EMCS contractor and installed according to the applicable sections.
  - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be installed according to the applicable sections.
- .3 Structural:
  - .1 Special steelwork as required for installation of Work.

#### **1.4 PERSONNEL QUALIFICATIONS**

- .1 Qualified supervisory personnel to:
  - .1 Continuously direct and monitor all work.
  - .2 Attend site meetings.

#### **1.5 EXISTING CONDITIONS**

- .1 Repair all surfaces damaged during execution of Work.
- .2 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

### **Part 2 Products**

#### **2.1 SPECIAL SUPPORTS**

- .1 Structural grade steel, primed and painted after construction, and before installation.

#### **2.2 WIRING**

- .1 As per requirements of Division 26.
- .2 For 70 V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600 V. Colour code to CSA 22.1.
- .3 For wiring under 70 V use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
  - .1 120V Power supply: To match or exceed breaker, size #12 minimum.
  - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
  - .3 Field wiring to digital device: At least 20AWG stranded twisted pair.
  - .4 Analog input and output: Shielded #20 minimum stranded twisted pair. Wiring must be continuous without joints.

- .5 Terminations:
  - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

## **2.3 CONDUIT**

- .1 As per requirements of Division 26.
- .2 Conduits must have a minimum of 20 mm (0.79 in) diameter.
- .3 Electrical metallic tubing to CSA C22.2 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 56. Rigid steel threaded conduit to CSA C22.2 45.
- .4 Junction and Pull Boxes: Welded steel.
  - .1 Surface mounting cast FS: Screw-on flat covers.
  - .2 Flush mounting: Covers with 25 mm minimum extension all round.
- .5 Cabinets: Sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .6 Outlet boxes: 100 mm minimum, square.
- .7 Conduit Boxes, Fittings:
  - .1 Bushings and connectors: With nylon insulated throats.
  - .2 With push pennies to prevent entry of foreign materials.
- .8 Fittings for Rigid Conduit:
  - .1 Couplings and fittings: Threaded type steel.
  - .2 Double locknuts and insulated bushings: Use on sheet metal boxes.
  - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .9 Fittings for Thin Wall Conduit:
  - .1 Connectors and couplings: Steel, set screw type.

## **2.4 WIRING DEVICES, COVER PLATES**

- .1 Conform to CSA.
- .2 Receptacles:
  - .1 Duplex: CSA type 5-15R.
  - .2 Single: CSA type 5-15R.
  - .3 Cover plates and blank plates: Finish to match other plates in area.

## **2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT**

- .1 Solid Masonry, Tile, and Plastic Surfaces: Lead anchors or nylon shields.
  - .1 Hollow masonry walls, suspended drywall ceilings: Toggle bolts.

- .2 Exposed Conduits or Cables:
  - .1 50 mm diameter and smaller: One-hole steel straps.
  - .2 Larger than 50 mm diameter: Two-hole steel straps.
- .3 Suspended Support Systems:
  - .1 Individual cable or conduit runs: Support with 6 mm diameter threaded rods and support clips.
  - .2 Two or more suspended cables or conduits: Support channels supported by 6 mm diameter threaded rod hangers.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Conduits for wiring.
  - .1 All wiring must be installed in EMT conduits.
  - .2 Use rigid conduits and weatherproof joints for conduits installed outside the building.

#### **3.2 SUPPORTS**

- .1 Install special supports as required and as indicated.

#### **3.3 ELECTRICAL GENERAL**

- .1 Do complete installation in accordance with requirements of:
  - .1 Division 26 and this specification.
  - .2 CSA 22.1 Canadian Electrical Code.
  - .3 ANSI/NFPA 70.
  - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA C22.3 No. 7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling, and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1,000 and 2,000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, and outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: Flash and make weatherproof.



- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, and outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

### 3.4 CONDUIT SYSTEM

- .1 Install telecommunication cables in conduits.
- .2 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to EMCS. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .3 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .4 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .5 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .6 Bend conduit so that diameter is reduced by less than 1/10<sup>th</sup> original diameter.
- .7 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .8 Limit conduit length between pull boxes to less than 30 m.
- .9 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .10 Use flexible conduits to make the transition between control elements and the EMT conduits. Flexible conduits must not exceed 500 mm in length (20 in.).
- .11 Fastenings and supports for conduits, cables, and equipment:
  - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
  - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
  - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.
- .12 Install polypropylene fish cord in empty conduits for future use.
- .13 Where conduits become blocked, remove and replace blocked sections.
- .14 Pass conduits through structural members only after receipt of Departmental Representative written approval.
- .15 Conduits may be run in flanged portion of structural steel.
- .16 Group conduits wherever possible on suspended or surface channels.
- .17 Pull Boxes:
  - .1 Install in inconspicuous, but accessible locations.
  - .2 Support boxes independently of connecting conduits.

- .3 Fill boxes with paper or foam to prevent entry of construction material.
- .4 Provide correct size of openings. Reducing washers not permitted.
- .5 Mark location of pull boxes on record drawings.
- .6 Identify AC power junction boxes, by panel and circuit breaker.
- .18 Install terminal blocks or strips indicated in cabinets to Division 26.
- .19 Install bonding conductor for 120 V and above in conduit.

### 3.5 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
  - .1 Circuits are continuous, free from shorts, unspecified grounds.
  - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

### 3.6 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
  - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover Plates:
  - .1 Install suitable common cover plate where wiring devices are grouped.
  - .2 Use flush type cover plates only on flush type outlet boxes.

### 3.7 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors, and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.

- .4 Tests: Perform ground continuity and resistance tests, using approved method appropriate to site conditions.

### 3.8 TESTS

- .1 Perform following tests in addition to tests specified Section 25 08 20.
  - .1 Preliminary tests:
    - .1 Conduct as directed to verify compliance with specified requirements.
    - .2 Make needed changes, adjustments, and replacements.
    - .3 Insulation resistance tests:
      - .1 Measure all circuits, feeders, equipment for 120 - 600 V with 1,000 V instrument. Resistance to ground to be more than required by Code before energizing.
      - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.
  - .2 Give 14 days written notice of intention to test.
  - .3 Conduct in presence of Departmental Representative and authority having jurisdiction.
  - .4 Conceal work only after tests satisfactorily completed.
  - .5 Report results of tests to Departmental Representative in writing.

### END OF SECTION



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 25 05 01 - EMCS: General Requirements.

**1.2 REFERENCES**

- .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
- .2 Canadian Standards Association (CSA International).
  - .1 CSA Z204-F94(C1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

**1.3 DEFINITIONS**

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements.

**1.4 SUBMITTALS**

- .1 In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
  - .1 Point name and location.
  - .2 Device type and range.
  - .3 Measured value.
  - .4 System displayed value.
  - .5 Calibration detail.
  - .6 Indication if adjustment required.
  - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Maintain records and logs of each maintenance task on site.
  - .2 Organize cumulative records for each major component and for entire EMCS chronologically.

- .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments, and modifications to EMCS made during warranty period.

#### **1.5 MAINTENANCE SERVICE DURING WARRANTY PERIOD**

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
  - .1 Initiate service calls when EMCS is not functioning correctly.
  - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
  - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
  - .4 Service personnel to be ready on site to service EMCS within 2 hours after receiving request for service.
  - .5 Perform work continuously until EMCS is restored to reliable operating condition.
- .3 Operation: Foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work Requests: Record each service call request, when received separately on approved form and include:
  - .1 Serial number identifying component involved.
  - .2 Location, date, and time call received.
  - .3 Nature of trouble.
  - .4 Names of personnel assigned.
  - .5 Instructions of work to be done.
  - .6 Amount and nature of materials used.
  - .7 Time and date work started.
  - .8 Time and date of completion.
- .5 Provide system modifications in writing.
  - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

#### **1.6 MAINTENANCE CONTRACT**

- .1 Provide complete technical support and expertise to the Departmental Representative and the Commissioning Manager in order to help prepare and implement the maintenance and preventative maintenance contracts.

- .2 Maintenance contracts must include:
  - .1 Annual control points verification, on the field, in order to verify their functionality and calibration.
  - .2 Annual visits.
  - .3 Emergency visits during occupied hours, per year.
  - .4 Emergency visits during unoccupied hours, per year.
  - .5 Complete inventory of installed system.

**Part 2 Products**

- .1 Not Used.

**Part 3 Execution**

**3.1 ON FIELD QUALITY CONTROL**

- .1 Perform at least three minor and one major inspection (or more if the manufacturer requires so) per year. Provide a detailed report to the Departmental Representative for each inspection.
- .2 Perform the inspections during normal office hours, between 8:00 am and 4:30 pm, from Monday to Friday, except on holidays.
- .3 The following inspections are minimum requirements and their results should not be considered as a satisfactory operating state.
  - .1 All calibrations must be completed with testing equipment that is certified to be at least 50% more accurate than the values used by the system.
  - .2 Verify and calibrate every input/output on the field in accordance with Canada Labour Code, Part 1 and CSA Z204 Standards.
  - .3 Provide a dated maintenance tasks list in accordance with the Submittal Procedure articles.
- .4 Minor inspections must include, but are not limited to the following:
  - .1 Visual and operation control of the building controllers, hardware, interface panel and other panels.
  - .2 If needed, fan verification and replacement of filters and controls.
  - .3 Visual inspections to spot flaws and air leakage; make sure that the pressure and pneumatic elements are correct.
  - .4 Review the system performance with the Departmental Representative to discuss the changes required.
- .5 Major inspections must include, but are not limited to the following:
  - .1 Minor inspections.
  - .2 Work station peripheral equipment cleaning, building controllers, controller interfaces and other panels, otter, and inner microprocessor faces.
  - .3 Signal verification, voltage and system insulation, buildings controllers, hardware, interfaces, and other panels.

- .4 Verify the calibration of every input/output element and recalibrate or replace them if necessary.
- .5 Mechanical adjustment and printer maintenance.
- .6 Diagnostic tests of the system software, if needed.
- .7 Software installation and update to make sure every component works on the latest version.
  - .1 Perform network analysis and provide a report in accordance with the Submittals Procedure section.
- .6 Correct the flaws found during the maintenance inspections and ambient controls.
- .7 Continue flaws corrections and system optimization.
- .8 The testing of systems that are affected by normal occupation and seasonal variations must be done during four consecutive seasons, after the job site has been received, transferred and occupied.
  - .1 Systems that are affected by the climate must be submitted to two tests: During winter and summer conditions when Work is almost completed.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 25 05 01 - EMCS: General Requirements.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
  - .2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements.
  - .1 IEEE Std 802.3<sup>TM</sup>-2002, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Access Method and Physical Layer Specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA).
  - .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 - General Requirements, Part 2 - Balanced Twisted-Pair Cabling Components, Part 3 - Optical Fiber Cabling Components Standard.
  - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
  - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

**1.3 DEFINITIONS**

- .1 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS - General Requirements.

**1.4 SYSTEM DESCRIPTION**

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529.
  - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
  - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
  - .1 EMCS-LAN.
  - .2 Network interface cards.
  - .3 Network management hardware and software.

- .4 Network components necessary for complete network.

## **1.5 DESIGN REQUIREMENTS**

- .1 EMCS Local Area Network (EMCS-LAN).
  - .1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
  - .2 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .3 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
  - .4 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
  - .5 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
  - .6 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
  - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
  - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
  - .1 Network medium: Shielded twisted cable compatible with network protocol to be used within buildings.

## **Part 2 Products**

- .1 Not Used.

## **Part 3 Execution**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 DESCRIPTION OF EXISTING EMCS**

- .1 Existing EMCS is an interface between users and the network of digital controllers of the system.
- .2 The existing EMCS consists of:
  - .1 A central control and management station located in the heating plant.
  - .2 Material and/or programs for communication via an Ethernet network.

**1.2 DESCRIPTION OF NEW MANAGEMENT AND CONTROL STATION**

- .1 General:
  - .1 One new secondary OWS to be located in the new building.
  - .2 The OWS to be connected to the central management and control system and all new points to be integrated and configured.
  - .3 This existing central station includes:
    - .1 A personal computer.
    - .2 An LCD monitor.
    - .3 Laser printer.
    - .4 Printer (digital LA-120).
  - .4 The communication link between the main central operation station and the secondary stations shall be Ethernet using BACNet, TCP/IP Protocol.
  - .5 All necessary components and accessories, such as Hub, programs, etc., to make installation functional are to be supplied and installed by this Contractor.

**1.3 DESCRIPTION OF OWS**

- .1 Portable OWS to be used as remote dial-up OWS with same capabilities as primary and secondary OWS including graphic display. Portable unit to be IBM compatible personal laptop computer, with the following as minimum:
  - .1 Intel 17-640 M, 1066 MHz bus.
  - .2 4 GB DDR3 ram, 1033 MHz.
  - .3 Antememory (hide) 4 MB, Type L2.
  - .4 Graphic card Nvidia Quatro FX880M, 1 GB memory.
  - .5 DVD ± RW double layed disc drive.
  - .6 Hard disk drive, 320 GB SATA 2, 7,200 rpm.
  - .7 Express card slot and SD memory slot.
  - .8 Windows 7 Pro.
  - .9 Enhanced 101-key keyboard.
  - .10 Touch screen, scroll zone, and two selection keys.

- .11 USB optical mouse.
- .12 15.6" color screen LED-HD, 1600 x 900 resolution.
- .13 8 cells LI-ON battery 73 WHr, c/w adaptor for rapid charge at 120 VAC.
- .14 Ethernet LAN adapter to connect to local Ethernet Network, 10/100/1,000 Mbps.
- .15 Wireless network 802.11 a/b/g/n.
- .16 Bluetooth 2.0.
- .17 Fan modem V90/V92, 56 KB/s.
- .18 Protective case with serviceable carrying straps.
- .19 3-year warranty.
- .20 Model Elite Book, No. 8740 of Hewlett Packard, Compaq or equal as approved by the Departmental Representative.

#### **1.4 OPERATION IN BACK-UP MODE**

- .1 Failure of the main OWS:
  - .1 The DDC system shall be able to operate normally in case of failure of the main central OWS (Autonomous Digital Controllers).
  - .2 The operator by means of a secondary OWS shall be able to perform all the operations usually dedicated to the main OWS, operator being privileged.

#### **1.5 SOFTWARE**

- .1 General:
  - .1 Each digital controller to be programmed to suit local DDC loops and also have the capacity to receive future and current programs. Software programs implemented in controllers so as to be fully operational in the back-up mode. OWS to read and apply normal operating control programming and also operation in back-up mode.
  - .2 Central control and management station shall print an hourly report confirming good operation of systems and peripherals. Normal operation of a system to be printed and has to be considered as a non-response to an interrogation. Start and stop program including hourly schedules, events programs, optimum starts, utilization cycles and unloading shall be treated in a priority basis. Priorities could be entered in the process by means of the keyboard of the station. Terminal shall permit the operation to establish required sequences and priorities.
  - .3 The time schedules on sensible use of energy shall not start or stop equipment which has been started or stopped by fire protection systems.
  - .4 All input and output values to the central station shall be decimal; operation does not have to be familiar with binary octal arithmetic's, binary code decimals and will not have to refer to reference tables.

- .5 System shall include a direct treatment central file generator program capable of introducing all what is necessary in the database, dedicate application programs, points and group of data, add, delete or modify data points, affect alarm parameters and peripheral programs. All assignments to be made by means of terminal keyboard. Systems requiring remote or manufacturer's programming are not acceptable. All programs supplied in this document and intended to be entered shall be typed on the keyboard and be read in the screen. Modification made to a program or set of application programs also the addition or removal of points shall not affect the treatment of data. Alarms to be displayed and control programs executed during data entry.
- .6 Operator has to have access to the system through a personal ID code and a password. Each operator has to be given on ID code to 16 characters long, alphanumerical. Operators have to be allowed to change their own password provided that the other password does not correspond to somebody else's password. System shall have to be quit manually from a pull-down menu of if the mouse or keyboard has not been in use for a given period of time, it shout take place automatically. Can least 0 to 100 minutes for eau operator or can be put off by operator. All operators to have right of access at their lever cup.
- .2 Alarms Treatment:
  - .1 Point alarms to be clarified as critical or non-critical.
  - .2 Critical alarms shall be displayed in a dialog box in color on the screen. Display to show at least: Hour and date the alarm condition happened, indicate the alarm state. Furthermore, critical alarms to be sent to the EMCS management system.
  - .3 Alarms have to be directed to alarm printer selected by user (segregation of alarms).
  - .4 A button to be provided to quiet down alarm. Virtual button to be located in dialog box. Quiet down can also be made by on authorized operator.
  - .5 The non-critical alarms to be directed to the printer and the hard disk of the central OWS in chronological order.
  - .6 The system to display on the color screen all unreleased alarms in order to warn the operator of such situations.
  - .7 A discrete message indicating the measures to be taken for each point identifiable by the operator, of at least 480 characters, from a dialog box.
- .3 Printing of Trend Data:
  - .1 Physical trend reports shall include up to 8 points selected by user and indicate the activity in real time of associated points. These information's to be printed in numerical form, bar diagrams, curves, pie charts, etc., as selected by operator. Graphic shall permit use of a different color for each point. As the values of new points are sampled, they have to be treated, and dynamically added to the graphic being built. Sampling interval to be adjustable from 5 seconds to 60 minutes.
  - .2 Standard reports are printed as the management printer. An intercept order can be given by the operator to stop printing.

- .3 User to be able to give a command that will archive the value of each point designated. The archived reference marks shall include the stat of the point, the key-name of the point and also the date and hour of the state change. The reports regarding reference marks for commands shall be printed as required by operator.
- .4 Provide capability of producing personalized reports so that user can make original report formats including test, point identification and values. Personalized reports can be started by a programmed schedule as manually upon request.
- .4 History Survey:
  - .1 Menu on the upper part of the screen permits to choose historic reports generated by archived data collected, such as:
    - .1 Alarm historic: Alarms are archived on hard disks data display or printing can be limited to critical alarms only. Data on archived alarms shall include the jour, the date, name of the point, type of alarm, value or state, alarm message, name of the operator, and hour of release.
    - .2 Operator's activities: All operator's activities have to be archived. Display or printing shall indicate the date of production. Display/impression of activities shall include date and hour of activity and also the nature of it (connection to the system, tentative to connect, modified point value including name of point).
    - .3 Historic of alarms from a digital controller: The historic of alarms biffed in the memory of a controller has to be displayable including the name of the point, hour and date, alarm state, value or state, and alarm message. The points of each controller in alarm state can be displayed or printed, including data pertaining to historic of the point.
- .5 Management of Digital System:
  - .1 The OWS of the control center shall contain utilities for the management of the network of digital controllers.
  - .2 Each digital controller to have a key name that can be identified by the user.
  - .3 All digital controllers shall be telesoftware to and from the hard disk of the central OWS for emergency spare archiving possibilities.
  - .4 Provide a program to supervise diagnostics of the equipment connected to the communication bus and having the capacity for the operator to control equipment to "On/Off" positions.
- .6 Dynamic Graphics Management:
  - .1 Program permits modification and/or integrate color graphics and also assign or integrate points (real or pseudo) to each graphic.
  - .2 Graphic display to be created by the use of central OWS.
  - .3 It will not be necessary for the operator to put the station off communication or to interface archiving or alarm functions.
  - .4 Graphics shall be created by selecting through the mouse or keyboard, symbols and system profiles in a built-in library.
  - .5 Furthermore, it will be possible to create personalized symbols, system profiles, floor plans, and building plans end keep them in a bank for graphics.

- .7 Other Functions:
  - .1 Supply utilities to be selected from a menu or the following desk accessories:
    - .1 Calculators: Arithmetic basis functions (addition, subtraction, multiplication, division, percentage, square root).
    - .2 Calendar: Electronic agenda with automatic appointments signalling.
    - .3 File: Electronic type.
    - .4 Control board: Control of normal PC basic operations: speed of flickering of prompter, rapidity of reaction of the mouse, color control of the screen, etc.
    - .5 Mate book: Archive notes in general.
  - .2 Furthermore, system shall include MS-Word program, program for graphic building, MS Excel. Basic system program shall include a functions of screen splitting into windows permitting the operator to supervised system in real time and use simultaneously programs of other sources.

**Part 2 Products**

- .1 Not Used.

**Part 3 Execution**

**3.1 PROGRAMMING**

- .1 Program all the graphics, alarm, trend logs, etc., in the Andover or Honeywell control station.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 05 02 - EMCS: Submittals and Review Process.
- .3 Section 25 05 03 - EMCS: Project Record Documents.
- .4 Section 25 30 02 - EMCS: Field Control Devices.
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE 2003, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
  - .1 C22.2 No. 205-M1983 (R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1 MD250005 2009, Energy Monitoring and control Systems (EMCS) Design Guidelines <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-f.pdf>.

**1.3 DEFINITIONS**

- .1 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements.

**1.4 SYSTEM DESCRIPTION**

- .1 The network of controllers is existing. The controllers are manufactured by Delta Controls. The new required controllers must communicate with the existing controllers.
- .2 A network of controllers using LCU, MCU, and TCU must be provided in accordance with the architectural system schematic. The network must be compatible with building systems and related operation sequences describe in this section.
- .3 Network of controllers has to be provided as indicated in System Architecture Diagram to support building systems and associated sequences of operations as detailed in these specifications.
  - .1 Provide sufficient controllers to meet intents and requirements of this section.
  - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.

- .4 Controllers: stand-alone intelligent control units. They have to:
  - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
  - .2 Incorporate communication interface ports for communication to LANs to exchange information with other controllers.
  - .3 Capable of interfacing with operator interface device.
  - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other controllers.
    - .1 Secondary input used for reset such as outdoor air temperature may be located in other controllers.
- .5 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
  - .1 Dial-up communications to use 56-kBit modems and voice grade telephone lines.
  - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

## 1.5 DESIGN REQUIREMENTS

- .1 Controllers must be able to execute the following functions:
  - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
  - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
  - .3 Perform Analog control using programmable logic (including PID), with adjustable dead bands and deviation alarms.
  - .4 Control of systems as described in sequence of operations.
  - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: At least 25% of each point type distributed throughout the MCUs and LCUs.
- .3 Controllers and related material and software must work properly in an environment where temperature can fluctuate from 0 to 44°C and relative humidity from 20 % to 90% without condensation.
- .4 Controllers (MCU, LCU): Mount in wall mounted cabinet with hinged, keyed-alike locked door.
  - .1 Provide for conduit entrance from top, bottom or sides of panel.
  - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
  - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .6 Interconnection cable connections must protect against over voltage and decrease in voltage.

## 1.6 SUBMITTALS

- .1 Make submittals in accordance with section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Submittal and Review Process.
  - .1 Submit product data sheets for each product item proposed for this project.

## 1.7 MAINTENANCE PROCEDURES

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

## Part 2 Products

### 2.1 MASTER CONTROL UNIT (MCU)

- .1 General: Primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
  - .1 MCU must support the existing Delta Protocol.
- .3 Capacity input/output of MCU include the following conditions:
  - .1 MCU I/O points as allocated in I/O Summary Table referenced in IM 250005 - 2009.
  - .2 LCUs may be added to support system functions.
- .4 Central Processing Unit (CPU).
  - .1 Processor to consist of minimum 16-bit microprocessor capable of supporting software to meet specified requirements.
  - .2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.
  - .3 Minimum addressable memory to be at manufacturer's discretion, but to support at least performance and technical specifications to include, but not limited to:
    - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
    - .2 Battery backed (72-hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL, and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downloadable from OWS.
  - .4 Include uninterruptible clock accurate to plus or minus 5 sec./month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72-hour operation in event of power failure.

- .5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
  - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.
  - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions, and modifications.
  - .3 Display simultaneously minimum of 16-point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English and French.
  - .4 Functions to include, but not be limited to, following:
    - .1 Start and stop points.
    - .2 Modify setpoints.
    - .3 Modify PID loop parameters.
    - .4 Override PID control.
    - .5 Change time/date.
    - .6 Add/modify/start/stop weekly scheduling.
    - .7 Add/modify setpoint weekly scheduling.
    - .8 Enter temporary override schedules.
    - .9 Define holiday schedules.
    - .10 View analog limits.
    - .11 Enter/modify analog warning limits.
    - .12 Enter/modify analog alarm limits.
    - .13 Enter/modify analog differentials.
  - .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "Global Points", but to provide totally open exchange of data between OT and other controller in network.
  - .6 Operator access to OTs: Same as OWS user password and password changes to automatically be downloaded to controllers on network.
  - .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
  - .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

## 2.2 LOCAL CONTROL UNIT (LCU)

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems, and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, and 4 DOs.

- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
  - .1 Include minimum 2 interface ports for connection of local computer terminal.
  - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
  - .3 Physically separate line voltage (70 V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
  - .4 Include power supplies for operation of LCU and associated field equipment.
  - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
  - .6 Provide conveniently located screw type or spade lug terminals for field wiring.

## 2.3 TERMINAL CONTROL UNIT (TCU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU functional specifications.
  - .1 TCU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook, Section 45.
- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open), and transmit alarm conditions to EMCS OWS.
- .3 VAV Terminal Controller.
  - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
  - .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
  - .3 Controller to operate independent of network in case of communication failure.
  - .4 Controller to include damper actuator and terminations for input and output sensors and devices.
  - .5 The Controls Contractor will provide the VAV manufacturer all the controls necessary for a factory installation.

## 2.4 SOFTWARE

- .1 General.
  - .1 Include as minimum: Operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

- .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
- .3 Include initial programming of controllers for entire system.
- .2 Program and Data Storage.
  - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
  - .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display, and modification by operator.
- .3 Programming Languages.
  - .1 Program Control Description Logic (CDL) software using English like or graphical, high level, general control language.
  - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. "GO TO" constructs not allowed unless approved by Departmental Representative.
- .4 Operator Terminal Interface.
  - .1 Operating and control functions include:
    - .1 Multi-level password access protection to allow user/manager to limit workstation control.
    - .2 Alarm management: processing and messages.
    - .3 Operator commands.
    - .4 Reports.
    - .5 Displays.
    - .6 Point identification.
- .5 Pseudo or Calculated Points.
  - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
  - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL):
  - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
  - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
  - .3 Perform changes to CDL on-line.

- .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
- .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
- .6 MCU to be able to perform following pre-tested control algorithms:
  - .1 Two position control.
  - .2 Proportional Integral and Derivative (PID) control.
- .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
- .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
- .9 Power Fail Restart: Upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
- .7 Event and Alarm Management: Use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Energy Management Programs: Include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
  - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
    - .1 Time of day scheduling.
    - .2 Calendar based scheduling.
    - .3 Holiday scheduling.
    - .4 Temporary schedule overrides.
    - .5 Optimal start stop.
    - .6 Night setback control.
    - .7 Enthalpy (economizer) switchover.
    - .8 Peak demand limiting.
    - .9 Temperature compensated load rolling.
    - .10 Fan speed/flow rate control.
    - .11 Cold deck reset.

- .12 Hot deck reset.
- .13 Hot water reset.
- .14 Chilled water reset.
- .15 Condenser water reset.
- .16 Chiller sequencing.
- .17 Night purge.
- .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
- .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: Features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) as well as accumulation to date for month.
  - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
  - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
  - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
  - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
  - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (e.g. kWh, litres, tonnes, etc.).
  - .6 Store event totalization records with minimum of 9,999,999 events before reset.
  - .7 User to be able to define warning limit and generate user-specified messages when limit reached.

## 2.5 LEVELS OF ADDRESS

- .1 Upon operator's request, EMCS to present status of any single point, system or point group, entire area, or entire network on printer or OWS as selected by operator.
  - .1 Display analog values digitally to one place of decimals with negative sign as required.
  - .2 Update displayed analog values and status when new values received.
  - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
  - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2-second intervals.

## 2.6 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support PWGSC point naming convention specified in Section 25 05 01 - EMCS: General Requirements.



**Part 3            Execution**

**3.1                LOCATION**

- .1        Location of controllers to be approved by Departmental Representative.

**3.2                INSTALLATION**

- .1        Install controllers in secure locking enclosures as indicated or as directed by Departmental Representative.
- .2        Provide necessary power from local 120 V branch circuit panel for equipment.
- .3        Install tamper locks on breakers of circuit breaker panel.
- .4        Equipments that must be functional in emergency and coordination mode are connected to an uninterrupted power supply (UPS).

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
- .2 Section 25 05 01 - EMCS: General Requirements.
- .3 Section 25 05 02 - EMCS: Submittals and Review Process.
- .4 Section 25 05 54 - EMCS: Identification.
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
- .6 Section 26 05 00 - Common Work Results – Electrical.
- .7 Section 26 27 26 - Wiring Devices.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7-1993 (R1999), Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250-03, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- .4 Canadian Standards Association (CSA).
  - .1 CSA-C22.1SB-F02, Canadian Electrical Code, Part 1 (19<sup>th</sup> Edition) Safety Standard for Electrical Instalaltions.

**1.3 DEFINITIONS**

- .1 Acronyms and Definitions: Refer to Section 25 05 01 - EMCS: General Requirements.

**1.4 SUBMITTALS**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

**1.5 EXISTING CONDITIONS**

- .1 Cutting and Adjusting: In accordance with the Architectural Section.
- .2 If needed, repair surfaces that were damaged during Work execution.
- .3 Hand over to the Departmental Representative all removed material that cannot be reused.

**Part 2 Products**

**2.1 GENERAL**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, vibration-proof assembly.
- .3 Operating conditions: 0 - 32°C with 10 - 90% relative humidity (RH) (non-condensing) unless otherwise specified.
- .4 Terminations: Use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie-talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor Installations: Use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Measure Range: As required by each system.

**2.2 TEMPERATURE SENSORS**

- .1 General - except in the case of ambient temperature sensors, the sensors type must be of the resistance or thermistance type and have the following characteristics.
  - .1 Resistance: Platinum, valued at 500 or 1,000 ohms at 0°C ( $\pm 0.2$  ohms) and designed to help minimize the effect of constraints, including three conductors wiring integrated with a coefficient of resistivity of 0.00385 ohm/ohm degrees Celsius.
  - .2 Thermistance: 10 kohms at 21°C, NTC characteristic. Sensors must be linearized in the controllers.
  - .3 Sensing element: Fully sealed.
  - .4 Rod and tip: Copper or stainless steel grade 304.
  - .5 Response time: Less than 3 seconds for a temperature variation of 10°C.
  - .6 Immersion wells: NPS  $\frac{3}{4}$ , stainless steel spring loaded construction, with heat transfer compound compatible with sensor.
- .2 Room temperature sensors and display wall modules.
  - .1 Temperature sensing and display wall module.
    - .1 LCD display to show space temperature and temperature setpoint.
    - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
    - .3 Jack connection for plugging in laptop personal computer, contractor supplied zone terminal unit and contractor supplied palm compatible handheld device for access to zone bus.
    - .4 Integral thermistor sensing element 10,000 ohm at 2°C.

- .5 Accuracy 0.2°C over range of 0 to 70°C.
- .6 Stability 0.02°C drift per year.
- .7 Separate mounting base for ease of installation.
- .2 Room temperature sensors.
  - .1 Wall mounting, in slotted type covers having finish as indicated.
  - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of  $\pm 0.2^\circ\text{C}$ .
- .3 Air Duct Temperature Sensors:
  - .1 General purpose air duct type: Suitable for insertion into air ducts at various orientations, insertion length 460 mm or as indicated.
  - .2 Averaging air duct type: Incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6,000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor Air Temperature Sensors.
  - .1 Outside air type: complete with probe length 100-150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 12 enclosure.

## 2.3 HUMIDITY SENSORS

- .1 Characteristics:
  - .1 Entry signal provided by relative humidity sensors with the previously detailed characteristics.
  - .2 4-20mA output signal with a maximum resistance of 500 ohms.
  - .3 Protections at the input and output against short circuits.
  - .4 Output variation: Less than 0.2% of full scale for supply voltage variation of  $\pm 10\%$ .
  - .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed  $\pm 1\%$  of full scale output.
  - .6 Integral zero and span adjustments.
  - .7 Temperature effects: Not to exceed  $\pm 1.0\%$  of full scale/6 months.
  - .8 Long term output drift: Not to exceed 0.25% of full scale/6 months.

## 2.4 PRESSURE TRANSMITTERS

- .1 Characteristics:
  - .1 Combined pressure transmitters.
    - .1 Internal materials: Suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohms maximum load.
  - .3 Output variations: Less than 0.2% full scale for supply voltage variations of  $\pm 10\%$ .

- .4 Combined non-linearity, repeatability, and hysteresis effects: Not to exceed  $\pm 0.5\%$  of full scale output over entire range.
- .5 Temperature effects: Not to exceed  $\pm 1.5\%$  full scale/ $50^{\circ}\text{C}$ .
- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Precision in the order of  $\pm 1\%$  on the full scale.

## 2.5 DIFFERENTIAL PRESSURE TRANSMITTERS

- .1 Characteristics:
  - .1 Internal materials: Suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohms maximum load.
  - .3 Output variations: Less than 0.2% full scale for supply voltage variations of  $\pm 10\%$ .
  - .4 Combined non-linearity, repeatability, and hysteresis effects: Not to exceed  $\pm 0.5\%$  of full scale output over entire range.
  - .5 Integral zero and span adjustment.
  - .6 Temperature effects: Not to exceed  $\pm 1.5\%$  full scale/ $50^{\circ}\text{C}$ .
  - .7 Over-pressure input protection to at least twice rated input pressure.
  - .8 Output short circuit and open circuit protection.
  - .9 Unit to have 12.5 mm NPT conduit connection. Enclosure to be integral part of unit.

## 2.6 DAMPER LIMIT SWITCH

- .1 Limit Switch:
  - .1 Acceptable products: Telemecanique; LSA1A Honeywell.

## 2.7 SOLID STATE RELAYS

- .1 General:
  - .1 Relays to be socket or rail mounted.
  - .2 Relays to have LED indicator.
  - .3 Input and output barrier strips to accept 14 to 28 AWG wire.
  - .4 Operating temperature range to be  $-20^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .
  - .5 Relays to be CSA certified.
  - .6 Input/output Isolation Voltage to be 4,000 VAC at  $25^{\circ}\text{C}$  for 1 second maximum duration.
  - .7 Operational frequency range, 45 to 65 HZ.

- .2 Input:
  - .1 Control voltage: 3 to 32 VDC.
  - .2 Drop out voltage: 1.2 VDC.
  - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
  - .1 AC or DC Output Model to suit application.

## 2.8 CURRENT TRANSDUCER

- .1 Requirements:
  - .1 Purpose: Combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
    - .1 4-20 mA DC.
    - .2 0-1 VDC.
    - .3 0-10 VDC.
    - .4 0-20 VDC.
  - .2 Frequency insensitive from 10 - 80 Hz.
  - .3 Accuracy to 0.5% full scale.
  - .4 Zero and span adjustments. Field adjustable range to suit motor applications.
  - .5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

## 2.9 CONTROL VALVE

- .1 Body: characterized ball.
  - .1 Flow characteristic as indicated on control valve schedule: Linear, equal percentage, quick opening.
  - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .3 Two or three ports, as indicated.
  - .4 Leakage rate ANSI Class IV, 0.01% of full open valve capacity.
  - .5 Packing easily replaceable.
  - .6 Stem, stainless steel.
  - .7 Plug and seat, stainless steel.
  - .8 Disc, replaceable, material to suit application.
  - .9 50 mm and under:
    - .1 Screwed National Pipe Thread (NPT) tapered female connections.
    - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
    - .3 Rangeability 50:1 minimum.

- .10 65 mm and larger:
  - .1 Flanged connections.
  - .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
  - .3 Rangeability 100:1 minimum.
- .2 Butterfly Valves 50 mm and larger:
  - .1 Body: For chilled water ANSI Class 150 cast iron lugged body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel lugged body.
  - .2 End connections to suit flanges that are ANSI Class 150.
  - .3 Extended stem neck to provide adequate clearance for flanges and insulation.
  - .4 Pressure limit: bubble tight sealing to 170 kPa.
  - .5 Disc/vane: 316 stainless steel.
  - .6 Seat: For service on chilled water PTFE (polytetrafluoroethylene), EPDM (Ethylene Propylene Diene Monomer).
  - .7 Stem: 316 stainless steel.
  - .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .9 Flow characteristic linear.
  - .10 Maximum flow requirement as indicated on control valve schedule.
  - .11 Maximum pressure drop as indicated on control valve schedule: Pressure drop not to exceed one half of inlet pressure.
  - .12 Valves are to be provided complete with mounting plate for installation of actuators.

## **2.10 FLOWMETERS (LIQUIDS, 50 mm (2 in) AND SMALLER)**

- .1 Characteristics:
  - .1 Mechanical flow meter.
  - .2 Pulsated output signal.
  - .3 Local total flow indication.
  - .4 Accuracy and linearity of  $\pm 1.0\%$ .
  - .5 Minimum turndown ratio of 10:1.
  - .6 Bronze or stainless steel body as indicated.
  - .7 Screw type connections.
- .2 Acceptable Products: Lecomte, LR Series; Neptune, MP Series; Kent C-700.

## **2.11 FLOWMETERS (STEAM)**

- .1 Characteristics:
  - .1 Vortex type flowmeter.
  - .2 Nominal pressure: According to the application.



- .3 Nominal temperature: According to the application.
- .4 Reliability:  $\pm 0.2\%$ .
- .5 Accuracy and linearity:  $\pm 1.0\%$ .
- .6 Minimum turndown ratio: 10:1.
- .7 Stainless steel body.
- .8 Connections:
  - .1 Screw type for flow meters smaller or equal to NPS 2.
  - .2 Flange type for flowmeters larger or equal to NPS 2½.
- .2 Acceptable Products: Onicon, F-2000 (as required by the application); Danfoss, MAG 3100 W; Endress + Hauser, PROMAG-50W.

## 2.12 CONTROL PANELS

- .1 Install new equipment in the existing panels. Provide new panels as required.
- .2 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .3 Multiple panels as indicated to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .4 Panels to be lockable with same key.

## 2.13 ELECTRONIC AIR FLOW SENSOR (SPV)

- .1 Duct direct mount electronic flow sensor, made of a flow sensor and a flow transmitter.
- .2 Each sensor is made of numerous air flow measuring points and only one electronic signal transmitter. The air flow readings are individually brought back to the transmitter, which calculates the average and transmits a signal proportional to the velocity or flow.
- .3 The flow station shall cover the entire area of the duct and measuring points shall be distributed equally, in order to maximize the accuracy. Install measuring tubes according to the manufacturer's recommendations. Observe the required straight distances required before and after the measuring station.
- .4 The transmitter includes a digital display to indicate the flow. Install the transmitter on a wall safe from vibrations.
- .5 Each sensor shall be laboratory calibrated at 2% for the whole range, from 0 to 20 m/s (0-4,000 ft/min). Calibration certificates in accordance with NIST shall be provided.
- .6 The transmitter must produce a 0-10 VDC or 4-20 mA signal linear and proportional to the velocity of air.
- .7 Acceptable Products: Ebtron, GTx-116-PC Model, or approved equal.

## 2.14 VARIABLE SPEED DRIVES

### .1 Description:

- .1 Speed reducers are variable speed type by variable frequency (VFD), with capacity adapted to motor size such as listed.
- .2 VFD to be furnished and installed in an adapted panel that will enable proper heat dissipation

### .2 Materials:

- .1 Planned to work with any mark of motor c.a.: induction motor, standard motor or high efficiency motor.
- .2 10% supply voltage variation. No input and output transformer for voltage adaptation.
- .3 3% input line reactor.
- .4 5%.output line reactor.
- .5 Safety from over-current.
  - .1 VFD stops immediately in case of short circuit. Interruption capacity is 40,000 A, without input fuse.
- .6 Safety from input line overvoltage and undervoltage.
- .7 Safety from phase and ground.
- .8 Safety from internal components overvoltage.
- .9 Electronically safety from momentary overload.
- .10 Efficiency: 96% or more at full speed and nominal load mode.
- .11 0.95 Power factor at full speed.
- .12 Operating conditions: 0 - 40 degrees C room temperature with maximum 95% relative humidity (RH) (non-condensing).
- .13 Speed range: 10% to 100% of motor nominal speed.
- .14 Adjustable starting and deceleration time: 3 to 280 sec.
- .15 All the releasing mechanisms in case of failure can be reset automatically or manually or limited to seven restart tries.
- .16 VFD is able to operate while motor is not linked for commissioning trials and adjustments.

- .17 Can start on rotary load up to motor nominal speed independently of rotation direction.
- .18 Frequency discharge circuit.
- .19 Disconnect mounted on control panel surface.
- .20 Bypass circuit of contactors for operation in case of drive failure.
- .21 Install drive and branch circuit in a single panel.
- .3 Control circuit:
  - .1 Conductive local parts of a switching device including following breakers:
    - .1 "Drive/Off/Line/Test" operation.
    - .2 "Local/Remote" speed control.
    - .3 Measure component selector switch.
  - .2 Microprocessor control circuit with LCD display back lighted showing following information:
    - .1 Voltage output.
    - .2 Load percentage (%).
    - .3 Speed percentage (%).
    - .4 Overload.
    - .5 Over-voltage and under-voltage.
    - .6 Phase loss.
    - .7 Over-current.
    - .8 Grounding failure.
    - .9 Overheating.
    - .10 Internal and external alarms with memory.
    - .11 Live putting.
    - .12 Ready for starting.
    - .13 Operation mode.
    - .14 Speed selected operation mode.
  - .3 Internal potentiometer controls of following operation parameters:
    - .1 Minimum speed.
    - .2 Maximum speed.
    - .3 Current limit.

- .4 Overload.
- .5 Voltage and frequency increases.
- .6 Input speed signal phase difference and circuit gain.
- .4 Tie line with external control system:
  - .1 Control circuit accepts each of the following standard signals to speed control:
    - .1 0 to 5 V DC.
    - .2 0 to 10 V DC.
    - .3 4 to 20 mA.
  - .2 Each variator will have to be able to communicate in FLN with the existing centralization system (Siemens).
  - .3 Accept "On/Off" mode dry contact from VFD.
  - .4 Accept dry contact for external alarm.
  - .5 Provide a dry contact to show VFD failure.
  - .6 Provide a dry contact to show VFD operation.
  - .7 Submit 0 to 10 V DC or 4 to 20 mA program signal to show motor speed and output voltage.
  - .8 Submit dry contact to show bypass circuit.
  - .9 Interlock the fresh air damper with the VFD.
- .5 Start-up:
  - .1 The start-up must be completed by a manufacturer's technician.
  - .2 Training course on the operation of the VFD.
  - .3 3-year warranty upon delivery on parts and labour.
  - .4 3-year warranty upon deliver for motor isolation.

**TABLE OF VARIABLE FREQUENCY DRIVES TO BE PROVIDED**

EQUIPMENT	HP	BYPASS	VOLTAGE	USE
P-10A	20	Yes	600/3/60	Secondary chilled water pump
P-10B	20	Yes	600/3/60	Secondary chilled water pump
CT-1	15	Yes	600/3/60	Cooling tower
EF-1	1	Yes	600/3/60	Exhaust fan - chiller room

## **2.15 REFRIGERANT (R-134A) DETECTION SYSTEM**

- .1 General:
  - .1 The installation must be complete with monitoring and gas detection system as indicated on the plans. The product must be CSA "ACNOR" certified and must follow IPC-D-275 standards for quality control. The product must have a one year warranty, from the certification date, on parts and labour
- .2 Start-up:
  - .1 Start-up must be completed by the manufacturer Honeywell - Vulcain Inc. A detailed report must be joined with the certification that attests proper installation.
  - .2 Start-up includes the following:
    - .1 System verification.
    - .2 Verification of installation of systems.
    - .3 Calibration and trial tests.
- .3 Controller:
  - .1 Three levels of alarms.
  - .2 Up to 32 transmitters on the RS-485 loop
  - .3 LCD screen with keypad
  - .4 Visual and audible alarms
  - .5 Microprocessor

- .4 Transmitters:
  - .1 The VA-301IRF transmitters are designed to analyze concentrations of toxic gasses and explosives: R-11, R-12, R22, R-123, R125, R134a, R410a and R500. The transmitters must be installed at an adequate height to detect gas concentrations quickly. Generally they must be installed at a height of 1 foot from the ground.
  - .2 Transmitters must have the following characteristics:
    - .1 Protection filters against magnetic and electric fields.
    - .2 Infrared sensor.
    - .3 0-1,000 ppm scale.
    - .4 Three levels of alarms.
    - .5 RS-485 output.
    - .6 Time-delay before and after alarm.
    - .7 LCD screen with keypad.
    - .8 Visual and audible alarms.
    - .9 Microprocessor.

## **2.16 WIRING**

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .2 For wiring under 70 V use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
  - .1 Field wiring to digital device: #18 AWG twisted pairs.
  - .2 Analog input and output: Shielded #18 minimum solid copper twisted pair.

## **2.17 ELECTRONIC CONTROL VALVE ACTUATORS**

- .1 Characteristics:
  - .1 Made of steel, cast iron or aluminum.
  - .2 Command signal of 0-10 VDC or 4-20 mA.
  - .3 Positioning time as required by application, but maximum 90 seconds.
  - .4 Fail position, as indicated.
  - .5 Visual indication of actual position of valve.

- .6 Characteristics allowing to satisfy requirements, as well as performance requirements of the valve.
- .7 Modulating actuator for tall HVAC coils. Two (2) positions actuators for terminal wall fin radiation.
- .8 Minimal close off pressure, as indicated on the valve list.

## **2.18 POWER TRANSMITTER**

- .1 Electric power transmitter will produce a linear 4-20 mA signal, proportional to the power input. Response time will be less than 400 ms. The meter will be of 3 phases and 4 wires type, with a minimum accuracy of 2% of the whole range.
- .2 Acceptable Products: H6001 of Veris Industries.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: Install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Electrical system:
  - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.
  - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3 Refer to electrical control schematics included as part of control design schematics on drawings mentioned in section 25 90 01 EMCS: Site Requirements, Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
  - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
  - .5 Install communication wiring in conduit.
    - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
    - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
    - .3 Conduit filling should not exceed 40% of their capacity.
    - .4 Design drawings do not show conduit layout.

- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative review before beginning Work. Wiring in mechanical rooms and in service rooms, and exposed wiring must be in conduit.
- .6 Provide to the Plumbing Contractor the control valves.

### 3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Install to ensure minimum field adjustments or calibrations.
- .2 Sensors must be readily accessible and adaptable to each type of application to allow quick and easy replacement and servicing without special tools or skills.
- .3 Outdoor Installation:
  - .1 Protect from solar radiation and wind effects by non-corroding shields.
  - .2 Install in NEMA 4 enclosures.
- .4 Duct Installations:
  - .1 Do not mount in dead air space.
  - .2 Locate within sensor vibration and velocity limits.
  - .3 Securely mount extended surface sensor.
  - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
  - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
  - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
  - .2 Wire multiple sensors in series for low temperature protection applications.
  - .3 Wire multiple sensors separately for temperature measurement.
  - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: Install for piping installations.
  - .1 Locate well in elbow where pipe diameter is less than well insertion length.
  - .2 Thermowell to restrict flow by less than 30%.
  - .3 Use thermal conducting paste inside wells.

### 3.3 CONTROL PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: Locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.



**3.4 "MAGNEHELIC" MANOMETERS**

- .1 Install a "Magnehelic" manometer near each static pressure sensor associated to an air handling system and near each duct air flow measuring station, as instructed by the Departmental Representative.
- .2 Install "Magnehelic" manometer as indicated on the plans.

**3.5 IDENTIFICATION**

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

**3.6 TESTING AND COMMISSIONING**

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

**END OF SECTION**



**Part 1 General**

**1.1 SEQUENCES**

- .1 Present sequencing of operations for systems, in accordance with IM 250005 - 2009: Energy Management and Control Systems (EMCS) Design Manual.

**1.2 GENERAL**

- .1 Following sequences apply for all the mechanical systems, when it is necessary.
- .2 Critical protections or those required by codes (detection of gas, fire, etc.) will not have to be by-passed in any way, neither manually, nor by computer. If an input is required to the centralized system, supply a relay to execute the double function of control and alarm.
- .3 When there is an input of information for proof of operation, a total of hours of operation of mechanical equipments (compressors, water tower, ventilators, pumps, air conditioning devices, etc.) will automatically be made, complete with operator control resetting.
- .4 Program alarms for all the following situations:
  - .1 Discrepancy between command and state signals.
  - .2 Room temperature at more than 2°C from the set-point.
  - .3 System temperature at more than 2°C from the set-point for longer than 30 minutes.
  - .4 Hydronic network temperature at more than 1°C from the set-point for longer than 30 minutes.
  - .5 Other values: Greater than 5% discrepancy with the set-point.
- .5 When the program switches control modes (example: cooling with heating), a dead range must be included on set-points. Also, several control stages in sequence contain a minimum time IN and OUT. These measures eliminate the danger of equipment cyclic functioning.
- .6 When restarting after breakdown, systems will be restarted with 15 minutes intervals (adjustable delay).
- .7 All butterfly control valves will be corrected by software programming or by characterised connecting rod and actuators to maintain a proportional valve flow with the control signal.
- .8 The following sequences must be read together with drawings and list of points. Supply all the control points necessary for the control sequences performing, listed or implicit.
- .9 Program trend log points for all the input and output analog points and variables that change in the time.
- .10 Unless otherwise specified, alarms will be transfer to following devices when these are a part of planned system in drawings or existing:

POINTS	ALARM	OPERATION HOURS	TENDANCE	ALARM DESTINATION	COMMENTS
ANALOG INPUTS	X		X	F,P,S	
ANALOG OUTPUTS	X		X	F,P,S	

POINTS	ALARM	OPERATION HOURS	TENDANCE	ALARM DESTINATION	COMMENTS
DIGITAL INPUTS	X	X		F,P,S	Related to the corresponding output
DIGITAL OUTPUTS		X		F,P,S	
SET-POINTS	X		X	F,P,S	
VARIABLES	X			F,P,S	
SYSTEM CONTROL	X			F,P,M	

F: File M: Modem P: Printer S: Screen

- .11 An optimal start program controls morning start-up of all air handling units in order to reach the "occupied" temperature set-point. The calculation takes into account outdoor air temperature, actual indoor air temperature, and warm-up period required, based upon past performance. Under "Heating" mode, start-up is delayed as long as possible. Under "cooling" mode, unit shall start and run on free cooling when possible. Outdoor air dampers are to remain closed during the morning warm-up period until the temperature reaches 20°C.

### 1.3 SF-1 SYSTEM (GENERAL VENTILATION SYSTEM)

- .1 Summer/Winter Mode.
- .1 The operator shall toggle summer/winter mode through the graphics at Operator Workstation.
- .2 Summer mode will disable reheat, perimeter heating and humidification.
- .3 Winter mode will enable reheat, humidification and perimeter heating operation sequence.
- .2 Occupied/Unoccupied.
- .1 The occupied versus unoccupied mode shall be dictated based on activation of an override pushbutton or a time-of-day schedule.
- .3 Occupied Schedules.

SYSTEM	SCHEDULE	NOTES
Fan Systems	Monday-Sunday 5:00am-12:00pm	
Economizer	Monday - Sunday 6:00am-10:00pm	

- .4 Winter Mode - Occupied.
- .1 On a signal from the EMCS, the supply fan and return fan shall start and run continuously, and the economizer dampers shall be allowed to modulate to satisfy the representative SAT reheat coil controller.
- .2 The SAT will never be permitted to drop below 13°C. SAT high limit of 4°C shall be maintained.

- .3 If after one minute, a no airflow condition is sensed by the fans current sensing relay, the fans shall stop, the AHU's economizer dampers shall close, and an alarm shall be sent to the operator's workstation.
- .4 At the end of the occupied mode, the fans shall stop and the AHU's economizer dampers shall close.
- .5 The economizer shall modulate toward minimum position based on heating/cooling demand from the zone reheat controller with least heating demand.
- .6 The economizer shall modulate toward maintaining a minimum 20% fresh air based on a MAT calculation. If  $OAT > -10^{\circ}\text{C}$ , the economizer minimum fresh air shall be based on maintaining a fixed damper position.
- .7 No mechanical cooling is permitted in Winter Mode.
- .8 The SAT low limit shall be reset from OAT as follows:

OAT	SAT
$-10^{\circ}\text{C}$	$20^{\circ}\text{C}$
$13^{\circ}\text{C}$	$13^{\circ}\text{C}$

- .9 Curve to be adjustable from Graphics Screen.
- .10 Maintain static pressure in duct by modulating variable frequency drive to control airflow.
- .11 If the SAT falls below  $4.4^{\circ}\text{C}$  when the AHU is running, shut down the supply fan and return fans, close the economizer dampers, and indicate a low temperature alarm to the EMCS. When  $OAT < 10^{\circ}\text{C}$ , enable humidifier to operate after AHU has run for 5 minutes.
- .12 The humidifier modulate to maintain return air RH at 30%.
- .5 Winter mode - Unoccupied.
  - .1 During the unoccupied mode the AHU shall remain "off", the economizer shall be closed. If any space temperature drops below  $20^{\circ}\text{C}$ , activate the AHU with economizer closed. Upon setpoint being reached disable the unit.
- .6 Summer Mode - Occupied.
  - .1 On a signal from the EMCS, the supply fan and return fan shall start and run continuously, and the economizer dampers shall be allowed to modulate to satisfy the representative space sensor based on the cooling coil controller.
  - .2 The SAT will never be permitted to drop below  $13^{\circ}\text{C}$ . SAT high limit of  $40^{\circ}\text{C}$  shall be maintained.
  - .3 If after one minute, a no airflow condition is sensed by the fans current sensing relay, the fans shall stop, the AHU's economizer dampers shall close, and an alarm shall be sent to the operator's workstation.
  - .4 At the end of the occupied mode, the fans shall stop and the AHU's economizer dampers shall close.
  - .5 The economizer shall modulate toward minimum position based on heating/cooling demand from the zone controller with least cooling demand.
  - .6 The economizer shall modulate toward maintaining a minimum 20% fresh air based on a MAT calculation. If  $OAT > -10^{\circ}\text{C}$ . The economizer minimum fresh air shall be based on maintaining a fixed damper position.

.7 When mechanical cooling is energized, the cooling control valve shall modulate to maintain 13°C. (SAT discharge from each coil).

.8 The SAT low limit shall be reset from OAT as follows:

OAT	SAT
-10°C	20°C
12°C	13°C

.9 Curve to be adjustable from Graphics Screen.

.10 Maintain static pressure in duct by modulating variable frequency drive to control air flow. No humidification has to be enabled.

.7 Summer mode - Unoccupied.

.1 During the unoccupied mode the AHU shall remain "off", the economizer shall be closed. If any space temperature rises above 25°C, activate the AHU with economizer closed. Upon setpoint being reached disable the unit.

#### 1.4 EF-1 (CHILLER ROOM VENTILATION SYSTEM)

.1 The room temperature sensor control the exhaust fan and the OA and exhaust dampers. If temperature rises above 25°C, activate the fan on low speed (adjust the VFD to supply a minimum of 160 L/s) and open the OA and exhaust dampers.

.2 On refrigerant gas detection (R 134a) activate the exhaust fan on high speed (adjust VFD to supply 1,600 L/s) and open also the second damper located on the OA duct. The OA and exhaust dampers are 100% open.

#### 1.5 CHILLED WATER SYSTEM.

.1 The chilled water is produced by a new water chiller, 300 tons capacity.

.2 The new water chiller is connected to the existing chilled water system.

.3 One of the primary chilled water pumps P-6A or P-6B operates during the cooling season. One pump is operating, while the second is in stand-by. The pumps start order is monthly alternated. At the stop of a pump, the stand-by pump will be activated and an alarm is signaled.

.4 One of the secondary chilled water pumps P-7A or P-7B operates during the cooling season to maintain static pressure in chilled water lines. The two pumps are VFD controlled. One pump is operating, while the second is in stand-by. The pumps start order is monthly alternated. At the stop of a pump, the stand-by pump will be activated and an alarm is signaled.

.5 If the return chilled water temperature rises above 13°C, the chiller will be activated.

.6 On the condenser side, one of the cooling tower pumps P-5A or P-5B starts at the chiller start-up. One pump is operating, while the second is in stand-by. The pumps start order is monthly alternated. At the stop of a pump, the stand-by pump will be activated and an alarm is signaled. During shutdown of the chiller when the cooling tower is available, the pump must run a minimum of 1 hour every 24 hours.

The temperature sensor located at the condenser inlet, modulate the three-way valve first, and the cooling tower fan speed to maintain the condenser inlet temperature as low as possible, a minimum of 18°C, while minimizing the operation of the fan, according to the following curve:

$$\text{Condenser Temp.} = (\text{Exterior WetBulb temperature} - 10) * 0,745 + 18$$

If the exterior temperature drops below 0°C, the minimum flow to the cooling tower must be 50%.

- .7 The water level controller, supplied with the cooling tower, will control the make-up water valve. The high level security probe, closes the make-up water valve upon activation.
- .8 On excessive vibration detection, the cooling tower shall stop.
- .9 Cycle cooling tower sump heater to maintain sump temperature above a pre-determined minimum setpoint.
- .10 On sensing of low sump temperature, open automatic drain valve.
- .11 Operate cooling tower filtration system.
- .12 Provide field interconnect wiring for condenser water treatment system, monitor system in EMCS.

## 1.6 ROOM HEATING CONTROL

- .1 In each room, the room temperature sensor opens the valve on a heating demand.

## 1.7 ZONE HEATING AND COOLING COIL

- .1 Summer/Winter mode.
  - .1 The operator shall toggle summer/winter mode through the graphics at Operator Workstation.
  - .2 Summer mode will disable reheat, perimeter heating and humidification.
  - .3 Winter mode will enable reheat, humidification and perimeter heating operation sequence.
  - .4 Occupied/Unoccupied.
    - .1 The occupied versus unoccupied mode shall be dictated based on activation of an override pushbutton or a time-of-day schedule.

SYSTEM	SCHEDULE	NOTES
Zone No.1	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 2	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 3	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 4	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 4	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	

SYSTEM	SCHEDULE	NOTES
Zone No. 5	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 6	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 7	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 8	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 9	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 10	Monday-Sunday 6:00am-9:00pm	
Zone No. 11	Continuous	
Zone No. 12	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 13	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	
Zone No. 14	Monday-Sunday 6:00am-9:00pm 12:00pm-1:00pm & 4:30pm-11pm	

.2 Winter mode - Occupied.

- .1 Based on a time or day schedule or activation of an override pushbutton the zones occupied versus unoccupied mode will be dictated.
- .2 The reheat coil control valve shall modulate to maintain SAT setpoint through a PI controller. The SAT setpoint shall be reset with OA, according to the following schedule:

OAT	SAT
13°C	13°C
-20°C	20°C

.3 Winter mode - Unoccupied.

- .1 The isolation block damper shall remain closed.

.4 Summer Mode - Occupied.

- .1 Based on a time of day schedule or activation of an override pushbutton the zones occupied versus unoccupied mode will be dictated.
- .2 The cooling coil shall modulate to maintain SAT setpoint through a PI controller. The SAT setpoint shall be reset with OA, according to the following schedule:

OAT	SAT
20°C	13°C

.5 Summer mode - Unoccupied.

- .1 During unoccupied mode, should the temperature rise above 23°C cycle the AHU and open the zone isolation damper.
- .2 The system shall operate to cooling the space with OA and exhaust dampers closed.



## 1.8 HEAT EXCHANGERS

- .1 Heating Control.
  - .1 Summer / Winter Mode.
    - .1 The operator shall toggle summer/winter mode through the graphics at Operator Workstation.
    - .2 Summer mode will disable reheat, perimeter heating and humidification.
    - .3 Winter mode will enable reheat, humidification and perimeter heating operation sequence.
- .2 Heating Exchanger Control and Circulating Pump Control.
  - .1 Winter Mode.
    - .1 The EMCS, using a PI loop output from the space with the greatest heating demand shall reset the HWS setpoint based on the following schedule:

PI Output	HWS
0%	30°C
100%	90°C
    - .2 The two steam control valves shall be staged.
    - .3 The heating circulating pump on the scheduled water loop shall be controlled as follows:
      - .1 OAT <2°C - pump operates continuous.
      - .2 OAT >18°C - pump off.
  - .2 Summer Mode.
    - .1 Disable pumps and steam control valves. Pump shall be programmed to operate one minute per day.
- .3 Glycol Heat Exchanger Control.
  - .1 Winter Mode.
    - .1 The EMCS, using a PI loop output from the supply water sensor, shall modulate the steam control valve to maintain 82°C.
    - .2 The heating circulating pump shall cycle with the AHU schedule and energize 15 minutes prior to AHU scheduled start.
    - .3 If OAT >15°C -the heating pump shall remain "off".
  - .2 Summer Mode.
    - .1 Disable pumps and steam control valves. Pump shall be programmed to operate one minute per day.

## 1.9 SUMP PUMP STATIONS

- .1 An alarm is activated on high water level detection.

## 1.10 CHILLER INTEGRATION

- .1 The following points must be available at the computer to be integrated in the control sequences and graphics:
  - .1 Reading and writing points:
    - .1 Temperature setpoint.
    - .2 Start and stop command.
    - .3 Maximum load.
  - .2 Reading points only:
    - .1 Temperature.
    - .2 System status.
    - .3 Demand signal.
    - .4 Compressor operation level (%).
    - .5 Evaporator and condenser pressure and temperature.
    - .6 Warnings.

### Part 2 Products

- .1 Not Used.

### Part 3 Execution

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

.1 The Administrative Sections under Division 00 (Bidding and Contract Requirements) and 01 (General Requirements) shall be considered to be part of these Specifications.

26 05 00	Common Work Results – Electrical
26 05 02	Scope of Work for Electrical
26 05 05	Building Services
26 05 20	Wire and Box Connectors 0-1000 V
26 05 21	Wires and Cables (0-1000 V)
26 05 27	Grounding - Primary
26 05 28	Grounding - Secondary
26 05 29	Hangers and Supports for Electrical Systems
26 05 31	Splitters, Junction, Pull Boxes and Cabinets
26 05 32	Outlet Boxes, Conduit Boxes and Fittings
26 05 34	Conduits, Conduit Fastenings and Conduit Fittings
26 05 38	Disconnect Switches Fused and Non-Fused up to 600 V – Primary
26 05 44	Installation of Cables in Trenches and in Ducts
26 05 80	Fractional Horsepower Motors
26 05 82	Motor Starters to 600 V
26 05 83	Connections to Mechanical Equipment
26 09 02	Metering and Switchboard Instruments
26 12 17	Dry Type Transformers up to 600 V Primary
26 12 19	Pad-Mounted, Liquid Filled, Medium Voltage Transformers
26 13 17	Full Load Interrupter Switches to 25kV
26 24 02	Distribution Panelboards
26 24 04	Underground Service
26 24 05	Coordination and Short Circuit Study
26 24 13	Switchboards
26 24 16	Panelboards
26 24 19	Motor Control Centers
26 27 16	Electrical Cabinets and Enclosures
26 27 26	Wiring Devices
26 28 21	Moulded Case Circuit Breakers
26 50 00	Lighting
26 52 01	Unit Equipment for Emergency Lighting
26 53 00	Exit Signs
26 57 01	Starting of Electrical Equipment and System
26 57 02	Testing, Adjusting and Balancing of Electrical Equipment and Systems
26 57 03	Electrical Equipment and systems Demonstration and Instruction

28 31 03 Multiplex Fire Alarm and Voice Communication Systems

## **1.2 CODES AND STANDARDS**

- .1 Do complete installation in accordance with CSA C22.1-2012 except where specified otherwise.
- .2 Emergency Electrical power supplies for buildings CSA 282
- .3 Do overhead and underground systems in accordance with CSA C22.3 No.1-10, 2010 except where specified otherwise.

## **1.3 CARE, OPERATION AND START-UP**

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

## **1.4 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

## **1.5 PERMITS, FEES AND INSPECTION**

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Engineer of changes required by Electrical Inspection Department prior to making changes.

## **1.6 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
  - .1 Submit shop drawings as indicated in the relevant specification sections, that include the following as a minimum.

- .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
- .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .5 If changes are required, notify Consultant of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Provide CSA certified equipment and material. Other acceptable certifications include (ETL, ULC, NSF)
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to consultant for approval before prior to tender close.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of work, load balance readings
  - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative and Consultant.
- .4 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

## 1.7 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings:
  - .1 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
    - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
    - .2 During progress of Work at a minimum of 25% and 60% complete, or as required to complete work to a satisfactory standard.
    - .3 Upon completion of Work, after cleaning is carried out.

**1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: provide Consultant with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance as per site policy.

**1.9 SYSTEM START-UP**

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

**1.10 OPERATING INSTRUCTIONS**

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

**Part 2 Products**

**2.1 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 00 - Product Requirements.
- .2 Where CSA certified equipment and material is not available, submit such equipment and material to consultant and inspection authorities for approval before delivery to site, and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

## 2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

## 2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities, owners Representative.
- .2 Plastic decal signs, minimum size 175 x 250 mm.

## 2.4 WIRING TERMINATIONS

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

## 2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black finish face, white core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.
  - .2 Sizes as follows:

### NAMEPLATE SIZES

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

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identification to be in English.
- .7 Identify equipment with Size 3 labels engraved.
- .8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .9 Terminal cabinets and pull boxes: indicate system and voltage.
- .10 Transformers: indicate capacity, primary and secondary voltages.

**2.6 Conduit, Cable and Pullbox Identification**

- .1 Identify all pull boxes, junction boxes and conduits with manufactured durable and clearly legible marking to identify the function and voltage of the system.

**2.7 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

**2.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1994.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1-2012
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

**3.2 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.
- .2 Label all boxes with CCT# and feed panel.

**3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.



- .1 Sleeves through concrete: schedule 40 steel pipe, plastic or sheet metal, sized for free passage of conduit, and protruding 50mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .4 The Electrical Contractor shall seal all penetrations for raceway, cables and all other penetrations made by the Electrical Contractor through rated assemblies to prevent the spread of smoke and fire. A system listed in ULc-FS, Firestop Systems and Components shall be used to maintain the rating of the assemblies.

### 3.4 LOCATION OF OUTLETS

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

### 3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Review Architectural elevations for mounting heights in specific areas.
- .4 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1200mm.
  - .2 Wall receptacles:
    - .1 General: 450 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 In mechanical rooms: 1400 mm.
    - .4 Exterior receptacles: 750mm
    - .5 Panelboards: as required by Code or as indicated.
    - .6 Fire alarm stations: 1200 mm.
    - .7 Fire alarm bells: 2100 mm.
    - .8 Wall mounted speakers: 2100 mm.

- .5 Co-ordinate with other trades on site to ensure specified heights work with other materials being supplied.

### 3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Carryout a co-ordination and arc flash study of all panels prior to ordering of panels and adjust panel and breaker ratings to match requirements from co-ordination study.
- .2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### 3.7 FIELD QUALITY CONTROL

- .1 The works in this section apply to the final installation by the electrical contractor, the equipment supplier to provide documentation as listed below.
- .2 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .3 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels test for hot/ neutral reversal
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: fire alarm verification as per CAN/ULC-S526,
  - .6 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

### 3.8 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**END OF SECTION**



**Part 1 Work Included**

**1.1 RELATED WORK**

- .1 The Administrative Sections under Division 00 (Bidding and Contract Requirements) and 01 (General Requirements) shall be considered to be part of these Specifications.

**1.2 GENERAL REQUIREMENTS**

- .1 General Clean-up.
- .2 All inspection and other permits, licenses required by various Inspection Agencies and local regulations related to Electrical Trade.
- .3 Supply scaffolding, platforms and ladders as required for scope.
- .4 Supply of electrical Switchgear and distribution transformers as defined in the attached single line and tables.
- .5 Supply and installation of all distribution and underground conductors.
- .6 Electrical connections to all mechanical plant and line voltage control equipment.
- .7 Installation of VSD's not included in packaged skids and provided by mechanical contractor.
- .8 Supply and install all outlets, wiring and lighting as shown on drawings.
- .9 Coordination between suppliers of the different electrical systems to ensure proper system integration as indicated in the specifications sections.
- .10 Shop Drawings.
- .11 Commissioning of systems.
- .12 Project Record Documents (As-Built Drawings) where specified.
- .13 Operating and Maintenance Data, where specified.

**1.3 MATERIALS**

- .1 Internal panel bus systems including all forms of buses integral with the electrical power system, together with their associated insulation, supports, bus ducts and protective devices.
- .2 Metering as shown in the single line including all associated enclosures and CT/PT.
- .3 Complete and verified fire alarm system modifications as indicated on plans.
- .4 Batteries, chargers and ancillary equipment required for auxiliary, stand-by or emergency lighting or power systems.

- .5 Conductors, including all types of wires, conductors, cables, which form an integral part of the electrical power system.
- .6 Cables and bus support systems which are intended to enclose or support all forms of electrical conductors used for any purpose covered by this scope. This includes cable trays, raceways and all forms of rigid, flexible, metallic and non-metallic conduit, and including conduit for communication systems or others, which may be installed at a later date, or buried conduit for wiring work by others, only when such buried conduit is indicated in the Contract Documents.
- .7 Control panels associated with any electrical equipment covered under this section of work.
- .8 Circuit breakers of all types and for all applications associated with electrical equipment which receives its power supply from the main, auxiliary, stand-by or emergency (including battery) system.
- .9 Lighting control system.
- .10 Grounding systems, as required by the Electrical Code, or as otherwise specified in the bid documents.
- .11 Lighting - all forms of electric lighting devices, both individual and packaged types, including complete modular and integrated ceilings together with all associated troffers, deflectors, diffusers, ballasts, lens, tubes and mounting devices, and which are used for all purposes, such as floodlighting exterior parking areas, landscaping lighting, display lighting etc.
- .12 Conductors, including all types of wires, conductors, cables, which form an integral part of the electrical distribution panels.
- .13 Control panels associated with any electrical distribution panels equipment covered under this section of Work.
- .14 Circuit breakers of all types, and for all applications associated with electrical equipment as defined in the breaker list. Panel boards to include all branch circuit breakers.
- .15 Panel Grounding systems, as required by the Electrical Code, or as otherwise specified in the bid documents.
- .16 Motor starters as indicated on the single line.
- .17 Transformers of various types, dry, encapsulated etc., and for all applications, including control transformers required to make the electrical distribution panels operate.
- .18 Carry out a full co-ordination study prior to construction, submit results to Consultant prior to construction. Results should include expected fault levels and should include all settings required for adjustable breakers. This should include all ground fault protection equipment.

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**Part 2            Work Excluded**

**2.1            GENERAL REQUIREMENTS**

- .1      Temporary power.
- .2      Temporary light.
- .3      Hoisting.
- .4      Barriers.

**2.2            OTHER WORK EXCLUDED**

- .1      Control wiring associated with equipment not supplied with this package.
- .2      Perforations through roofing materials for electrical servicing or attachments.
- .3      Control transformers supplied with Mechanical Equipment as specified in mechanical specifications.
- .4      Items specifically excluded by notes on the drawings.

**Part 3           Units of Measurement**

**3.1           GENERAL**

- .1      The Contract Documents have been prepared using the modified International System (SI) units of metric measurement. Whenever appropriate, available metric products shall be used unless otherwise specified herein.
- .2      Only metres (m) and millimetres (mm) are used. Generally, metres are used for measurements of 10 metres or more, and millimetres for measurements below 10 m.
- .3      All measurements on drawings are in millimetres unless otherwise indicated.

**3.2           CONVERSIONS**

- .1      The following three conversion methods were used in product and location dimensions:
  - .1      Hard Conversion: Industry available products which are manufactured in metric measurements.
  - .2      Soft Conversion: Products which are still manufactured in Imperial units and are converted in specifications using arithmetic conversion factors.
  - .3      Rationalized Conversion: Dimensions which are soft converted and rounded off for ease of measurements.
- .2      In cases where measurements may be open for interpretation, dual dimensions have been incorporated until hard conversions can be used exclusively.

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**Part 4 Definitions**

**4.1 GENERAL**

- .1 All terminologies, abbreviations and acronyms used in this document are as listed in the various Standards, Codes, Rules and Bulletins used herein.

**Part 5 Format**

**5.1 SECTIONS**

- .1 The Sections are written in a three-part format: General, Products and Execution.

**5.2 REFERENCE**

- .1 Imperative tense has been used throughout this Document for work intended for the successful Contractor. There shall be no work exclusions unless they have been clearly identified as such herein.
- .2 Any reference to "Design Authority" shall mean Stantec Consulting Ltd.
- .3 The word "provide" shall mean "supply and install" unless otherwise indicated.

**Part 6 Codes**

**6.1 GENERAL**

- .1 All Codes, Standards, Rules, Regulations, Bulletins, By-laws etc., shall be those that are currently enforced in the locality of job site, unless otherwise specified herein.

**END OF SECTION**



**Part 1 General**

**1.1 COORDINATION**

- .1 Continuity of operation of occupied areas of the facilities is to be maintained. Unavoidable interruption of electrical service is to be coordinated with the Departmental Representative.
- .2 Coordinate material provisions, proper arrangements, space requirements, specific installation and connection requirements, and installation schedules.
- .3 Submit a written method of procedure document and work schedule for the conversion of the electrical service in this building to the Departmental Representative.
- .4 Obtain approval of proposed methodology and schedule prior to interruption of electrical service.
- .5 Provide minimum of 6 weeks lead time for major interruption to electrical systems in any building exceeding 4 hours. Shorter interruptions to power supply to be scheduled at least 5 working days in advance.
- .6 Work associated with the removal, replacement, testing, and commissioning of electrical power equipment may dictate that the building will be without electrical power for periods exceeding 4 hours during this work. As this will disrupt normal building operations, the Contractor is to develop methodologies to minimize the impact of the required power interruptions to normal activities.
  - .1 The Contractor shall thoroughly plan, schedule and layout the work in such a manner as to minimize all outage times and to perform the work over a weekend or overnight.
  - .2 Contractor to provide personnel, tools and supervision necessary to complete the work during this proposed period.

**1.2 TEMPORARY POWER**

- .1 Continuity of operation of occupied areas of the facility is to be maintained. Unavoidable interruption of electrical service to all or a portion of the building is to be coordinated with the Departmental representative.
- .2 Temporary power connections to consist of all work necessary for alternate electrical supply to buildings or individual electrical elements within buildings necessary to maintain normal operations.
- .3 Temporary power supply to originate from the existing electrical distribution system or a stand-alone engine generating unit.
  - .1 Provide all necessary interconnect wiring, connections and overcurrent protection devices where existing facilities cannot be utilized.
  - .2 Coordinate interruption of power to electrical services or equipment for a connection to the temporary power supply and reconnection to the new electrical system and conform to Departmental Representative's scheduling restrictions.

- .4 Provide temporary power connections for electrical systems and equipment where maximum power interruption times to normal building operations indicated must be exceeded. Interruption times for electrical systems within this building no to exceed 4 hours.

**Part 2 Products**

**2.1 Not Used**

**Part 3 Execution**

**3.1 BUILDING ELECTRICAL SERVICE CONVERSION**

- .1 Building 124 – D-Block: A new 347/600V 3-phase electrical service to be provided to serve this building from a new pad-mounted transformer.
- .1 New 347/600V, 3 phase service entrance switchgear, 6-ES-SG-1, with essential and normal distribution breakers to be installed in the electrical room.
- .2 A new feeder from the new switchgear normal distribution breaker to be installed and connected to new 225 KVA 600-120/208V, 3-phase dry-type transformer.
- .3 Remove existing 120/208V 3-phase pad-mounted liquid-filled transformer, high-voltage switch, and service conductors.
- .4 New 500 KVA 25kV-347/600V 3-phase pad-mounted liquid-filled transformer, 124-5-TR, and high-voltage switch.
- .5 New 347/600V service conductors to be installed from the new switchgear, 6-ES-SG-1, to a new pad-mounted transformer, 124-5-TR.
- .6 A new feeder from the new 600-120/208V transformer to be installed and connected to the existing 120/208V switchboard, 2-ES-SG-1.
- .7 The new electrical service equipment to be energized and commissioned.
- .8 Digital metering equipment in the new switchgear to be connected to the metering network via the campus LAN.
- .9 The new main essential power breaker to be spare until an essential distribution system is developed within the building as part of any future major renovation to the building.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials and installation for wire and box connectors.

**1.2 RELATED SECTIONS**

- .1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA International) latest revision
  - .1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2 CSA C22.2No.65, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste according to site policies.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded copper conductors.
  - .2 Clamp for stranded copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.
  - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1      Remove insulation carefully from ends of conductors so as not to score the conductor and:
  - .1      Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2      Install mechanical pressure type connectors with appropriate compression tool recommended by manufacturer and tighten screws. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
  - .3      Install fixture type connectors and tighten. Replace insulating cap.
  - .4      Install bushing stud connectors in accordance with EEMAC 1Y-2.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**1.2 REFERENCES**

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

**1.3 PRODUCT DATA**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies

**Part 2 Products**

**2.1 BUILDING WIRES**

- .1 **Single Conductors:** stranded for 8 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material up to #8, 1000V rated #6 and larger, rated RW90.
- .3 BX cable for final drops to lighting fixtures.
- .4 Copper conductors: size as indicated, with insulation rating as per 2.1.4 of PVC/ nylon.
- .5 Armour: Aluminum

**2.2 TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Teck 90 cable only to used where building construction does not allow access for junction and pull boxes,
- .3 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .4 Insulation:
  - .1 Type: ethylene propylene rubber.

- .2 Chemically cross-linked thermosetting polyethylene rated type RW90 600V. Use 1000V for connection between 600V VSD's and motors.
- .5 Inner jacket: polyvinyl chloride material.
- .6 Armour: galvanized steel.
- .7 Overall covering: thermoplastic material.
- .8 Fastenings:
  - .1 One hole malleable iron or steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables
  - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .9 Connectors:
  - .1 Watertight approved for TECK cable.

### **Part 3 Execution**

#### **3.1 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34
  - .2 In cable troughs in accordance with Section 26 05 31
  - .3 In underground ducts in accordance with Section 26 05 44
  - .4 In surface and lighting fixture raceways in accordance with Section 26 50 00
  - .5 In wireways and auxiliary gutters in accordance with Section 26 05 37

#### **3.2 INSTALLATION OF TECK CABLE 0 -1000 V**

- .1 Install cables.
  - .1 Group cables for parallel runs wherever possible on channels.
  - .2 Where multiple circuits are run on a cable tray maintain a minimum of 25% of the largest cable diameter separation between adjacent circuits.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0 - 1000 V.

#### **3.3 WIRE SIZE SCHEDULE**

- .1 Lighting Circuits: No. 12AWG minimum.
- .2 Power Circuits: No. 12 AWG minimum, except as follows:
  - .1 No. 10 AWG for 15 A, 120 V circuits longer than 23 m.
  - .2 Refer to section 26 05 21.25 for details of wiring in patient care areas.

- .3 Motor Circuits: No. 12 AWG minimum, except as otherwise indicated on drawings or in schedules.
- .4 Feeder Circuits: as indicated on drawings or in schedules.
- .5 Fire Alarm System Circuit in accordance with manufacturers recommendations, minimum size:
  - .1 Alarm: No.14 AWG.
  - .2 Auxiliary: No.14AWG.
  - .3 Signal, single conductor: No.16AWG.
  - .4 Signal, multi-conductor: No. 18 AWG.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results - Electrical.

**1.2 REFERENCES**

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
  - .1 ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association (CSA)
  - .1 CSA C22.2No.0.4-M1982(R1993), Bonding and Grounding of Electrical Equipment (Protective Grounding).

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies

**Part 2 Products**

**2.1 MATERIALS**

- .1 Connect new electrical service equipment to existing building grounding system, modify as appropriate.
- .2 Rod electrodes: copper clad steel, 16 mm dia by 3 m long.
- .3 Conductors: bare, stranded, soft annealed copper wire, size as indicated on drawings with minimum size #6 for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.
- .4 Conductors: pvc insulated coloured green, stranded soft annealed copper wire, size as indicated on drawings with minimum size #6 for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .5 Conductors: pvc insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.
- .6 Bolted removable test links.
- .7 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
  - .1 Grounding and bonding bushings,
  - .2 Protective type clamps,
  - .3 Bolted type conductor connectors,
  - .4 Thermite welded type conductor connectors,

- .5 Bonding jumpers, straps,
- .6 Pressure wire connectors.
- .8 Wire connectors and terminations: to Section 26 05 22 - Connectors and Terminations.

## **Part 3 Execution**

### **3.1 GROUNDING INSTALLATION**

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.2No.0.4 and requirements of local authority having jurisdiction.
- .2 Ground fences to grounding system independent of station ground.
- .3 Install ground rods for building ground system,
- .4 Install connectors in accordance with manufacturer's instructions.
- .5 Protect exposed grounding conductors from mechanical injury.
- .6 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermite process or permanent mechanical connectors to ANSI/IEEE 837.
- .7 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .8 Use cable sizes as indicated on drawing minimum No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG mhd bare copper cable for taps on risers from main ground bus to equipment.
- .9 Use tinned copper conductors for aluminum structures.
- .10 Do not use bare copper conductors near un-jacketed lead sheath cables.

### **3.2 ELECTRODE INSTALLATION**

- .1 Install ground rod electrodes. Make grounding connections to station equipment using compression or welded connection.
- .2 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding equipment and connections as indicated including: metallic water main, line sky wire, neutral. Noncurrent carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cut-out bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies and outdoor lighting.

- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station

### 3.4 NEUTRAL GROUNDING

- .1 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.
- .2 Interconnect electrodes and neutrals at each grounding installation.
- .3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.
- .4 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

### 3.5 CABLE SHEATH GROUNDING

- .1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.
- .2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.
- .3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

### 3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.
- .3 Perform test before energizing electrical system.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results - Electrical.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
  - .1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as indicated to electrically conductive underground water pipe.
- .2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, type PVC.
- .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermite welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

**Part 3 Execution**

**3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point street side of water pipe. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end and load end.
- .11 Ground secondary service pedestals.

### 3.2 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install rod, plate electrodes and make grounding connections.
- .4 Bond separate, multiple electrodes together.
- .5 Use (size as indicated) copper conductors for connections to electrodes.
- .6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

### 3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to primary 600 V system.

### 3.4 EQUIPMENT GROUNDING

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

**3.5 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections sized as per the Canadian Electrical Code.

**3.6 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

**END OF SECTION**





**Part 1 General**

**1.1 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

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

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Secure equipment to masonry, tile and plaster surfaces with approved anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole malleable 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.
- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .13 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**

**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance site policies

**Part 2 Products**

**2.1 SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged 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 At least three spare terminals on each set of lugs in splitters less than 400 A.

**2.2 JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

**2.3 CABINETS**

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

**Part 3 Execution**

**3.1 SPLITTER INSTALLATION**

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.

- .3 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

### 3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase.
- .3 Colour code junction box lids to match source of supply designation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA C22.1-latest edition, Canadian Electrical Code, Part 1.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

**2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

**2.3 MASONRY BOXES**

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

**2.4 CONCRETE BOXES**

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

**2.5 CONDUIT BOXES**

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

**2.6 FITTINGS - GENERAL**

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

**2.7 SERVICE FITTINGS**

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

**Part 3 Execution**

**3.1 INSTALLATION**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

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

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings with expanded ends.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

**2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits
- .4 Threaded rods, 6mm dia., to support suspended channels.

**2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

**2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.5 FISH CORD**

- .1 Polypropylene.

## **Part 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 Co-ordinate with other trades to ensure maintenance access is maintained to equipment.
- .3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas
- .4 Use electrical metallic tubing (EMT) except in cast concrete.
- .5 Use rigid pvc conduit underground.
- .6 Use flexible metal conduit for connection to motors and transformers in dry areas, and connection to surface or recessed light fixtures
- .7 Use liquid tight flexible metal conduit for connection to motors, transformers or vibrating equipment in damp, wet or corrosive locations, machine rooms, and to moveable wall or furniture.
- .8 Use explosion proof flexible connection for connection to explosion proof motors or vaporisers.
- .9 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .10 Minimum conduit size for lighting and power circuits: 21 mm.
- .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 21 mm dia.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.



### 3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 If locating conduits behind infrared or gas fired heaters maintain a minimum 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### 3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### 3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Only install conduits in concrete floor where indicated to serve floor boxes
- .2 Locate to suit reinforcing steel. Install in centre one third of slab.
- .3 Protect conduits from damage where they stub out of concrete.
- .4 Install sleeves where conduits pass through slab or wall.
- .5 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .6 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .7 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .8 Organize conduits in slab to minimize cross-overs.
- .9 Maintain accurate as built drawings of conduit locations.

### 3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope.

### 3.6 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.

- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)

**1.3 PRODUCT DATA**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 DISCONNECT SWITCHES**

- .1 Ratings: 600 Volts for 600 volt distribution, 240 volts for 120/208 volt distribution. Unless otherwise shown, 3 pole for 3 phase, 3 wire distribution, 3 pole and solid neutral for 3 phase 4 wire distribution. Ampere ratings as shown on the drawings or to suit load requirements. For motors, use disconnect switches with HP ratings at least equal to motor HP.
- .2 Enclosures: CSA code gauge galvanized steel, hinged doors, external operating handles. Disconnect switches in dry locations shall be EEMAC-1 and EEMAC-3 where exposed to weather. Provide ON-OFF switch position indication on switch enclosure cover.
- .3 Finish: One primer coat and one finish coat on all metal surfaces, colours as per Section 26 05 00.
- .4 Switch mechanisms: Quick make and quick break action with self wiping contacts, solderless pressure lug connectors. For switches 100 amperes and over, provide non-tracking arc shrouds. All switch poles to operate together from a common operating bar. Provide for padlocking disconnect switches in "Off" position. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in ON position.
- .5 Neutral Bars: Where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.
- .6 Fuse Holders: Provide fuse holders (relocatable and suitable without adapters) on load side of switches, ampere rating equal to switch ratings, suitable for fuses specified.
- .7 Fuse Rating: Install so that rating is visible.

- .8 Identification: Provide lamacoid plate on each switch showing voltage, source of supply and load being fed, for example:

Chiller CH-1  
575V Volts  
Fed from 6MDP

## 2.2 FUSES

- .1 All fuses to be 100,000 ampere (minimum) interrupting capacity of the current limited type. In addition, fuses feeding motors to be of the time delay type. Provide one full set of spare fuses, three for each different ampere rating used, stored in suitable enclosure.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results - Electrical.

**1.2 REFERENCES**

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

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies

**Part 2 Products**

**2.1 N/A**

**Part 3 Execution**

**3.1 CABLE INSTALLATION IN DUCTS**

- .1 Install cables as indicated in ducts, all duct installations to meet standard details as indicated in Appendix B of the CSA 22.1 and as identified on the drawings.
  - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.
- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

**3.2 MARKERS**

- .1 Mark cable every 150 m along duct runs and changes in direction.
- .2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

**3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 MΩ.
- .5 Pre-acceptance tests.
  - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V Megger on each phase conductor.
  - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Remove and replace entire length of cable if cable fails to meet any of test criteria.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.2 No. 100-latest edition, Motors and Generators.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for motors. Include product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.

**1.4 CLOSEOUT SUBMITTALS**

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

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 N/A**

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

**END OF SECTION**





**Part 1 General**

**1.1 REFERENCES**

- .1 CSA C22.2 No. 60947-4-1-07, Part 4: Contactors and motor-starters.

**1.2 RELATED SECTIONS**

- .1 Refer to 23 05 03 Electric motors 600V or less
- .2 Refer to 26 29 23 Variable Speed Drives

**1.3 STARTER REQUIREMENTS**

- .1 In general, there are categories of starting equipment for three phase motors.
  - .1 Integral Mounted Starters: For this equipment, supply disconnects and wire to the terminals of the equipment.
  - .2 Separately Mounted Starters: For motors without integral mounted starters, supply disconnects and wire to the terminals of the equipment.
  - .3 Motor control centre Mounted Starters: For motors without integral mounted starters and in areas where groups of motors are located together, supply motor control centre mounted starters as indicated on the drawings and wire the equipment.
- .2 Connect manual starters for all single phase motors unless otherwise indicated on the motor schedule.
- .3 Provide interlocking between starters where required.
- .4 All starter accessories such as pilot lights, Hand-Off-Auto, Start-Stop, etc. shall be heavy duty oil tight, unless otherwise specified.

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures
- .2 Indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.

**1.5 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 26 05 00 Common Work Results
- .2 Include operation and maintenance data for each type and style of starter.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Starters: to CSA-C22.2 No. 60947-4 with AC4 utilization category.
- .2 Starter to be supplied by Eaton, Square D or Allen Bradley.

**2.2 ENCLOSURE**

- .1 All individually mounted motor starters shall be enclosed in a general purpose sheet steel enclosure unless in wet areas where they shall be watertight EEMAC 4.

**2.3 MANUAL MOTOR STARTERS**

- .1 Manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 Overload heaters, manual reset, trip indicating handle.
  - .3 Rated volts and poles to suit application.
- .2 Accessories:
  - .1 Toggle switch: heavy duty labelled as indicated.
  - .2 Indicating lights: heavy duty type and red pilot light to indicate energized motor circuit and where called for, green pilot light to indicate de-energized motor circuit. Pilot lights to be push-to-test transformer type.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

**2.4 FULL VOLTAGE NON REVERSING (FVNR) MAGNETIC STARTERS**

- .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Electronic motor overload with phase loss and unbalance protection in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.

- .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 HOA Selector switches: heavy duty labelled as indicated. Provide stop/start button for hand mode and reset button for overloads.
  - .2 Indicating lights: heavy duty type and red pilot light to indicate energized motor circuit and where called for, green pilot light to indicate de-energized motor circuit. Pilot lights to be push-to-test transformer type.
  - .3 In addition to standard, 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.
  - .4 Control transformer 600/120 V of sufficient VA to handle coil and associated controls.
  - .5 120 V holding coil.

## **2.5 CONTROL TRANSFORMER**

- .1 A control transformer of sufficient VA capacity, dry type, with primary voltage as indicated and 120V secondary, complete with primary and secondary fuses (HRC Form J), installed within starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## **2.6 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 Common Work Results.

## **2.7 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 Common Work Results Requirements.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, engraved as indicated.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

### 3.2 STARTER VERIFICATION

- .1 Field check motor starters supplied prior to commissioning equipment. As a minimum, verify the following:
  - .1 Check of control circuits
  - .2 Verify that overload relay installed is correctly sized for motor used
  - .3 Record overload relay size and motor nameplate amperage
  - .4 Visual inspection of fuses and contactors
  - .5 Ensure all connections are tight.
- .2 Measure and record motor amps, under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running
- .3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

### 3.3 OVERLOAD RELAYS

- .1 For starters provided, select solid state, adjustable overload relays in accordance with relay and motor manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during startup to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time loads, provide special overload relays to suite the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection.

### 3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 57 02 - Testing, Adjusting and Balancing of Electrical Equipment and Systems and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED WORK**

- .1 Refer to 23 05 03 Electric motors 600V or less
- .2 Refer to 26 05 82 Motor Starters to 600 V
- .3 Refer to 25 30 02 for requirements on Variable Speed Drives

**1.2 REQUIREMENTS**

- .1 Provide a complete system of wiring to motors and controls as specified herein and as shown on the drawings.
- .2 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under all contracts related to this project. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied under other contracts.
- .3 All control wiring diagrams shown on the mechanical drawings illustrate typical control circuits applicable to the equipment. Control circuits may vary with different manufacturers of equipment. Verify all control circuits with the suppliers of the equipment and make any corrections that may be required. Where line voltage controls are shown supply and install wiring between device and control equipment supplied by others.
- .4 Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.
- .5 Do not operate motors and controls until approval is obtained from the trade providing equipment.
- .6 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on drawings. Where necessary, obtain conduit locations from other trades' drawings and shop drawings.
- .7 Assist in placing in operation all mechanical equipment having electrical connections.
- .8 Provide all power wiring for all motors and 120V control wiring as indicated on the drawings.
- .9 In general, wiring for freezestats, firestats, E.P. switches, P.E. switches, dampers, temperature controllers, flow switches, solenoid valves, etc., for heating ventilating and air conditioning equipment will be under a separate contract. Provide terminations in starters and MCC's for control wiring so that starter control circuits may be extended. Where 120 volt power is required for mechanical equipment, i.e. roll type filters, refrigerated aftercoolers, control cabinets, line voltage thermostats etc. wiring to the equipment terminals is the work of this Division.
- .10 Refer to Motor Control Equipment Schedule and single line electrical drawings.

**Part 2 Products**

**2.1 3 PHASE MOTOR DISCONNECT SWITCHES**

- .1 Industrial Type "A", having quick make, quick break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use EEMAC 4 enclosures outdoors and in damp and wet locations, and EEMAC 1 in indoor dry locations. Switches to be H.P. rated, Schneider Square D, or Eaton heavy duty type.

**2.2 120 VOLT, 1 PHASE DISCONNECT SWITCHES**

- .1 Manual starter without overload relay, providing starter is marked "rated for Motor disconnect".

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Provide lockable disconnect switches adjacent to all motors in accordance with CSA 22.1.
- .2 Provide all wiring between all force flow and unit heaters and their thermostats. Install wiring between all flow switches and valve monitors and the fire alarm panel.
- .3 Where starter or VSD is not installed in an MCC, mount starter/ VSD to wall or on a Unistrut frame adjacent to the equipment being installed.
- .4 Do control wiring as indicated on the drawings and the motor control schedules.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials, components, cabinets, instruments and installation for metering and switchboard Instruments.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3 Section 26 05 00 - Common Work Results - Electrical.

**1.3 REFERENCES**

- .1 CAN3-C17-M84(R2008), Alternating - Current Electricity Metering.

**1.4 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate meter, instrument, outline dimensions, panel drilling dimensions and include cutout template.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 ELECTRICAL POWER METERING**

- .1 Electrical power metering units shall be provided as indicated.
- .2 Measurement:
  - .1 True RMS 3-phase voltage, current, and power
  - .2 Exceeds Class 0.2 revenue accuracy
  - .3 Instantaneous 3-phase voltage, current, frequency, and power factor
  - .4 Energy: bi-directional, absolute, net, time-of-use, and loss compensation
  - .5 Demand: rolling block, predicted, and thermal
  - .6 128 samples per second
  - .7 Harmonics: individual and total harmonic distortion up to the 63<sup>rd</sup>
  - .8 Sag/Swell
  - .9 Waveform recording
  - .10 K-factor for voltage and current inputs
- .3 Communications:

- .1 Waveform recording
  - .2 10Base-T or 10Base-FL Ethernet port option, as indicated, with EtherGate™ for direct data transfer for Ethernet to as many as 31 RS-485 devices.
  - .3 Two RS-485 ports, one switchable to RS-232
  - .4 One front panel optical port
  - .5 Modbus™ TRU and DNP 3.0 protocol support
  - .6 Modbus Master Support
- .4 Approved Manufacturer: Metering unit shall be approved equal to Power Measurement ION 7550.

## 2.2 TEST TERMINAL / SWITCH BLOCKS

- .1 Test blocks to facilitate the testing of current transformers, potential transformers, relays and meters to be approved equal to Type FT1. For current transformer application, the test blocks shall be equipped with bar to short the terminals when the cover is pulled out.
- .2 Test blocks shall be wired left to right R, Y, B, N when looking from front of the switchgear.

## 2.3 CURRENT TRANSFORMERS

- .1 Current transformers shall be provided as specified on the drawings and herein. Current transformers: each breaker compartment shall have provision for front-accessible mounting of up to four current transformers per phase (ANSI standard relay accuracy), two on bus side and two on cable side of circuit breaker. The current transformer assembly shall be insulated for the full voltage rating of the switchgear. There current transformers wiring shall be Type SIS #12AWG. Relaying and metering accuracy shall conform to ANSI standards.
- .2 All current transformers shall be as follows:
  - .1 Type: Indoor, window
  - .2 Voltage: Class 600V
  - .3 Voltage: BIL 10 kV full wave
  - .4 Voltage: 60Hz – 1 min – 4 kV
  - .5 Continuous current rating
  - .6 Temp rise – 55 degree C above, 30 degree C ambient
  - .7 Housing: Butyl or epoxy moulded
- .3 Primary/secondary ratio as required.
- .4 Burden and accuracy consistent with connected metering and relay devices, 60 Hertz.
- .5 The current transformers shall be capable of withstanding the available fault current and shall be wired to termination devices, which are readily accessible, and equipped with automatic disconnecting and short circuiting features.



## 2.4 POTENTIAL TRANSFORMERS

- .1 Potential transformers are draw-out mounted with primary current-limiting fuses and shall have ratio as indicated. The transformers shall have mechanical rating equal to the momentary rating of the circuit breakers and shall have metering accuracy per ANSI standards.
  - .1 Type: Indoor, window
  - .2 Voltage: Class 600V
  - .3 Voltage: BIL 10 kV full wave
  - .4 Voltage: 60Hz – 1 min – 4 kV
  - .5 Thermal Rating: 400 VA (minimum)
  - .6 Fuses: current limiting HRC primary & secondary fuses in line legs.
  - .7 Temp rise – 55 degree C above, 30 degree C ambient
  - .8 Accuracy class: 1.2 WXYZ
  - .9 Ratio – as indicated
  - .10 Equipped with disconnecting device and wired to termination blocks as indicated.
- .2 Primary/secondary ratio as required.
- .3 Burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

## 2.5 METERING INSTRUMENT TRANSFORMER CABINET

- .1 Sheet steel CSA enclosure to accommodate current transformers.

## 2.6 SHOP INSTALLATION

- .1 Ensure adequate spacing between current transformers installed on each phase.
- .2 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.
- .3 Install meters and instrument transformers in separate compartment of switchboard.

## Part 3 Execution

### 3.1 METERING INSTALLATION

- .1 Install the revenue meter alongside of the main switchboard and the instrument transformers for the revenue meter in separate compartment of switchboard.
- .2 Install meters and instruments in location free from vibration and shock.
- .3 Make connections in accordance with diagrams.
- .4 If applicable, ensure power factor corrective equipment connected on load side of meter.
- .5 Connect meter and instrument transformer cabinets to ground.

- .6 Locate meters within 9 m of instrument transformers. Use 35 mm conduit for interconnections. Use separate conduit for each set of current transformer connections, exclusive for metering.

### 3.2 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 01 - Common Work Results - Electrical and in accordance with manufacturer's recommendations.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.
- .4 Perform tests to obtain correct calibration.
- .5 Do not dismantle meters and instruments.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Provide enclosed dry type transformers as shown on the single line, note the transformers for the imaging equipment are rated for non-linear loads.
- .2 Product Data - Three Phase, Four Wire Secondary
- .3 Transformers to conform to CSA C57.12 and L2 standards, and are to be approved to CSA Code Part 2, Standard C22.2, No. 47 and CSA C9.

**1.2 RELATED SECTIONS**

- .1 Section 26 05 27 – Secondary Grounding.

**1.3 REFERENCES**

- .1 CSA-C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.
- .2 CSA-C9-M1981 (R2001) - Dry-Type Transformers.
- .3 CAN/CSA-C22.2 No. 47-M90 (R2007) - Air-Cooled Transformers (Dry Type).
- .4 NEMA ST20-1992 (R1997) - Dry Type Transformers for General Applications. (Rescinded Standard - included for information only)
- .5 CSA (Canadian Standards Association).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, power, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Test Reports: Indicate loss data, efficiency at 25%, 50%, 75% and 100% rated load, and sound level.
- .3 Installation Data: Manufacturer's special installation requirements.
  - .1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
  - .2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Section 01 78 00: Submission procedures.

- .2 Record Documentation: Record actual locations of transformers in project record documents.

## 1.7 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

## 1.8 REGULATORY REQUIREMENTS

- .1 Products: Listed and classified by CSA testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- .2 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

## Part 2 Products

### 2.1 TWO-WINDING TRANSFORMERS

- .1 Manufacturers:
  - .1 Schneider Electric; Product: Premium 30.
  - .2 Eaton; Product: Premium.
  - .3 Substitutions: Equal and approved.
- .2 Description: NEMA ST20, factory-assembled, air cooled dry type transformers ratings as indicated.
- .3 Primary Voltage: 600 volts, 3 phase for main distribution
- .4 Secondary Voltage: 208Y/120 volts, 3 phase for main distribution
- .5 Transformer quantities, voltages and ratings are shown on the single line diagram
- .6 Insulation system and average winding temperature rise for rated kVA as follows:
  - .1 16-750 kVA: Class 220 with <80 degrees C rise.
- .7 Case temperature: Do not exceed <35 degrees C rise above ambient at warmest point at full load.
- .8 Winding Taps:
  - .1 Transformers Less than 15 kVA: Two 5% below rated voltage, full capacity taps on primary winding.
  - .2 Transformers 15 kVA and Larger: shall have a minimum of four 2.5% full capacity primary taps: two above normal and two below normal for 600 V primaries.

- .9 Sound Levels: Maximum sound levels:
  - .1 0-9 kVA: 40 dB.
  - .2 10-50 kVA: 45 dB.
  - .3 51-150 kVA: 50 dB.
  - .4 151-300 kVA: 55dB.
  - .5 301-750 kVA: 60dB.
- .10 Basic Impulse Level: 10 kV for transformers less than 750 kVA
- .11 Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- .12 Mounting:
  - .1 1-15 kVA: Suitable for wall mounting.
  - .2 16-75 kVA: Suitable for wall or floor mounting depending on location.
  - .3 Larger than 75 kVA: Suitable for floor mounting.
- .13 Coil Conductors: Continuous copper windings with terminations brazed or welded.
- .14 Enclosure: NEMA ST20, sprinkler proof. Provide lifting eyes or brackets.
- .15 Isolate core and coil from enclosure using vibration-absorbing mounts.
- .16 Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

## 2.2 SOURCE QUALITY CONTROL

- .1 Section 01 43 00: Quality Assurance.
- .2 Production, test each unit according to NEMA ST20.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Install transformers to manufacturer's instructions.
- .2 Set transformer plumb and level.
- .3 Use flexible conduit, <600 mm minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- .4 Mount wall-mounted transformers using integral flanges or accessory brackets provided by the manufacturer.
- .5 Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- .6 For transformers hung from structure provide manufacturer approved spring isolators.
- .7 Provide grounding and bonding to Section 26 05 28.
- .8 Record secondary voltage when transformers are carrying approximately 75% of full load. Adjust tap connections to give a continuous secondary voltage of 120 volts phase to neutral. Set tap connections for above 120 volts rather than below.

- .9 Connections to transformers shall be in flexible conduit and shall enter the enclosure below the coils.
- .10 Before energization, keep transformers or storage room enclosures above 10°C ambient

### **3.2 FIELD QUALITY CONTROL**

- .1 Section 01 45 00: Quality Control.
- .2 Perform inspections and tests listed in NETA ACCEPT, Section 7.2.

### **3.3 ADJUSTING**

- .1 Measure primary and secondary voltages and make appropriate tap adjustments.

**END OF SECTION**

**Part 1 General**

**1.1 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers, Inc. (IEEE)
  - .1 ANSI/IEEE 386, Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
- .2 Canadian Standards Associate (CSA International)
  - .1 CAN/CSA-C22.1-12, Canadian Electrical code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CAN/CSA-C2.1, Single-Phase and Three-Phase Liquid-Filled Distribution Transformers.
  - .3 C227.4, Three-Phase, Pad-Mounted Distribution Transformers with Separable Insulated High-Voltage Connectors.
  - .4 CAN/CSA-C802.1, Minimum Efficiency Values for Liquid-Filled Distribution Transformers.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings to include:
  - .1 Front view elevation outline drawing and weight.
  - .2 Nameplate diagram.
  - .3 Ratings (on nameplate) including:
    - .1 kVA rating
    - .2 Primary and secondary voltages
    - .3 Taps
    - .4 Basic Impulse Level
    - .5 Impedance
  - .4 Product data sheets (including all specified accessories).
  - .5 Anchoring method and dimensioned foundation template.
  - .6 Protective fuse(s) time-current characteristics.
  - .7 Record of all standard type tests as per CSA C227.4 section 7.4.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for pad mounted liquid filled medium voltage transformers for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

- .2 Operations and maintenance instructions to include:
  - .1 Final as-built drawings and information for items listed in Paragraph 1.3.2, and shall incorporate all changes made during the manufacturing process.
  - .2 Wiring diagrams.
  - .3 Test report certified by the manufacturer and signed by a professional engineer or otherwise authorized person, acknowledging that all routine tests have been performed as per CSA C227.4 section 7.2.
  - .4 Installation information.
  - .5 Insulating liquid capacity and maintenance data.
  - .6 Protective fuse(s) time-current characteristics.

## Part 2 Products

### 2.1 EQUIPMENT

- .1 Three-phase, pad-mounted, distribution transformers with separable insulated high-voltage connectors: to CSA C227.4.
- .2 Load-break switch connection: radial for loop feed as specified.

### 2.2 TRANSFORMER CHARACTERISTICS

- .1 Primary voltage: 24,940V, 60Hz, wye connected, 3-phase, 3-wire, solidly grounded.
- .2 Secondary Voltage:
  - .1 As indicated, 60Hz, wye connected, 3-phase, 4-wire, grounded.
  - .2 As indicated, 60Hz, delta connected, 3-phase, 3-wire.
- .3 Capacity: as indicated at rated voltage.
- .4 Angular displacement: 0 degrees (wye-wye) or 30 degrees (delta-wye)
- .5 Transformer characteristics summary table:

Tag	Capacity	Primary		Secondary		Type
		Voltage	BIL	Voltage	BIL	
	500kVA	24,490V	125kV	600Y/347V	30kV	Loop Feed

### 2.3 ACCESORIES

- .1 Dial type top oil temperature indicator with maximum oil temperature drag pointer and two sets of independently adjustable alarm contacts.
- .2 Provide the following options for all transformers rated 3000kVA and less:
  - .1 Three (3) three-phase, two-position, oil-immersed load-break switches with provisions for padlocking. Two (2) line load-break switches (SWA & SWB), and one (1) transformer winding switch (SWT).



- .2 High-voltage off-circuit taps, 4 @ 2.5% 2-FCAN 2-RCBN, with off-circuit externally operable five position tap changer.
- .3 Mounting bracket and switch assembly for future installation of mechanical interlock installed on loop primary feed disconnect switches 'A' (SWA) and 'B' (SWB) to permit the following interlock operation:
  - .1 Interlock key removable from switch 'off' position only. Key required to switch to 'on' position and is not removable in that position.
  - .2 Lock bolt movement to be controlled by rotation of key.
- .4 Three (3) spare bayonet fuses suitable for transformer rating and grounded wye-connected high-voltage windings. Spare bayonet fuses shall be in addition to three (3) bayonet fuses installed in transformer.
- .5 A barrier between high-voltage and low-voltage compartments.
- .3 Provide the following options for all transformers rated above 3000kVA:
  - .1 High-voltage off-circuit taps, 4 @ 2.5% 2-FCAN 2-FCBN, with off-circuit externally operable five position tap changer.

## **2.4 FINISH**

- .1 Transformer finish: Equipment Green, Munsell 9 GY 1.5/2.6, to EEMAC Standard Y1-2.

## **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 INSPECTION**

- .1 Check factory made connections of transformer unit for mechanical security and electrical continuity.
- .2 Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

### **3.3 INSTALLATION**

- .1 Ensure concrete pad is fully cured before transformer is installed.
- .2 Set and secure transformer unit in place, rigid, plumb and square.
- .3 Make connections.
- .4 Connect transformer unit ground bus to system ground.
- .5 Wire two sets of contacts on test point reset fault indicators to communications cable.
- .6 Ensure care is taken to prevent contamination of liquid and components when field filling transformers.

- .7 Use only metal hose when field filling transformer with oil: do not use rubber hose.
- .8 Set taps to produce rated secondary voltage at no load.

### 3.4 TESTING

- .1 Test medium voltage transformers in accordance with Section 26 57 02 – Testing, Adjusting and Balancing of Electrical Equipment and Systems.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.31-04 (R2009), Switchgear Assemblies
  - .2 CSA C22.2 No.193-M1983(R2004), High-Voltage Full-Load Interrupter Switches.
  - .3 ANSI/IEEE C37.74-2003, IEEE standard requirements for subsurface, vault, and pad-mounted load-interrupter switchgear and fuse load-interrupter switchgear for alternating current systems up to 38KV.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 This specification governs the requirements for load interrupting SF<sub>6</sub> insulated switches for use in vaults or electrical rooms as indicated.
- .2 Switches are to be designed, tested and built per applicable sections of ANSI C37.71.
- .3 Switches to be pad-mounted style with milled steel enclosure NEWA 3R rated.
- .4 Switches to be capable of operation at 25 kV service.

**2.2 CONFIGURATION**

- .1 The switch assembly shall have four switched fault protected ways with OPEN-CLOSE-GROUND/TEST positions on each 3-pole switch group.
- .2 Operators shall be front tank accessible.
- .3 Each switch shall have bottom/top cable entry utilizing elbow and bushing entrance fittings. The bottom shall incorporate an overall metal frame and cover assembly.

**2.3 RATINGS**

- .1 Primary Voltage nominal 24,940/14,400 V Grd. Y
- .2 Maximum Primary Voltage 29,000 V
- .3 Primary Phase 3

.4	Frequency	60 Hz
.5	Switchgear BIL (full wave impulse)	125 kV
.6	AC 1 minute withstand	40 kV
.7	DC 15 minute withstand	78 kV
.8	Main bus continuous current	600 A
.9	Continuous & Load Break Current	600 A
.10	Fault closing duty-cycle 10x sym. current	12,500 A
.11	Interrupting symmetrical current	12,500 A
.12	Short circuit symmetrical current	12,500 A

## 2.4 SWITCH CONSTRUCTION

- .1 All switch components and entrances shall be assembled in a single ¼ inch thick stainless steel fully welded hermetically sealed tank with entrances internally connected by copper wire bus capable of handling momentary and continuous current duty.
- .2 Switches will be shipped factory filled with SF6 gas. Tank shall be designed to withstand 15 PSIG internal pressure and an external pressure of 14 PSIG without affecting the performance of the switch.
- .3 The following standard components shall be included:
  - .1 Filling valve
  - .2 Four (4) lifting eyes
  - .3 Viewing windows to permit inspection of the switch contacts
  - .4 Gas pressure gauge
  - .5 Corrosion resistant tank design using stainless steel and brass fasteners with no external aluminum parts.
  - .6 Tank ground provisions
  - .7 Tank finish to be two-part epoxy primer with glass flake urethane topcoat. Total finish thickness shall be not less than 4 mils.
  - .8 Padlockable operating mechanism with position indicators.
- .4 Entrances:
  - .1 Entrances to be one or more of the following rated at 125KV BIL for a 25KV BIL for a 25KV system:
    - .1 600 amp apparatus bushing, rated 40KA asymmetrical momentary, 25KA symmetrical short time current.
- .5 Switch operation:
  - .1 Each switch way is to be equipped with an internally mounted operating mechanism capable of providing quick make, quick break operation in either

switching direction. The mechanism must be capable of delivering sufficient torque and shall be provided with latches for each position to assure load interrupting, fault closing and momentary ratings. The mechanism shall use compression type springs to ensure long life and reliability. All switch positions are to be clearly identified and padlockable. Padlockable ground stops shall be provided on each switch operator.

- .2 The operating shaft shall be made of stainless steel for maximum corrosion resistance. A rotary seal using compression springs for positive, low pressure sealing shall be used around the operating shaft to maximize the service life of the seal.
- .6 Switch contacts:
  - .1 Switch contacts shall be plated, high conductivity copper alloy to assure permanent low resistance and to avoid sticking during operation.
  - .2 The contacts shall be designed to ensure arcing does not occur in the area of main current interchange and, increase contact pressure increases with current flow.
  - .3 Contacts shall have sufficient open contact separation to assure efficient arc extinction and to withstand field DC testing levels and maintain BIL levels.
  - .4 Temperature rise shall not exceed ANSI C37.71 standards for this type of device. Switch contacts shall be visible in the open and ground/test positions through viewing windows.
- .7 Mounting frame:
  - .1 The switch to be horizontal mounted with a base frame height of 1000-1200mm (to be confirmed at vendor drawing review stage). Frames shall be open bolted unpainted galvanized steel construction with removable paneled sides, front and rear.
- .8 Potential Indication:
  - .1 Potential indication with test feature to be provided with switch including LCD display. Provide all necessary accessories for potential indicator operation at 25 kV.

## 2.5 FINISH

- .1 Switch enclosure finish: Equipment Green, Munsell 9 GY 1.5/2.6, to EEMAC Standard Y1-2.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Install full load interrupter switch according to manufacturer's instructions.
- .2 Ensure concrete pad is fully cured before switch is installed.
- .3 Set and secure switch unit in place, rigid, plumb, and square.
- .4 Connect switch unit ground bus to system ground.

- .5 Complete all connections.

### 3.2 TESTING

- .1 Test medium voltage materials in accordance with Section 26 57 02 – Testing, Adjusting and Balancing of Electrical Equipment and Systems.
- .2 Each individual switch shall undergo a mechanical operation check.
- .3 AC hi-pot tested at 40 kV, 1-minute phase-to-phase and phase-to-ground and across the open contacts.
- .4 Circuit resistance to be checked on all ways.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED SECTIONS**

- .1      Section 26 05 00 - Common Work Results for Electrical
- .2      Section 26 57 01 - Starting of Electrical Equipment and System
- .3      Section 26 05 27 - Grounding – Secondary

**1.2               SYSTEM**

- .1      This section includes the distribution panelboards construction, operation and specification requirements.

**1.3               REFERENCE STANDARDS**

- .1      Details indicate components required and general arrangement, busbar spacing's, clearances, busbar mountings, cable spaces, etc., to be in accordance with CSA standards, the Consultant and electrical inspection authority.
- .2      CSA C22.2 No. 29-M1983(R2011) - Panelboard and panelboard enclosures.
- .3      CSA C22.2 No. 76-M1981(R2012) - Splitters

**1.4               COORDINATION WITH OTHER WORK**

- .1      Co-ordinate with the equipment supplier a composite system for all protection circuits.

**Part 2            Products**

**2.1               ACCEPTABLE PRODUCTS**

- .1      Eaton or engineer approved equal.

**2.2               DISTRIBUTION PANELBOARDS**

- .1      Distribution panelboards: 600/347V and 208/120V, 3-Phase, 4-wire, solid neutral. Components as indicated on drawings. All busbar clearances, busbar spacing, etc., to be in strict accordance with CSA requirements. Entire assembly and all components to be CSA approved.
- .2      Main bus shall be copper with the rating shown on the drawings. The neutral bar shall have a rating equal to the phase buses.
- .3      The main breaker or main lugs shall be rated to cable size and quantity as indicated on the single line drawing.

- .4 Cables over 100A will be aluminum, all breakers and lugs will be compatible.

## **2.3 FEEDER BREAKER SECTION**

- .1 Feeder breaker section to consist of an assembly of 3 pole moulded case circuit breakers with interrupting capacity of not less than the rating shown on the drawings

## **2.4 TRIM**

- .1 Cover around all circuit breakers held on by machine screws.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Coordinate distribution panelboards delivery and installation with building construction.
- .2 Where conduits are installed in the top or sides of the distribution panelboards waterproof fittings shall be utilized.

### **3.2 DISTRIBUTION PANELBOARDS NAMETAGS**

- .1 Provide lamicaid nametags indicating name of building, and panel source.
- .2 Provide lamicaid nametags for all breakers. Lettering on nametags to be not less than 9.5 mm high.

### **3.3 SHOP DRAWINGS**

- .1 Full shop drawings of the distribution equipment to be submitted to the Consultant for review prior to manufacture of equipment specified. Equipment to comply with intended requirements of this specification. Equipment drawings rejected at discretion of the Consultant to be altered so as to comply with requirements and intent of these specifications and to be resubmitted for checking without undue delay.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Common Work Results - Electrical: Section 26 05 00

**1.2 COORDINATION WITH POWER SUPPLY AUTHORITY**

- .1 Coordinate and meet requirements of power supply authority. Ensure availability of power when required.

**1.3 RELATED WORK**

- .1 Conduits, Conduit Fastenings and Conduit Fittings: Section 26 05 34

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies

**Part 2 Products**

**2.1 COMPONENTS**

- .1 Rigid PVC Conduit and Fittings: To Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: Aluminium, type RWU-90, to Section 26 05 21, size and number of conductors as indicated.
- .3 Markers: Markers shall be square with 25 mm letters.
- .4 Cable Lugs: Suitable for the application and use as required by the Canadian Electrical Code, approved by the electrical inspection authority and acceptable to the local supply authority.
- .5 Duct Spacers: Fabricated plastic, C.S.A. approved for use.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install cables in ducts as indicated.
- .2 Allow adequate conductor length for connection to supply by power supply authority.
- .3 Allow adequate conductor length for connection to service equipment.

### **3.2 DUCTBANK INSTALLATION**

- .1 Lay PVC ducts with configuration as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than shown by CSA details indicated on drawings, both horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight.
- .2 Slope ductbanks 150 mm per 30 m minimum to drainage point. Adjust final slopes on-site to coordinate with existing utilities.
- .3 Install on undisturbed soil where possible. Backfill required to be compacted to match structural and civil specifications.
- .4 Clean and swab all ducts. Install galvanized iron pillories in spare ducts. Cap spare ducts.

### **3.3 SERVICE INSTALLATION**

- .1 General routing to follow that indicated on drawings.
- .2 Ensure spacing on ducts is done as indicated on drawings and in accordance with diagrams in B4-4 of CSA 22.1

**END OF SECTION**

**Part 1 General**

**1.1 DESCRIPTION**

- .1 Provide a coordination/protective study and short circuit study of all equipment specified herein and submit for review.
- .2 Include the following:
  - .1 Utility overcurrent and fault protection devices.
  - .2 600V circuit breaker overcurrent and overload devices.
  - .3 347/600V MCC's and connecting feeder cables.
  - .4 600V transformer damage curves, magnetizing currents for all transformers 150 kVA and larger.
  - .5 Locked rotor currents, acceleration times and damage curves for motors 75 kW and larger.
  - .6 Any additional data necessary for successful completion of the coordination and short circuit study.
- .3 Data shall clearly state the operating time in cycles of each breaker and indicate whether the time current curves for relays are inclusive of breaker trip times or otherwise.
- .4 Prepare a summation chart showing all ratings and settings with easy reference to the appropriate curve.
- .5 Symmetrical and asymmetrical fault current calculations shall be submitted to verify the correct choice of the protective elements of the system.
- .6 Prepare a systems single line diagram on which the resultant short circuit values, device numbers and equipment ratings are shown. Ensure panel ratings match the anticipated fault levels.
- .7 Provide arc fault incident energy at each panel.
- .8 Include a list of recommended settings for each relay.

**1.2 QUALIFICATIONS**

- .1 This study shall be provided by the supplier of the distribution equipment.

**1.3 SUBMITTALS**

- .1 Submit the complete study prior to submittal of shop drawing of electrical equipment.
- .2 Calibration and verification to be conducted after approval of study.

**Part 2            Products**

**2.1            TRIPPING DEVICES**

- .1      Relay style, breaker sizes and panel ratings have been selected on a preliminary basis for design purposes. Final selection shall be based on the results of this study and shall be included at no extra cost.

**Part 3            Execution**

**3.1            DATA**

- .1      The study should provide all calculated values, breaker curves and set points for trip units

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 This section includes the main switchboard construction, operation and specification requirements.

**1.2 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results for Electrical
- .2 Section 26 05 27 - Grounding – Primary
- .3 Section 26 05 28 - Grounding – Secondary
- .4 Section 26 09 02 – Metering and Switchboard Instruments
- .5 Section 26 57 01 - Starting of Electrical Equipment and System
- .6 Section 26 57 02 - Testing, Adjusting and Balancing of Electrical Equipment and Systems

**1.3 REFERENCES**

- .1 CSA-C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.
- .2 CSA-C22.2 No. 5-09 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- .3 Details indicate components required and general arrangement, busbar spacing's, clearances, busbar mountings, cable spaces, etc., to be in accordance with CSA standards, the Consultant and electrical inspection authority.
- .4 CSA C22.2 No. 244-05 Switchboards
- .5 ULC (Underwriters Laboratories Inc.).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.
- .3 Full shop drawings of the distribution equipment to be submitted to the Consultant for review prior to manufacture of equipment specified. Equipment to comply with intended requirements of this specification. Equipment drawings rejected at discretion of the Consultant to be altered so as to comply with requirements and intent of these specifications and to be resubmitted for checking without undue delay
- .4 Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; and switchboard instrument details.
- .5 The following information shall be submitted to the Engineer:
  - .1 Co-ordination and fault study as spec section 26 24 05
  - .2 Master drawing index

- .3 Front view elevation
  - .4 Floor plan including maintenance clearances
  - .5 Top view
  - .6 Single line
  - .7 Schematic diagram
  - .8 Nameplate schedule
  - .9 Component list
  - .10 Conduit entry/exit locations
  - .11 Assembly ratings including:
    - Short-circuit rating
    - Voltage
    - Continuous current
  - .12 Major component ratings including:
    - Voltage
    - Continuous current
    - Interrupting ratings
  - .13 Cable terminal sizes, this should match the cable schedule size and quantity as a minimum.
  - .14 Product data sheets
  - .15 Minimum of 20% spare ways to fitted out for future use
- Where applicable the following additional information shall be submitted to the Engineer:
- Busway connection
  - Connection details between close-coupled assemblies
  - Composite floor plan of close-coupled assemblies
  - Key interlock scheme drawing and sequence of operations

## 1.5 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Test Reports: Indicate results of factory production tests.
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

## 1.6 CLOSEOUT SUBMITTALS

- .1 Section 01 78 00: Submission procedures.
- .2 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

- .3 Record Documentation: Record actual locations of switchboard in project record documents.

## **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Section 01 78 30: Spare Parts and Maintenance Materials.
- .2 Extra Stock Materials: Provide two (2) of each key.

## **1.8 QUALITY ASSURANCE**

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

## **1.9 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by CSA testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## **1.10 DELIVERY, STORAGE, AND PROTECTION**

- .1 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- .2 Handle to NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Switchgear assembly: to EEMAC G8-3.3 and CAN/CSA-C22.2 No.31.

### **2.2 MANUFACTURERS**

- .1 Basis of design: Eaton; Product: Pow-R-Line C switchboard, refer to single line drawing.
- .2 Substitutions: Equal and approved by engineer.

### **2.3 SWITCHBOARDS**

- .1 Secondary switchgear: 347/600V, 3-Phase, 4-wire, 800A design of uniform height, depth and width throughout. Minimum short circuit capacity of 50 kA (RMS symmetrical) sized as indicated. Components as indicated on drawings. Drawing shows general arrangement only. All busbar clearances, busbar spacing, etc., to be in strict accordance with CSA requirements. Entire assembly and all components to be CSA approved. Switchboard to be barriered with suitable buspads between sections, as required.
- .2 Switchboard and all associated equipment to be service entrance rated.
- .3 Main switchboard to be totally enclosed in sheet metal panels with front panels of dish or formed type construction. Internal barriers to be provided to separate the various components with suitable bushed ports or buspads in barriers. Provide all panels with a channel base.

- .4 Free-standing, floor-mounted, dead front, front access, indoor, steel channel sills for base mounting. Provision for future extension both sides.
- .5 The main busbar connections and risers to be clearly identified with phase markings A, B, C, and N throughout. Full capacity neutral busbar.
- .6 Switchboard bussing to be rectangular section Copper 800A capacity. All joints to be tinplated and securely bolted. All bussing to be withstand 50 kA (minimum) symmetrical short circuit at 600V.
- .7 Provide bus stabs at front of main breaker section complete with busbar drillings and cable connectors to accept aluminum cables as shown on cable schedule.
- .8 Provide drip shield sprinkler protection and gasketed doors.
- .9 Provide lock-off mechanism for each breaker and breaker space.
- .10 Main incoming section to contain:
  - .1 Insulated case power air circuit breakers and moulded case circuit breaker sized as indicated.
  - .2 Provision for installation of digital metering equipment.
- .11 Main breaker assembly shall be CSA approved as a main service entrance device for 100% of their continuous ampere rating. Circuit breaker trip unit and sensors to be integral with the circuit breakers. Protective control for the main circuit breakers shall be microprocessor based fully adjustable RMS type units having long-time, short time, instantaneous adjustable elements.
- .12 Main Section Devices: Individually mounted and compartmented.
- .13 Distribution section to contain:
  - .1 Moulded case circuit breakers sized as indicated.
  - .2 Plated copper bus, from main section to distribution sections including vertical bussing.
- .14 Distribution Section Devices: Individually mounted, blanked off spaces for future units.
- .15 Auxiliary Section Devices: Group mounted
- .16 Blanked off spaces for future units.
- .17 Ventilating louvres: sprinkler proof.
- .18 Bus Material: Copper, standard size.
- .19 Bus Connections: Bolted, Welded, accessible from front & rear only for maintenance.
- .20 Ground Bus: Extend length of switchboard.



- .21 Breaker fault rating must match switchgear rating as a minimum.
- .22 Moulded Case Circuit Breakers: CAN/CSA-C22.2 No. 5, integral thermal and instantaneous magnetic trip in each pole.
- .23 Include shunt trip, undervoltage release and interlocks where indicated.
- .24 Moulded Case Circuit Breakers with Current Limiters: CAN/CSA-C22.2 No. 5, moulded case circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole. Include shunt trip, undervoltage release and interlocks where indicated.
- .25 Solid-State Moulded Case Circuit Breakers: CAN/CSA-C22.2 No. 5, with electronic sensing, timing and tripping circuits for adjustable current settings.
- .26 Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.
- .27 Enclosure: Sprinkler proof.
  - .1 Align sections at front only.
  - .2 Switchboard Height: manufacturers standard, excluding floor sills, lifting members and pull boxes.
  - .3 Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
- .28 Mimic Bus: Show bussing, connections and devices in single line form on the front panels of the switchboard using black colour, fastened flat against the panel face with screws.
- .29 Provide spare ways as indicated on breaker schedule. Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated in the breaker schedule.

## 2.6 POWER CIRCUIT BREAKER

- .1 Power circuit breaker: to ANSI/IEEE C37.13 and CSA 22.2 No.5.
- .2 Fixed type, 600V class.
  - .1 Continuous current rating: as indicated.
  - .2 Trip rating: as indicated.
  - .3 Interrupting rating: 42kA, rms symmetrical.
- .3 Protective devices shall be 3 pole fixed low-voltage power circuit breakers. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.
- .4 Sensor and plug standard trip ratings shall be 200, 250, 300, 400, 600 and 800 amperes.

- .5 Standard features include on-off indicator, spring charged/discharged indicator, manual charge handle, and manual control pushbuttons.
- .6 Power circuit breakers shall be manually operated (MO) or electrically operated (EO) as indicated on the drawings.
- .7 Electrically operated breakers shall be complete with control switch, breaker contact position status, 120 Vac motor operator; the charging time of the motor shall not exceed 6 seconds, and emergency manual spring charging handle with anti-pump provisions.
- .8 All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, UL 1066 and NEMA SG-3 standards. The circuit breakers shall carry a cUL label.
- .9 Power circuit breakers shall be provided with trip unit:
  - .1 Each low-voltage power circuit breaker shall be equipped with a solid state tripping system consisting of self-powered RMS sensing relay with phase current sensors, microprocessor-based trip device, and self-powered direct acting shunt trip. Current sensors shall provide operation and signal function. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker.
  - .2 The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.
  - .3 Complete system selective coordination shall be provided by the addition of individually adjustable time/current curve shaping 120Vas solid-state elements. All power circuit breakers shall have the following elements:
    - .1 Adjustments for long delay pickup and time.
    - .2 Individual adjustments for short delay pickup and time, and include I<sup>2</sup>t settings.
    - .3 Adjustable instantaneous pickup. The instantaneous element shall be capable of being defeated or turned off.
  - .4 The trip unit shall provide zone interlocking for the short-time delay functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with not intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after a preset time delay. Factory shall wire zone interlocking for the power and molded case circuit breakers within the switchgear.
  - .5 The trip unit shall be provided with a maintenance mode switch to enable preset accelerated instantaneous override trip settings to reduce arc flash energy. The trip units shall indicate when it is in maintenance mode.
- .10 Optional features

- .1 All power circuit breakers shall have the following optional features:
  - .1 120Vac shunt trip
  - .2 120Vac spring release
  - .3 Zone interlocking
  - .4 Breaker status auxiliary switches, 4 N.O. and 4 N.C. contacts
  - .5 Overcurrent trip alarm switch
  - .6 Lockout devices
  - .7 Padlocking provisions
- .2 All 'normal' power circuit breakers as indicated on drawings shall have the following optional features in addition to those specified above:
  - .1 Under-voltage tripping device (27) with field adjustable time delay (2) adjustable from 0.1 to 20 seconds and capacitor trip power supply.
  - .2 Electrical (motor) operator (EO) with local 'Open/Close' and remote 'Close capability.
  - .3 Zone interlocking to delay tripping of main breaker (BM) until normal breaker \*BN) has cleared fault condition.
  - .4 Second 120Vac shunt trip.
  - .5 Control relay (CR)
  - .6 3-way selector switch (43, OP-AUTO-CL) with spring return to 'Auto' position.

## **2.6 TRIM**

- .1 Sectionalized.
- .2 Cover around all circuit breakers held on by machine screws.

## **2.4 SOURCE QUALITY CONTROL**

- .1 Section 01 43 00: Quality Assurance.
- .2 Shop inspect and test switchboard according to NEMA PB 2.
- .3 Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least seven (7) days before inspections and tests are scheduled.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Section 01 70 00: Examination and preparation.

- .2 Verify that field measurements are as instructed by manufacturer.

### **3.2 INSTALLATION**

- .1 Install switchboard in locations shown on Drawings, according to CSA-C22.1.
- .2 Tighten accessible bus connections and mechanical fasteners after placing switchboard to manufacturers torque specifications.
- .3 Coordinate main switchboard delivery and installation with building construction.
- .4 Where conduits are installed in the top or sides of the switchboard waterproof fittings shall be utilized.
- .5 Nameplates:
  - .1 Black plate, white letters, size to match existing.
  - .2 Complete switchgear labelled with name and voltage.
  - .3 Main breaker labelled: "Main Breaker".
  - .4 Distribution units labelled: as indicated.
- .6 Test service entrance board and components in accordance with Section 26 57 02 - Testing, Adjusting and Balancing of Electrical Equipment and Systems

### **3.3 FIELD QUALITY CONTROL**

- .1 Section 01 45 00: Field inspection testing.
- .2 Perform inspections and tests listed in NETA ATS, Section 7.1.

### **3.4 ADJUSTING**

- .1 Adjust all operating mechanisms for free mechanical movement.
- .2 Tighten bolted bus connections to manufacturer's written instructions.
- .3 Adjust circuit breaker trip and time delay settings to values as instructed by Consultant and/or coordination study.

### **3.5 CLEANING**

- .1 Section 01 74 00: Cleaning and waste processing.
- .2 Touch up scratched or marred surfaces to match original finish.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Distribution panelboards.
- .2 Branch circuit panelboards.

**1.2 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results for Electrical
- .2 Section 26 05 28 - Grounding – Secondary
- .3 Section 26 57 01 - Starting of Electrical Equipment and System

**1.3 REFERENCES**

- .1 CSA-C22.1-12 - Canadian Electrical Code, Part I (22nd Edition ), Safety Standard for Electrical Installations.
- .2 CSA-C22.2 No. 29-11 - Panelboards and Enclosed Panelboards.
- .3 Details indicate components required and general arrangement, busbar spacing's, clearances, busbar mountings, cable spaces, etc., to be in accordance with CSA standards, the Consultant and electrical inspection authority.
- .4 CSA C22.2 No. 29-M1983(R2011) - Panelboard and panelboard enclosures.
- .5 CSA C22.2 No. 76-M1981(R2012) - Splitters

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Section 01 78 00: Submission procedures.
- .2 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- .3 Record Documentation: Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Section 01 78 30: Spare Parts Maintenance Materials
- .2 Extra Stock Materials: Provide two (2) of each panelboard key.

**1.8 QUALITY ASSURANCE**

- .1 Products of This Section: Manufactured to ISO 9000 ISO 14000 certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

**1.9 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by CSA as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 DISTRIBUTION PANELBOARDS (CDP and MDP panels not covered in Switchgear section)**

- .1 Manufacturers:
  - .1 Eaton; Product: Pow-R-Line 3A.
  - .2 Schneider Electric; Product: i-Line.
  - .3 Substitutions: Equal and approved
- .2 Distribution panelboards: 208/120V, 3 Phase, 4-wire, with solid neutral. Components as indicated on drawings. All busbar clearances, busbar spacing's, etc., to be in strict accordance with CSA requirements. Entire assembly and all components to be CSA approved.
- .3 Main bus shall be copper with the rating shown on the drawings. The neutral bar shall have a rating equal to the phase buses.
- .4 The main breaker or main lugs shall be rated to accept aluminum insulated conductors.
- .5 Service Conditions:
  - .1 Temperature: <30 degrees C.
  - .2 Altitude: =<1000 m.
- .6 Provide copper ground bus in each panelboard.
- .7 Minimum integrated short circuit rating: 22KA.
- .8 Moulded Case Circuit Breakers: CSA-C22.2 No. 5, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- .9 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- .10 Enclosure: CSA-C22.2 No. 5, Sprinkler proof, cabinet box.
- .11 Cabinet Front: Surface type, fastened with hinged door with flush lock, metal directory frame finished in manufacturer's standard gray enamel.

- .12 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .13 Two keys for each panelboard and key all panelboards alike.
- .14 Trim with concealed front bolts and hinges.
- .15 Trim and door finish: baked grey enamel and as per colour schedule.
- .16 Provide minimum of 20% spare ways.

## 2.2 TRIM

- .1 Cover around all circuit breakers held on by machine screws

## 2.3 BRANCH CIRCUIT AND LIGHTING PANELBOARDS

- .1 Manufacturers:
  - .1 Eaton; Product: Pow-R-Line 2.
  - .2 Schneider Electric; Product: NF or NQ.
  - .3 Substitutions: Equal and approved
- .2 Description: CSA-C22.2 No.29, circuit breaker type, lighting and appliance branch circuit panelboard.
- .3 Panelboard Bus: Copper, ratings to match incoming breaker (minimum) as indicated on single line. Provide copper ground bus in each panelboard. Provide a fully rated neutral bus.
- .4 Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panelboards; 22,000 amperes rms symmetrical for 600 volt panelboards or as indicated.
- .5 Breakers: to be moulded case thermal magnetic, nonadjustable thermal magnetic trip, non-interchangeable trip unit, single, two and three pole, 347/600 V, with trip free position separate from "On" or "Off" positions. Two and three pole breakers to have common simultaneous trip, and able to be located in any circuit position within the panelboard. Minimum interrupting rating of breakers to be as follows:
  - .1 347/600 V panelboards - 22,000 A at 600 V.
  - .2 Allow for 20A single pole circuit breakers for all circuits (this will be updated at a future point with completed panel schedules).
  - .3 Provide a minimum of two (2) lock-on devices for each panelboard
- .6 Breakers: to be moulded case thermal magnetic, nonadjustable thermal magnetic trip, non-interchangeable trip unit, single, two and three pole, 120/208 V, with trip free position separate from "On" or "Off" positions. Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard. Minimum interrupting rating of breakers to be as follows:
  - .1 120/208 V panelboards - 10,000 A at 250 V.
  - .2 Allow for 20A single pole circuit breakers for all circuits (this will be updated at a future point with completed panel schedules, prior to ordering).
- .7 Provide a minimum of two (2) lock-on devices for each panelboard
- .8 Enclosure: CSA-C22.2 No. 5, sprinkler proof.
- .9 Cabinet Box: dimensions manufacturers' standard.

- .10 Cabinet Front: Flush in occupied spaces, trim should cover drywall edge, surface in non-occupied spaces in cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- .11 Panels on Conditional power to be 84 ckt's, panels on vital and delayed vital to be 84 ckt's ratings to match incoming breaker as a minimum.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install panelboards to CSA-C22.1 manufacturer's written instructions.
- .2 Install panelboards plumb. Install recessed panelboards flush with wall finishes.
- .3 Height: <1 800 mm to top of panelboard; install panelboards taller than 1 800 mm with bottom no more than 100 mm above floor.
- .4 Provide filler plates for unused spaces in panelboards.
- .5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- .6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- .7 Provide spare conduits out of each recessed panelboard to an accessible location above ceiling Minimum spare conduits: 2 empty 1 inch. Identify each as SPARE and cap ends.
- .8 Ground and bond panelboard enclosure according to Section 26 05 26.

### **3.2 FIELD QUALITY CONTROL**

- .1 Section 01 45 00: Quality Control
- .2 Perform inspections and tests listed in NETA ATS Section 7.4 for switches, Section 7.5 for circuit breakers.

### **3.3 ADJUSTING**

- .1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20% of each other.
- .2 Maintain proper phasing for multi-wire branch circuits.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED WORK**

- .1 Section 26 05 00 - Common Work Results - Electrical.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.
  - .2 CSA C22.2 No. 254-05 (R2010) Motor Control Centres (Tri National Standard, with UL 845 and NMX-J-353-ANCE)

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.
- .3 Manufacturer Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

**1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures .
- .2 Indicate:
  - .1 Outline dimensions
  - .2 Configuration of identified compartments.
  - .3 Floor anchoring method and dimensioned foundation template.
  - .4 Cable entry and exit locations.
  - .5 Dimensioned position and size of busbars and details of provision for future extension.
  - .6 Schematic and wiring diagrams.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Site policies.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include data for each type and style of starter.

**1.7 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

**Part 2 Products**

**2.1 SUPPLY CHARACTERISTICS**

- .1 600V, 60Hz, 3 phase, 4 wire.

**2.2 GENERAL DESCRIPTION**

- .1 Compartmentalized vertical sections with common power busbars.
- .2 Floor mounting, free standing, enclosed dead front.
- .3 Indoor CSA 1 enclosure, front mounting.
- .4 Class I Type A .

**2.3 VERTICAL SECTION CONSTRUCTION**

- .1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.
- .2 Each vertical section divided into compartment units, minimum 305 mm high.
- .3 Each unit to have complete top and bottom steel plate for isolation between units.
- .4 Horizontal wire ways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.
- .5 Vertical wire ways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.
- .6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.
- .7 Incoming cables to enter at top or bottom with terminals.
- .8 Provision for outgoing cables to exit via top or bottom [with terminals].
- .9 Removable lifting means.
- .10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.
- .11 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

## 2.4 SILLS

- .1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

## 2.5 BUSBARS

- .1 Main horizontal and branch vertical, three phase high conductivity copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:
  - .1 Main horizontal busbars: To match incoming breakers as shown on drawings .
  - .2 Branch vertical busbars: 200 A.
  - .3 20% spare capacity for future use
- .2 Branch vertical busbars for distribution of power to units in vertical sections.
- .3 No other cables, wires, equipment in main and branch busbar compartments.
- .4 Brace busses to withstand effects of short-circuit symmetrical current as shown on the drawings.
- .5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

## 2.6 GROUND BUS

- .1 Copper ground bus extending entire width of motor control centre.
- .2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

## 2.7 STARTER UNIT COMPARTMENTS

- .1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.
- .2 Unit mounting:
  - .1 Engaged position - unit stabbed into vertical bus.
  - .2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.
  - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
  - .4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.
- .3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 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. Provide adjustable overload relays, no heaters allowed.
- .6 Pushbuttons, H-O-A switch and indicating lights (On and Off) mounted on door front.
- .7 Control transformer for each unit.
- .8 Devices and components by one manufacturer to facilitate maintenance.
- .9 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

## **2.8 WIRING IDENTIFICATION**

- .1 Provide wiring identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

## **2.9 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
  - .1 Motor control centre main nameplate: size No. 7, engraved.
  - .2 Individual compartment nameplates: size No. 5, engraved as indicated.

## **2.10 FINISHES**

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Paint motor control centre exterior light gray and interiors white.

## **2.11 SOURCE QUALITY CONTROL**

- .1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.
- .2 Manufacturer to provide proof of quality control program in accordance with CAN/CSA-Q9000.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.
- .2 Make field power and control connections as indicated.
- .3 Ensure overload relays are properly adjusted for the load.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hour period.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 REFERENCES**

- .1 The Munsell System of Colour Notation.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- .2 Entire enclosure capable of withstanding maximum impact force of 86 MN/m<sup>2</sup> area without rupture of material.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- .4 Enclosure equipped with hot dipped galvanized mounting rails 1m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.
  - .1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
  - .2 Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .5 Cover: tamperproof, bolt-on, domed to shed water.
- .6 Door: minimum 1 m wide, hinged, 3 point latching, with padlocking means.
- .7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, vermin.
- .8 Enclosure construction such as to allow any configuration of single or ganged enclosures.
- .9 Enclosure capable of being shipped in knocked-down condition.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.
- .2            Mount equipment in enclosure.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3 Section 26 05 00 - Common Work Results - Electrical.

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA-C22.2 No.55-M1986(July 2001) Special Use Switches.
  - .4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

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

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 SWITCHES**

- .1 20 A, 120 V, single pole, double pole, three-way, four-way switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
- .2 Manually-operated general purpose ac switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 White Decora style in all public areas, toggle style elsewhere

- .3 Fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 All line voltage switches of one manufacturer throughout project.
- .5 Illuminated Switches where indicated to be lit in the off position.

## 2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
  - .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer, specification grade.
- .4 GFCI 5-15R or 5-20R receptacles to be provided where indicated, devices to have the following features:
  - .1 Class A 5mA trip
  - .2 White urea moulded housing.
  - .3 Suitable for No. 10 AWG for back and side wiring.
  - .4 Feed through
  - .5 LED trip indicator

## 2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
  - .1 Refer to Lighting Control Section 26 09 24 for lighting control devices and switches.
  - .2 20A T Slot outlets will be specification grade, 20A 125V, 2 pole 3 wire self grounding. Back and side wired, white.

## 2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 White Nylon or polycarbonate for wiring devices mounted in flush-mounted outlet box.

- .5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
- .8 In use covers for receptacles mounted outdoors.

### Part 3 Execution

#### 3.1 INSTALLATION

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover plates:
  - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials for molded-case circuit breakers and circuit breakers.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 24 16 – Panelboards

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA-C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, eleventh edition, and NMJ-J-266-ANCE-2010).

**1.4 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers with minimum interrupting capacity of kA symmetrical (rms) to match panel rating.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.

**Part 2 Products**

**2.1 BREAKERS GENERAL**

- .1 Molded-case circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on molded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient..
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips .
- .6 Circuit breakers to have minimum kA symmetrical rms interrupting capacity that matches the panel rating as indicated on the drawings.

**2.2 ELECTRONIC TRIP BREAKERS**

- .1 Molded case circuit breaker above 200A to operate automatically by means of electronic trip unit with adjustable for continuous rating and long and short time adjustment and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection

**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 and instantaneous tripping for short circuit protection.

**2.4 FEATURES**

- .1 Include:
  - .1 locking device

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
  - .2 ANSI C72.11, High-frequency Fluorescent Lamp Ballasts
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM)
  - .1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 United States of America, Federal Communications Commission (FCC)
  - .1 FCC (CFR47) EM and RF Interference Suppression.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval and review by Engineer.
- .3 Photometric data to include: VCP Table and spacing criterion.
- .4 Submit manufacturer's technical data for all fixtures, lamps, ballasts and drivers.
- .5 Information to be included:
  - Operating frequency and voltage
  - THD, power factor
  - Wattage
  - Colour Temp
  - Colour rendering index

## 1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with site policies.

## Part 2 Products

### 2.1 LED DRIVERS

- .1 LED Driver shall be installed inside an electrical enclosure.
  - .1 Wiring inside electrical enclosure shall comply with 600V/105°C rating or higher.
  - .2 Class A sound rating.
  - .3 Minimum operating ambient temperature of -40°C.
  - .4 Life expectancy of 50,000 hours at Tcase of  $\leq 70^{\circ}\text{C}$ .
  - .5 Life expectancy of 100,000 hours at Tcase of  $\leq 62^{\circ}\text{C}$ .
  - .6 Maximum self rise of  $25^{\circ}\text{C}$  in open air without heat sink.
  - .7 LED Driver maximum allowable case temperature is  $75^{\circ}\text{C}$  – see product label for measurement location
  - .8 LED Driver reduces output power to LEDs if maximum allowable case temperature is exceeded.
  - .9 LED Driver has a failure rate  $\leq 0.01\%$  per 1,000 hours at Tcase  $\leq 70^{\circ}\text{C}$ .
  - .10 LED Driver has a failure rate of  $0.01\% - 0.02\%$  per 1,000 hours at Tcase of  $70^{\circ}\text{C} - 80^{\circ}\text{C}$ .
  - .11 LED Driver tolerates sustained open circuit and short circuit output conditions without damage.
  - .12 The maximum available output current and power parameters of the driver should meet the limitation for Class 2 inherently limited in accordance with the Canadian Standard CSA C22.2 No. 223.

### 2.2 FINISHES

- .1 Baked enamel finish:
  - .1 Conditioning of metal before painting:
    - .1 For corrosion resistance conversion coating to ASTM F1137.
    - .2 For paint base, conversion coating to ASTM F1137.
  - .2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel to give smooth, uniform appearance, free from pinholes or defects.
  - .3 Reflector and other inside surfaces finished as follows:
    - .1 White, minimum reflection factor 85%.
    - .2 Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-ometer not to exceed 0.05.
    - .3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.
    - .4 Gloss not less than 80 units as measured with Gardner 60E gloss meter.



- .5 Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.
- .2 Alzak finish:
  - .1 Aluminium sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:
    - .1 Finish for mild commercial service, minimum density of coating  $7.8 \text{ g/m}^2$ , minimum reflectivity 83% for specular, 80.5% for semi-specular and 75% for diffuse.
    - .2 Finish for regular industrial service, minimum density of coating  $14.8 \text{ g/m}^2$ , minimum reflectivity 82% for specular and 73% for diffuse.
    - .3 Finish for heavy duty service, minimum density of coating  $21.8 \text{ g/m}^2$ , minimum reflectivity 85% for specular, 65% for diffuse.

## 2.3 LUMINAIRES

- .1 Refer to Luminaire Schedule on drawings
- .2 Provide all mounting kits and accessories to suite fitting and location.
- .3 Provide dimming drivers where required and ensure coordination with lighting control equipment.
- .4 Provide drywall mounting kits where required to match ceiling types indicated on drawings
- .5 All fixture manufacturers are shown for design intent, other fixtures and manufacturers are acceptable subject to review by the client and consultant.
- .6 Any alternative fixtures must match or exceed the schedule fixtures.
- .7 Provide LED Lamps throughout do not substitute for fluorescent.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.

### 3.2 WIRING

- .1 Install recessed luminaires to permit removal from below, unless noted otherwise, to gain access to outlet or pre-wired luminaires box. Make final connection from boxes to luminaires with flexible conduit. AC-90 (with No. 12 AWG conductors) may be used but shall be independently supported, (e.g. not from connectors), and have anti-shorts installed. With either type of connection method, the length of the flexible connection shall not exceed 3 meters.

### 3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling. Support luminaires from ceiling grid in accordance with local inspection requirements.

**3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to ceiling grid lines.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials and installation for emergency lighting systems.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3 Section 26 05 21 - Wires and Cables (0-1000 V).
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**1.3 REFERENCES**

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

**1.4 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Engineer.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

**1.6 WARRANTY**

- .1 For batteries, the 12 months warranty period is extended, with no-charge replacement during the first 5 years.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, ac.
- .3 Output voltage: 24 V dc, to be confirmed on-site.
- .4 Operating time: 60 min.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED 5 W, minimum
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: White
- .13 Auxiliary equipment:
  - .1 Test switch.
  - .2 Time delay relay.
  - .3 Battery disconnect device.
  - .4 AC input and DC output terminal blocks inside cabinet.
  - .5 Cord and plug connection for AC.
  - .6 RFI suppressors.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

END OF SECTION



**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Code for Preferred Packaging
- .2 Canadian Standards Association (CSA)
  - .1 CSA C22.2 No.141- M1985(R1992), Unit Equipment for Emergency Lighting.
  - .2 CSA C860- 96, Performance of Internally-Lighted Exit Signs.
- .3 National Fire Protection Association (NFPA) requirements

**1.2 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittals.
- .2 Submit product data sheets for exit lights. Include product characteristics, performance criteria, physical size, limitations and finish.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with site policies.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products**

**2.1 STANDARD UNITS**

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.
- .2 Housing for recessed ceiling-mount, the unit shall come standard with a flat trim plate of die-cast aluminum with finish, a back box of galvanized steel, and a hardware kit for back box installation recessed in finished ceiling.
- .3 Extruded one-piece aluminum housing.
- .4 Lamps: energy efficient LED.
- .5 Operation: 25 years of continuous operation without relamping.
- .6 Green running man pictogram, with directions arrows as required.

- .7 Face plate to remain captive for relamping.
- .8 Multi – KO mounting not accepted.
- .9 Acceptable product or material: Lumacell LA series complete with Nexus RF accessories, or approved equivalent.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install exit lights.
- .2 Connect fixtures to exit light emergency circuits.

**END OF SECTION**



**Part 1 General**

**1.1 Related Work**

- .1 Section 26 57 02 - Testing, Adjusting and Balancing of Electrical Equipment and Systems
- .2 Section 26 57 03 - Electrical Equipment and Systems Demonstration and Instruction

**1.2 Coordination**

- .1 Coordinate starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:
  - .1 Electrical equipment and systems.
  - .2 Other equipment and systems supplied under this scope.
- .2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

**Part 2 Products**

**2.1 (Not used)**

**Part 3 Execution**

**3.1 Energizing Electrical System**

- .1 Prior to energizing main electrical system:
  - .1 Verify supply authority voltage and phase rotation.
  - .2 Close and open all devices to ensure proper mechanical operation.

**3.2 Energizing Equipment**

- .1 Prior to energizing equipment provided under other Sections ensure all testing and installation is complete.
- .2 Confirm equipment nameplate data with characteristics of power supply.

**END OF SECTION**



**Part 1 General**

**1.1 Intent**

- .1 Provide commissioning of electrical equipment and systems in accordance with this and related sections.
- .2 Except where otherwise specified, arrange and pay for testing, adjusting, balancing and related requirements specified herein and related to the equipment supply scope.
- .3 If test results do not conform to applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.
- .4 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.
- .5 All site tests of major plant shall be witnessed by persons designated by the Owner, who shall also sign the test documentation.
- .6 Submit procedures proposed in writing for approval two (2) weeks prior to test for all major plant.

**1.2 Related Sections**

- .1 Section 26 05 00 - Common Work Results - Electrical
- .2 Section 26 57 01 - Starting of Electrical Systems and Equipment

**1.3 Manufacturer's Production Test Records**

- .1 If requested, submit copies of production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment.

**1.4 Site Testing Reports**

- .1 Log and tabulate test results on appropriate test report forms.
- .2 Submit forms to Consultant for approval prior to use.
- .3 Submit completed test report forms as specified, immediately after tests are performed.

**1.5 Reference Documents**

- .1 Perform tests in accordance with:
  - .1 The Contract Documents
  - .2 Requirements of authorities having jurisdiction
  - .3 Manufacturer's published instructions
  - .4 Applicable CSA, IEEE, IPCEA, EEMAC and ASTM standards

- .2 If requirements of any of the foregoing conflict, notify Consultant before proceeding with test and obtain clarification.

#### **1.6 Manufacturer's Site Services**

- .1 Arrange and pay for the site services of appropriately qualified manufacturer's representatives where site testing, adjusting, or balancing of electrical equipment or systems' performed by Manufacturer's representatives is:
  - .1 Fire Alarm System
  - .2 Transformers
  - .3 Electrical Switchboards and Panelboards
  - .4 Motor Control Centres
  - .5 Metering
  - .6 Otherwise required to ensure that electrical equipment and systems are operation in full compliance with the Contract Documents.

#### **1.7 Sequencing and Scheduling**

- .1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.
- .2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

#### **1.8 Contractor and Manufacturer Reports**

- .1 Arrange for Manufacturer to submit copies of all production test records for production test required by EEMAC and CSA standards for manufactured electrical equipment to the Consultant prior to shipping.
  - .1 Minimum of 5 years experience in the maintenance and testing of electrical equipment and systems at all voltage levels up to and including 25kV class.
  - .2 Personnel involved in power systems testing shall have proven experience in the use of the following test equipment:
    - .1 Insulation resistance testers (Meggers) at 250V, 1000V, and 25000V
    - .2 DC hipot test equipment up to 100 kV DC.
    - .3 Capacitance bridges.
    - .4 Transformer ratio test equipment.
    - .5 Contact resistance testers (doctor).
    - .6 Protective relay test equipment of current injection type for testing and calibration of induction disc and solid state protective devices.
  - .3 The Contractor will be responsible for appointing a verification agent to direct verification of fire alarm system in accordance with:
    - .1 CAN/ULC-S537, "Standard for the Verification of Fire Alarm System Installations".
    - .2 Requirements of authority having jurisdiction in the province of Saskatchewan.

**Part 2 Products**

**2.1 Test Equipment**

- .1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

**Part 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 and 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 manufacturer's 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.
  - .6 Function test secondary transfer schemes (if any) by simulated loss of incoming feeders to ensure proper operation.
- .3 Instrumentation:
  - .1 Test and calibrate all meters, digital metering units in accordance with manufacturer's bulletins.
  - .2 Check calibration on all ammeters using 5 Amp secondary injection test.
  - .3 Perform wiring checks as listed above.

- .4 Breakers - Moulded Case Breakers 150 Amp Frame and Larger:
  - .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, panel manufacturer to test units as follows:
    - .1 Inspect and test as per most recent installation and maintenance brochure.
    - .2 Perform tests using relay test unit as applicable, with corresponding test instruction.
    - .3 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.
    - .4 Check C/T and P/T ratios and compare to coordination data.

### 3.3 CDP and Final branch Panel Boards

- .1 Enclosure:
  - .1 Visually inspect.
  - .2 Torque all bus connections.
  - .3 Breakers - moulded Case Breakers 150 Amp Frame and Larger:
    - .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 and compare to coordination data.

### 3.4 Motor Control Centres

- .1 Visually inspect and clean.
- .2 Remove starter covers to expose all bussing and confirm phasing continuity and rotation and identification of bussing.
- .3 Torque test all bus connections and cable terminations to manufacturer's recommended levels.
- .4 After bus connections have been torque tested, apply red lacquer to bolted connections.
- .5 Megger test - phase to phase and phase to ground.
- .6 Ductor test bus connections and starter/feeder assemblies as follows:
  - .1 Across starter assembly with disconnect and contactor contacts closed (from line side of disconnect to load side of contactor).
  - .2 From source connection at MCC to each starter disconnect line terminals to check MCC bussing and stab connections.
- .7 Ensure all starters are properly labelled prior to testing.

### 3.5 Protective Relaying

- .1 Set and test protective relays to settings provided in coordination study.
- .2 The manufacturer's instructions for specific relay must always be used for information concerning connections, adjustments, repairs, timing and data.
  - .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 instructions.
  - .3 If 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 the trip operation.
  - .5 Check C/T and P/T ratios and compare to coordination data.

### 3.6 Medium Voltage Cables

- .1 Inspect for physical damage. Visually inspect jacket and insulation condition.
- .2 Inspect for shield grounding, cable support, bending radius and termination.
- .3 Verify conductor shielding is grounded.
- .4 Verify compression connections are installed in compliance with manufacturer's recommendation.

- .5 Verify cable termination installed is in compliance with manufacturer's recommendation.
- .6 Inspect for proper phase identification and arrangement installed is in compliance with Contract Documents.
- .7 Perform shield continuity test and record results.
- .8 Perform insulation tests, using 250 VDC for minimum 60 sections (each conductor with others and shield grounded) and record results.
- .9 Record relative humidity and temperature.
- .10 Apply a low frequency high potential test in at least five equal increments until maximum test voltage is reached, in accordance with the manufacturer's recommendation. Record dc leakage current at each step. Apply grounds for a time period adequate to drain all insulation and stored charge. Record results.

### **3.7 Grounding System**

- .1 Verify ground system is in compliance with Contract Documents.
- .2 Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4-M1982 and Canadian Electrical Code.
- .3 Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, and system neutral and record results.
- .4 Contractor to correct the resistance between the main grounding electrodes and ground which is measured greater than 5 ohms.
- .5 Investigate point-to-point resistance values which exceed 0.5 ohm.

### **3.8 Load Break Switches**

- .1 Inspect for physical and mechanical condition.
- .2 Perform mechanical operator tests in accordance with manufacturer's instructions.
- .3 Check blade alignment, clearances and arc interrupter operation.
- .4 Perform insulation resistance tests on each pole, phase-to-phase and phase-to-ground, for one (1) minute and record results.
- .5 Perform a DC high potential test on each pole with switch closed and record results. Test each pole to ground with other poles grounded for one (1) minute.
- .6 Perform contact resistance test and record results across each switch blade and fuse holder.
- .7 Inspect for shield grounding, cable support, bending radius and termination.
- .8 Verify conductor shielding is grounded.



### 3.9 Factory Testing of Transformer

- .1 Each transformer shall be completely factory tested and the results certified, proving the performance of the units to provide capacities as listed in these specifications.
- .2 Factory tests for each transformer to include:
  - .1 Resistance measurements of all windings.
  - .2 Ratio test at rated connection and on all taps.
  - .3 Polarity and phase relation tests
  - .4 Audible sound level tests.
  - .5 No load loss at rated voltage and losses at 25%, 50%, 75% and 100% load.
  - .6 Exciting current at rated voltage.
  - .7 Laboratory test of insulating liquid.
  - .8 Impedance.
  - .9 Applied potential test.
  - .10 Induced potential test.
  - .11 B.I.L. test.
  - .12 Hi-pot test.
  - .13 Heat run, temperature rise tests on each transformer.
- .3 Submittals
  - .1 Submit for review, shop drawings of all items specified in this section in accordance with "Shop Drawings" in the General Conditions.
  - .2 At completion of work the prior to final acceptance, provide maintenance manuals for all items specified in this section.
- .4 Site Testing
  - .1 After the transformers have been set in place, prior to energizing, verify that the transformers have been installed and tested in accordance with recommended practice and are suitable for energizing and use. Without limiting the foregoing, the work shall, as a minimum, include the following:
  - .2 Prior to connecting, the Electrical Contractor is to inspect visually and conduct the following tests.
    - .1 Megger insulation and correct reading to 20-1/2 C base. Megger high voltage to ground with the secondary grounded for the duration of the test. Megger low voltage to ground with the primary grounded for the duration of the test.
    - .2 Perform electrical centres test on high voltage off-load tap changer switch.
    - .3 Perform ratio test for all transformer tap positions.
    - .4 Verify the shipping braces and shipping shims have been removed.
  - .3 After the connection of line, load, control and alarm wiring, but prior to energizing, the contractor is to inspect the installation and confirm the following:

- .1 That the transformer has been properly cleaned, is dry and free of foreign materials and contaminants and otherwise is suited for energizing.
- .2 That all bus and connector bolts have been installed, tightened, torqued properly, and un-insulated surfaces of connectors and buses have been taped.
- .3 That transformer taps have been set to provide the secondary voltage required.
- .4 That all insulators are in perfect condition, without cracks, chips or surface contaminants.
- .5 That core, coil, terminal boards, tap changers, bushings and all insulated surfaces have not been damaged.
- .6 That the forced cooling fans are functioning and that the power supply circuits to the fans have been properly connected and protected.
- .7 That all alarm and indicating devices are operating correctly, are properly connected either internally and externally from the terminal of the instrument to the external system, including the following:
- .4 Any other tests or inspections deemed necessary or appropriate by the manufacturer.

### **3.10 Fused And Non-fused Disconnect Switches**

- .1 Visually inspect and clean.
- .2 Ductor test across switch blade contact surfaces.
- .3 Megger test.
- .4 Mechanical function test.

### **3.11 Lighting**

- .1 Function test all light switches, luminaires, dimmers and lighting control equipment such as photo-cells, daylight sensors, occupancy sensors and time clock settings.
- .2 Prior to energizing line voltage lighting control system, ensure manufacturer has checked all equipment and wiring for proper installation and termination. .
- .3 Check operation of all emergency lighting units and exit lights.
- .4 Record all settings for all lighting control devices such as time clock, sensors, etc.

### **3.12 Testing of Wiring and Wiring Devices**

- .1 Test service grounding conductors for ground resistance.
- .2 Test all wiring devices for correct operation and circuitry.

**3.13 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 panel boards, 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.

**3.14 Fire Alarm System Testing - General**

- .1 Contractor will be responsible for directing verification of fire alarm system installation in accordance with:
  - .1 CAN/ULC-S537, Standard for Verification of Fire Alarm System Installations, and
  - .2 Requirements of authority having jurisdiction.
- .2 Contractor shall be responsible for:
  - .1 Performing verification procedure

**3.15 Fire Alarm System Testing - Prerequisites to Verification**

- .1 Prior to requesting verification, do the following:
  - .1 Inspect system to ensure that the following items are completely installed, connected and fully operational in accordance with requirements of the Contract Documents and Manufacturer's recommendations:
    - .1 Complete fire alarm system including all components thereof
    - .2 All fire suppression and detection devices
    - .3 All other auxiliary equipment connected to fire alarm system
  - .2 Ensure that any subsequent work remaining to be performed on the above-noted items will not invalidate examinations and tests performed during verification procedures.
  - .3 Ensure that operation and maintenance data has been submitted.
- .2 Submit written report to Consultant, certifying that the above prerequisites have been fulfilled and specifying known exceptions in the form of a list of items to be completed, corrected or submitted.
- .3 Consultant will, within two (2) weeks after receipt of written request:
  - .1 Advise Contractor to proceed with verification, or
  - .2 Advise contractor that prerequisites are not adequately fulfilled

**3.16 Fire Alarm System Testing - Verification**

- .1 The contractor and manufacturer will proceed with verification of system
  - .1 Perform all work and tests on system required by verification procedure.

- .2 Repair defective work and replace defective components
- .3 Provide verification certificate

### **3.17 Voltage Testing and Adjusting**

- .1 Test voltage at MDP and CDP.
- .2 Test voltage at motor control centre.
- .3 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by Consultant.

### **3.18 Variable Frequency Drive Tests**

- .1 Factory Testing (by Mechanical Contractor)
  - .1 VFD units shall be factory-tested prior to shipment. Provide confirmation from factory of actual test completed and provide a copy of results.
  - .2 Provide certified copies of production test results required by CSA and EMAC, prior to acceptance of the equipment.
- .2 Field Testing (by Mechanical Contractor)
  - .1 The VFD supplier shall provide on site start-up, fine-tuning, commissioning, operator training and instruction.
  - .2 Allow for all costs and labour for as many trips as necessary to complete requirements.
  - .3 It is the intent of the specification to provide a VFD installation that does not adversely affect the electrical system in this building. Included in the Contract Documents is information on the building electrical system including:
    - .1 Single line drawing.

The VFD supplier can use this information to evaluate the predicted effect of the VFD installation on the revised electrical system and advise the Electrical Consultant of these effects, relative to existing conditions. For the purposes of analysis, the point of common coupling (PCC) will be taken as the secondaries of the 600 V transformers located adjacent to the main electrical room.
    - .2 The Contractor, shall conduct a harmonic analysis upon completion of the fine tuning and commissioning phase of the installation. Should the waveform analysis indicate that either the input or output voltage and current levels of the VFD(s) exceed NEMA Standards for electric motors and IEEE 519, the VFD supplier shall provide, at their cost, all the necessary line filtering equipment to correct the harmonic distortion back to the levels prior to the installation of the VFD(s).
  - .4 Provide certified copies of all production test results required by CSA and NEMA.

### **3.19 Coordination and Short Circuit Study**

- .1 Provide a coordination/protective system study and short circuit study of all equipment specified in Section 26 24 05.

**3.20 Calibration and Verification**

- .1 Description
  - .1 Calibrate and verify the following equipment items supplied under this contract:
    - .1 Primary switchgear
    - .2 600V and 208V distribution equipment
- .2 The calibration and Verification shall be carried out in the field after installation and connection of equipment, but prior to energization, in the presence of the Owner and the Consultant.
- .3 Submittals
  - .1 Submit details of all test procedures and instruments, together with technicians names, to the Consultant, prior to proceeding.
  - .2 Submit written verification report after installation is completed to reflect as-built conditions.
- .4 Qualification
  - .1 Work shall be performed by a firm with relevant experience in testing 600V switchgear and protective relaying.
  - .2 This firm shall also perform the final checkout and testing of the equipment specified in Item 3.13 of this Section.
- .5 Products
  - .1 Not applicable.
- .6 Calibration and Verification
  - .1 The calibration and verification shall be carried out in the following stages:
    - .1 Primary switchgear
    - .2 600v switchgear and distribution
    - .3 Provide one qualified electrician to assist in the calibration and verification.
    - .4 Provide all other facilities, equipment and personnel as reasonably required to assist in the calibration and verification.
  - .2 For each circuit breaker, calibrate all protective relays and overcurrent device time and instantaneous trips in accordance with requirements of the protected equipment and overall coordination scheme. Field set each relay according to the recommend settings.
  - .3 Verify all transformer ratios, insulation values, fuse sizes, C.T. and P.T. ratios, etc. and certify that the installation is in accordance with the requirements of the manufacturer and the Coordination/Short Circuit Study. Submit a written report on this verification to the Consultant.
  - .4 Carry out the tests required of calibration and verification firm as specified in the other related sections.
  - .5 Ensure all bus and cable connections are tightened to manufacturer's specifications.

.6 All relays are to be cleaned with dry, dust free compressed air.

**3.21 Electrical Equipment and Systems Demonstration and Instruction**

.1 Provide operation and maintenance instruction and demonstration in accordance with relevant technical specifications.

**END OF SECTION**

**Part 1 General**

**1.1 INTENT**

- .1 Provide demonstration and instruction sessions to familiarize operation and maintenance personnel with electrical systems and their operation and maintenance supplied under this scope.
- .2 Submit system sign off sheets for each system listed prior to substantial completion.

**1.2 MANUFACTURER'S SITE SERVICES**

- .1 Arrange and pay for appropriately qualified manufacturers representatives to provide or assist in providing electrical equipment and system demonstration and instruction as specified herein.

**1.3 CONTRACTOR/OWNER COORDINATION**

- .1 Owner will chair demonstration and instruction sessions.
- .2 Establish agendas for demonstration and instruction sessions in conjunction with Owner. Coordinate scheduling of sessions with Owner.

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 SYSTEMS DEMONSTRATION AND INSTRUCTION SEMINARS**

- .1 Provide demonstration and instruction seminars for the following equipment and systems identified. Include in demonstrations and instruction seminars, the information specified for each piece of equipment and system.
  - .1 Normal Power Distribution (Below 750 V):
    - .1 Distribution Switchgear:
    - .2 Circuit breaker or disconnect switch operation.
    - .3 Protective features on breakers.
    - .4 Protective relaying - calibration and operation.
    - .5 Metering - calibration and operation.
    - .6 Safety procedures.
    - .7 Troubleshooting procedures.
    - .8 Visual maintenance inspections.

- .9 Maintenance procedures.
    - .10 Testing requirements and procedures.
  - .2 Dry Type Transformers:
    - .1 Tap adjustment procedures.
    - .2 Drying and cleaning requirements.
    - .3 Temperature and alarm devices.
    - .4 Safety procedures.
    - .5 Visual maintenance inspections.
    - .6 Maintenance procedures.
    - .7 Testing requirements and procedures.
  - .3 Panelboards:
    - .1 Types and sizes of breakers.
    - .2 Spare capacity.
    - .3 Visual maintenance inspections.
    - .4 Maintenance procedures.
    - .5 Testing requirements and procedures.
  - .4 Branch Circuits:
    - .1 Power receptacle system.
    - .2 Miscellaneous wiring devices.
    - .3 Miscellaneous equipment.
- .2 Motor Control:
  - .1 Motor Control Centres:
    - .1 Types of starters:
    - .2 Overcurrent protection
    - .3 Overload protection
    - .4 Control power supply
    - .5 Selector switches (H.O.A., on-off, etc.)
    - .6 Pilot lights
    - .7 Starter assemblies-installation features.
    - .8 Metering.
    - .9 Safety procedures.
    - .10 Troubleshooting procedures.
    - .11 Visual inspections.
    - .12 Maintenance procedures.



- .13 Testing requirements and procedures.
- .2 Manual Motors Starters:
  - .1 Overload protection.
  - .2 Troubleshooting procedures.
  - .3 Maintenance requirements.
- .3 Fire Alarm System (existing):
  - .1 Trouble conditions, alarm and silence.
  - .2 Annunciator and control panel operation.
  - .3 Control panel module replacement.
  - .4 Alarm lamp replacement.
  - .5 Power supply.
  - .6 Sequence of operation under alarm conditions.
  - .7 Troubleshooting procedures.
  - .8 Maintenance requirements and procedures.
- .4 Lighting:
  - .1 Interior Lighting:
    - .2 Description of each luminaire with respect to driver or any other special features:
      - .1 Troubleshooting procedures.
      - .2 Maintenance procedures.
  - .3 Lighting Controls:
    - .1 Line voltage switching.
    - .2 Troubleshooting procedures.
    - .3 Maintenance procedures.
- .5 Mechanical Equipment Connections and Controls
- .6 Grounding System

### 3.2 SITE TOURS

- .1 Provide a series of walk through Contractor guided tours of facility to allow operators to familiarize themselves with the buildings electrical systems.
- .2 Coordinate timing of tours with the Owner.

**SYSTEM COMPLETION AND COMMISSIONING**

**SYSTEM:** \_\_\_\_\_

The above system is installed as per the drawings and specifications, is complete and has been commissioned.

**Electrical Contractor**

Signed by: \_\_\_\_\_ Dated: \_\_\_\_\_

**General Contractor**

Signed by: \_\_\_\_\_ Dated: \_\_\_\_\_

Deficiencies Attached

This system has been reviewed by:

**The Consultant**

Signed by: \_\_\_\_\_ Dated \_\_\_\_\_

The Owner's personnel have been instructed in the operation and maintenance of the above system:

**The Owner**

Signed by: \_\_\_\_\_ Dated \_\_\_\_\_

The above does not constitute a waiver of any of the requirements of the Contract Documents.

ELECTRICAL  
CONTRACTOR

GENERAL  
CONTRACTOR

Address:

Phone:

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 26 05 01 - Common Work Results - Electrical.

**1.2 REGULATORY REQUIREMENTS**

- .1 The fire alarm system to be designed and installed to meet the following standards:
  - .1 C.S.A. Standard C22.1, Canadian Electrical Code, Part 1 2012
  - .2 The National Building Code 2010 edition.
  - .3 CAN/ULC S524-06: Standard for Installation of Fire Alarm System.
  - .4 CAN/ULC S525: Audible Signal Devices.
  - .5 CAN/ULC S526: Visual Signal Devices.
  - .6 CAN/ULC S528: Manual Stations for Fire Alarm Systems including accessories.
  - .7 CAN/ULC S529: Smoke Detectors
  - .8 CAN/ULC S537-04: Standard for Verification of Fire Alarm System.
- .2 Installation subject to approval of consultant, fire marshall, and building inspector for final acceptance.

**1.3 SYSTEM DESCRIPTION**

- .1 Equipment to be ULC approved.
- .2 The system shall be addressable and shall use speakers, bells or electronic sounders for audible signalling devices and strobes for visual signalling appliances as indicated.
- .3 Fire Alarm System to be fully addressable, zoned, non-coded, single stage, annunciated, microprocessor based, employing multiplexing for data acquisition, utilizing end devices, distribution and control. System shall be complete with all necessary hardware, software and memory, specifically tailored for this installation.
- .4 All products included must be capable of being verified as a complete system under full warranty by the contractor.
- .5 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to monitoring agency.
- .6 Modular in design to allow for future expansion.
- .7 Operation of system shall not require personnel with special computer skills.

#### 1.4 SHOP DRAWINGS

- .1 The Contractor will perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective submittal has been approved by the Consultant. Such work will be in accordance with approved submittals.
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings to include a complete material list with manufacturer, style, model number and quantity.
- .3 Shop drawings to include manufacturer's specification sheets with photographic depiction of all system components. Specification and descriptive data to include dimension, weight, appearance, connection provisions, materials, metal gauges and operating specification, characteristics, features and controls.
- .4 Shop drawings to include the following diagrams:
  - .1 Complete engineering drawings of all custom made components indicating all materials, gauges, finishes and wiring diagrams.
  - .2 Complete system block diagrams indicating all components, interconnection and cabling in accordance with the latest adopted edition of ULC S524.
  - .3 Complete wiring diagram showing terminal identification, cable type and cable designation.
- .5 Provide factory data sheets for the following:
  - .1 All materials provided.
- .6 All system devices indicating:
  - .1 Typical wiring connections,
  - .2 Installation instructions,
  - .3 Control settings,
  - .4 Component limitations.
- .7 Provide device samples when requested by the Consultant.

#### 1.5 QUALITY ASSURANCE

- .1 Verification tests to conform to: CAN/ULC-S537-04.
- .2 Submit inspection report, to Engineer.

#### 1.6 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include:
  - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
  - .2 Technical data - illustrated parts lists with parts catalogue numbers.

- .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
- .4 List of recommended spare parts for system.
- .5 Copy of Verification Report and Certificate.

#### **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Engineer.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

#### **1.8 WARRANTY/SERVICE**

- .1 System installer to include with his base price a guarantee stating:
  - .1 Service to be provided on system within 24 hours of call origination during the warranty period. Provide list of service shop locations and number of Fire Alarm technicians at each shop.
  - .2 Full warranty on new system to be provided for a period of 12 months.
  - .3 During warranty period the system installer at his expense shall repair and replace all such defective work and other work to the new system damaged thereby which fails or becomes defective during the term of the warranty, provided that such failure is not caused by improper usage or physical damage.
  - .4 Warranty date to commence from date of final acceptance of this work.

#### **1.9 TRAINING**

- .1 The Fire Alarm system supplier to conduct training programs for designated maintenance and operating personnel. Training to be carried out at the project site. Program to include but not be limited to the following:
  - .1 Operation: designated personnel to be trained to accomplish and understand all aspects of system operation.
  - .2 Maintenance: designated personnel to be trained to perform routine maintenance on the system.
- .2 Training period schedule to be confirmed with the Consultant. Training periods to take place after the system final verification.
- .3 Provide a formal training agenda and issue certificates to attendees upon completion.
- .4 Provide maintenance manuals and record drawings as part of training materials.

#### **1.10 TESTS AND ADJUSTMENTS**

- .1 Upon completion of system installation, tests to be conducted by the system installer to determine system conformity to requirements of the specification. Tests to be conducted in presence of the Owners representative and Consultant who may suspend or

discontinue tests at any time performance is considered unsatisfactory. Resumption of testing to cover the previously untested elements and any completed elements at the discretion of the Consultant.

- .2 All equipment or wiring provided by system installer which tests prove to be defective or operating improperly to be corrected or replaced promptly at no additional cost to the Owner.

#### **1.11 SYSTEM SUPERVISION**

- .1 Fire Alarm manual stations, detectors, sprinkler (fire protection) circuits, and annunciation network lines to be fully supervised utilizing a "Class A loop".
- .2 Communication lines between CPU, networked Fire Alarm panels and Fire Command Centre to be fully supervised utilizing Class A loop.
- .3 Complete system to be supervised against failure of operating power, open circuits, and ground. Supervision to be maintained on all circuits even in the event of a power failure, when the system is on battery standby. Any of the above shall cause trouble buzzer to sound at the main control panel and at the Fire Command Centre and also light a common trouble lamp in the same panels. Trouble on system to produce a tone distinct from the tone of the alarm signals.
- .4 Loop Isolating Modules are required however, are not indicated on the drawings. Locate Isolation modules per CAN/ULC S527 – Installation of Fire Alarm Systems. Use the architectural drawings to identify smoke/fire separations. Identify Isolation Module locations on Record Drawings.

#### **1.12 LABELLING – DEVICES AND PULLBOXES**

- .1 Provide a 'Brother' style commercial quality label on each Fire Alarm device. Label to be clearly visible from the ground and contain the address information to correspond to the walk test voice or page.
- .2 Provide a red lamacoid label on all Fire Alarm equipment boxes such as isolators, relays, terminal blocks, etc., and wiring pull boxes. Lamacoid to be a minimum size 25mm x 50mm with clear white lettering indicating function, circuit address etc.

#### **1.13 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

#### **2.2 SYSTEM OPERATION**

- .1 Actuation of any alarm initiating device (manual station, water flow detecting device, or fire detector) to evoke Alarm sequence:
  - .1 Cause electronic latch to lock-in alarm state at all control units and data gathering panel/transponder.

- .2 Send signal to local fire authority.
- .3 Indicate zone of alarm at all control units and remote annunciators.
- .4 Cause audible and visual devices throughout building to operate ALARM (temporal) signal.
- .5 Release any electromagnetically secured doors.
- .6 Cause fire doors, if normally held open, to close automatically.
- .7 Shutdown or startup fans as per the mechanical equipment sequence of operation.
- .8 Send ALARM status to building management system.
- .9 Send ALARM status to building access control system.
- .2 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .3 Actuation of supervisory device to:
  - .1 Cause electronic latch to lock-in supervisory state at all control units and data gathering panel/transponder.
  - .2 Indicate respective supervisory zone at local and remote annunciators.
  - .3 Cause audible signal at all control units to sound.
  - .4 Activate common supervisory sequence.
- .4 Alarm or supervisory device indication not to return to normal status until control unit has been reset.
- .5 Trouble on system to:
  - .1 Indicate circuit in trouble on all control units.
  - .2 Activate "System Trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; visual indication to remain until trouble is cleared and system is back to normal.
- .6 Troubles on system: suppressed during course of alarm.
- .7 Trouble condition on any circuit in system not to initiate alarm conditions.
- .8 The system to provide the following features and functions:
  - .1 The system to be capable of on site programming to accommodate and facilitate expansion, building parameter changes or changes required by the Owner and/or local codes. System programming to be software based.
  - .2 To accommodate and facilitate scope changes, initiation circuits shall be individually configured on site to provide either:
    - .1 alarm and supervisory operation
    - .2 alarm only
    - .3 supervisory only
    - .4 current limited alarm
    - .5 no alarm
    - .6 normally closed device monitoring
    - .7 non-latching circuit
    - .8 alarm verification circuit.

- .3 System to incorporate an alarm and trouble log. System shall have the capability to store a minimum of 300 alarms and 300 supervisory troubles in a historical data file, which can be recalled via system keypad.
- .4 Control panel to have a chronological display of multiple events for trouble shooting and system history.
- .5 Control panel to have a dedicated:
  - .1 alarm LED with acknowledge switch.
  - .2 supervisory LED with acknowledge switch.
  - .3 trouble LED with acknowledge switch.
- .6 Provide separate dedicated switches with indicator lights behind locked glass door to control:
  - .1 Signal disconnect.
  - .2 Door Closing/Security disconnect.
  - .3 Air Handling system disconnect.
  - .4 Spare.
- .7 The control panel to have the capability of annunciating a trouble reminder audibly and visually. This feature is to be programmable at specific time intervals, thus reminding the Owner that a trouble has been silenced and should be serviced.
- .8 System shall be complete with a minimum of 4 levels of password protection. Passwords to be custom selected for Owner use and field programmable.
- .9 The system shall have the capacity for all the alarm, monitor and control points indicated in these documents plus fifty percent spare points (alarm monitor and control) in place.
- .10 The system shall be complete with (80 character minimum) LCD readout and numerical keypad at the main control panel.
- .11 System to be complete with computer port to enable down loading and/or changes to system from a laptop computer utilizing Windows based software.
- .12 The system shall be connected to the Hospital emergency (vital) Power system and shall be complete with battery standby, sized to operate the related system in standby mode for a period of 12 hours, and to operate the visual and audible signals for 30 minutes at the end of the standby period.
- .13 All alarm initiating devices shall be individually addressable, and grouped into their respective zones as indicated on the drawings for annunciation on the main graphic annunciator.
- .14 Fire protection sprinkler flow switches typically have a built-in adjustable 0 to 60 seconds alarm time delay. Coordinate with the sprinkler trade and set for approximately 30 seconds.

## **2.3 CONTROL PANEL**

- .1 Existing: Manufacturer Notifier.

## **2.4 INITIATING/ INPUT CIRCUITS**

- .1 Receiving circuits for alarm initiating devices such as manual stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit and DGP's/transponders.



- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit and/or DGP's/transponders.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

## **2.5 ALARM OUTPUT CIRCUITS**

- .1 Alarm output circuits connected to signals shall be wired in class B configuration to central control unit and/or DGP's/transponders.

## **2.6 AUXILIARY CIRCUITS**

- .1 Auxiliary contacts for control functions.
- .2 Actual status indication (positive feedback) from controlled device.
- .3 Alarm and/or supervisory trouble on system to cause operation of programmed auxiliary output circuits.
- .4 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .5 Auxiliary circuits: rated at 2A, 24Vdc, fuse-protected.

## **2.7 WIRING**

- .1 Copper conductors.
- .2 To initiating circuits: 18AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16AWG minimum, and in accordance with manufacturer's requirements.
- .4 To speaker circuits: twisted, shielded pairs, and in accordance with manufacturer's requirements.
- .5 To telephone circuits: twisted, shielded pairs, and in accordance with manufacturer's requirements.
- .6 To control circuits: 14AWG minimum, and in accordance with manufacturer's requirements.

## **2.8 MANUAL STATIONS**

- .1 Manual Fire Alarm Stations: as follows:
  - .1 Type: Addressable.
  - .2 Construction: Metal or Lexan.
  - .3 Square pattern, pull lever type
  - .4 Mounting: Flush in all finished areas (surface acceptable in Equipment Rooms).
  - .5 Operation:
    - .1 First Stage: Manual lever.

- .2 Second State: Key operated.
- .6 Provide weatherproof design in exterior locations.
- .2 Manual stations to have lexan tamper proof covers with local audible alarm in resident care buildings.

## 2.9 THERMAL DETECTORS

- .1 Combination rate-of-rise and fixed temperature rated at 135 degrees F (57.2 degrees C) for areas where ambient temperatures does not exceed 100 degrees F (37.7 degrees C), and 200 degrees F (93.3 degrees C) for areas where temperature does not exceed 150 degrees F (65.5 degrees C).
- .2 Low profile, ceiling-mount type with positive indication of activation.
- .3 Rate-of-Rise Element: Air chamber, flexible metal diaphragm, and factory-calibrated, moisture-proof, trouble-free vent, and operate when rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
- .4 Fixed-Temperature Element: Fusible-alloy retainer and actuator shaft.

## 2.10 PRODUCTS-OF-COMBUSTION DETECTORS (SMOKE DETECTORS)

- .1 Technology utilizing photo-electronic complete with addressable base shall be provided in all areas as indicated on drawings.
- .2 POC sensors shall communicate actual chamber values to system control panel. Sensors shall not have a self-contained sensitivity setting, sensitivity setting to be determined at control panel. In all areas initially, alarm set point will be set at 1% obscurity during evening hours, and 3.7% obscurity during daytime hours.
- .3 The control panel shall be programmed to automatically compensate for environmental changes at the remote sensors. Even if the smoke detector chamber is contaminated with dust, or other particles, the control panel will still alarm at the prescribed alarm set point. The POC shall report ambient conditions to the control panel.
- .4 The POC sensor shall be stable even withstanding air-gusts up to 10 m/sec velocity. The detector shall have a 30 mesh insect screen and have a completely sealed back to prevent entry of dust, moisture and air turbulence. The electronics of the unit shall be totally shielded to protect against false alarms due to EMI and RFI. The detector head shall be easily disassembled to facilitate cleaning. All wiring to the smoke detector shall be wired to the base only, thus when removing the head for maintenance or cleaning no wiring is disturbed. The detector head shall contain an LED which shall glow continuously to indicate alarm, or a sensor trouble condition. The detector head shall contain a locking screw to prevent unauthorized removal of the head from the base.
- .5 Duct mounting POC detectors to be complete with addressable module, duct casting, sampling tubes for installation in air systems and pilot lamp. Duct detectors to be complete with remote alarm LED as well as remote keyed test switches on a single gang plate located near the duct detector at an accessible location.
- .6 Provide 5 spare smoke detectors and bases. Allow for 20m of wiring, installation and verification. Locate as directed on site. Any spare material not used to be handed over to Owner.

## 2.11 FIRE ALARM SPEAKERS/STROBES

- .1 Wall: Mounting: designed for ceiling or wall mounted on flush boxes in finished areas. Provide matching red surface mounting boxes in unfinished areas and service rooms

- .2 Rating of ¼, ½, 1, 2 watts, frequency range from 40 - 4000 Hz. Magnet weight of not less than 168 grams. Axial sensitivity of not less than 95 dB at 1m with 1 watt input from 100 to 10,000 Hz  $\pm 1$  dB.
- .3 Speaker transformer to be equipped with ½, 1, 2, and 4 watt taps.
- .4 Provide 3 additional speakers c/w 30m of wiring for each. Make allowances to install as determined during audibility commissioning. Any additional speakers not installed to be handed over as spare material.
- .5 Visual signal: to ULC S527 and as follows:
  - .1 Construction:
  - .2 High intensity Xenon flasher.
  - .3 Rated Candela - 15.
  - .4 Pyramid shaped.
  - .5 Polycarbonate lens with red print reading "FIRE".
  - .6 Connect visual signal appliances to dedicated supervised output circuit(s) in the fire alarm control panel and synchronize at minimum 20 flashes per minute.

## **2.12 ADDRESSABLE MONITOR MODULES**

- .1 Addressable monitor elements to meet or exceed the following technical requirements:
  - .1 Compatible with main Fire Alarm system.
  - .2 Field programmed.
  - .3 Individually identifiable.
  - .4 Supervised.
  - .5 Complete with lamicond identification on cover identifying address and device monitored.

## **2.13 ADDRESSABLE CONTROL MODULES**

- .1 Addressable control elements to meet or exceed the following technical requirements:
  - .1 Compatible with main Fire Alarm system.
  - .2 Field programmed.
  - .3 Individually identifiable.
  - .4 Supervised.
  - .5 Contact rating: 0.5 amperes 120 volts AC, 2 amperes at 24 volt DC, with one (1) set of Type C contacts.
  - .6 Complete with lamicond identification on cover identifying address and device controlled.

## **2.14 ADDRESSABLE DETECTOR BASES**

- .1 Addressable detector bases to meet or exceed following technical requirements:
  - .1 Compatible with main Fire Alarm system.
  - .2 Field programmable.
  - .3 Supervised, including removal of specified plug-in detector devices

**2.15 END-OF-LINE DEVICES**

- .1 End-of-line devices to control supervisory current in alarm circuit and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.
- .2 Provide end-of-line devices wall mounted in separate boxes at 1800mm above the finished floor level.
- .3 Flush mount devices in finished areas.
- .4 Provide finished stainless steel or anodized aluminum cover plates.
- .5 Provide permanent lamicoid labels on plates to indicate the related circuits.
- .6 Clearly locate and identify the end-of-line devices on record drawings.

**2.16 ANCILLARY DEVICES**

- .1 Addressable remote relay units to initiate fan shutdown and door closing.

**2.17 ISOLATION MODULES**

- .1 Provide to automatically isolate wire-to-wire short circuits on DCLC branch. Isolator module shall limit number of modules or detectors that may be rendered inoperative by short-circuit fault on SLC loop segment or branch. At least 1 isolator module shall be provided for each floor or protected zone of building. No more than 25 devices shall be connected to 1 isolator module.
- .2 If wire-to-wire short occurs, isolator module shall automatically open-circuit (disconnect) SLC. When short-circuit condition is corrected, isolator module shall automatically reconnect isolated section.
- .3 Does not require address-setting, and its operations shall be totally automatic. Not necessary to replace or reset isolator module after normal operation.
- .4 Mount in standard 4-inch (101.6-mm) deep electrical box or in surface-mounted back box.
- .5 Single LED: Flash to indicate isolator is operational and illuminate steadily to indicate short-circuit condition has been detected and isolated.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 450mm of air outlets. Maintain at least 600mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .2 Connect alarm circuits to main control panel.
- .3 Connect signalling circuits to main control panel.
- .4 Install remote relay units to control fan shut down.
- .5 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .6 Provide necessary raceways, cable and wiring to make interconnections as required by equipment manufacturer.

- .7 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .8 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

### **3.2 AUTOMATIC DETECTORS**

- .1 Locate automatic smoke and thermal detectors in locations as shown indicated.
- .2 Maintain minimum 450mm clear to mechanical air diffusers and registers.
- .3 Typically maintain minimum 450mm clear in all directions around detectors.
- .4 Mount detectors out of line of direct heat and minimum 3m from unit heaters.
- .5 Mount smoke detectors associated with smoke control doors, on the ceiling on both sides of the doors; typically 1200mm from door. Do not mount detectors closer than 900mm or farther than 1500mm from the doors.
- .6 Install duct smoke detectors on the supply air side of air handling units as per manufactures installation instructions. Exact location of duct detectors to be coordinated with Division 23 and Fire Alarm system manufacturer.

### **3.3 ISOLATORS**

- .1 Addressable loop isolators shall be provided in each circuit per zone area, and for each stairway such that a fault on any device in that zone shall not affect any other zone.
- .2 Short circuit isolation shall be installed per floor and for every 25 devices within the floor where Class A loops are utilized.

### **3.4 WIRING**

- .1 Make conductor terminations on fixed terminal strips with separate terminal for each conductor. No loose wiring connections allowed.
- .2 Fire Alarm wiring splices are to be minimal. Wire extensions are not acceptable.
- .3 Neatly install wiring clamped with nylon cable straps.
- .4 Neatly identify all wiring terminations and terminal strips as indicated on shop drawings.
- .5 Attach wiring diagram to inside of panel doors.
- .6 All cables crossing fire zones to be protected by 1-hour fire rating.
- .7 Class A fire alarm branch and backbone cabling to be installed with separation between loops as required by CAN/ULC S-527.

### **3.5 CONNECTION OF MISCELLANEOUS SYSTEMS**

- .1 Provide outputs for control of the following auxiliary equipment.
  - .1 Interposing relays required for all voltages above 24 volts.

### **3.6 PROGRAMMING**

- .1 This contract to include programming for all the equipment installed under this Contract.

### **3.7 PROTECTION OF COMPLETED WORK**

- .1 Protect equipment in areas of construction to prevent the entry of dust, paint and any other foreign matter into the devices or panels.

### **3.8 SYSTEM INSPECTION**

- .1 Carry out a complete inspection and test of system on completion of the installation to ensure the following:
  - .1 System is complete and functional in accordance with the contract documents and regulatory requirements.
  - .2 System is installed in accordance with the manufacturer's recommendations.
  - .3 Fire suppression detection devices are connected into the system and are functioning.
  - .4 All auxiliary equipment has been connected and functioning.
  - .5 On completion of inspection deliver three (3) final sets of maintenance and operating instructions manuals to the Consultant.

### **3.9 PERFORMANCE VERIFICATION**

- .1 The Electrical Division Contractor shall be responsible for directing performance verification of the Fire Alarm system in accordance with the latest CAN-S537, Standard for Verification of Fire Alarm System Installations.
- .2 Provide partial verifications to suit the progress of the work and any staged occupancy as required.
- .3 Submit all verification reports to the Consultant. Provide an unconditional Appendix C and written test reports from the equipment manufacturer showing that the ENTIRE system has been tested, verified and commissioned by certified verification company and that the Fire Alarm system complies with all points of the specifications. Include the verification worksheets identifying every device and its status (i.e. smoke detector - room xx, verified for operation and supervision).
- .4 The qualified Fire Alarm verification agency shall be independent of the installing company.
- .5 Prior to requesting the final performance verification ensure that Fire Alarm system is fully operable and that subsequent work to be performed on system will not invalidate examinations and tests performed during verification procedure.
- .6 The Division 26 Contractor and Fire Alarm system manufacturer's representative shall be present at all times during the verification procedure and shall undertake the following:
  - .1 Provide all required testing equipment and tools.
  - .2 Disassemble and reassemble system components.
  - .3 Disconnect and reconnect wiring.
  - .4 Perform required field adjustments.
  - .5 Repair defective work and replace defective components.
  - .6 Perform all other work on the system required by verification procedure.

- .7 Provide adequate number of portable communication devices during entire verification.
- .7 Include all costs for Fire Alarm system verifications, including the Fire Alarm System Manufacturer's representative's costs.
- .8 Provide a minimum of ten workings days written notice ahead of the verification process to the Owners Representatives and the Consultant.

### **3.10 FIRE DEPARTMENT DEMONSTRATION**

- .1 Arrange, attend and carry out a Fire Department demonstration of the completed system after the final unconditional verification.
- .2 Activate alarms and demonstrate all controls as requested.

### **3.11 DEMONSTRATION**

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 32 12 16 – Asphalt Paving
- .2 Section 32 16 15 – Concrete Walks, Curbs and Gutters
- .3 Section 03 30 00 – Cast-In-Place Concrete

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D422-63, Standard Test Method for Particle-Size Analysis of Soils.
  - .4 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ; ) (600 kN-m/m ; ).
  - .5 ASTM D1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ; ) (2,700 kN-m/m ; ).
  - .6 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
    - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
  - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

**1.3 DEFINITIONS**

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
  - .1 Rock : solid material in excess of 1.00 m ; and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.
  - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
  - .1 Weak, chemically unstable, and compressible materials.
  - .2 Frost susceptible materials:
    - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136 : Sieve sizes to CAN/CGSB-8.2.
    - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45
    - .3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- .7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

#### 1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Control.
- .3 At least 2 weeks before beginning work the Contractor shall submit to the Engineer for review, a complete and detailed outline of the procedures and methods that he/she will employ for this section of the Work.
- .4 The Contractor shall not begin work until the Engineer has reviewed the submittal.

#### 1.5 MINIMUM QUALITY CONTROL TESTING

- .1 Refer to Section 01 45 00 - Quality Control.
- .2 Moisture density curves to ASTM D698.
- .3 Sieve analyses to ASTM C136.
- .4 Field densities to ASTM D2167 or to ASTM D2922..
- .5 Minimum quality control test frequencies specified as follows are the minimum number required. The Contractor shall perform as many tests as are necessary to ensure that the Work conforms to the requirements of the Contract regardless of the minimum number required.
- .6 Provide moisture/density curves for each type of material from each source of material to be compacted to a specified density.
- .7 Field densities:

- .1 Pit-run gravel - one for each 2000 m<sup>2</sup> of compacted layers.
- .2 Crushed gravel - one for each 2000 m<sup>2</sup> of compacted layers.
- .3 Imported fill - one for each 2000 m<sup>2</sup> of compacted layers.
- .4 Backfill (from excavated material) one for each 4000 m<sup>2</sup> of compacted layers.
- .5 Trench Backfill - one for every 100 m of trench of 1.0 m fill depth.

#### 1.6 QUALITY ASSURANCE

- .1 Refer to Section – 01 45 00 Quality Control.
- .2 Submit to the Engineer a list of sources of materials including sand, gravel, imported fill materials and concrete.
- .3 Provide samples, test results, sieve analyses and reports for preliminary approval of materials.
- .4 Preliminary approval of materials does not constitute general acceptance. Acceptance depends upon satisfactory field test results and performance in place.
- .5 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### 1.7 PERMITS

- .1 Obtain all permits required for this section of the work with the exception of those specifically listed as being obtained by others and abide by the stipulations of the permits.
- .2 Abide by the stipulations of permits obtained by others.

#### 1.8 EXISTING CONDITIONS

- .1 Buried services:
  - .1 Before commencing work establish location of buried services on and adjacent to site.
  - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
  - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
  - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
  - .5 Prior to beginning excavation Work, notify applicable authorities having jurisdiction to establish location and state of use of buried utilities and structures. Authorities having jurisdiction are to clearly mark such locations to prevent disturbance during Work.
  - .6 Confirm locations of buried utilities within 5 m of excavation by careful test excavations or soil hydrovac methods.
  - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
  - .8 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before removing and/or re-routing. Costs for such Work to be paid by Contractor.
  - .9 Record location of maintained, re-routed and abandoned underground lines.
  - .10 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:

- .1 Conduct, with Engineer, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
- .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Engineer.
- .3 Where required for excavation, cut roots or branches as directed by Engineer and in accordance with Section 32 01 90.33 - Tree and Shrub Preservation.

## Part 2 Products

### 2.1 MATERIALS

- .1 Gravel
  - .1 Pit run gravel shall be maximum size 75 mm complying with the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
75 mm	100
25 mm	80 max
2.75 mm	60 max
75 micro-m	10 max
  - .2 Gravel for stabilization of trench bottoms.
    - .1 Well graded sandy gravel - 75 mm maximum size complying with the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
75 mm	90 - 100
4.75 mm	20 - 50
0.5 mm	5 - 25
75 micro-m	0 - 5
    - .2 Washed rock - 75 mm maximum size with maximum 5% passing the 4.75 mm sieve.
  - .3 Base course gravel for road base replacement - 25 mm maximum size complying with the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
25 mm	100
19 mm	95 - 100
9.50 mm	60 - 80
4.75 mm	40 - 60
2.00 mm	25 - 45
425 micro-m	10 - 25
75 micro-m	2 - 10
- .2 Concrete
  - .1 Concrete fill for backfill or sand bag fill - conform to CSA3-A23.1 - 15 MPa, Type 50 sulphate resistant.
  - .2 Concrete for repair of existing structures shall conform to CSA3-A23.1 - 25 MPa at 28 days made with Type 50 sulphate resistant cement.

- .3 Sand
- .1 Sand for bedding of pipe and for backfill of trenches shall comply with the following gradation:
- | <u>Sieve Size</u> | <u>Percent Passing</u> |
|-------------------|------------------------|
| 9.5 mm            | 100                    |
| 4.75 mm           | 90 - 100               |
| 150 micro-m       | 20 max.                |
- .4 Imported fill
- .1 Imported backfill material for trenches shall be free from organic material or any perishable or objectionable material that would prevent proper consolidation.
- .5 Casing
- .1 Casings for crossings shall be steel pipe AWWA C200 with welded joints and wall thickness as shown on the drawings.
- .2 Casing size shall be governed by the size of the carrier pipe and the type of pipe coating. Casings shall be large enough to permit installation of the carrier pipe to the alignment and grade shown on the drawings, without damage to the carrier pipe, pipe lining or pipe coating.
- .3 Casing shall be epoxy coated 0.305 mm thickness.

### 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 or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

#### 3.2 SITE PREPARATION

- .1 The Contractor shall provide temporary fencing, gates or fence repairs in accordance with Section 01 56 00, as required to secure areas that are presently fenced. Upon completion of construction the Contractor shall make permanent repairs so that completed fences are restored to original condition.
- .2 Windrow reusable gravel and keep separate from the remainder of the excavated material so that it can be replaced when the backfilling operation has been completed.
- .3 Strip topsoil and stockpile adjacent to, but separate from gravel and sub-soil.
- .4 Width of stripping shall be sufficient to permit excavation, pipelaying, backfilling and replacement of topsoil without mixing of materials and loss of topsoil.
- .5 Depth and width of stripping shall be subject to the approval of the Engineer.
- .6 Cut pavement in straight lines parallel to the trench centreline.
- .7 Cut width shall not exceed the specified maximum trench width at ground surface.

- .8 Prevent the destruction of pavement in excess of the allowable width by supporting the trench by sheeting or other means.
- .9 Cutting pavement in excess of the allowable width is allowed if the nature of the soil is such that sheeting of the trench wall is impractical.
- .10 Dispose of cut pavement.
- .11 Where, in the opinion of the Engineer, the existing pavement is of such condition that precutting of pavement is not necessary, the pavement may be cut by trenching equipment on the receipt of written permission.
- .12 The Contractor shall grade the right-of-way to level the existing slopes that are in excess of 15 degrees and to provide suitable working space.
- .13 Grade in such a manner so as to not interfere with existing drainage.
- .14 Side slope banks must be cut back, as per the Occupational Health and Safety Act of Saskatchewan for Excavation and Trenching.
- .15 The Contractor shall do all grading at crossings of roads, streams and gulleys, and shall grade so that banks are not unduly damaged and stream flow or surface drainage is not disrupted.

### **3.3 PROTECTION**

- .1 Protect existing features in accordance with Section 01 56 00 - Temporary Barriers and Enclosures and applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Engineer approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

### **3.4 STRIPPING OF TOPSOIL**

- .1 Begin topsoil stripping of areas as indicated and as directed Engineer after area has been cleared of brush, weeds, and grasses and removed from site.
- .2 Strip topsoil to depths as indicated and as directed by Engineer.
  - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Engineer.
  - .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil as directed by Engineer.

### **3.5 STOCKPILING**

- .1 Stockpile fill materials in areas designated by Engineer.
  - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.

- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

### 3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements and the Health and Safety Act for the Province of Saskatchewan.
  - .1 Where conditions are unstable, Engineer to verify and advise methods.
- .2 Obtain permit from authority having jurisdiction for temporary diversion of water course.
- .3 Construct temporary Works to depths, heights and locations as directed by Engineer.
- .4 During backfill operation:
  - .1 Unless otherwise indicated or directed by Engineer, remove sheeting and shoring from excavations.
  - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
  - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .5 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .6 Upon completion of substructure construction:
  - .1 Remove cofferdams, shoring and bracing.
  - .2 Remove excess materials from site and restore watercourses as directed by Engineer.

### 3.7 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Engineer's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
  - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures to approved collection and runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.
  - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

### 3.8 EXCAVATION

- .1 Depth - Excavate the trench to a depth sufficient to lay the pipe and bedding as shown on the drawings. If any part of the trench bottom is excavated in error below the specified grade, correct with approved materials compacted as specified under Pipe Bedding, at the Contractor's expense.
- .2 Width - Excavate trench width at the bottom such that the pipe can be laid as specified and backfill placed and compacted as specified. Trench width dimensions are specified

under installation of pipe. Increase trench widths to allow placing of timber supports, sheeting and bracing, but do not exceed maximum widths shown on the drawings without corrective measures. Make trench walls vertical to 300 mm above the top of the pipe and maintain widths above this level within limits shown on the drawings or in accordance with safety regulations. Pipe design is dependent upon the type of bedding specified and the class of backfilling in the pipe zone, as well as the width of the trench. If the Contractor uses trenching equipment or trenching methods that result in a wider trench than specified under the installation of pipe, then corrective work shall be performed as required by the Engineer, at the Contractor's expense. The corrective work may take the form of either or both of the following:

- .1 Supply and installation of a higher class of bedding and backfilling in the pipe zone.
- .2 Supply and installation of a stronger class pipe.
- .3 Length - excavate trenches only as far in advance of pipelaying as safety and traffic conditions permit and as far as the Engineer shall allow.
- .4 Crossings shall be made for livestock and vehicles at all local roads and well defined trails.
- .5 Excavate so that the pipeline can be laid to the line and grade as shown on drawings or as established by the Engineer.
- .6 Inspection
  - .1 Notify the Engineer for inspection after the excavation is completed.
  - .2 Do not place any material on the soil until the Engineer has viewed the depth of excavation and the character of the foundation material.
- .7 Fill with 15.0 MPa compressive strength concrete, any overexcavation carried out in error or carried out without prior approval of the Engineer.
- .8 Stockpile material excavated alongside the trench in authorized working areas in a manner that will not endanger the work, hinder pedestrian or vehicle traffic, block surface drainage or obstruct access to other utilities. Where excavated material cannot be piled along the trench in compliance with the above restrictions, remove it from the site and stockpile at an acceptable location for return to the trench for backfilling. Do not stockpile excavated material over existing pipelines.
- .9 Common Excavation
  - .1 Excavation of materials with the exception of surface gravel, pavement or rock is classified as common excavation.
  - .2 In ledge rock, boulders or large stones, overexcavate 150 mm below the pipeline level.
- .10 Rock Excavation
  - .1 Rock is either single boulders, pieces of concrete or masonry with a volume in excess of  $0.25 \text{ m}^3$ ; or any material that cannot be removed by a tracked machine, having a bucket capacity of 0.95 to  $1.15 \text{ m}^3$ , and which requires for its removal, drilling and blasting or breaking up with a power operated hand tool.
  - .2 No soft or disintegrated rock which can be removed with a hand pick; no material which can be ripped with a crawler tractor having a rated horsepower of 200 to 249; no loose or previously blasted rock or broken stone and no rock exterior to the minimum limits for measurement allowed, which may fall into the excavation will be measured or allowed.
  - .3 Frozen material is not classified as rock.



- .4 Remove rock to a disposal site as per Article 1.8 - Disposal.
- .11 Unsuitable Material
  - .1 Unsuitable material is material in the trench at subgrade that is unstable or which contains ashes, cinders, organic material, large pieces of inorganic material or is otherwise unsuitable and which, in the judgment of the Engineer, should be removed.
  - .2 Excavate and remove unsuitable material to a width and depth ordered by the Engineer. Backfill the subgrade with an approved material compacted in 150 mm lifts to provide a continuous bearing for pipes. Replacement material shall be pit run gravel, washed rock or well graded sandy gravel.
  - .3 Payment will be made for removal and replacement of unsuitable material if the work is ordered by the Engineer.
  - .4 Material that becomes unstable or unsuitable through the Contractor's failure to divert surface water or control ground water in the trench shall be excavated and removed as waste material and replaced with approved material at the expense of the Contractor.
- .12 Hand Trenching, Tunnelling, Boring And Augering
  - .1 Employ hand trenching, tunnelling, boring or augering methods where specified on the drawings or ordered by the Engineer.
  - .2 Tunnelling, boring, augering or hand trenching may be used if it is to the advantage of the Contractor to use such methods in lieu of machine trenching.
  - .3 Submit in writing to the Engineer complete details regarding tunnelling, boring or augering methods proposed and do not commence work until after the Engineer has advised in writing that the Work may proceed.
- .13 Temporary Protective Structures
  - .1 Temporary protective structures, bracing, shoring and sheeting are the responsibility of the Contractor and shall be designed by a Professional Engineer registered in Saskatchewan.
  - .2 Observe safety regulations of the Occupational Health and Safety Act with regard to protection of the work, property, structures adjacent to the work and maintenance of trench widths.
  - .3 When closed sheeting is required it shall be installed such that adjacent soil cannot enter the trench either below or through sheeting.
  - .4 Increase trench widths as necessary to allow placing of supports, sheeting and bracing, but do not exceed the maximum trench width shown on the drawings without taking corrective measures.
  - .5 Where damage to adjacent structures will not result, remove temporary protective structures and backfill as specified for the pipe zone and trench.
  - .6 Leave temporary structures in place where damage to adjacent structures may result or if ordered by the Engineer.
- .14 Special Supports
  - .1 Construct special supports of timber, concrete or other material, as ordered by the Engineer, where the bottom of the trench is unstable and over excavation is judged by the Engineer to be uneconomical.
  - .2 Payment will be allowed as extra work if special supports are ordered by the Engineer.
- .15 Interfering Services

- .1 Provide for the uninterrupted flow of all watercourses, sewers and drains encountered during the work.
- .2 Support existing watermains, sewer pipes, gas lines, pipes, or other buried structures to protect them from damage.
- .3 Repair and make good at the Contractor's expense, any damage which may occur to any watermain, sewer pipe, gas line or other pipe and to any electrical conductors, cable, sidewalk, curb or structure.
- .4 Determine the location of all structures, pipes, manholes and valves by contact with the Owners and the examination of drawings. If necessary explore and excavate for such purposes.

### 3.9 PIPE BEDDING

- .1 In general, pipeline pipe bedding consists of removal of rocks and debris from the trench and grading of the bottom of the trench to provide support throughout the length of the pipeline. This is referred to as Class C Bedding.
- .2 Under difficult conditions, such as in rock or gravel Class B (Sand Bedding) shall be provided. Place sand in the trench bottom and compact to 95% of the maximum density as determined by the Standard Proctor Compaction Test.
- .3 In some cases, the Engineer may order Class A (concrete bedding). Place concrete the full width of the trench to the depth shown on the drawings.
- .4 Pipe bedding shall be in accordance with the drawings and with the Contract Specifications for the installation of the pipe.
- .5 Do not proceed with placing pipe bedding until the Engineer has inspected the trench.

### 3.10 BACKFILLING IN THE PIPE ZONE

- .1 The pipe zone is defined as that part of the trench from the bottom of the pipe bedding to 300 mm above the top of the pipe, or above the top of the highest pipe in a combined trench.
- .2 Backfilling in the pipe zone shall be in accordance with the drawings and with the Contract Specifications for the installation of the pipe.

### 3.11 TRENCH BACKFILL

- .1 Trench backfill is defined as backfill above the pipe zone.
- .2 Do not proceed with trench backfill until the Engineer has inspected and approved the bedding and backfill in the pipe zone.
- .3 Place backfill in a dry trench.
- .4 Place backfill by rolling down a slope in the trench or lower by machine. Prevent backfill from dropping vertically.
- .5 Backfill as close as possible to pipe laying operations so that trenches are left open no longer than absolutely necessary.
- .6 Plan the backfilling operation so that exposure of the backfill material to frost is kept to a minimum. Use no large frozen chunks of soil as backfill.

### 3.12 CLASSES OF BACKFILL

- .1 Class I

- .1 Place pit-run gravel or sand in uniform lifts over the whole width of the trench, each lift compacted to 95% of the maximum density as determined by the Standard Proctor Compaction Test.
- .2 Compact the top 0.6 m to 100% of the maximum density as determined by the Standard Proctor Compaction Test.
- .3 Remove all surplus excavated material, and stockpile on site as directed, or dispose of it as directed by the Engineer.
- .4 Where the excavation is carried out on an earth or gravel street, bring the compacted granular material up to the original grade and restore the surface to original or better condition.
- .5 Where the excavation is carried out on a paved street bring the compacted granular material up to the elevation of the base course as shown on the drawing.
- .2 Class II (Common Fill)
  - .1 Place native backfill material in 150mm lifts over the width of the trench, each lift compacted using mechanical compaction equipment. Compact each lift to 95% (98% upper two lifts) of the maximum density as determined by the Standard Proctor Compaction Test.
  - .2 Backfill material shall be free of wood, brush or other perishable objectionable material. No rocks larger than 200 mm shall be included in the material.
  - .3 Moisture content of the backfill material shall be controlled by the Contractor as necessary to achieve compaction as specified at the Contractor's expense. Supply and add water if it is necessary to increase moisture content. Spread and dry backfill material if moisture content is above optimum.
  - .4 Supply and place imported material at the Contractor's expense if moisture content cannot be adjusted.
  - .5 Where in the opinion of the Engineer the excavated material is unsuitable for backfilling purposes, the Contractor shall upon written order from the Engineer use imported material.
  - .6 Where the excavation was carried out on a gravel street, bring the compacted excavated material up to the base of the surface gravel as shown on the drawings or as specified.
  - .7 Where the excavation was carried out on an earth street, bring the compacted excavated material up to the original street level.
- .3 Class III
  - .1 Class III backfill is machine backfill, with native backfill material placed in the trench in layers 900 mm thick and compacted by running a tracked machine along the trench as backfilling proceeds.
  - .2 Tracked machine shall have a gross vehicle weight equal to or greater than 14,000 kg (Cat D6 or larger)
  - .3 Backfill material shall be free of wood, brush or other perishable objectionable material. Rocks larger than 200 mm may be placed in the backfill.
  - .4 Round the backfill over the trench as directed by the Engineer to allow for settlement.
  - .5 Remove all surplus excavated material and grade in a manner satisfactory to the Engineer.
- .4 Class IV

- .1 Place native backfill material uncompacted in the trench.
- .2 Backfill material shall be free of wood, brush or other perishable objectionable material. Rocks larger than 200 mm may be placed in the backfill.
- .3 Round the backfill over the trench as directed by the Engineer to allow for settlement.
- .5 Backfilling Tunnels, Boreholes
  - .1 Backfill all voids around casings or around carrier pipe if there is no casing with sand placed manually, mechanically or pneumatically.
  - .2 Alternatively, the Contractor may pressure grout voids or fill them with urethane foam.
- .6 Backfill On Hillsides
  - .1 The Contractor shall construct diversion mounds and ditches to direct surface water away from the pipeline, where requested by the Engineer.

### 3.13 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Engineer.
- .2 Replace topsoil as directed by Engineer.
- .3 Reinstall lawns to elevation which existed before excavation and/or as noted on drawings.
- .4 Reinstall pavements and sidewalks disturbed by excavation to thickness/structure specified and elevation which existed before excavation.
- .5 Clean and reinstall areas affected by Work as directed by Engineer.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

### 3.14 TRENCH SETTLEMENT DURING GUARANTEE PERIOD

- .1 During the guarantee period, the Contractor shall replace materials and rectify all failures that occur as a result of settlement of trench backfill or collapse of trench walls.
- .2 Trenches in which backfill settles shall be refilled with the specified backfill material. Paved surfaces that are adjacent to trenches or on trench backfill, which fail during this period, shall be replaced or repaired in an approved manner.
- .3 Replacement of materials and rectification of failures that occur as a result of settlement of trench backfill or collapse of trench walls is entirely the responsibility of the Contractor and such repair work shall be done at the Contractor's expense.

### 3.15 MAINTENANCE DURING GUARANTEE PERIOD

- .1 During the guarantee period, the Contractor is responsible for extra road maintenance required as a result of trench settlement or disruption of surface drainage.
- .2 The Contractor shall coordinate this extra maintenance with the normal maintenance provided by the Owner and make whatever arrangements that may be required with the Owner.

**3.16 RELEASES**

- .1 The Contractor shall submit to the Engineer, prior to the release of holdback, signed clearances on forms approved by the Engineer, from all landowners, tenants and authorities, acknowledging that the Contractor has performed the work to their satisfaction.

**END OF SECTION**



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**Part 1            General**

**1.1            DESCRIPTION**

- .1        This section specifies requirements for the landscape maintenance during the guarantee/warranty period.
- .2        The guarantee/warranty period shall be one year from construction completion.
- .3        The maintenance period shall be 30 days from construction completion as awarded by the Consultant or at the date of the second cut of sod, whichever is greater.

**1.2            QUALIFICATIONS**

- .1        The work shall be installed in accordance with The City of Regina Standard Construction Specifications for Landscape Construction and these Specifications, the most stringent condition to apply.

**1.3            RELATED WORK**

- .1        Landscape maintenance requirements for the duration of the construction period are included in the applicable sections. This section describes maintenance requirements during the 30 day period.

**1.4            REFERENCE STANDARDS**

- .1        Pruning Methods: ANSI A300 (Part 1), Latest edition.

**1.5            DELIVERY, STORAGE AND HAULING**

- .1        Deliver and store fertilizer, seed and chemicals in waterproof containers showing contents, mass, analysis, and name of manufacturer.

**1.6            DAMAGE TO PROPERTY**

- .1        The Contractor shall repair and pay for damages caused by Contractor's personnel and equipment during the term of the contract.
- .2        The Contractor shall report damages immediately to the Consultant.
- .3        Within three (3) days of any damages, return grass areas, plant materials, equipment and any other property to their original condition prior to damage. Scalping of turf and mechanical damage to trees, including tearing of bark, shall be considered as damage.

**1.7            HOURS OF WORK**

- .1        Perform maintenance working during regular hours of 7:00 to 18:00, Monday to Friday.
- .2        Obtain Owner's approval to do maintenance outside of regular working hours.
- .3        The Contractor shall provide the Consultant with at least two (2) days advance notification of intent of spraying for weed and insect control.

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**1.8 MAINTENANCE LOG**

- .1 Keep daily maintenance logs throughout duration of the contract.
- .2 Include in log: detail activities, areas in which activities were carried out, and approximate time for start-up and completion of each log.
- .3 For each billing period attach maintenance log to invoice. Maintenance logs to be submitted monthly.

**1.9 MAINTENANCE SEASON**

- .1 The maintenance season, also referred to as the growing season, shall commence April 15 and end October 15, or shall be determined upon receipt of Construction Completion. Garbage pickup and litter control to occur year-round.

**Part 2 Products**

**2.1 FERTILIZERS AND CHEMICAL CONTROL**

- .1 Use of "Weed and Feed" type products are not permitted.
- .2 In addition to the feeding specified, apply any nutrients and soil amendments required as indicated by deformed chlorite or stunted growth, or as determined by soils analysis.

**2.2 PEST AND DISEASE CONTROL**

- .1 Only as specifically reviewed and approved by the Owner.

**Part 3 Execution**

**3.1 GENERAL**

- .1 Schedule timing of operations and use of site.
  - .2 Do each operation continuously and complete within a reasonable time period.
  - .3 Do all maintenance including, but not limited to, the work in this specification to keep all areas neat, clean, and in healthy growing condition.
  - .4 The Consultant shall be the sole judge in determining an acceptable level of maintenance.
  - .5 Collect and dispose of excess material and debris to municipal disposal site weekly.
  - .6 Provide equipment and material necessary for maintenance to acceptable horticultural standards.
  - .7 Report vandalism or other third party damage immediately to the Consultant.
  - .8 Maintain and submit a maintenance log for each project showing maintenance activities performed and date of activities. Submit maintenance log monthly as well as with each invoice.
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**3.2 WATERING AND IRRIGATION**

- .1 Apply sufficient water to ensure continuous, healthy growth of all plant materials, with sufficient time between waterings to promote deep root growth. Apply water in soft spray to avoid "packing" of soil. Do not impede use of sidewalks and other paved areas.
- .2 Areas with no underground irrigation systems: supply labour, hoses and sprinkler equipment necessary to provide adequate watering.

**3.3 PRUNING**

- .1 Prune all plant material in accordance with ANSI A300 (Part 1), Latest edition.

**3.4 WEED CONTROL**

- .1 Perform weed control in accordance with Provincial chemical application regulations.
- .2 Prepare and apply spray mixture according to manufacturer's recommendation at recommended rates with an even spray, maximum pressure of 200 kPa. Do not use mist blower.
- .3 Confine spray to the area being treated.
- .4 Apply on calm, windless days.
- .5 Apply to dry plants only, when no rain is expected within 24 hours, at air temperature between 15 and 30 degrees C.
- .6 Repair and pay for damages caused by herbicides.

**3.5 PEST AND DISEASE CONTROL**

- .1 Perform pest and disease control in accordance with Provincial chemical application regulations.
- .2 Confirm proper, positive identification of infestations and consult with Consultant before taking corrective action.
- .3 Strictly adhere to manufacturer's specifications.
- .4 Determine susceptibility of plant species to chemical damage prior to any application.
- .5 Perform treatments with due regard for climactic conditions, the public, and the surroundings.
- .6 Repair and pay for damages caused by chemical applications.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Protection of existing trees and shrubs to be preserved.
- .2 Related Sections:
  - .1 All sections.

**1.2 REFERENCES**

- .1 Department of Justice Canada.
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

**1.3 PENALTIES**

- .1 Restitution for damages to, or removal of, existing plant material to be preserved shall be based on the value of the plant material as determined using formulae described by the International Society of Arboriculture "Guide for Plant Appraisal", ninth edition.
  - .1 A certified arborist will perform the assessment and valuation of damages and may include the cost of repair, removal and replacement as determined by such assessment.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Snow fencing: red in colour, as approved by the Consultant.

**Part 3 Execution**

**3.1 IDENTIFICATION AND PROTECTION**

- .1 Identify plants and limits of root systems to be preserved as approved by Consultant.
- .2 Erect snow fence at furthest possible distance from trees to be preserved.
- .3 Protect plant and root systems from damage, compaction and contamination resulting from construction as approved by Consultant.
- .4 Ensure no pruning is done inside drip line. If pruning inside drip line is required consult an arborist or Canadian Certified Horticultural Technician (CCHT) as approved by Consultant.
- .5 Prune exposed roots cleanly at side of trench nearest plants to be preserved. Pruned ends to point obliquely downwards.
- .6 Water entire root zone to optimum soil moisture level to a depth of 300mm for the duration of excavation.

- .7 Do not undertake pruning of any Elm trees during the annual pruning ban from April 1 to August 31.

- .1 All Elm tree prunings to be disposed of at an approved waste facility.

### 3.2 CONSTRUCTION ACCESS, PARKING AND STORAGE

- .1 Comply with all requirements of the Public Service Vehicles Act.
  - .1 Use construction access/egress routes as approved by the Consultant.
- .2 If access to the site is required within the drip line of existing trees, then protect the access route so that the weight of vehicles is spread out over a greater surface area.
- .3 Store equipment, topsoil, or other construction materials beyond the drip line of trees or outside the extent of tree protection provided.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM D698-[00a], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.5-[M91(March 1999)], Low Flash Petroleum Spirits Thinner (Reaffirmation of December 1991).
  - .2 CAN/CGSB-1.74-[2001], Alkyd Traffic Paint.
- .3 Saskatchewan Ministry of Highways and Infrastructure Standard Specifications Manual (MHISSM)

**1.3 SAMPLES**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Divert unused aggregate materials from landfill to facility for reuse as approved by Consultant.
- .6 Dispose of unused paint and paint thinner materials at official hazardous material collections site as approved by Consultant.
- .7 Fold up metal banding, flatten and place in designated area for recycling.
- .8 Do not dispose of unused paint and paint thinner material into sewer system, into streams, lakes, onto ground or in other location where it will pose health environmental hazard.
- .9 Divert unused asphalt from landfill to facility capable of recycling materials.

Part 2 Products

2.1 MATERIALS

- .1 Aggregates to: MHISSM – Section 3000 to 3999
- .2 Prime & Tack Coat: to MHISSM – Section 4000
- .3 Asphalt concrete: to MHISSM – Section 4100
- .4 Granular subbase:
  - .1 The subbase aggregate shall be composed of fragments of durable rock, free from injurious quantities of soft or flaky particles, shale, loam and organic or other deleterious material.
  - .2 The gradation of subbase aggregate shall be within the following limits:

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
56 mm	100
80 µm	5-15
Plasticity Index	0 - 6

- .5 Granular base:
  - .1 When tested according to A.S.T.M. Designation C135, Method of Test for Sieve Analysis, the material shall meet the following gradation requirements:

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
<u>Size</u>	<u>Type 32</u>
25 mm	100
20 mm	93 – 100
12.5 mm	72 – 93
5 mm	45 – 77
2 mm	29 – 56
800 µm	17 – 38
400 µm	13 – 26
160 µm	7 – 14
80 µm	7 – 11
Plasticity Index	0 - 6

- .2 The percentage passing the designated sieve sizes for any representative sample, when plotted on a semi-log grading chart, shall show a free flowing concave curve without sharp breaks, within the limits specified above. The material passing through the 400 µm sieve shall have a Liquid Limit not greater than 25 and a Plasticity Index not greater than six (6).
- .3 The aggregate shall consist of hard, durable particles free from injurious quantities of soft or flaky particles, loam or organic matter, or other deleterious material. The gravel shall be crushed gravel passing a 25 mm sieve.

- .4 Granular material retained on the 5 mm sieve shall have a minimum average of forty-five percent (45%) of the aggregate with at least one fractured face. Average will be defined as the average all tests for each working shift.
- .6 Prime coat and tack coat:
- .1 The bituminous material shall be MC70 to MC250, RC70 to RC250 or SS-1. Where SS-1 is used, the dilution with water shall be 1:1.
- .7 Asphalt concrete:
- .1 Aggregate shall consist of hard, durable, uniformly graded, crushed gravel or steel slag and shall not contain organic or soft materials nor materials that break up when alternately frozen and thawed or wetted and dried, nor other deleterious materials.
- .2 When tested according to ASTM Designation C136, method of Test for Sieve Analysis, the aggregate material shall meet the following gradation requirements:

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
20 mm	
16 mm	100
12.5 mm	90 – 100
10 mm	79 – 92
5 mm	50 – 72
2 mm	32 – 51
800 µm	20 – 35
400 µm	15 – 27
160 µm	7 – 15
80 µm	4 – 11

- .3 The minimum sand equivalent value shall be 45 when tested in accordance with ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates.
- .4 The coarse aggregate must conform to the requirements for gravel ASTM Designation D692.
- .5 The fine aggregate must conform to the requirements of the Standard Specifications for fine aggregate for Bituminous Concrete Pavements, ASTM Designation D1073.
- .6 When the mineral aggregate is deficient in mineral filler, the Contractor shall add in the weigh hopper of the asphalt plant, mineral filler in such quantities as will be required to meet the gradation of aggregate as specified above. Mineral filler shall consist of Portland Cement, Pozzolan, commercially ground stone dust, or other mineral dust approved by the Engineer. Mineral filler shall have a plasticity index of zero.
- .7 The asphaltic binder shall be uniform in character, free of water and shall not foam when heated to 175°C. It shall meet the following specifications:

ASTM CHARACTERISTICS	ASTM TEST METHOD	SPECIFICATIONS	
		150-200(A)	300-400(A)

		MIN	MAX	MIN	MAX
Penetration @ 25°C, 100 g, 5 sec	D5	(see table below)		(see table below)	
Viscosity @ 60°C, MPa's	D2171				
Flash Point (Cleveland Open Cup), °C	D92	205		175	
Thin Film Oven Test Weight Loss, max. %	D1754	-	1.0	-	2.0
Penetration @ 25°C of residue, % of orig.	D5	50	-	-	-
Ductility: @ 25°C	D113	100	-	-	-
Solubility in Trichloroethylene, min. %	D2042	99.5	-	99.5	-

- .8 The limits of the viscosity and penetration shall be as follows:

LIMITS					
150-200(A)	Viscosity	<u>55</u>	<u>78</u>	<u>50</u>	<u>92</u>
	Penetration	150	150	200	200
300-400(A)	Viscosity	<u>45</u>	<u>26.5</u>	<u>17</u>	<u>27</u>
	Penetration	300	300	400	400

- .8 Traffic paint: yellow and white as required to CAN/CGSB-1.74.  
.9 Paint thinner: to CAN/CGSB-1.5.

### Part 3 Execution

#### 3.1 FOUNDATIONS

- .1 Foundations for roadways comprise:  
Light Duty:
- .1 250 mm compacted thickness of granular sub base or match existing.
  - .2 150 mm compacted thickness of granular base or match existing.
- .2 Construction of granular foundations: SDOHSSM – Section 3000 to 3999  
.3 Compaction: compact each lift of granular material to 98% maximum density to ASTM D698. Maximum lift thickness: 150 mm.

#### 3.2 PAVEMENT THICKNESS

- .1 Pavements for light duty surfaces: 40 mm A.C.

#### 3.3 PAVEMENT CONSTRUCTION

- .1 Surface preparation: MHISSM – Section 4100  
.2 Application of prime coat and tack coat: MHISSM – Section 4100



- 
- .3 Construction of asphalt concrete: MHISSM – Section 4100

**3.4 TRAFFIC MARKINGS**

- .1 Paint parking space divisions and other pavement markings in accordance with manufacturer's recommendations.
- .2 Use paint thinner in accordance with manufacturer's requirements.
- .3 Replace parking space division lines where parking stalls are disturbed during construction.
- .4 Parking space division lines are to be 100mm wide yellow paint.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED WORK**

- .1 Section 31 23 33 – Excavating, Trenching and Backfilling

**1.2 PROTECTION**

- .1 Prevent damage to buildings, landscaping, curbs, sidewalks, trees, and adjacent property. Make good any damage.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Pea Rock, approximately 15mm minus in diameter.
- .2 Edging: Sure-loc Crisp Edge Aluminum Edger or approved equivalent. Size to be 3.2mm x 102mm with stakes at 1.2m O.C. Finish to be black anodized.
- .3 Geotextile filter: TenCate Mirafi MSCAPE or approved equivalent.

**Part 3 Execution**

**3.1 SUBGRADE**

- .1 Ensure that subgrade preparation conforms to levels and compaction required to allow for installation of granular mulch. Ensure grade slopes away from building.

**3.2 GEOTEXTILE FILTER**

- .1 Install geotextile filter as indicated.

**3.3 EDGING**

- .1 Install edging true to grade, in location, layout as indicated.

**3.4 PEA ROCK**

- .1 Place pea rock mulch to thickness of 100mm.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 03 30 00 – Cast – in – place Concrete
- .2 03 35 00 – Concrete Finishing
- .3 32 12 16 – Asphalt Paving
- .4 31 23 33 – Excavation, Trenching and Backfilling

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C117-[04], Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-[05], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D260-[86(2001)], Standard Specification for Boiled Linseed Oil.
  - .4 ASTM D698-[00ae1], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>3</sup>) (600 kN-m/m<sup>3</sup>).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-3.3-[99(March 2004)], Kerosene, Amend. No. 1, National Standard of Canada.
  - .2 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1-[04]/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS/
- .3 Inform Construction Manager of proposed source of materials and provide access for sampling at least 4 weeks prior to commencing work.
- .4 If materials have been tested by accredited testing laboratory within previous 2 months and have passed tests equal to requirements of this specification, submit test certificates from testing laboratory showing suitability of materials for this project.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 47 21 - Construction/Demolition Waste Management and Disposal

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**Part 2            Products**

**2.1                MATERIALS**

- .1      Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2      Reinforcing steel: in accordance with the drawings.
- .3      Joint filler or Curing Compound: in accordance with Section 03 30 00 - Cast-in-Place Concrete or as noted on the drawings.
- .4      Granular base: material to Section 32 12 16.2.1.5 – Asphalt Paving-
- .5      Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.
- .6      Fill material: to Section 31 23 33.3.12 - Excavation, Trenching and Backfilling
- .7      Boiled linseed oil: to ASTM D260.
- .8      Kerosene: to CAN/CGSB-3.3.

**Part 3            Execution**

**3.1                GRADE PREPARATION**

- .1      Do grade preparation work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2      Construct embankments using excavated material free from organic matter or other objectionable materials.
  - .1      Dispose of surplus and unsuitable excavated material in approved location on or off site.
- .3      When constructing embankment provide for shoulders to match existing, where applicable, outside of neat lines of concrete.
- .4      Place fill in maximum 150 mm layers and compact to at least 95% (98% upper two lifts) of maximum dry density to ASTM D698.

**3.2                GRANULAR BASE**

- .1      Obtain Construction Manager's approval of subgrade before placing granular base.
- .2      Place granular base material to lines, widths, and depths as indicated.
- .3      Compact granular base in maximum 150 mm layers to at least 98% of maximum density to ASTM D698.

**3.3                CONCRETE**

- .1      Obtain Construction Manager's approval of granular base and reinforcing steel prior to placing concrete.
- .2      Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete and Section 03 35 00 – Concrete Finishing.
- .3      Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.

- .4 Provide edging as indicated with 10mm radius edging tool.
- .5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Construction Manager can be demonstrated. Hand finish surfaces when directed by Construction Manager.

### 3.4 TOLERANCES

- .1 Finish surfaces to within 3 mm in 3m as measured with 3m straightedge placed on surface.

### 3.5 EXPANSION AND CONTRACTION JOINTS

- .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals to match existing.
- .2 Install expansion joints as required at joints.
- .3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

### 3.6 ISOLATION JOINTS

- .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .2 Install joint filler in isolation joints [in accordance with Section [03 30 00 - Cast-in-Place Concrete] or as indicated.
- .3 Seal isolation joints with sealant approved by Construction Manager.

### 3.7 CURING

- .1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound as directed by Construction Manager.
- .2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

### 3.8 BACKFILL

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material as directed by Construction Manager.
  - .1 Compact and shape to required existing contours as directed by Construction Manager.

### 3.9 LINSEED OIL TREATMENT

- .1 Apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters, after concrete has cured for specified curing time and when surface of concrete is clean and dry.
- .2 Linseed oil mixture to consist of 50% boiled linseed oil and 50% mineral spirits by volume.
- .3 Apply treatment when air temperature above 10 degrees C.

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- .4 Apply first coat at 135 mL/m<sup>2</sup>.
  - .5 Apply second coat at 90 mL/m<sup>2</sup> when first coat has dried.

**3.10 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 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**

**1.1 RELATED SECTIONS**

- .1 Section 32 92 23 – Sodding
- .2 Section 32 93 10 – Trees, Shrubs and Ground Cover Planting

**1.2 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties. Testing must be approved prior to placement of topsoil.

**1.3 DISPOSAL**

- .1 Divert unused soil amendments from landfill to official hazardous material collections site approved by Consultant.
- .2 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

**Part 2 Products**

**2.1 TOPSOIL**

- .1 Topsoil: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
  - .1 Neither heavy clay nor of light sandy nature, containing a minimum of 5% organic matter to maximum of 20% by weight.
  - .2 Acidity range (pH) of 6.5 to 8.0.
  - .3 Contain no toxic elements or growth inhibiting materials.
  - .4 Finished surface free from:
    - .1 Debris and stones over 50 mm diameter.
    - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
  - .5 Consistence: friable when moist.

**2.2 PLANTING SOIL**

- .1 Planting soil for planting beds and sodded areas: mix 3 parts topsoil with 1 part peat moss, manure or compost, and 1 part sand.

**2.3 SOIL AMENDMENTS**

- .1 Fertilizer:
  - .1 Formulation ratio and application rate to be determined based on recommendation of approved soil test. Submit test results to Consultant for approval.
  - .2 Industry accepted standard medium containing nitrogen, phosphorous, potassium

- and other micro-nutrients suitable to specific plant species or application or defined by soil test.
- .2 Peatmoss:
    - .1 Derived from partially decomposed species of Sphagnum Mosses.
    - .2 Elastic and homogeneous, brown in colour.
    - .3 Free of wood and deleterious material which could prohibit growth.
    - .4 Shredded particle minimum size: 5mm.
  - .3 Sand: washed coarse silica sand, medium to coarse textured.
  - .4 Organic matter: compost Category A, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
  - .5 Compost: a mixture of soil and decomposing organic matter used as a fertilizer, mulch, or soil conditioner. Compost is processed organic matter containing 40% or more organic matter as determined by the Walkley-Black or LOI test. Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth, and contain no toxic or growth inhibiting contaminants. Composed bio-solids must meet the requirements of the Guidelines for Compost Quality, Category A produced by the Canadian Council of the Ministers of the Environment (CCME), January 1996.
  - .6 Manure: to be well decomposed cattle excrement, rich in organic matter and humus containing balanced proportions of nitrogen , phosphorous and potash.
    - .1 Reasonably free of living vegetation, weed seeds, and couch grass or brome grass rhizomes.
    - .2 In a pulverised, friable condition, not containing fresh, or "green" manure, clay, silt, gravel or other foreign material.

## **2.4 SOURCE QUALITY CONTROL**

- .1 Advise Consultant of sources of topsoil to be utilized with sufficient lead time for testing.
- .2 Contractor is responsible for amendments to supply topsoil as specified.
- .3 Soil testing by recognized testing facility for PH, P and K, and organic matter.
- .4 Testing of topsoil will be carried out by testing laboratory designated by Consultant. Soil sampling, testing and analysis to be in accordance with Provincial standards. Testing is to be approved by Consultant prior to placement. Costs for testing to be included within topsoil price.

## **2.5 PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Stockpile topsoil in locations as designated by Consultant.
- .2 Do not spread topsoil in frozen or muddy conditions.

## **Part 3 Execution**

### **3.1 PREPARATION OF EXISTING GRADE**

- .1 Verify that grades are correct. If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant.

- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 50mm above surface. Dispose of removed material off site.
- .4 Cultivate entire area which is to receive topsoil to minimum depth of 100mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

### **3.2 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL**

- .1 Place topsoil after Consultant has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15mm below finished grade.
- .4 Spread topsoil to following minimum depths after settlement.
  - .1 135mm for sodded areas.
  - .2 500mm for shrub beds.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

### **3.3 APPLICATION OF FERTILIZER**

- .1 Spread fertilizer uniformly over entire area of planting soil at rate determined on basis of soil test results and as directed by the Consultant.
- .2 Mix fertilizer thoroughly to full depth of the planting soil.

### **3.4 FINISH GRADING**

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Consultant. Leave surfaces smooth, uniform and firm against deep footprinting.

### **3.5 ACCEPTANCE**

- .1 Upon approval of the testing results, the Consultant will inspect the topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

### **3.6 CLEANING**

- .1 Clean adjacent walks and road surfaces at the end of each working day, or as directed.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

### **3.7 WARRANTY**

- .1 Guarantee all work for a period of one year or until all deficiencies are rectified, whichever is greater, commencing on the date of construction completion.

- 
- .2 Bring back to design grade all areas that have settled during the warranty period.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 32 91 21 - Topsoil Placement and Grading.

**1.2 SUBMITTALS**

- .1 Samples.
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Obtain approval of samples by Consultant.

**1.3 SCHEDULING**

- .1 Schedule sod laying to coincide with preparation of soil surface.
- .2 Schedule sod installation when frost is not present in ground.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.
  - .1 Turf Grass Nursery Sod types:
    - .1 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivar[s].
  - .2 Turf Grass Nursery Sod quality:
    - .1 Not more than 2 broadleaf weeds or 10 other weeds per 40 square metres.
    - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
    - .3 Mowing height limit: 45 to 65 mm.
    - .4 Soil portion of sod: 6 to 15 mm in thickness.
- .2 Fertilizer:
  - .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
  - .2 Type and application rate to be determined by soils test.

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**2.2 SOURCE QUALITY CONTROL**

- .1 Obtain approval from Consultant of sod sample.
- .2 When proposed source of sod is approved, use no other source without written authorization from Consultant.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Verify that grades are correct and prepared in accordance with Section 32 91 21 - Topsoil Placement and Grading. If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant.
- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth, even grade, to tolerance of plus or minus 8mm, for Turf Grass Nursery Sod, surface to drain naturally.
- .4 Remove and dispose of weeds; debris; stones 50mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

**3.2 SOD PLACEMENT**

- .1 Lay sod within 24hours of being lifted if air temperature exceeds 20 degrees C.
- .2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .3 Roll sod as directed by Consultant. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

**3.3 MAINTENANCE DURING ESTABLISHMENT PERIOD**

- .1 Perform following operations from time of installation until acceptance.
- .2 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100mm.
- .3 Cut grass to 50mm when or prior to it reaching height of 75mm. Remove clippings which will smother grassed areas as directed by Consultant.
- .4 Maintain sodded areas weed free.
- .5 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.

**3.4 ACCEPTANCE**

- .1 Turf Grass Nursery Sod areas will be accepted by Consultant provided that:
  - .1 Sodded areas are properly established.
  - .2 Sod is free of bare and dead spots.

- .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50mm.
- .4 Sodded areas have been cut minimum 2 times prior to acceptance.
- .5 Fertilizing in accordance with fertilizer program has been carried out at least once.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

### 3.5 **CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

### 3.6 **WARRANTY**

- .1 Guarantee all work and health of sod for one year or until all deficiencies are rectified, whichever is greater, commencing on the date of construction completion.
- .2 Bring back to design grade all areas that have settled during warranty period.
- .3 Replace all dead or damaged sod 45 days prior to end of warranty period.

**END OF SECTION**





**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for plant material, accessories, planting, tree support, mulching and maintenance.
- .2 Related Sections:
  - .1 Section 32 01 90 – Landscape Maintenance
  - .2 Section 32 15 40 – Crushed Stone Surfacing.
  - .3 Section 32 91 21 – Topsoil Placement and Grading.

**1.2 REFERENCES**

- .1 Agriculture and Agri-Food Canada (AAFC).
  - .1 Plant Hardiness Zones in Canada-[2000].
- .2 Canadian Nursery Landscape Association (CNLA).
  - .1 Canadian Standards for Nursery Stock-[2001].
- .3 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

**1.3 DEFINITIONS**

- .1 Mycorrhiza: association between fungus and roots of plants. This symbiosis, enhances plant establishment in newly landscaped and imported soils.

**1.4 SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data for:
  - .1 Fertilizer.
  - .2 Mycorrhiza.
  - .3 Anti-desiccant.
  - .4 Guying assembly including clamps, collar, guying wire, anchors and wire tightener.
  - .5 Mulch.

**1.5 STORAGE AND PROTECTION**

- .1 Protect plant material from frost, excessive heat, wind and sun during delivery.
- .2 Immediately store and protect plant material which will not be installed within 1 day after arrival at site in storage location approved by Consultant.
- .3 Protect plant material from damage during transportation:
  - .1 When delivery distance is less than 30 km and vehicle travels at speeds under 80

- km/h, tie tarpaulins around plants or over vehicle box.
- .2 When delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.
- .3 Protect foliage and root balls using anti-desiccants and tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.
- .4 Protect stored plant material from frost, wind and sun and as follows:
  - .1 For bare root plant material, preserve moisture around roots by heeling-in or burying roots in sand or topsoil and watering to full depth of root zone.
  - .2 For pots and containers, maintain moisture level in containers. Heel-in fibre pots.
  - .3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.

## 1.6 WARRANTY

- .1 The Contractor hereby warrants that plant material as itemized on plant list will remain free of defects for 1 full growing season, or 1 year from construction completion whichever is greater, providing adequate maintenance has been provided.
- .2 End-of-warranty inspection will be conducted by Consultant.
- .3 Consultant reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

## Part 2 Products

### 2.1 PLANT MATERIAL

- .1 Type of root preparation, sizing, grading and quality: comply to Canadian Standards for Nursery Stock.
  - .1 Source of plant material: grown in Zone 3 in accordance with Plant Hardiness Zones in Canada.
  - .2 Plant material must be planted in zone indicated as appropriate for its species.
  - .3 Plant material in location appropriate for its species.
- .2 Plant material: free of disease, insects, defects or injuries and structurally sound with strong fibrous root system.
- .3 Trees: with straight trunks, well and characteristically branched for species except where specified otherwise. Refer to drawing for sizes.
  - Coniferous trees to be min. 1800mm height.
  - Deciduous trees to be min. 50mm caliper.
- .4 Shrubs: natural form, typical of genus, species and variety, minimum of 4 canes..
- .5 Container grown plants – refer to drawings for shrub sizes.
  - Coniferous shrubs to be minimum #2 pot size.
  - Deciduous shrubs to be minimum #2 pot size.
  - Grown in containers for minimum of 3 months.
  - Established root system which will hold soil when removed from container.

- Container sized in proportion to plant size.
- Root bound plants are not acceptable.

- .6 The supply and planting of bare root stock and collected stock will not be permitted, unless specified by the Consultant.

## **2.2 WATER**

- .1 Free of impurities that would inhibit plant growth.

## **2.3 STAKES**

- .1 T-bar, steel, 40 x 40 x 5 x 2440 mm.

## **2.4 GUYING WIRE**

- .1 Arbour tape or equivalent.

## **2.5 GUYING COLLAR**

- .1 Arbour knot or equivalent.

## **2.6 MULCH**

- .1 Wood chip: clean untreated shredded wood chips, free of bark, small branches and leaves, to be used in new tree well(s) and shrub beds as noted on drawings.
- .2 Pea Rock granular mulch to be used in shrub bed(s) as noted on drawings.

## **2.7 FERTILIZER**

- .1 Synthetic commercial type as recommended by soil test report.

## **2.8 ANTI-DESICCANT**

- .1 Wax-like emulsion.

## **2.9 SOURCE QUALITY CONTROL**

- .1 Obtain approval from Consultant of plant material prior to planting. Consultant retains the right to refuse plant material after planting if branching or health is compromised.
- .2 Imported plant material must be accompanied with necessary permits and import licenses. Conform to Federal, Provincial or Territorial regulations.

## **Part 3 Execution**

### **3.1 PRE-PLANTING PREPARATION**

- .1 Ensure plant material acceptable to Consultant.
- .2 Remove damaged roots and branches from plant material.

- .3 Apply anti-desiccant to conifers and deciduous trees in leaf in accordance with manufacturer's instructions.

### 3.2 EXCAVATION AND PREPARATION OF PLANTING BEDS

- .1 Preparation of planting beds is specified in Section 32 91 21 - Topsoil Placement and Grading.
- .2 For individual planting holes:
  - .1 Complete utility and irrigation locates prior to excavation.
  - .2 Notify the Consultant of any buried obstructions which may affect layout of plant material
  - .3 Stake out location and obtain approval from Consultant prior to excavating.
  - .4 Excavate to depth and width as indicated.
  - .5 Dispose of excess material.
  - .6 Scarify sides of planting hole.
  - .7 Remove water which enters excavations prior to planting. Notify Consultant if water source is ground water.

### 3.3 PLANTING

- .1 For jute burlapped root balls, cut away top one third of wrapping and wire basket without damaging root ball. Do not pull burlap or rope from under root ball.
- .2 For container stock or root balls in non-degradable wrapping, remove entire container or wrapping without damaging root ball.
- .3 Plant vertically in locations as indicated. Orient plant material to give best appearance in relation to structure, roads and walks.
- .4 Place plants at same depth as originally grown. Check that excess topsoil is not paced over the root ball prior to planting. Root flare is to match final grade.
- .5 For trees and shrubs:
  - .1 Backfill soil in 150 mm lifts. Tamp each lift to eliminate air pockets. When two thirds of depth of planting pit has been backfilled, fill remaining space with water. After water has penetrated into soil, backfill to finish grade.
  - .2 Form watering saucer as indicated.
- .6 For ground covers, backfill soil evenly to finish grade and tamp to eliminate air pockets.
- .7 Water plant material thoroughly.
- .8 After soil settlement has occurred, fill with soil to finish grade.
- .9 Dispose of burlap, wire and container material off site.

### 3.4 TRUNK PROTECTION

- .1 Install trunk protection on deciduous trees as indicated.
- .2 Install trunk protection prior to installation of tree supports when used.

### 3.5 TREE SUPPORTS

- .1 Install tree supports as indicated.
- .2 After tree supports have been installed, remove broken branches with clean, sharp tools.

### 3.6 MULCHING

- .1 Ensure soil settlement has been corrected prior to mulching.
- .2 Spread mulch as indicated.

### 3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following maintenance operations from time of planting to acceptance by Consultant.
  - .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
    - .1 For evergreen plant material, water thoroughly in late fall prior to freeze-up to saturate soil around root system.
  - .2 Remove weeds monthly.
  - .3 Replace or re-spread damaged, missing or disturbed mulch.
  - .4 For non-mulched areas, cultivate as required to keep top layer of soil friable.
  - .5 If required to control insects, fungus and disease, use appropriate control methods in accordance with Federal, Provincial and Municipal regulations. Obtain product approval Consultant prior to application.
  - .6 Remove dead or broken branches from plant material.
  - .7 Keep trunk protection and guy wires in proper repair and adjustment.
  - .8 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings. Provide the Consultant with a list and map of replaced plant material throughout the maintenance and warranty period.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials and installation for foundation and underslab drainage.

**1.2 RELATED SECTIONS**

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM D698-00ae1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B1800-[02], Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
    - .1 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
- .3 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999 (CEPA)
- .4 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and [recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Divert unused geotextiles from landfill to plastic recycling facility for disposal approved by Construction Manager.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

**1.5 SITE CONDITIONS**

- .1 Examine sub-surface investigation report which is available for inspection at office of the Construction Manager.
- .2 Known underground utility lines and buried objects are as indicated on plans.

**Part 2 Products**

**2.1 BEDDING AND SURROUND MATERIALS**

- .1 Coarse filter aggregate: to CSA-A23.1/A23.2, Group 1 20-5 mm.

- .2 Fine filter aggregate: to CSA-A23.1/A23.2 in accordance with Section 31 23 33 – Excavation, Trenching and Backfilling.
- .3 Flexible plastic tubing and fittings. Corrugated Perforated and Non-perforated nominal inside diameter 150 mm.
- .4 Filter fabric: Water pervious; non-woven; acceptable products:
  - .1 Nilex 4545.
  - .2 Amoco 4551.
  - .3 Approved equivalent.

## **2.2 BACKFILL MATERIAL**

- .1 Type 2, in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Excavated or graded material existing on site may be suitable to use if approved by Consultants.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Ensure graded subgrade conforms with required drainage pattern before placing bedding material.
- .2 Ensure improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of General Contractor.
- .3 Ensure foundation wall and dampproofing and waterproofing have been installed and approved by General Contractor before placing bedding material.

### **3.2 BEDDING PREPARATION**

- .1 Cut trenches in subgrade and place bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .2 Shape bed true to grade and to provide continuous, uniform bearing surface for tubing.
- .3 Shape transverse depressions, as required, to suit joints.
- .4 Compact each layer full width of bed to at least 95% of corrected maximum dry density.
- .5 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

### **3.3 PIPE OR TUBING INSTALLATION**

- .1 Ensure tubing interior and coupling surfaces are clean before laying.
- .2 Lay perforated tubing to slope as indicated. For pipe face perforations and coupling slots downward.
- .3 Lay non-perforated tubing to slope of 1:50 from perforated tubing to disposal area. Make joints watertight.
- .4 Grade bedding to establish tubing slope.



- .5 Install end plugs at ends of collector drains to protect tubing ends from damage and ingress of foreign material.
- .6 Connect non-perforated tubing to sump pit by appropriate adapters manufactured for this purpose.
- .7 Provide cleanouts on non-perforated tubing at changes of tubing direction and in runs greater than 15 m.
- .8 Provide flush cleanouts where directed by Construction Manager.
- .9 Connect drainage system to building storm sewers, as indicated.

### **3.4 PIPE OR TUBING SURROUND MATERIAL**

- .1 Upon completion of tubing laying and after Construction Manager has inspected Work in place, surround and cover tubing and install geotextile filter as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness, as indicated. Do not drop material within 1 m of tubing.
- .3 Place layers uniformly and simultaneously on each side of tubing.
- .4 Compact each layer from tubing invert to mid-height of tubing to at least 95% of corrected maximum dry density.
- .5 Compact each layer from mid-height of tubing to underside of backfill to at least 90% of corrected maximum dry density.

### **3.5 BACKFILL MATERIAL**

- .1 Place backfill material above tubing surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Under paving and walks, compact backfill to at least 98% corrected maximum dry density. In other areas, compact to at least 95% corrected maximum dry density.

**END OF SECTION**



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Site Name : [REDACTED]		Structure No : 124			Structure name : "D" Block					
Asbestos Present : Yes		Vermiculite Present :			Survey Date : 01/25/2005		Last Inspected : 03/31/2015			
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-1		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A19
Ceiling	Metal Decking			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						A20
Wall	Gypsum board Filler Compound			T-N-A						A21
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-10		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-11		Room Description : Bathroom								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-12		Room Description : Bathroom								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-13		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Straight Run-Fiberglass			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-14		Room Description : General Office								
Std. Comments : No destructive testing										

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V24
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-15		Room Description : Laundry Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V20
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-16		Room Description : Classroom								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A26
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V24
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-17		Room Description : Stairwell								
Std. Comments : No destructive testing										
Comments : Stairwell includes first floor landings.										
Ceiling	Drywall - Filler Compound			T-N-A						V33
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-18		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V24
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V20

## Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Pipe	Straight Run Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	A25
Wall	Gypsum board Filler Compound	252.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-19		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A28
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						A27
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	193.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Potential				
Room : 1-2		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V20
Wall	Block			P-A						
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-20		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Ductwork	Duct Sealant			T-N-A						A30
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	A29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-21		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Pipe	Straight Run Insulated	3.70	Metre(s)	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-22		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-23		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-24		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.20	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-25		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						

## Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Pipe	Straight Run Insulated	3.70	Metre(s)	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-26		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-27		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-28		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						A31
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound	97.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-29		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound	2.30	Sq. M	Good	Chrysotile: 1.5%	B	7	Yes	No	V29
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						A32
Wall	Block			P-A						



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 1 Room : 1-3 Std. Comments : No destructive testing		Level Description : Floor - Main Room Description : General Office			Asbestos Present : No					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						A22
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1 Room : 1-30 Std. Comments : No destructive testing		Level Description : Floor - Main Room Description : Janitor Room			Asbestos Present : Yes					
Ceiling	Drywall - Filler Compound	2.30	Sq. M	Fair	Chrysotile: 1.5%	B	7	Yes	No	V29
Floor	Concrete/Terrazo			C-N-A						
Wall	Block			P-A						
Level : 1 Room : 1-31 Std. Comments : No destructive testing Comments : Stairwell includes first floor landings.		Level Description : Floor - Main Room Description : Stairwell			Asbestos Present : Yes					
Ceiling	Drywall - Filler Compound	24.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 1 Room : 1-32 Std. Comments : No destructive testing		Level Description : Floor - Main Room Description : Janitor Room			Asbestos Present : Yes					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V22
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	50.00	Sq. M	Good	Chrysotile: 1.5%	B	7	Yes	No	V29
Level : 1 Room : 1-33 Std. Comments : No destructive testing		Level Description : Floor - Main Room Description : Common Areas			Asbestos Present : Yes					
Ceiling	Drywall - Filler Compound	11.00		Fair	Chrysotile: 1.5%	A	7	Yes	No	V29
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	50.00	Sq. M	Good	Chrysotile: 1.5%	B	7	Yes	No	V29
Level : 1 Room : 1-34 Std. Comments : No destructive testing		Level Description : Floor - Main Room Description : Bedroom 1			Asbestos Present : Yes					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-35		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-36		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-37		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-38		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-39		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-4		Room Description : General Office								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V22
Pipe	Fittings Insulated			T-N-A						V20
Pipe	Straight Run-Fiberglass			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-40		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-41		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound	2.80	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound	34.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Level : 1		Level Description : Floor - Main			Asbestos Present : Yes					
Room : 1-42		Room Description : Stairwell								
Std. Comments : No destructive testing										
Comments : Stairwell includes first floor landings.										
Ceiling	Drywall - Filler Compound	24.00	Sq. M	Good	Chrysotile: 1.5%	A	7	Yes	No	V29
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-43		Room Description : Classroom								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V24
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main			Asbestos Present : No					
Room : 1-44		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main			Asbestos Present : Yes					
Room : 1-45		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Pipe	Fittings Insulated			T-N-A						V32
Pipe	Straight Run Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-46		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-47		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-48		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : Yes				
Room : 1-49		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Pipe	Straight Run Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-5		Room Description : General Office								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A24
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A23
Floor	Carpet			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V22
Pipe	Fittings Insulated			T-N-A						V20
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-50		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-51		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V24
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-52		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V24
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						A33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-53		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V31
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : Potential				
Room : 1-54		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V33
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V32
Wall	Block			P-A						
Level : 1		Level Description : Floor - Main				Asbestos Present : Potential				
Room : 1-55		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V33
Floor	Concrete/Terrazo			C-N-A						
Wall	Block			P-A						
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-56		Room Description : Stairwell								
Std. Comments : No destructive testing										
Comments : Stairwell includes first floor landings.										
Ceiling	Drywall - Filler Compound			T-N-A						V33
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-57		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V22
Pipe	Fittings Insulated			T-N-A						V32

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1				Level Description : Floor - Main		Asbestos Present : No				
Room : 1-58				Room Description : Common Areas						
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V33
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1				Level Description : Floor - Main		Asbestos Present : No				
Room : 1-59				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1				Level Description : Floor - Main		Asbestos Present : Potential				
Room : 1-6				Room Description : Janitor Room						
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Concrete/Terrazo			C-N-A						
Wall	Block			P-A						
Level : 1				Level Description : Floor - Main		Asbestos Present : No				
Room : 1-60				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1				Level Description : Floor - Main		Asbestos Present : No				
Room : 1-61				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-62		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-63		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-64		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-65		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-66		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V33
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V27
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-67		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V32
Wall	Gypsum board Filler Compound			T-N-A						V33
Level : 1		Level Description : Floor - Main				Asbestos Present : Potential				
Room : 1-68		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Metal Decking			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Wall	Block			P-A						
Wall	Brick			C-N-A						
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-7		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V19
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Tile - Vinyl/Asbestos			T-N-A						V22
Wall	Gypsum board Filler Compound			T-N-A						V21

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-8		Room Description : Bathroom								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - Main				Asbestos Present : No				
Room : 1-9		Room Description : Bathroom								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V21
Level : 1		Level Description : Floor - General				Asbestos Present : No				
Room : E		Room Description : Elevator Car								
Std. Comments : No destructive testing										
Floor	Sheet flooring			T-N-A						A61
Wall	Siding - Metal			C-N-A						
Level : 1		Level Description : Floor - Main				Asbestos Present : Potential				
Room : G		Room Description : Garage								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V21
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						A60
Wall	Block			P-A						
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-1		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V41
Ceiling	Metal Decking			C-N-A						
Floor	Carpel			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-10		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-11		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-12		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-13		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-14		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-15		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-16		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-17		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V43
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-18		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V36
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-19		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-2		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A41
Ceiling	Metal Decking			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-20		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-21		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-22		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-23		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-24		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-25		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-26		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-27		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						A36
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						A37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						A35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-28		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-29		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-3		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V41
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-30		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-31		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A40
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						A38
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						A39

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-32		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V38
Pipe	Fittings Insulated									V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-33		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : Yes				
Room : 2-34		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Pipe	Fittings Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-35		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated									V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-36		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated									V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-37		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated									V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : Yes				
Room : 2-38		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-39		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated									V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-40		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated									V42
Wall	Gypsum board Filler Compound			T-N-A						V39

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Second Floor				Asbestos Present : Yes				
Room : 2-41		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V36
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V42
Pipe	Fittings Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-42		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V39
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-43		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V39
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Floor - General				Asbestos Present : No				
Room : 2-44		Room Description : Stairwell								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-45		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V43
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-46		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V39

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-47		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-48		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-49		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-5		Room Description : Locker Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V36
Ductwork	Duct Sealant			T-N-A						A46
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-50		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-51		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-52		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-53		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-54		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V39
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Wall	Gypsum board Filler Compound			T-N-A						V39
Level : 2		Level Description : Floor - General				Asbestos Present : No				
Room : 2-55		Room Description : Stairwell								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-56		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V38
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-57		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V38
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-58		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : Yes				
Room : 2-59		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Pipe	Fittings Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-6		Room Description : Locker Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V36
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor			Asbestos Present : No					
Room : 2-60		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor			Asbestos Present : No					
Room : 2-61		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor			Asbestos Present : No					
Room : 2-62		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor			Asbestos Present : Yes					
Room : 2-63		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Pipe	Fittings Insulated	3.00	Sq. M	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V35

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-64		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-65		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-66		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V36
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						A42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-67		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-68		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V35

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Floor - General				Asbestos Present : No				
Room : 2-69		Room Description : Stairwell								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-7		Room Description : Locker Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V36
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-70		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						A44
Floor	Tile - Vinyl/Asbestos			T-N-A						A43
Pipe	Fittings Insulated			T-N-A						A45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-71		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-72		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-73		Room Description : Bedroom 1								
Std. Comments : No destructive testing										



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-74		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-75		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-76		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-77		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-78		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-79		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-8		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V36
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-80		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V38
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
Level : 2		Level Description : Second Floor				Asbestos Present : No				
Room : 2-81		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V38
Pipe	Fittings Insulated			T-N-A						V45

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V35
<b>Level : 2</b> <b>Room : 2-82</b> <b>Std. Comments : No destructive testing</b>		<b>Level Description : Floor - General</b> <b>Room Description : Stairwell</b>			<b>Asbestos Present : No</b>					
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
<b>Level : 2</b> <b>Room : 2-83</b> <b>Std. Comments : No destructive testing</b>		<b>Level Description : Second Floor</b> <b>Room Description : Common Areas</b>			<b>Asbestos Present : No</b>					
Ceiling	Drywall - Filler Compound			T-N-A						V35
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V42
Wall	Gypsum board Filler Compound			T-N-A						V35
<b>Level : 2</b> <b>Room : 2-9</b> <b>Std. Comments : No destructive testing</b>		<b>Level Description : Second Floor</b> <b>Room Description : Bedroom 1</b>			<b>Asbestos Present : No</b>					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V40
Ceiling	Drywall - Filler Compound			T-N-A						V35
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V37
Pipe	Fittings Insulated			T-N-A						V45
Wall	Gypsum board Filler Compound			T-N-A						V35
<b>Level : 3</b> <b>Room : 3-1</b> <b>Std. Comments : No destructive testing</b>		<b>Level Description : Third Floor</b> <b>Room Description : Hallway</b>			<b>Asbestos Present : No</b>					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
<b>Level : 3</b> <b>Room : 3-10</b> <b>Std. Comments : No destructive testing</b>		<b>Level Description : Third Floor</b> <b>Room Description : Bedroom 1</b>			<b>Asbestos Present : No</b>					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-11		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-12		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-13		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-14		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-15		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-16		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-17		Room Description : Furnace / Utility Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V55
Floor	Tile - Vinyl/Asbestos			T-N-A						V54
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-18		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-19		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-2		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A52
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						A53
Pipe	Straight Run-Fiberglass			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-20		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-21		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-22		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-23		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-24		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-25		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-26		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V48
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-27		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						A49
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						A47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						A48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-28		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V47

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-29		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-3		Room Description : Hallway								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V56
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-30		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-31		Room Description : Storage Room								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						A51
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-32		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-33		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : Yes				
Room : 3-34		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-35		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-36		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V55

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-37		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : Yes				
Room : 3-38		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-39		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-4		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-40		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V55

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3 Room : 3-41 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Common Areas			Asbestos Present : No					
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3 Room : 3-42 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Janitor Room			Asbestos Present : No					
Ceiling	Drywall - Filler Compound			T-N-A						V55
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3 Room : 3-43 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Janitor Room			Asbestos Present : No					
Ceiling	Drywall - Filler Compound			T-N-A						V55
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3 Room : 3-44 Std. Comments : No destructive testing		Level Description : Floor - General Room Description : Stairwell			Asbestos Present : No					
Ceiling	Drywall - Filler Compound			T-N-A						V48
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 3 Room : 3-45 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Storage Room			Asbestos Present : No					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						A54
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						A55
Level : 3 Room : 3-46 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Common Areas			Asbestos Present : No					
Ceiling	Drywall - Filler Compound			T-N-A						V55
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor			Asbestos Present : No					
Room : 3-47		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor			Asbestos Present : No					
Room : 3-48		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor			Asbestos Present : No					
Room : 3-49		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
Level : 3		Level Description : Third Floor			Asbestos Present : No					
Room : 3-5		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor			Asbestos Present : No					
Room : 3-50		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
<b>Level : 3</b> <b>Room : 3-51</b> <b>Std. Comments : No destructive testing</b>										
				<b>Level Description : Third Floor</b>				<b>Asbestos Present : No</b>		
				<b>Room Description : Bedroom 1</b>						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
<b>Level : 3</b> <b>Room : 3-52</b> <b>Std. Comments : No destructive testing</b>										
				<b>Level Description : Third Floor</b>				<b>Asbestos Present : No</b>		
				<b>Room Description : Bedroom 1</b>						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
<b>Level : 3</b> <b>Room : 3-53</b> <b>Std. Comments : No destructive testing</b>										
				<b>Level Description : Third Floor</b>				<b>Asbestos Present : No</b>		
				<b>Room Description : Bedroom 1</b>						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55
<b>Level : 3</b> <b>Room : 3-54</b> <b>Std. Comments : No destructive testing</b>										
				<b>Level Description : Third Floor</b>				<b>Asbestos Present : No</b>		
				<b>Room Description : Bedroom 1</b>						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V55
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V55

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3 Room : 3-55 Std. Comments : No destructive testing		Level Description : Floor - General Room Description : Stairwell		Asbestos Present : No						
Ceiling	Drywall - Filler Compound			T-N-A						V55
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 3 Room : 3-56 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Storage Room		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Pipe	Fittings Insulated			T-N-A						V56
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-57 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Bedroom 1		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-58 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Bedroom 1		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-59 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Bedroom 1		Asbestos Present : Yes						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 5%	C	7	Yes	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-6 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Storage Room		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-60		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-61		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-62		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : Yes				
Room : 3-63		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 5%	C	7	No	No	V25
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-64		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-65		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-66		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V56
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-67		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V48
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V56
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-68		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V48
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Floor - General				Asbestos Present : No				
Room : 3-69		Room Description : Stairwell								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V48
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-7		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-70		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V54
Pipe	Fittings Insulated			T-N-A						A56
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-71		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V56
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-72		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-73		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-74		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-75		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-76		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-77		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor				Asbestos Present : No				
Room : 3-78		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 3 Room : 3-79 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Bedroom 1		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-8 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Storage Room		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-80 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Bedroom 1		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-81 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Bedroom 1		Asbestos Present : No						
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3 Room : 3-82 Std. Comments : No destructive testing		Level Description : Floor - General Room Description : Stairwell		Asbestos Present : No						
Ceiling	Drywall - Filler Compound			T-N-A						V48
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 3 Room : 3-83 Std. Comments : No destructive testing		Level Description : Third Floor Room Description : Common Areas		Asbestos Present : No						
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						V53

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 3		Level Description : Third Floor			Asbestos Present : No					
Room : 3-9		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Fittings Insulated			T-N-A						V53
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 4		Level Description : Fourth Floor			Asbestos Present : Yes					
Room : 4-1		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Straight Run Insulated	4.60	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	V57
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor			Asbestos Present : No					
Room : 4-10		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor			Asbestos Present : No					
Room : 4-11		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor			Asbestos Present : No					
Room : 4-12		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-13		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-14		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-15		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-16		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-17		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V54
Wall	Gypsum board Filler Compound			T-N-A						V58

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 4 Room : 4-18 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Common Areas				Asbestos Present : Yes				
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	4.60	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	V57
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4 Room : 4-19 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Bedroom 1				Asbestos Present : No				
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4 Room : 4-2 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Hallway				Asbestos Present : Yes				
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	A57
Wall	Gypsum board Filler Compound			T-N-A						A58
Level : 4 Room : 4-20 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Bedroom 1				Asbestos Present : No				
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4 Room : 4-21 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Bedroom 1				Asbestos Present : No				
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
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# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-22		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-23		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-24		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-25		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Ceiling	Drywall - Filler Compound			T-N-A						V48
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V48
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-26		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-27		Room Description : Storage Room								
Std. Comments : No destructive testing										



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor			Asbestos Present : No					
Room : 4-28		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor			Asbestos Present : No					
Room : 4-29		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor			Asbestos Present : Yes					
Room : 4-3		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						A59
Pipe	Straight Run Insulated	8.20	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	V57
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor			Asbestos Present : No					
Room : 4-30		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-31		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-32		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-33		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : Yes				
Room : 4-34		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	1.50	Metre( s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	V57
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-35		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-36				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-37				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : Yes				
Room : 4-38				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	1.50	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	V57
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-39				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-4				Room Description : Storage Room						
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-40		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-41		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-42		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-43		Room Description : Janitor Room								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Floor - General				Asbestos Present : No				
Room : 4-44		Room Description : Stairwell								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-45		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V54

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-46				Room Description : Common Areas						
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-47				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-48				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-49				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor		Asbestos Present : No				
Room : 4-5				Room Description : Storage Room						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-50		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-51		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-52		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-53		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-54		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Floor - General			Asbestos Present : No			
Room : 4-55				Room Description : Stairwell						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 4				Level Description : Fourth Floor			Asbestos Present : No			
Room : 4-56				Room Description : Storage Room						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor			Asbestos Present : No			
Room : 4-57				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor			Asbestos Present : No			
Room : 4-58				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4				Level Description : Fourth Floor			Asbestos Present : Yes			
Room : 4-59				Room Description : Bedroom 1						
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	Yes	No	V57
Wall	Gypsum board Filler Compound			T-N-A						V58

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-6		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : Yes				
Room : 4-63		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Pipe	Straight Run Insulated	3.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	Yes	No	V57
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-64		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-65		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-66		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Ceiling	Metal Decking			C-N-A						
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58



# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 4 Room : 4-67 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Janitor Room			Asbestos Present : No					
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4 Room : 4-68 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Janitor Room			Asbestos Present : No					
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4 Room : 4-69 Std. Comments : No destructive testing		Level Description : Floor - General Room Description : Stairwell			Asbestos Present : No					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 4 Room : 4-7 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Storage Room			Asbestos Present : No					
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4 Room : 4-70 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Storage Room			Asbestos Present : No					
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V54
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4 Room : 4-71 Std. Comments : No destructive testing		Level Description : Fourth Floor Room Description : Common Areas			Asbestos Present : No					
Ceiling	Drywall - Filler Compound			T-N-A						V48
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V48

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-72		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-73		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-74		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-75		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-76		Room Description : Bedroom 1								
Std. Comments :No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-77		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-78		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-79		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-8		Room Description : Storage Room								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 48"			T-N-A						V49
Floor	Carpet			C-N-A						
Floor	Concrete			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-80		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-81		Room Description : Bedroom 1								
Std. Comments : No destructive testing										

# Asbestos Report

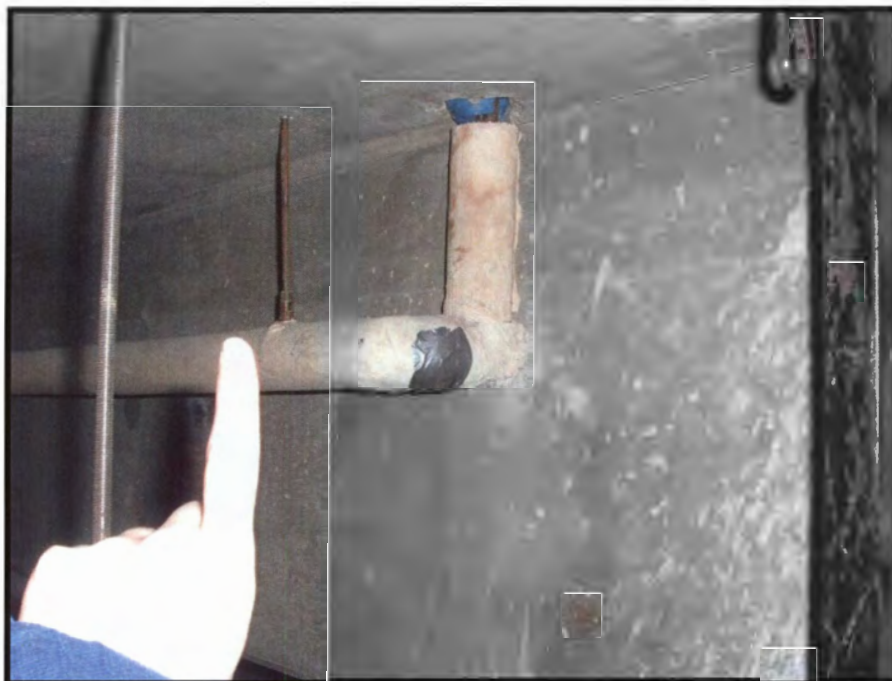
Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Tile - Vinyl/Asbestos			T-N-A						V51
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Floor - General				Asbestos Present : No				
Room : 4-82		Room Description : Stairwell								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V52
Ceiling	Drywall - Filler Compound			T-N-A						V58
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-83		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Drywall - Filler Compound			T-N-A						V58
Ceiling	Metal Decking			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : 4		Level Description : Fourth Floor				Asbestos Present : No				
Room : 4-9		Room Description : Bedroom 1								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						V50
Ceiling	Metal Decking			C-N-A						
Floor	Sheet flooring			T-N-A						V47
Wall	Gypsum board Filler Compound			T-N-A						V58
Level : B		Level Description : Crawl Space				Asbestos Present : Yes				
Room : B-1		Room Description : Pipe Chase								
Std. Comments : No destructive testing										
Ceiling	Cast in Place Concrete			C-N-A						
Floor	Earth			C-N-A						
Pipe	Fittings Insulated			T-N-A						A01
Pipe	Fittings Insulated			T-N-A						A02
Pipe	Fittings Insulated			T-N-A						A05
Pipe	Fittings Insulated			T-N-A						A07
Pipe	Fittings Insulated			T-N-A						A08
Pipe	Insulated - Fibreglass			C-N-A						
Pipe	Straight Run Insulated			T-N-A						A04
Pipe	Straight Run Insulated			T-N-A						A06
Pipe	Straight Run Insulated	15.30	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	Yes	No	A09
Wall	Concrete			C-N-A						
Wall	Spray-on Acoustical Insulation			T-N-A						A03

# Asbestos Report

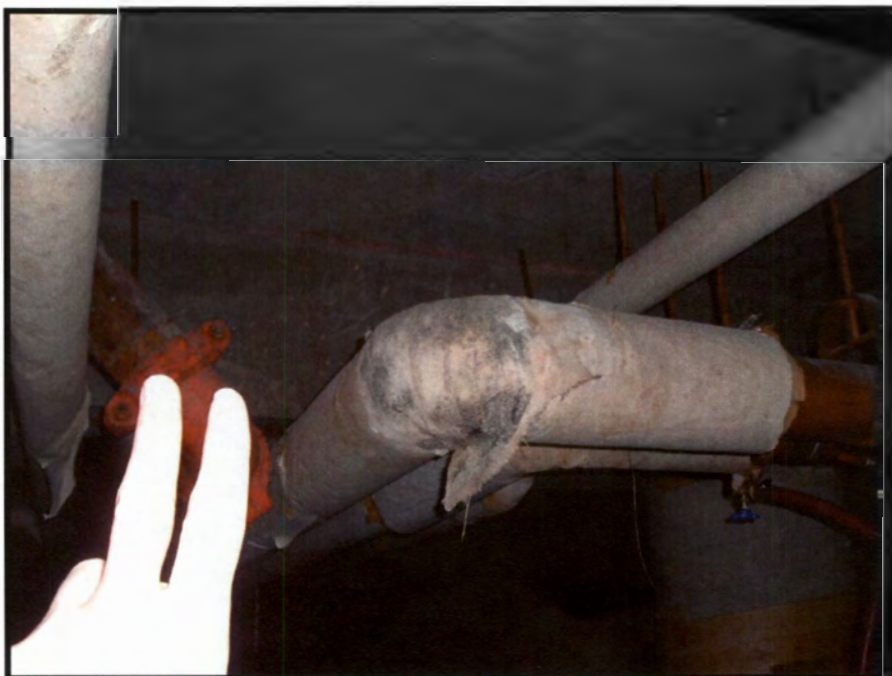
Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Level : B		Level Description : Basement				Asbestos Present : No				
Room : B-3		Room Description : Elevator Room								
Std. Comments : No destructive testing										
Ceiling	Cast in Place Concrete			C-N-A						
Floor	Concrete			C-N-A						
Pipe	PCV			C-N-A						
Wall	Concrete			C-N-A						
Level : B		Level Description : Basement				Asbestos Present : Yes				
Room : B-4		Room Description : Common Areas								
Std. Comments : No destructive testing										
Ceiling	Cast in Place Concrete			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						A14
Pipe	Fittings Insulated			T-N-A						V10
Pipe	Fittings Insulated	6.40	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	A	7	Yes	No	V09
Pipe	Straight Run-Fiberglass			C-N-A						
Wall	Block			P-A						
Wall	Concrete			C-N-A						
Level : B		Level Description : Basement				Asbestos Present : Yes				
Room : B-5		Room Description : Mechanical Room								
Std. Comments : No destructive testing										
Ceiling	Cast in Place Concrete			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						A15
Pipe	Fittings Insulated			T-N-A						A16
Pipe	Straight Run Insulated	4.00	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	B	7	Yes	No	V09
Wall	Block			P-A						
Level : B		Level Description : Basement				Asbestos Present : Yes				
Room : B-6		Room Description : Mechanical Room								
Std. Comments : No destructive testing										
Ceiling	Cast in Place Concrete			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Fittings Insulated			T-N-A						A17
Pipe	Straight Run-Fiberglass			C-N-A						
Pipe	Straight Run Insulated	6.40	Metre(s)	Good	Chrysotile: 35% Crocidolite: 10%	B	7	Yes	No	V09
Wall	Block			P-A						
Wall	Concrete			C-N-A						
Level : B		Level Description : Basement				Asbestos Present : Yes				
Room : B-7		Room Description : Hallway								
Std. Comments : No destructive testing										
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A11
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A12
Ceiling	Acoustical Tile - 24" by 24"			T-N-A						A13

# Asbestos Report

Design / Material	Description	Quantity	Units	Condition	Asbestos Type	Access	Action	Visible	Friable	Sample
Ceiling	Cast in Place Concrete			C-N-A						
Floor	Concrete/Terrazo			C-N-A						
Pipe	Fittings Insulated			T-N-A						A10
Pipe	Straight Run-Fiberglass			C-N-A						
Pipe	Straight Run Insulated	2.10	Metre( s)	Good	Chrysotile: 35% Crocidolite: 10%	C	7	No	No	V09
Wall	Block			P-A						
Level : B		Level Description : Floor - General			Asbestos Present : Yes					
Room : B-8		Room Description : Stairwell								
Std. Comments : No destructive testing										
Comments : Stairwell includes all landings and floors.										
Ceiling	Drywall - Filler Compound	120.00	Sq. M	Good	Chrysotile: 0.5%	A	7	Yes	No	A34
Floor	Concrete/Terrazo			C-N-A						
Wall	Brick			C-N-A						
Level : B		Level Description : Basement			Asbestos Present : Potential					
Room : B-9		Room Description : Telephone/Data								
Std. Comments : No destructive testing										
Ceiling	Cast in Place Concrete			C-N-A						
Floor	Concrete			C-N-A						
Pipe	Straight Run-Fiberglass			C-N-A						
Wall	Block			P-A						



**Photograph 1: Sample 124-B1-1, Small Pipe, Hot Water Heating  
Return / Mudding on Pipe Elbow**



**Photograph 2: Sample 124-B1-2, Medium Pipe, White Paper  
/ Mudding on Pipe Elbow**





**Photograph 3: Sample 124-B1-3 / Spray-Applied Insulation**



**Photograph 4: Sample 124-B1-4, Orange Pipe, High Pressure Steam  
/ Mudding on Straight Run**





**Photograph 5: Sample 124-B1-5, Orange Pipe, High Pressure Steam  
/ Mudding on Pipe Elbow**



**Photograph 6: Sample 124-B1-6, Green Pipe, High Pressure Condensate  
/ Mudding on Straight Run**



**Photograph 7: Sample 124-B1-7, Green Pipe, High Pressure  
Condensate / Mudding on Pipe Elbow**



**Photograph 8: Sample 124-B1-8, Green Pipe, Condensate Return  
/ Mudding on Pipe Elbow**



**Photograph 9: Sample 124-B1-9 / Cement Pipe**



**Photograph 10: Sample 124-B7-10, Above Ceiling Tile, Smaller White-Coloured Pipe / Mudding on Pipe Elbow**





**Photograph 11: Sample 124-B7-11, 2' x 2',  
Small and Medium Pinholes / Ceiling Tile**



**Photograph 12: Sample 124-B7-12, 2' x 2',  
Small Random Pinholes with Deep Fissures / Ceiling Tile**



**Photograph 13: Sample 124-B7-13, 2' x 4', Medium Random Pinholes with Fissures / Ceiling Tile**



**Photograph 14: Sample 124-B4-14, Hot Water Heating Return Pipe / Mudding on Pipe Elbow**



**Photograph 15: Sample 124-B5-15, Hot Water Supply Line (Smaller)  
/ Mudding on Pipe Elbow**



**Photograph 16: Sample 124-B5-16, Hot Water Return Line (Smaller) / Pipe Elbow Mudding**





**Photograph 17: Sample 124-B6-17, Hot Water Heating Return (Yellow Pipe)  
/ Mudding on Pipe Elbow**



**Photograph 18: Sample 124-11-19, 2' x 2', Small Random Pinholes with  
Deep Fissures / Ceiling Tile**



**Photograph 19: Sample 124-11-20, Hot Water Heating Return  
/ Mudding on Pipe Elbow**



**Photograph 20: Sample 124-11-21, from Ceiling Space  
/ Drywall Joint Compound**





**Photograph 21: Sample 124-13-22, 12"x 12",  
Beige with White and Brown Flecks / Floor Tile**



**Photograph 22: Sample 124-15-23, 2' x 2',  
Small and Medium Pinholes / Ceiling Tile**



**Photograph 23: Sample 124-15-24, 2' x 2', Medium Random Pinholes with Fissures / Ceiling Tile**



**Photograph 24: Sample 124-118-25 / Cement Pipe**



**Photograph 25: Sample 124-116-26, 2' x 2', Small and Medium Pinholes with Small Fissures / Ceiling Tile**

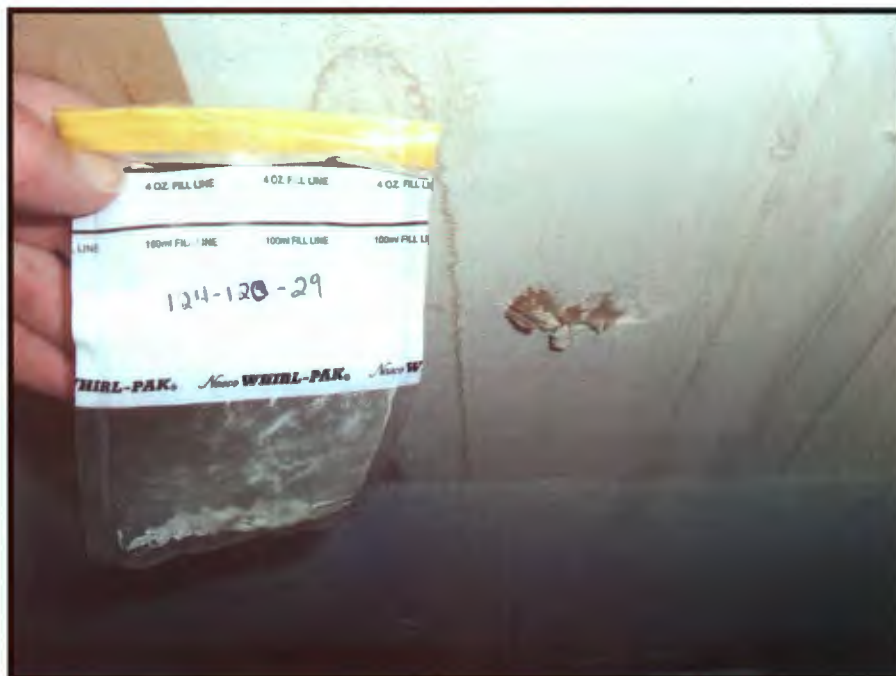


**Photograph 26: Sample 124-119-27, Blue, Gray, and Beige Aggregate / Sheet Flooring**





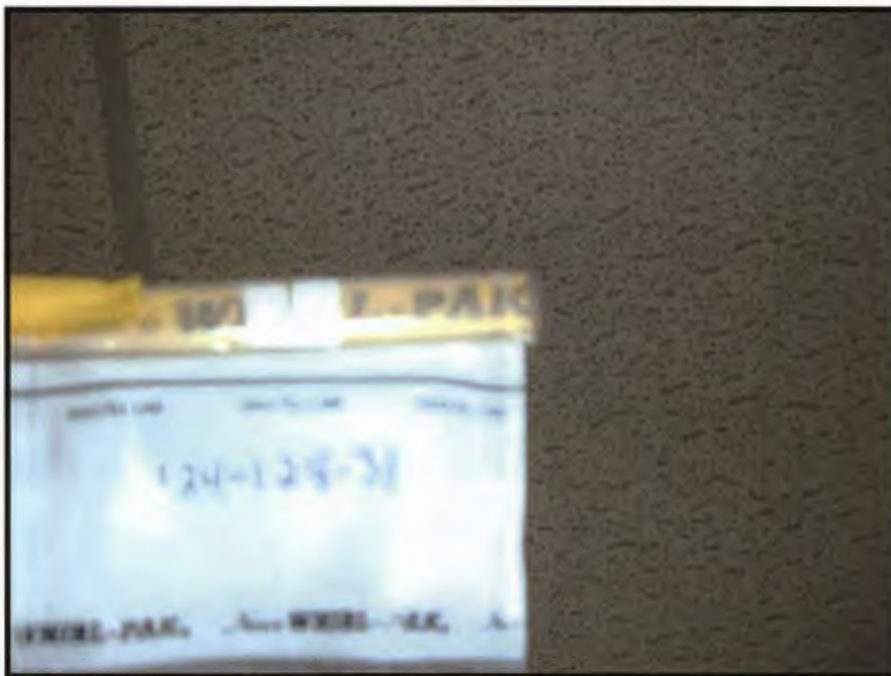
**Photograph 27: Sample 124-119-28, 2' x 2',  
Varied-Sized Pinholes with Long Fissures / Ceiling Tile**



**Photograph 28: Sample 124-120-29, Wall inside Heater Vent  
/ Drywall Joint Compound**



**Photograph 29: Sample 124-120-30, First Floor / Duct Joint Mastic**



**Photograph 30: Sample 124-128-31, 2' x 4', Small and Medium Pinholes with Large Fissures / Ceiling Tile**





**Photograph 31: Sample 124-129-32, First Floor Ceiling Space / Mudding on Pipe Elbow**



**Photograph 32: Sample 124-152-33, above Ceiling Tile  
/ Drywall Joint Compound**

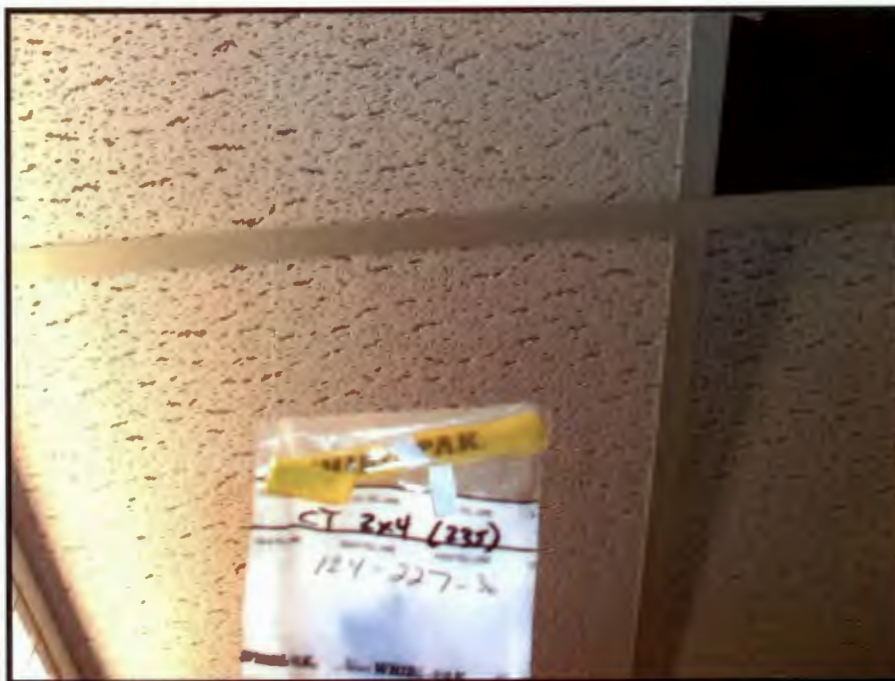


**Photograph 33: Sample 124-B8-34, Ceiling Material under Stair, First Landing up from Basement / Drywall Joint Compound**



**Photograph 34: Sample 124-227-35, above Ceiling Tile / Drywall Joint Compound**





**Photograph 35: Sample 124-227-36, 2' x 4', White, Medium Pinholes with Deep Fissures / Ceiling Tile**



**Photograph 36: Sample 124-227-37, Blue, Gray, and Beige Aggregate / Sheet Flooring**





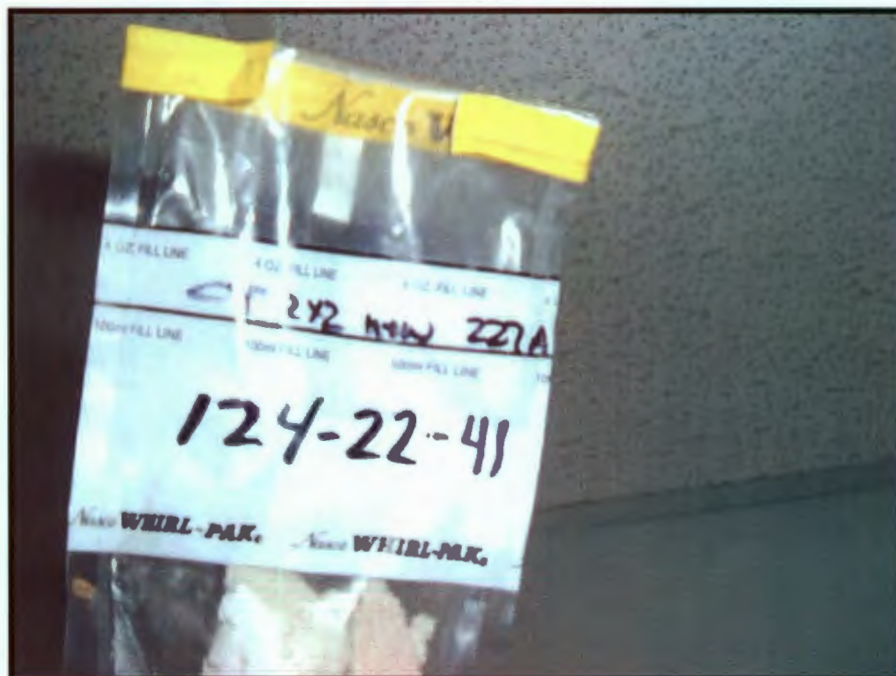
Photograph 37: Sample 124-231-38, 12"x 12", Yellow with Yellow and White Marble Design / Floor Tile



Photograph 38: Sample 124-231-39, Second Floor / Drywall Joint Compound



**Photograph 39: Sample 124-231-40, 2' x 2', White, Small Pinholes with Deep Fissures / Ceiling Tile**



**Photograph 40: Sample 124-22-41, 2' x 2', White, Small and Medium Pinholes with Deep Fissures / Ceiling Tile**



**Photograph 41: Sample 124-266-42 / Mudding on Pipe Elbow**



**Photograph 42: Sample 124-270-43, 12"x 12",  
Beige with White and Brown Streaks / Floor Tile**





**Photograph 43: Sample 124-270-44, 12"x 12",  
Light Beige with White and Brown Streaks / Floor Tile**



**Photograph 44: Sample 124-270-45 / Mudding on Pipe Elbow**

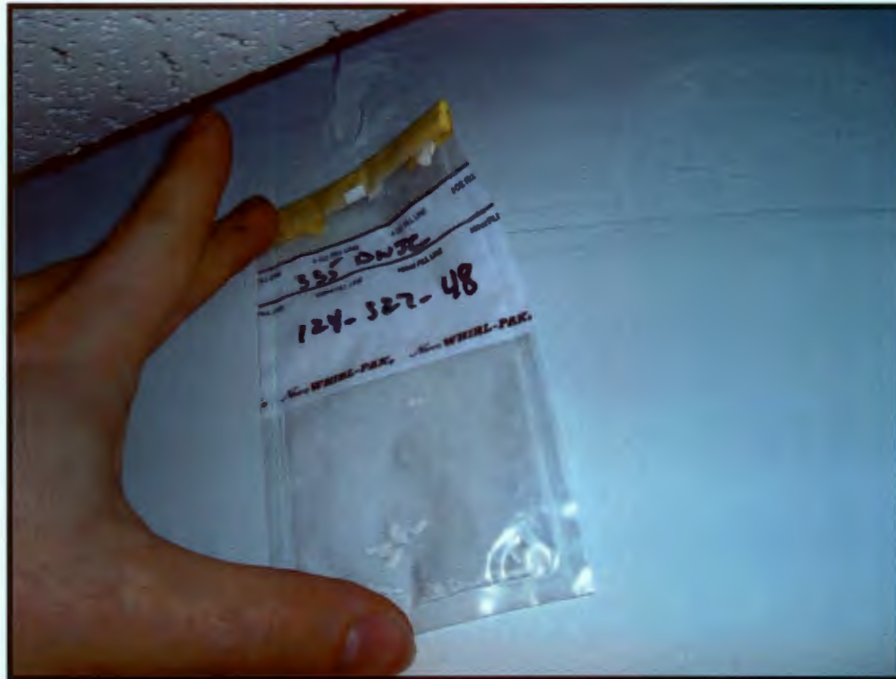


**Photograph 45: Sample 124-25-46, above Ceiling Tile  
/ Duct Joint Mastic**

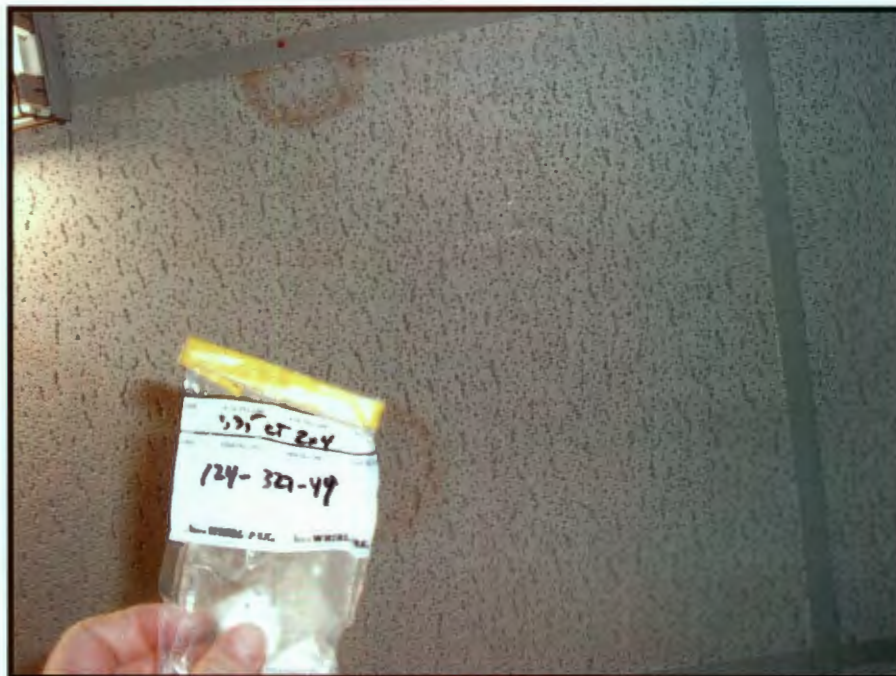


**Photograph 46: Sample 124-327-47, White with  
Blue and Beige Aggregate / Sheet Flooring**

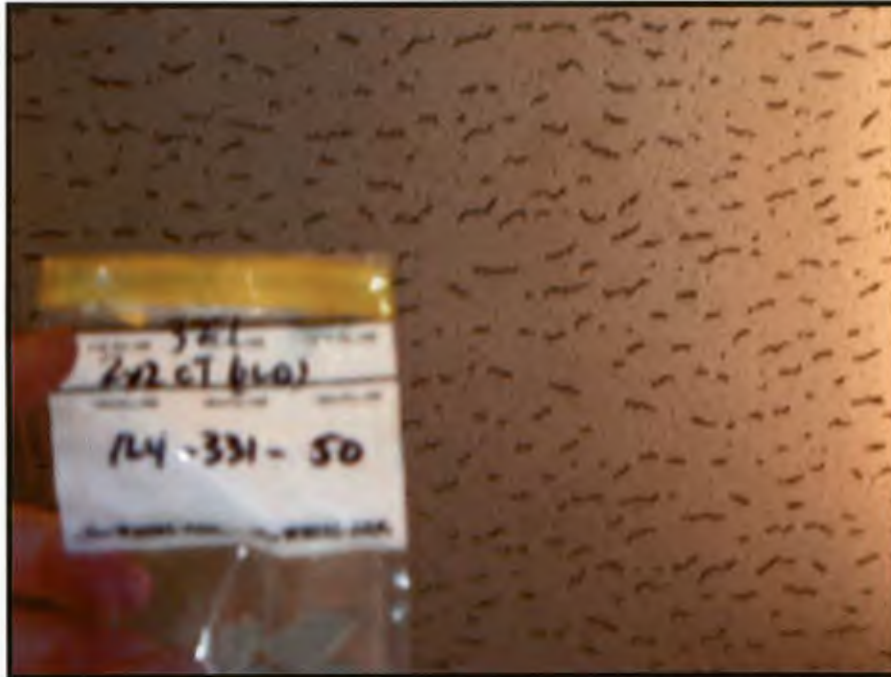




**Photograph 47: Sample 124-327-48, from Wall above Ceiling Tile / Drywall Joint Compound**



**Photograph 48: Sample 124-327-49, 2' x 4', White, Medium Pinholes with Fissures / Ceiling Tile**

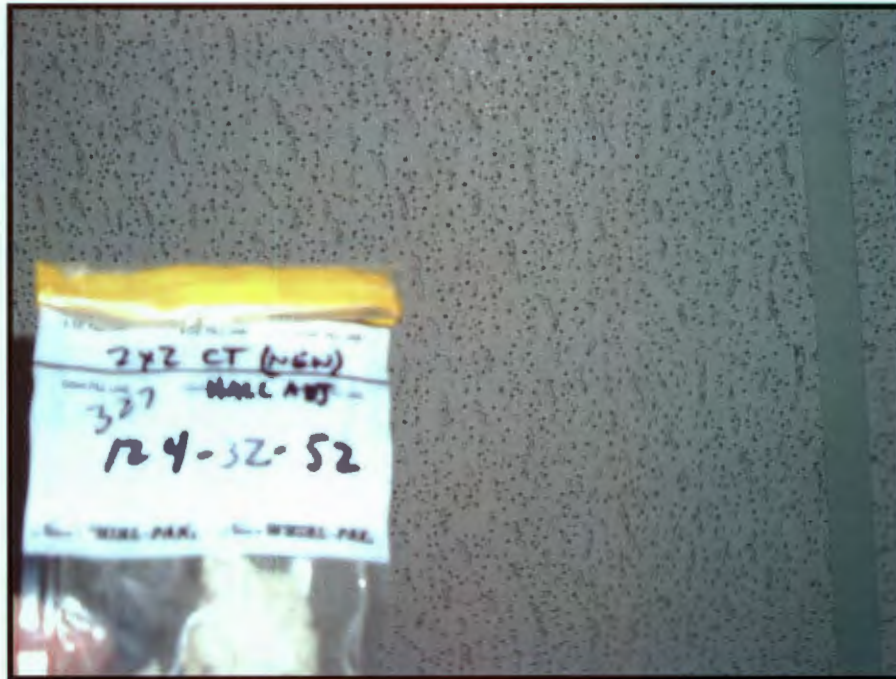


**Photograph 49: Sample 124-331-50, 2' x 2', White, Small Pinholes and Deep Fissures / Ceiling Tile**



**Photograph 50: Sample 124-331-51, 12"x 12", Yellow with Yellow and White Marble Design / Floor Tile**





**Photograph 51: Sample 124-32-52, 2' x 2', Small and Medium Pinholes with Fissures / Ceiling Tile**



**Photograph 52: Sample 124-32-53, Third Floor / Mudding on Pipe Elbow**





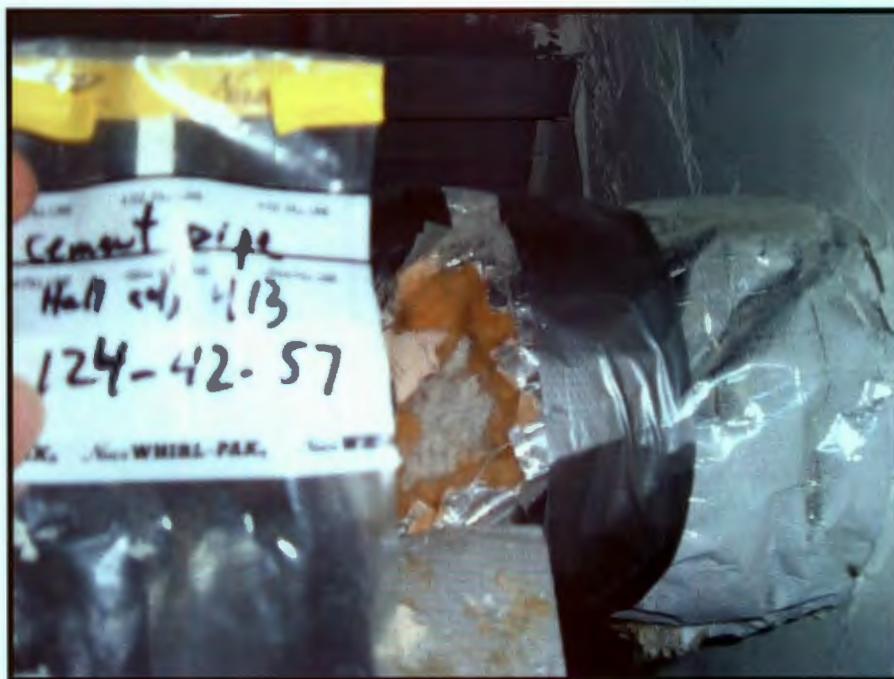
**Photograph 53: Sample 124-345-54, 12"x 12", Beige with White and Brown Streaks / Floor Tile**



**Photograph 54: Sample 124-345-55, Third Floor / Drywall Joint Compound**



**Photograph 55: Sample 124-370-56, Third Floor Storage Room /  
Mudding on Pipe Elbow**



**Photograph 56: Sample 124-42-57, Coming in from  
Ceiling / Cement Pipe**



**Photograph 57: Sample 124-42-58, above Ceiling Tile  
/ Drywall Joint Compound**



**Photograph 58: Sample 124-43-59, Adjacent to Room 455A  
/ Mudding on Pipe Elbow**

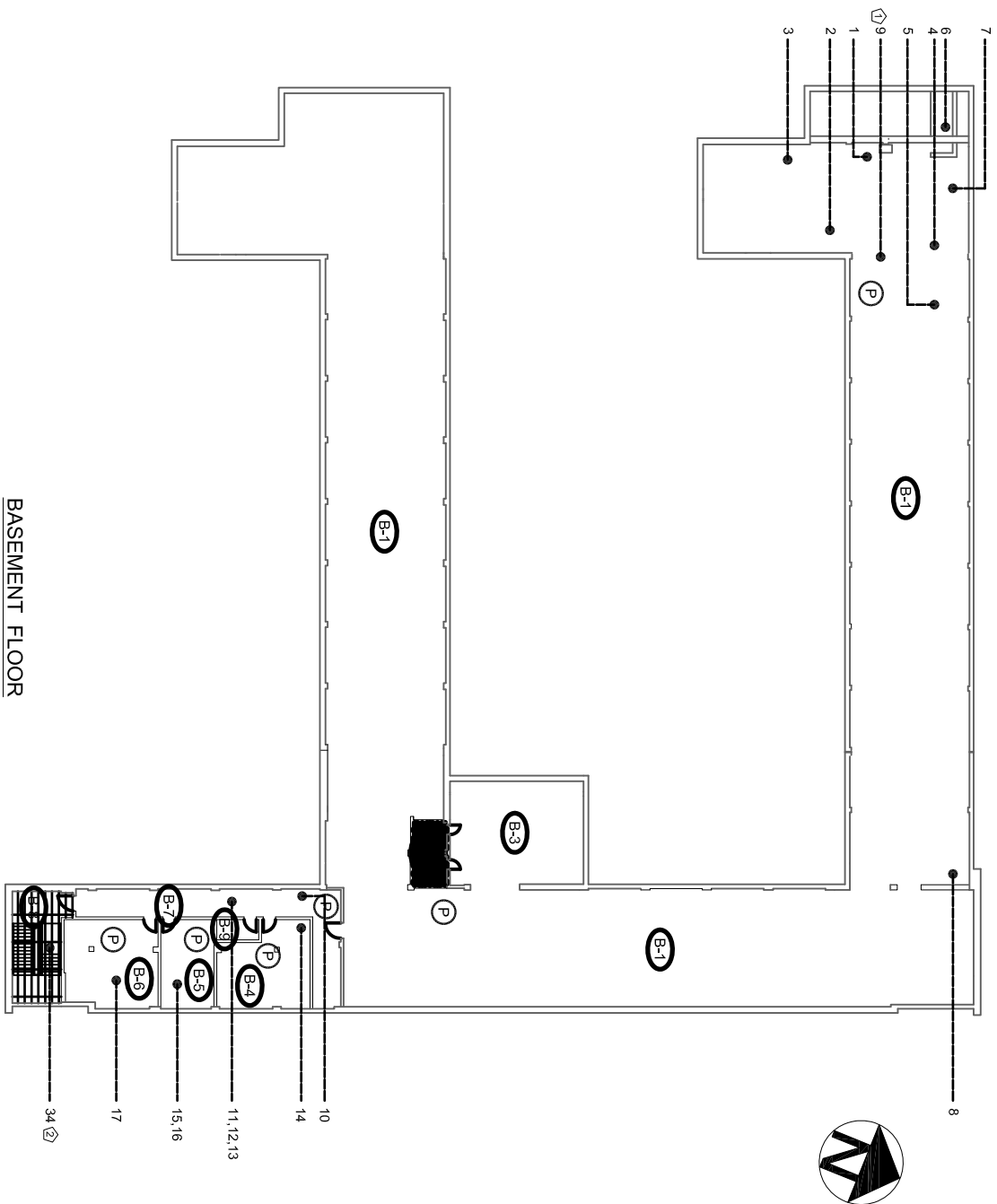




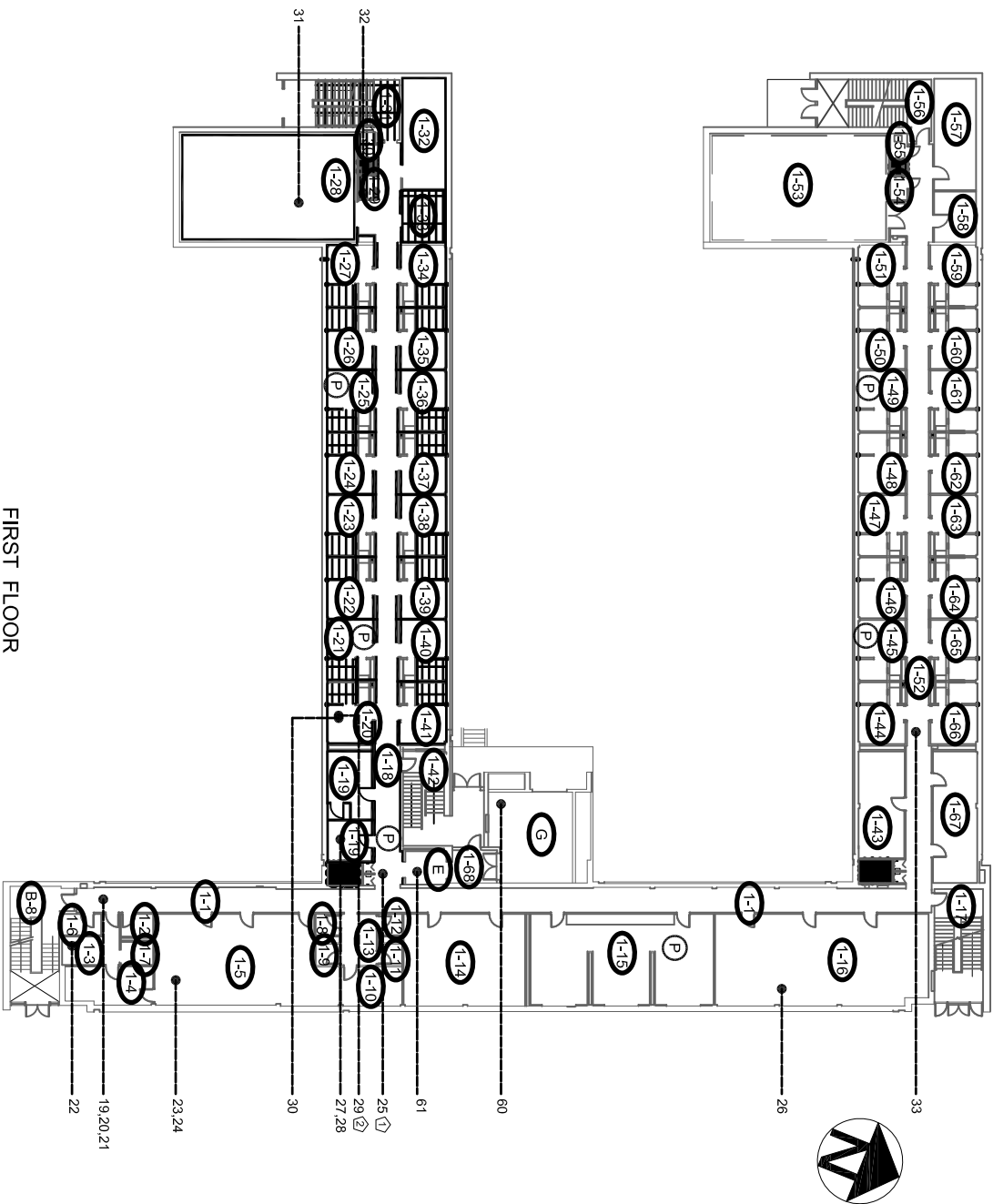
**Photograph 59: Sample 124-G-60, Garage/ Mudding on Pipe Elbow**



**Photograph 60: Sample 124-E-61, Elevator / Sheet Flooring**



BASEMENT FLOOR



FIRST FLOOR

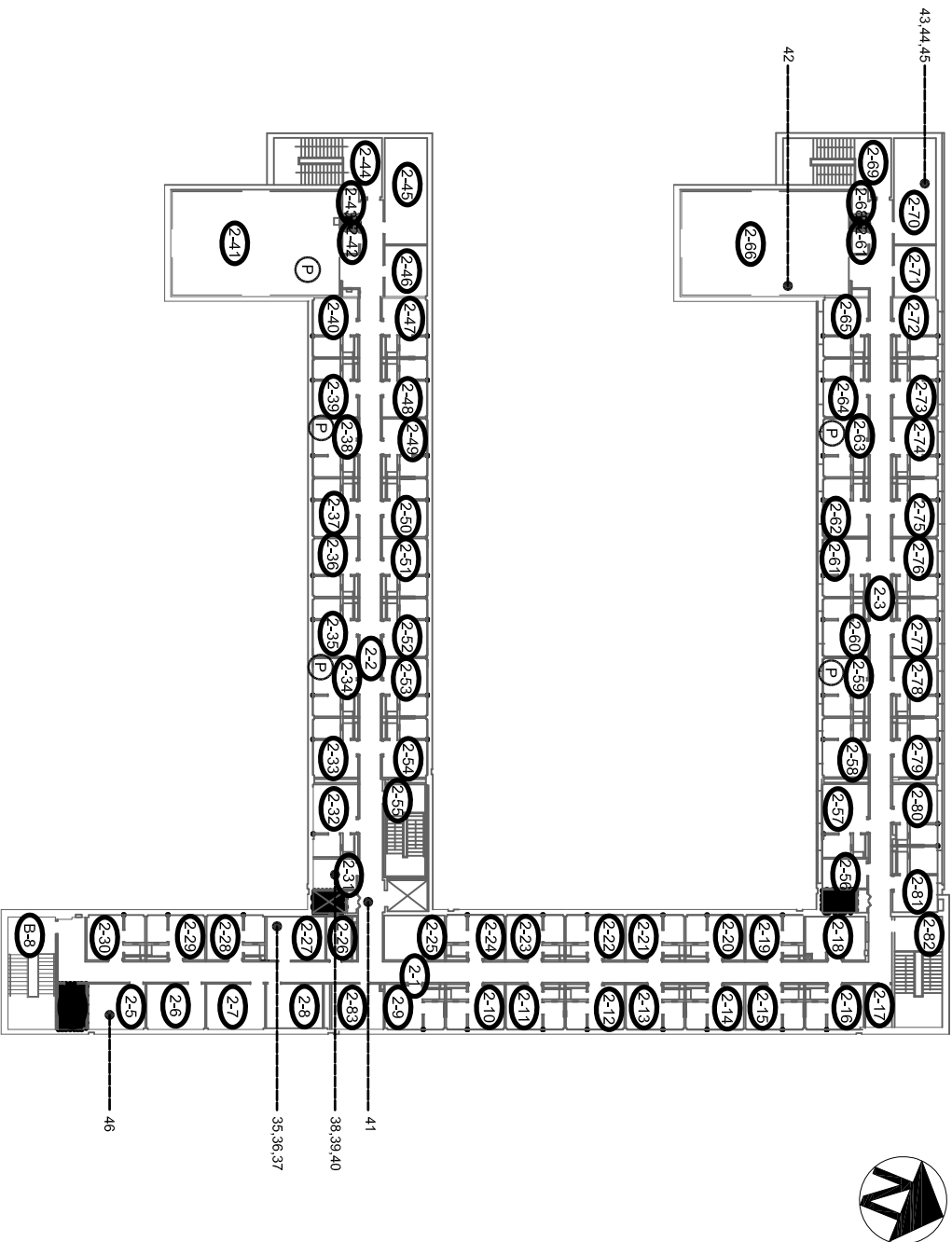
LEGEND

- 1 SAMPLE ROOM NUMBER
- ASBESTOS NON-DETECTED
- ASBESTOS DETECTED
- ASBESTOS - WALL
- ASBESTOS - INSULATION ON DUCTWORK ABOVE CEILING
- ASBESTOS - INSULATION ON PIPING
- ASBESTOS - CEILING
- ASBESTOS - FLOOR
- ASBESTOS - CEILING & FLOOR
- NO ACCESS
- LEVELS
- 1 - FIRST FLOOR

NOTES

- 1 - CEMENT PIPE
- 2 - DRYWALL JOINT COMPOUND

PROJECT	
DEPOT, REGINA, SASKATCHEWAN	
LOCATION	
BUILDING#124	
"D" BLOCK	
PROJECT NUMBER	
05-1325-0016	
DATE	
MARCH 2005	
DRAWING SCALE	
NTS	
DRAWING NUMBER	



SECOND FLOOR

PROJECT

DEPOT, REGINA, SASKATCHEWAN

LOCATION

BUILDING#124

"D" BLOCK

PROJECT NUMBER

05-1325-0016

DATE

MARCH-2005

DRAWING NUMBER

DRAWING SCALE

NTS

LEGEND

SAMPLE ROOM NUMBER

ASBESTOS NON-DETECTED

ASBESTOS DETECTED

ASBESTOS - WALL

ASBESTOS - INSULATION ON DUCTWORK ABOVE CEILING

ASBESTOS - INSULATION ON PIPING

ASBESTOS - CEILING

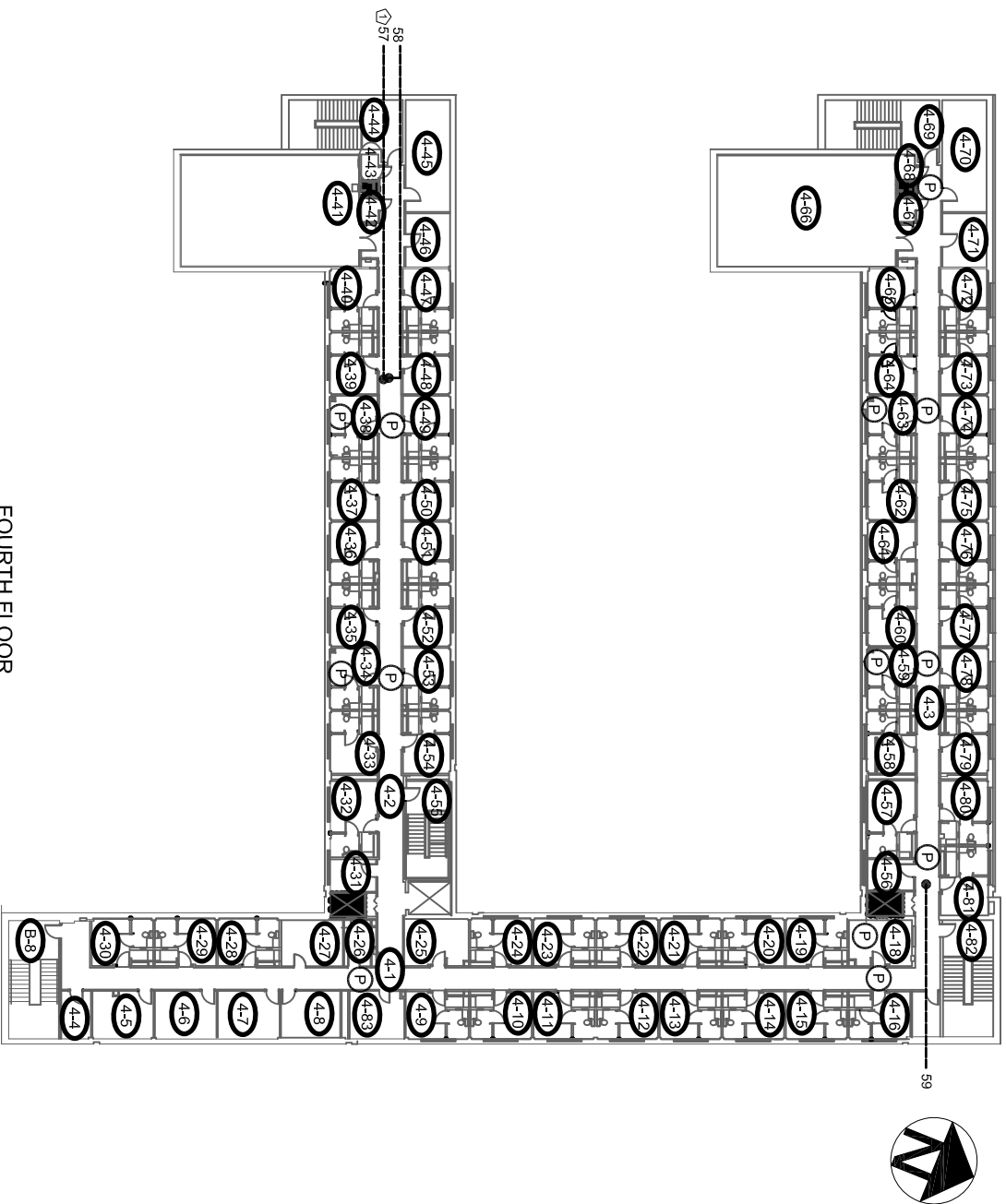
ASBESTOS - FLOOR

ASBESTOS - CEILING & FLOOR

NO ACCESS

LEVELS

1 - SECOND FLOOR



FOURTH FLOOR

PROJECT		DEPOT, REGINA, SASKATCHEWAN	
LOCATION		BUILDING#124 "D" BLOCK	
PROJECT NUMBER		05-1325-0016	
DATE		MARCH 2005	
DRAWING NUMBER		NTS	

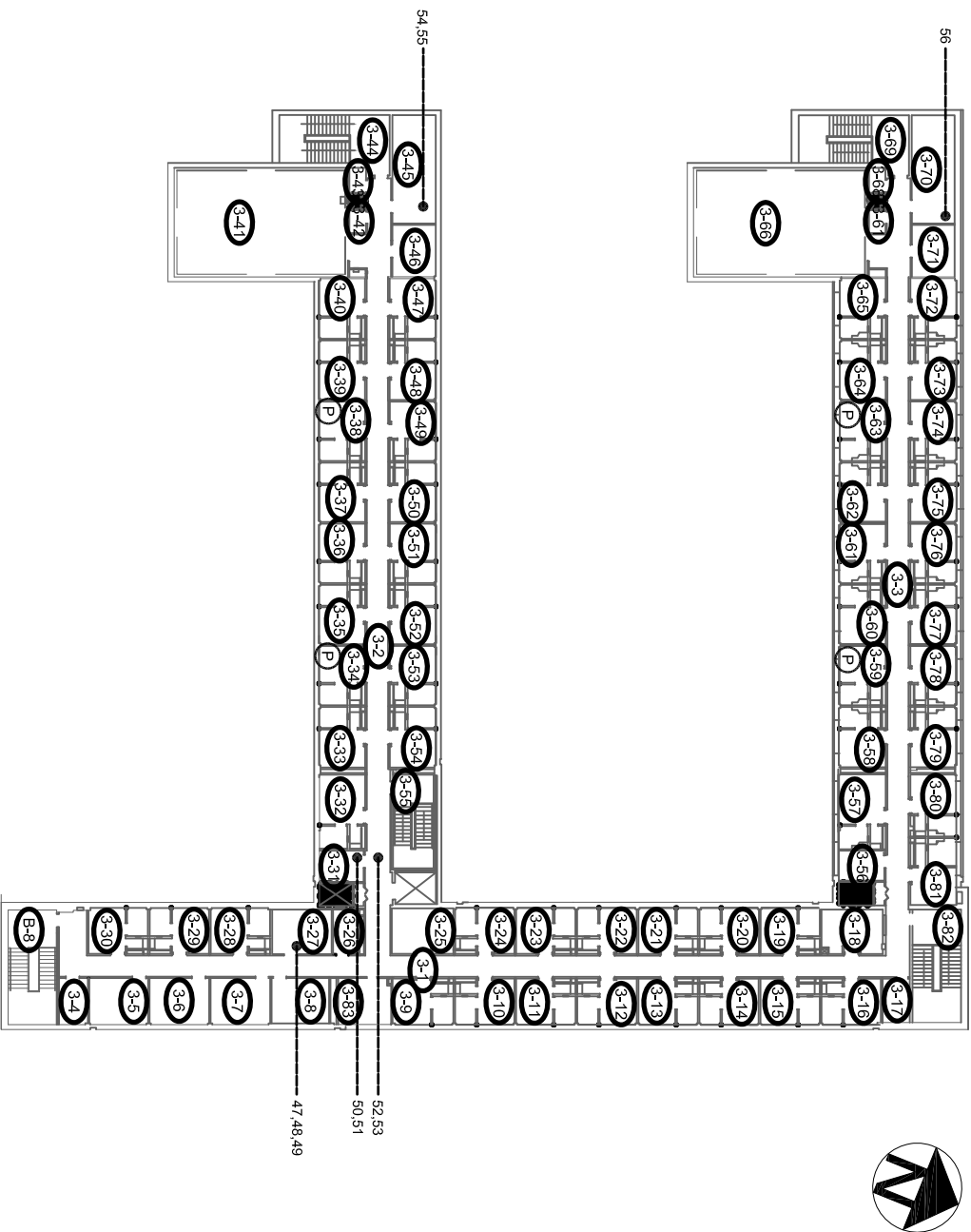
LEGEND

- ① SAMPLE ROOM NUMBER
- ASBESTOS NON-DETECTED
- ASBESTOS DETECTED
- ASBESTOS - WALL
- ASBESTOS - INSULATION ON DUCTWORK ABOVE CEILING
- Ⓟ ASBESTOS - INSULATION ON PIPING
- ▨ ASBESTOS - CEILING
- ▤ ASBESTOS - FLOOR
- ▧ ASBESTOS - CEILING & FLOOR
- NO ACCESS
- LEVELS
- 1 - FOURTH FLOOR

NOTES

- ① - CEMENT PIPE





THIRD FLOOR

PROJECT		DEPOT, REGINA, SASKATCHEWAN	
LOCATION		BUILDING#124 "D" BLOCK	
PROJECT NUMBER		05-1325-0016	
DATE		MARCH-2005	
DRAWING NUMBER		NTS	

1 - THIRD FLOOR

