



**Issued for Tender**

## **Cafeteria Demolition & Rehabilitation**

Ottawa, Ontario

NCC no. DC 1110-23 & DC 1110-20

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Kwc 1437



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## **Part 1           General**

### **1.1               DESCRIPTION OF THE WORK**

- .1       Work includes all labour, services, materials, products, construction machinery and equipment necessary for the work in accordance with or reasonably inferable from the Contract Documents.
- .2       Work of this project generally consists of, but is not limited to: selective demolition and hazardous materials abatement, and fit-up of a cafeteria. Fit-up work includes, Architectural, Structural, Mechanical and Electrical and Food Services components and systems.

### **1.2               PRE-CONTRACT AWARD CONDITIONS**

- .1       Prior to the award of Contract, the Contractor must submit within 10 days of receiving the letter of notification: a site specific health and safety plan, corporate health and safety policy, and all other documents required by the letter of notification (Performance and Labour & Material bonds, insurance certificate, WSIB certificate), and information required for security access application.
- .2       If the requested documentation is not received within 10 business days of receiving the letter of notification, the NCC reserves the right to proceed on to the next lowest compliant bidder.

### **1.3               ADDENDA**

- .1       Answers to questions directed to the NCC Representative and all amendments to the drawings or specifications during the tender period shall be issued in the form of Addenda.
- .2       Addenda form part of the Contract Documents.

### **1.4               CONTRACT METHOD**

- .1       Construct the Work under a single stipulated sum construction contract.

## **Part 2           Contract Administration**

### **2.1               CONTRACT DOCUMENTS**

- .1       All contract documents are complementary. Items indicated in one and not in the other are deemed to be included in the contract work.
- .2       Drawings are intended to convey the scope of work and to indicate general arrangements. Obtain NCC Representative's approval of exact locations before installation.
- .3       Obtain direction from NCC Representative before proceeding if a possible obstacle or interference with an indicated installation is identified.
- .4       When the Contractor encounters an obstacle or interference that could have been reasonably foreseen and the Contractor failed to obtain direction from the NCC

Representative in the matter, the NCC Representative may require that the work of the Contractor be modified in whole or part in response to the obstacle or interference. The Contractor shall assume the costs of additional work arising from such work.

## **2.2 CODES, STANDARDS AND CONTRACT DOCUMENT CONFLICTS**

- .1 Unless otherwise specified or indicated, perform work in accordance with the National Building Code of Canada, current addition, and all applicable provincial or local building codes.
- .2 In the instance of a conflict among building codes, referenced standards and contract documents, the more stringent requirement shall apply.

## **2.3 TAXES**

- .1 Pay all applicable federal, provincial and municipal taxes.

## **2.4 FEES, PERMITS, CERTIFICATES AND BY-LAWS**

- .1 Provide all authorities having jurisdiction with information appropriate to the exercise of their authority to review, approve and inspect. Assume cost of such submissions.
- .2 Pay all applicable fees and obtain all applicable permits and certificates.
- .3 Obtain and pay for the municipal building permit.
- .4 Upon request by the NCC Representative, provide inspection certificates to evidence that work conforms to requirements of the authorities having jurisdiction.

## **2.5 SUBMITTALS**

- .1 Administrative
  - .1 Submit to NCC Representative submittals listed for review. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work.
  - .2 Work affected by submittal shall not proceed until review is complete.
  - .3 Review submittals and stamp all submittals with Contractor's shop drawing stamp prior to submission to NCC Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of the Work and Contract Documents.
  - .4 Verify field measurements and affected adjacent Work are coordinated.
- .2 Shop drawings and product data
  - .1 "Shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data that are to be provided by Contractor to illustrate details of a portion of the Work.
  - .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connection, explanatory notes and other information necessary for completion of Work.
  - .3 Adjustments made on shop drawings by NCC Representative are not intended to change Contract Price.
  - .4 Make changes in shop drawings as NCC Representative may require.
  - .5 Submit four (4) copies, unless indicated otherwise, of shop drawings for each requirement requested in specification Sections and as NCC Representative may reasonably request
  - .6 Submit four (4) copies, unless indicated otherwise, of product data sheets or brochures for requirements requested in Specification Sections and as NCC



Representative may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

- .3 Samples
  - .1 Submit for review, samples as requested in respective Specification Sections and as indicated on the drawings.
  - .2 Deliver samples prepaid to NCC Representative's business address.

## **2.6 SCHEDULE**

- .1 Submit a schedule of work for approval, in a form acceptable to NCC Representative and within five (5) days of award of contract. Show in schedule dates for:
  - .1 shop drawing, material lists and samples submissions;
  - .2 equipment and material delivery;
  - .3 work commencement and completion for each trade as corresponds to each trade section of the Specification;
  - .4 Substantial and final completion date within time period required by Contract Documents.
  - .5 submit updated schedules at each progress meeting and as reasonably requested by the NCC Representative.

## **2.7 COST BREAKDOWN**

- .1 Submit to NCC Representative breakdown of Contract price in detail as directed by NCC Representative. Obtain NCC Representative's approval of same prior to first progress claim submission.
- .2 Approved cost breakdown will be used as basis for progress claim payments.

## **2.8 PROJECT MEETINGS**

- .1 Administrative
  - .1 NCC Representative will schedule and administer regular progress meetings throughout the progress of work, at times, frequency and locations set by the NCC Representative.
  - .2 The NCC Representative will distribute written notice of each meeting in advance of meeting date to Contractor, Consultant, and all other affected parties.
  - .3 The Contractor shall attend.
  - .4 The Contractor shall ensure affected Subcontractors attend.
  - .5 The NCC Representative will record minutes and include significant proceedings and decisions and identify 'action by' parties.
  - .6 The NCC Representative will reproduce and distribute copies of minutes to meeting participants and affected parties not in attendance.

## **2.9 AS-BUILT DRAWINGS**

- .1 NCC Representative will provide two sets of white prints for record drawing purposes.
- .2 Maintain project record drawings and record accurately all deviations from Contract documents as project progresses. Maintain on-going as-built records on site, ready for inspection during the course of the construction.
- .3 Update these drawings daily.
- .4 Record changes in red. Mark on one set of prints and at completion of project and prior to final inspection, neatly transfer notations to second set and submit both sets to NCC Representative.

- .5 Provide a cost for the As-Built Drawings in the Contractor cost breakdown.

## **2.10 DOCUMENTS REQUIRED ON-SITE**

- .1 Maintain at job site, one copy each of following:
  - .1 Contract drawings,
  - .2 Specifications,
  - .3 Addenda,
  - .4 Change orders,
  - .5 Other modifications to Contract,
  - .6 Approved work schedule,
  - .7 Permits,
  - .8 Field test reports,
  - .9 Reviewed shop drawings.
  - .10 As-built drawings.

## **2.11 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP**

- .1 Use only new materials, unless indicated otherwise.
- .2 Exceed or meet the minimum requirements of standards referenced in the specifications, such as the Canadian Standards Association (CSA), and the National Building Code of Canada (current edition), and of all applicable federal, provincial, and municipal codes. In the case of conflict or discrepancy between these requirements, the most stringent applies.
- .3 Workmanship
  - .1 Workmanship shall be best quality, executed by workers experienced and skilled in respective duties for which they are employed.
  - .2 Employ persons fit for and skilled in their required duties.
  - .3 Assume the costs of redoing work that, in the NCC Representative's opinion, does not meet the specified quality of workmanship.
- .4 Alternatives
  - .1 The NCC Representative will only consider Alternatives
    - .1 for materials, products or processes specified with the term "and/or approved equivalent" applied and;
    - .2 submitted in accordance with the "General Instructions for Tendering"-
  - .2 The NCC Representative will approve alternatives that are in his opinion equal in material content, workmanship and quality to the materials, products or processes identified and at least conformant to the standards specified.
  - .3 Assume the cost of additional work or modifications to the design due to the use of NCC Representative approved alternatives.

## **2.12 SECURITY CLEARANCE**

- .1 In accordance with the Security Policy of the Government of Canada, all persons undertaking work or services at the property covered by this contract must have met the requirements of a Site Access Security Assessment. The Site Access Security Assessment requires disclosure of information concerning:
  - .1 financial information (credit check),
  - .2 education,
  - .3 employment history,
  - .4 personal history and relatives, and
  - .5 criminal record (if any) for which a pardon has not been granted. (Fingerprint impressions may be necessary).

- .2 The NCC reserves the right to refuse access to personnel not passing a Site Access Security Assessment.
- .3 Unless otherwise indicated, access to site (employees, deliveries, visitors, and pick-ups of material etc.) must be coordinated with, and approved by the designated NCC Representative.

### **2.13 SITE SECURITY**

- .1 Where security has been reduced by work of the Contract, provide temporary means to maintain security.
- .2 Cooperate with NCC and Security staff in maintenance of security.

### **2.14 SECURITY AND CONFIDENTIALITY**

- .1 Exercise utmost care to ensure the security of any material prepared or received in handling this project.
- .2 Without the prior written permission of the NCC Representative, do not distribute, publish, display or reproduce any documents, photographs, site plans, maps or information related to the project (or collected during the project), in any medium, including the internet.
- .3 Without the prior written permission of the NCC Representative, do not disclose any documents, photographs, site plans, maps or information related to the project unless such disclosure:
  - .1 Is reasonably required to obtain necessary permits and approvals to perform the work;
  - .2 Is reasonably required to facilitate the contracting and performance of sub-contractors, consultants and other parties involved in completing the contracted work;
  - .3 Is required by law.
- .4 When requested by the NCC, return to the NCC all copies of all site photographs and construction documents, site plans and maps related to the project.
- .5 All the above restrictions apply to all sub-contracts for work and services related to the project.

### **2.15 RELICS AND ANTIQUITIES**

- .1 Protect relics and antiquities, items of historical or scientific interest and similar objects found during the course of work.
- .2 Immediately notify NCC Representative of any findings and await NCC Representative's written instructions before proceeding with work adjacent to findings.
- .3 If any vestiges of early human occupancy of the land are uncovered during construction, suspend construction activity and notify the NCC Representative.
- .4 Relics, antiquities and items of historical or scientific interest shall remain the property of the Crown.

### **2.16 ENVIRONMENTAL PROTECTION**

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

- .1 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.
- .3 Drainage
  - .1 Do not pump water containing suspended materials into waterways, sewer or drainage system.
- .4 Tree and Plant Protection
  - .1 Protect trees and plants on site.
- .5 Pollution Control
  - .1 Control emissions from equipment and plant to local authorities emission requirements.
  - .2 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- .6 Spills Reporting
  - .1 Prepare an environmental emergency measure plan and post at the place of work indicating:
    - .1 The site's refuelling area.
    - .2 The NCC Environmental Emergency Service telephone number (613) 239-5353. Call immediately in the event of accidental spill of fuel or other pollutant.
  - .2 Assume financial responsibility to clean up effects of spill.

## **2.17 WASTE DISPOSAL**

- .1 Unless otherwise indicated or specified, materials indicated for removal become the Contractor's property and shall be taken from site.
  - .1 Dispose of waste materials in accordance with requirements of authorities having jurisdiction and as described in the Contract Documents.

## **Part 3 ON-SITE ACTIVITIES**

### **3.1 SIGNS**

- .1 Site boards and other advertising are prohibited on this project.
- .2 All signage shall be bilingual in French and English.
- .3 Proposed wording and signage shall be submitted for review and approval by NCC Representative.
- .4 Provide warning signage to clearly identify area under construction and access restrictions (protective gear, sign-in, etc.).

### **3.2 OWNER OCCUPANCY**

- .1 The site and the building will remain occupied during the implementation of the work of this contract. Areas above and adjacent the work will be occupied during the entire construction period.
- .2 Cooperate and cooperate with NCC so as to minimize conflict and impacts to other activities in building.

### **3.3 CONTRACTOR'S USE OF SITE AND FACILITIES**

- .1 NCC Representative will arrange with the Contractor a work schedule and procedures for entry to the property. Do not commence work until these requirements have been confirmed and approved by NCC Representative.
- .2 Do not unreasonably encumber exterior of site with materials or equipment.
- .3 Execute the work with least possible disturbance to the normal use of the site.
- .4 Protect grass, trees and other surfaces on the ground from damage in areas not directly affected by the work. Refer to the "DAMAGES" article below.
- .5 Move stored products or equipment as directed by NCC Representative to ensure public pedestrian access around property.
- .6 Provide for personnel and vehicle access. Maintain safe exiting routes from the site and building at all times.
- .7 Provide 14 days notice to and obtain requisite permissions from the NCC Representative and utility companies of any intended interruption of services. Keep duration of these interruptions to a minimum.
- .8 Park in area designated for Contractor's use unless NCC Representative specifically authorizes other parking arrangements.
- .9 Smoking is prohibited within 50 feet of buildings. A designated smoking area will be identified by the NCC Representative. The Contractor shall ensure adequate sealed cigarette butt disposal.

### **3.4 PROJECT COORDINATION**

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

### **3.5 SETTING-OUT OF WORK**

- .1 Provide devices needed to lay out and carry out the work. Supply such devices as required to facilitate NCC Representative's inspection of work.

### **3.6 FIRE SAFETY**

- .1 Provide fire extinguishers to protect the work in progress.
- .2 Advise NCC Representative of any work that would impede fire apparatus / personnel response.
- .3 Know the location of nearest fire alarm box and telephone, including the emergency phone number.
- .4 Observe at all times smoking regulations. There is no-smoking in or near the Work. The NCC Representative will designate a smoking area.

### **3.7 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

- .1 Installation/Removal
  - .1 Provide construction facilities and temporary controls in order to execute work efficiently.
  - .2 Remove from site all such work after use.

- .2 Hoarding
  - .1 Erect hoarding indicated and as necessary to protect building occupants, the public, workers and property from injury or damage.
  
- .3 Weather Enclosures
  - .1 Provide weathertight closures at openings in floors and roofs where required to protect building components as the work proceeds.
  - .2 Design enclosures to withstand wind pressure.
  
- .4 Dust Tight Screens
  - .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, building occupants and public.
  - .2 Maintain and relocate protection until such Work is complete.
  
- .5 Dewatering
  - .1 Provide temporary drainage and pumping facilities to keep excavations, building and site free from water.
  
- .6 Site Storage/Loading
  - .1 Confine the Work and operations of employees to limits indicated by Contract Documents and as directed by the NCC Representative. Do not unreasonably encumber premises with Products.
  - .2 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the Work.
  
- .7 Ventilation
  - .1 Provide ventilation to prevent accumulation of dust, fumes, mists, vapours, or gases in areas of Work.
  - .2 Provide ventilation through portable fan(s) exhausted to the out of doors to prevent migration of dust and debris within the building.
  - .3 Dispose of exhaust materials in manner that does not contaminate adjacent areas.
  - .4 Continue operation of ventilation and exhaust systems for sufficient time after cessation of operations to ensure removal of pollutants.
  
- .8 Temporary Telephone
  - .1 Provide and pay for temporary telephone necessary for own use.
  
- .9 Electricity and Water
  - .1 Existing services required for the work may be used by the Contractor without charge. Ensure capacity is adequate prior to imposing loads. Connect, use, and disconnect at own expense and responsibility. Coordinate with NCC Representative.
  - .2 Provide and pay for temporary service where existing services are unsuitable. Connect, use, and disconnect at own expense and responsibility. Coordinate with NCC Representative.
  
- .10 Access Equipment
  - .1 Provide all scaffolding, ladders and lifting equipment required for the work.
  
- .11 Signage
  - .1 Meet with NCC Representative prior to commencement of work to prepare list of signs and other devices required for the project. Signs and notices for safety and instruction shall be in both official languages. Do not post any sign without prior permission of the NCC Representative.

- .13 Temporary Heating
  - .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
  - .2 Building electrical supply may be used. Ensure capacity is adequate prior to imposing loads. Connect, use and disconnect at own expense and responsibility. Coordinate with NCC Representative. Owner will pay for Electrical Utility usage costs.

### **3.8 POWER/EXPLOSIVE ACTUATED FASTENING DEVICES**

- .1 Do not employ power guns using explosives without prior written permission of NCC Representative.

### **3.9 PROTECTION OF WORK AND SITE**

- .1 Protect finished work against damage until take-over.
- .2 Protect hard and soft landscaping adjacent to the work form damage unless indicated or described otherwise.
- .3 Protect adjacent building spaces and occupants against spread of dust, harmful vapours, hazardous materials and dirt. Use devices and methods that minimize inconvenience and risk to the occupants.

### **3.10 CUTTING AND PATCHING**

- .1 Do cutting and patching as indicated and as specified.
- .2 In the absence of explicit indication or specification, and as directed by the NCC Representative, do cutting and patching as follows:
  - .1 Perform cutting, fitting, and patching to complete the Work.
  - .2 Remove and replace defective and non-conforming work that is to form the base or substrate for new work.
  - .3 Perform work to avoid damage to other work.
  - .4 Prepare surfaces to receive patching and finishing.
  - .5 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit, unless indicated otherwise.
  - .6 Make cuts with clean, true, smooth edges.

### **3.11 LOCATION OF EQUIPMENT AND FIXTURES**

- .1 Location of equipment, fixtures, outlets and distribution systems indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures, outlets and distribution systems to minimize interference between systems, to allow access for maintenance and to maximize the usable space.
- .3 Inform the NCC Representative of a conflicting installation. Install as directed
- .4 Inform NCC Representative of impending installation and obtain approval for actual location

### **3.12 EXISTING SERVICES**

- .1 Where work involves disruption of existing services:
  - .1 Execute work at times directed by NCC Representative,
  - .2 Submit schedule to and obtain approval from NCC Representative for any shutdown or closure of active services,

- .3 Notify NCC Representative at least 14 days before service disruption,
- .4 Adhere to approved schedule.
  
- .2 Immediately advise NCC Representative when unknown services encountered.

**3.13 DAMAGES**

- .1 Restore or replace to their original condition existing public and/or privately owned property, structures, finishes, services, and/or utilities damaged during the execution of the work of this contract, or make adequate compensation to affected parties.
  
- .2 The terms “restore” and “replace” include labour, equipment and material costs.

**3.14 CLEAN-UP**

- .1 Provide on-site waste containers for collection of waste materials and debris and locate as directed by NCC Representative. Store volatile waste in covered metal containers, and remove from premises at end of each working day.
  
- .2 At the end of each work period, and more often if directed by the NCC Representative, remove debris from site, neatly stack material for use, and clean up generally. Conduct disposal operations to comply with municipal and site ordinances, anti-pollution laws and as required by the Contract Documents.
  
- .3 Upon completion, remove temporary protections installed under this contract and remove surplus materials. Make good defects noted at this stage.
  
- .4 Cleaning during construction
  - .1 Clean-up work area as the work progresses in order to prevent migration of dust and debris.
  - .2 Clean as directed by the NCC Representative.
  
- .5 Final clean-up
  - .1 For site, broom clean hard landscaped surfaces. Rake clean other landscaped areas. Hose down with water and wash hard landscaped surfaces as directed by NCC Representative.
  - .2 Broom clean all interiors before inspection process.
  - .3 Clean as directed by the NCC Representative.

**END OF SECTION**



**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Health and safety considerations required to ensure that the NCC shows due diligence towards health and safety on construction sites, and meets the requirements laid out in the NCC's *Policy - Occupational Health and Safety for Construction*.

**1.2                RELATED SECTIONS**

- .1        Section 01 00 01 – General Requirements.

**1.3                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 Ontario
  - .1        Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. [1990 June 2002].

**1.4                SUBMITTALS**

- .1        Make submittals in accordance with Section 01 00 01 – General Requirements.
- .2        Submit site-specific Health and Safety Plan prior to Award of Contract. Plan shall include:
  - .1        Results of site specific safety hazard assessment.
  - .2        Results of safety and health risk or hazard analysis for site tasks and operation.
- .3        Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to the NCC Representative weekly.
- .4        Submit copies of reports or directions issued by Federal or Provincial health and safety inspectors.
- .5        Submit copies of incident and accident reports.
- .6        Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 00 01 – General Requirements.
- .7        The NCC Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor prior to Award of Contract. Revise Plan as appropriate and resubmit prior to Award of Contract.
- .8        The NCC Representative'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        On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

## **1.5 FILING OF NOTICE**

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

## **1.6 SAFETY ASSESSMENT**

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

## **1.7 MEETINGS**

- .1 Schedule and administer Health and Safety meeting with the NCC Representative prior to commencement of Work.

## **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 The NCC Representative 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 and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

## **1.10 COMPLIANCE REQUIREMENTS**

- .1 Comply with Ontario Health and Safety Act and Regulations for Construction Projects, R.S.O..

## **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 the NCC Representative 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 minimum 2 years' site-related working experience specific to activities associated with similar projects.
  - .2 Have working knowledge of occupational safety and health regulations.
  - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

- .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
- .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

**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 NCC Representative.

**1.14 CORRECTION OF NON-COMPLIANCE**

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

**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.

**1.17 DESIGNATED SUBSTANCES, VOLATILE COMPOUNDS, UNFORESEEN HAZARDS**

- .1 Notify NCC Representative 48 hours in advance of work in occupied areas involving designated substances (under applicable provincial legislation), hazardous substances (Canada Labour Code Part II Section 10), and before painting, installing carpet, or using volatile compounds.
- .2 Asbestos: Stop work and notify NCC Representative immediately if a material resembling asbestos is encountered. Do not proceed at such locations without written instructions from the NCC Representative.
- .3 Silica: Use appropriate respiratory protection and ventilation during the demolition and/or modification of structures with products that contain silica. Silica is a crystalline component of concrete and cement. Silica dust is created by blasting, grinding, crushing and sandblasting silica-containing materials.

**1.18 BUILDING SMOKING ENVIRONMENT**

- .1 Smoking is not permitted in the Building. Obey smoking restrictions on building property.

**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 REQUIREMENTS**

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

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Two weeks prior to Interim (Substantial) Performance of the Work, submit to the NCC Representative four final copies of operating and maintenance manuals in English and French.
- .2    Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .3    Provide evidence, if requested, for type, source and quality of products supplied.

**1.3                FORMAT**

- .1    Organize data as instructional manual.
- .2    Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3    When multiple binders are used correlate data into related consistent groupings.
  - .1    Identify contents of each binder on spine.
- .4    Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5    Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6    Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7    Text: manufacturer's printed data, or typewritten data.

- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.

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

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of 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.

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

- .1 Maintain, at site for NCC Representative one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Change Orders and other modifications to Contract.
  - .5 Reviewed shop drawings, product data, and samples.
  - .6 Field test records.
  - .7 Inspection certificates.
  - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction.
  - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
  - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
  - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by NCC Representative.

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

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

## **1.7 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system include description of unit or system, and component parts.
  - .1 Give function, normal operation characteristics and limiting conditions.
  - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 Include summer, winter, and any special operating instructions.

- .5 Maintenance Requirements: include routine procedures and guide for 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 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.
- .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 MAINTENANCE MATERIALS**

- .1 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 [location as directed]; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to NCC Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock 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 [location as directed]; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to NCC Representative.
  - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 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 [location as directed]; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to NCC Representative.
    - .2 Include approved listings in Maintenance Manual.

**1.10 DELIVERY, STORAGE AND HANDLING**

- .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.
- .5 Remove and replace damaged products at own expense and for review by NCC Representative.

**1.11 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to NCC Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that NCC Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to NCC Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of applicable item of work.
- .4 Verify that documents are in proper form, contain full information, and are notarized.
- .5 Co-execute submittals when required.
- .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with NCC Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 9 month warranty inspection, measured from time of acceptance, by NCC Representative.
- .9 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Cross-reference to warranty certificates as applicable.
    - .7 Starting point and duration of warranty period.
    - .8 Summary of maintenance procedures required to continue warranty in force.
    - .9 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .10 Organization, names and phone numbers of persons to call for warranty service.
    - .11 Typical response time and repair time expected for various warranted equipment.
  - .3 Contractor's plans for attendance at 9 month post-construction warranty inspections.
  - .4 Procedure and status of tagging of equipment covered by extended warranties.
  - .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the NCC Representative to proceed with action against Contractor.

**1.12 WARRANTY TAGS**

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by NCC Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**1 General**

**1.1 GENERAL**

- .1 Commissioning of project components and systems is of the utmost importance to ensure the successful operation of this project. The project will not be considered complete until all systems have been demonstrated to work precisely in accordance with the contract requirements.

**1.2 RESPONSIBILITY**

- .1 Responsibility for the satisfactory completion of the project and demonstration that the requirements of commissioning are satisfied rests with the Contractor, who will employ and pay for the specialist supervision, inspection and testing as required to complete the work described.

**1.3 COMMISSIONING PROCESS**

- .1 The Commissioning Process consists of:
  - .1 Testing of "New" components installed as defined in the Tender Documents.
  - .2 Testing of systems including existing systems which have been modified or extended as part of the Work as defined in the Tender Documents.
  - .3 Integrated Systems performance testing and fine-tuning as defined within the Tender Documents.

**1.4 ROLES AND RESPONSIBILITIES**

- .1 The roles and responsibilities of the NCC Representative, the Consultant Team, and the Contractor for the Commissioning Process are as follows:
  - .1 The Contractor is responsible for the coordination of overall commissioning process.
  - .2 The NCC Representative may participate in some or all of the testing and verification of project components, systems, and integrated systems to meet the client and project objectives.
  - .3 The Contractor shall participate in all of the performance testing and verification of building components, systems, and integrated systems to ensure that project components, systems, and integrated systems work correctly as per the project requirements and design intent.
  - .4 The Contractor shall be responsible for organizing and implementing all aspects of the commissioning process outlined herein.

**1.5 PREPARATION**

- .1 The Contractor shall have contract documents, shop drawings, product data, and operation and maintenance data in hand during equipment performance verification process.
- .2 The Contractor, his suppliers, and/or manufacturers shall provide qualified and experienced personnel in terms of testing the various systems.
- .3 All contractor's construction start-ups must be completed before commencing commissioning operational performance tests and verification.

**1.6 RELATED SECTIONS**

- .1 All applicable Division 1 Sections.
- .2 All applicable Division 21 Sections.
- .3 All applicable Division 22 Sections.
- .4 All applicable Division 23 Sections.
- .5 All applicable Division 26 Sections.

**1.7 SCHEDULES**

- .1 Unless otherwise specified in writing by the NCC Representative, all testing and related requirements specified herein will be successfully performed prior to the issuance of the Interim Certificate of Completion.

**1.8 COORDINATION**

- .1 Coordinate all sub-trades, other Divisions, manufacturers, suppliers, and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.
- .3 Where any components or systems require testing prior to starting ensure that such work has been completed and approved prior to starting of these components and systems.

**1.9 WITNESSING OF COMMISSIONING**

- .1 Prior to starting and testing of components or systems prepare a schedule for the required testing. Review schedule and revise as required to obtain acceptance of NCC Representative.
- .2 Provide sufficient notice (minimum ten working days) prior to commencing tests.
- .3 NCC Representative may witness all or any portion of testing and starting procedures performed by the Contractor.
- .4 Contractor to be present for all tests.

**1.10 PRESIDING AUTHORITIES**

- .1 Initial equipment start-up shall be successfully completed by the Contractor prior to performance verification and certification by presiding authorities having jurisdiction.
- .2 To facilitate turnover of project, call and arrange for authorities to witness procedures in a manner that avoids unnecessary duplication of tests. It shall be the responsibility of the Contractor to confirm which tests the presiding authorities having jurisdiction are required to attend. Confirm to NCC Representative that the presiding authorities will be present for each test, as required.

- .3 Any costs associated with the presiding authorities attending testing during the daytime or during off-hours shall be the responsibility of the Contractor. Include all such costs in tender price.
- .4 Obtain certificates of approval, acceptance and comply with rules and regulations of "the authorities having jurisdiction". Provide originals of all certificates to the NCC Representative in Closeout Submittals.

### **1.11 CORRECTION OF DEFICIENCIES**

- .1 Correct all contract deficiencies found during commissioning.

## **2 Products**

- .1 N/A

## **3 Execution**

### **3.1 TESTING OVERVIEW**

- .1 Ensure integrated system operations conform with design documents providing required and performance with proper interaction between related systems.
- .2 Verify performance of components and systems operating in conjunction with one another under all conditions and modes of operation.
- .3 Each system is to be operated for as long as required to complete commissioning.
- .4 NCC Representative to verify that reported results of testing and procedures are checked and verified to be correct. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

### **3.2 COORDINATION**

- .1 Integrated system testing shall take place only after the mechanical and electrical systems testing and commissioning has been completed and accepted by the NCC Representative.
- .2 Arrange for and confirm to NCC Representative that the presiding authorities having jurisdiction will be present for each test, as required.

### **3.3 RESPONSIBILITIES**

- .1 NCC Representative will do the following during Systems and Integrated System Testing and Fine tuning:
  - .1 Witness and provide instruction in a series of pre-planned integrated system performance tests under conditions simulating, to the extent possible, full and partial operating loads and emergency load conditions.
  - .2 Review and verify Contractor recorded test results.
  - .3 Diagnose problems and determine if they are a result of Contract Deficiencies.
  - .4 Request repeat tests as required following correction of Contract Deficiencies.

- .5 Conduct user surveys and take environmental measurements as necessary to identify existing and potential problems.
- .6 Provide direction and instruct in the fine-tuning of the systems under test to satisfy the operating requirements.
- .2 Perform the following during Systems and Integrated Systems testing and Fine Tuning:
  - .1 Employ all coordination, resources, services, measures and responsibilities to execute the entire testing and commissioning program (process) without damage to project systems or components, at no additional cost to Crown.
  - .2 Modify operating parameters of the systems to satisfy the fine tuning requirements outlined by the NCC Representative so to ensure proper system operation. For example:
    - .1 Make adjustments which may become apparent as testing proceeds;
    - .2 Undertake modifications to suit changes as equipment settles down during the running in period;
    - .3 Documentation of results;
    - .4 Diagnosis of problems;
    - .5 Correct contract deficiencies previously outstanding as well as any identified during Systems and Integrated Systems Testing and Fine Tuning;
    - .6 Fine Tuning will provide for the adjustment of the system where the integrated systems testing have shown a need, such as but not limited to:
      - .1 Temperature, relative humidity, air movement in the occupied zone, ventilation, air purity, noise, vibration, and pressure.

**END OF SECTION**

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## **Part 1 General**

### **1.01 RELATED REQUIREMENTS**

- .1 Section 01 00 01 – General Requirements
- .2 Section 02 82 00.03 Asbestos/Mould Abatement – Maximum Precautions
- .3 Section 02 83 11 Lead Base Paint Abatement – Intermediate Precautions

### **1.02 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA S350-M1980(R1998), Code of Practice for Safety in Demolition of Structures.

### **1.03 SUBMITTALS**

- .1 Submit shop drawings In accordance with 01 00 01 General Requirements.
- .2 Before proceeding with demolition of load bearing walls, columns, beams, floor joist, submit for review by NCC Representative shoring and underpinning drawings prepared by qualified professional engineer registered or licensed to practice in the Province of Quebec, showing proposed method.

### **1.04 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials in accordance with 01 00 01 General Requirements.

### **1.05 SITE CONDITIONS**

- .1 Review "Designated Substance Report" and take precautions to protect environment.
- .2 Should material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify NCC Representative immediately.
  - .1 Do not proceed until written instructions have been received from NCC Representative.

## **Part 2 Products – Not Used**

## **Part 3 Execution**

### **3.01 PREPARATION**

- .1 Inspect buildings and site with NCC Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.
  - .1 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and



previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

- .2 Immediately notify NCC Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
- .3 Immediately notify the NCC Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

### **3.02 PROTECTION**

- .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
  - .1 Protect building systems, services and equipment.
  - .2 Provide temporary dust screens, covers, railings, supports and other protection as required.

### **3.03 SITE REMOVALS**

- .1 Remove items as indicated.

### **3.04 DEMOLITION**

- .1 Remove parts of existing building to permit new construction. Sort materials into appropriate piles for reuse, recycling and disposal.
- .2 Trim edges of partially demolished building elements to tolerances as defined by NCC Representative to suit future use.
- .3 Other items as indicated.

**END OF SECTION**

## **Part 1           General**

The work program consists of the removal of wall, ceiling and mechanical equipment within the cafeteria and associated washrooms (rooms 243, 244 and 245) to the original materials / skeleton in preparation for the renovation / expansion of this area.

As per provided plans, existing room 258 (i.e. change room) and hallway room 259 will be incorporated into the existing cafeteria room. It is also noted that the existing entrance to the cafeteria from the main hallway will be expanded to allow for a larger door, thus requiring the removal of asbestos plaster walls. Existing walls will also be removed down to the structural components to allow for mechanical services to be replaced. It is our understanding that the plaster walls are covered in drywall but applied on a variation of metal, stone and wood lath. Based on the presence of potential plaster on stone, there is the potential that mechanical chipping may be required.

The ceiling height will be expanded thus requiring the removal of the existing ceiling and bulkheads located throughout the cafeteria space. It is our understanding that the plaster ceilings are applied on metal and wood lath. Pipe conduits within the ceiling space will be removed, as required.

Access to the cafeteria work area is proposed to be located in room 258. Any openings created in room 258 are to be supported or constructed in a manner to minimize structural disturbance.

### **Based on the above workplan, the following are the asbestos-containing materials observed within the building that are to be removed using Type 3 procedures:**

- .1 Asbestos-containing stippled ceiling plaster observed on the ceiling bulkheads and false ceilings;
- .2 Asbestos-containing ceiling plaster that forms the entire ceiling of the cafeteria room;
- .3 Asbestos-containing wall plaster that forms the interior walls of the cafeteria and also suspected of being present on the hallway side of the wall;
- .4 Asbestos-containing pipe elbows and potential pipe wraps present within the ceiling space;
- .5 Asbestos-containing floor tiles in the hallway may be removed to allow for the removal of the wall and addition of a new door.

## **1.2           SUMMARY**

- .1 Comply with requirements of this Section when performing following Work:
  - .1 Removal or disturbance as specified of more than one square metre of friable asbestos containing material during the repair, alteration, maintenance or demolition of a building or any machinery or equipment located on the site.
  - .2 The scope of work for this project is to remove the asbestos identified within the cafeteria room identified within a Designated Substance Survey completed by DST Consulting Engineers in 2011.
  - .3 Additional information is identified within a subsequent letter entitled "Monck Wing Basement, Exploratory Opening," completed by DST Consulting Engineers in March, 2014.

The information within these reports can be reviewed at the NCC office at 40 Elgin Street, Ottawa, ON.

### 1.3 REFERENCES

#### Asbestos

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.205-[94], Sealer for Application to Asbestos-Fibre-Releasing Materials.
- .2 Canadian Standards Association (CSA International)
- .3 Department of Justice Canada
  - .1 Canadian Environmental Protection Act (CEPA), 1999.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .6 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH)
  - .1 NIOSH 94-113, NIOSH Manual of Analytical Methods (NMAM), 4th Edition.
- .7 U.S. Department of Labour - Occupational Safety and Health Administration - Toxic and Hazardous Substances
  - .1 29 CFR 1910.1001, Asbestos Regulations.
- .8 Ontario Ministry of Labour, Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations (O.Reg. 278/05). American Conference of Governmental Industrial Hygienists (ACGIH), Bioaerosols Assessment and Control [1999].

#### Mould

- .9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .10 New York City Department of Health - Bureau of Environmental and Occupational Disease Epidemiology's Guidelines on the Assessment and Remediation of Fungi in Indoor Environment [2000]
- .11 United States Department of Labor Occupational Safety and Health Administration (OSHA)
  - .1 29 CFR 1910.134 - Respiratory Protection.
  - .2 29 CFR 1910.1200 - Hazard Communication.
- .12 United States Environmental Protection Agency (EPA), Mould Remediation in Schools and Commercial Buildings, [2001].

## 1.4 DEFINITIONS

- .1 Airlock: system for permitting ingress or egress without permitting air movement between contaminated area and uncontaminated area, typically consisting of two curtained doorways at least 2 m apart.
- .2 Amended Water: water with a non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.
- .3 Asbestos Containing Materials (ACMs): materials that contain 0.5% or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.
- .4 Asbestos Work Areas: area where work takes place which will, or may disturb ACMs.
- .5 Authorized Visitors: Engineers, Consultants, designated representatives, and representatives of regulatory agencies.
- .6 Cleaning solution: detergent solution
- .7 Competent worker: in relation to specific work, means a worker who:
  - .1 Is qualified because of knowledge, training and experience to perform the work.
  - .2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
  - .3 Has knowledge of all potential or actual danger to health or safety in the work.
  - .4 Can demonstrate that mould remediation training has been obtained, is capable of identifying existing microbial hazards in workplace and selecting appropriate control strategy for microbial exposure
- .8 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:
  - .1 Place two overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet along one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.
  - .2 Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing.
  - .3 Overlap each polyethylene sheet at openings not less than 1.5 m on each side.
- .9 DOP Test: testing method used to determine integrity of Negative Pressure unit using dioctyl phthalate (DOP) HEPA-filter leak test.
- .10 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .11 Glove Bag: prefabricated glove bag as follows:
  - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
  - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
  - .3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.
  - .4 Straps for sealing ends around pipe.

- .12 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .13 Mould contaminated work area: specific area or location where actual work is being performed or other areas of facility where it has been determined that it may be hazardous to public health as result of mould remediation.
- .14 Negative pressure: system that extracts air directly from work area, filters such extracted air through High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building.
- .15 Non-Friable Materials: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .16 Occupied Areas: any area of building or work site that is outside Asbestos Work Area.
- .17 Polyethylene sheeting sealed with tape: polyethylene sheeting of type and thickness specified sealed with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealants, and to prevent escape of asbestos fibres through sheeting into clean area.
- .18 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.

## 1.5 SUBMITTALS

- .1 Before beginning work:
  - .1 Obtain from appropriate agency and submit to NCC representative / Consultant necessary permits for transportation and disposal of asbestos waste. Ensure that dump operator is fully aware of hazardous nature of material being dumped, and proper methods of disposal. Submit proof satisfactory to NCC representative / Consultant suitable arrangements have been made to receive and properly dispose of asbestos waste.
  - .2 Submit proof satisfactory to NCC representative / Consultant that all asbestos / mould workers have received appropriate training and education by a competent person on hazards of asbestos / mould exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Submit proof of attendance in form of certificate.
  - .3 If mould is identified, before commencing work, provide NCC representative / Consultant proof that worker had instruction and training in potential health hazards of mould exposure, handling of hazardous materials, in personal hygiene including protective clothing, in entry and exit from Mould Contaminated Work Area, and in use of disposal procedures including building materials. This training can be performed as part of a program to comply with requirements of the OHS A Hazard Communication Standard (29 CFR 1910.1200) or equivalent.
  - .4 Ensure supervisory personnel have attended asbestos / mould abatement course, of not less than two days duration, approved by NCC representative / Consultant. Submit proof of attendance in form of certificate. Minimum of one Supervisor for every ten workers.

- .5 Provide layout of proposed enclosures and decontamination facilities to NCC representative / Consultant for review. Can be done during pre-abatement meeting.
- .6 Submit documentation including test results for sealer proposed for use.
- .7 Submit Provincial and/or local requirements for Notice of Project form.
- .8 Submit proof of Contractor's Asbestos Liability Insurance.
- .9 Submit proof satisfactory to NCC representative / Consultant that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.
- .10 Submit Worker's Compensation Board status and transcription of insurance.
- .11 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including but not limited to following:
  - .1 Encapsulants.
  - .2 Amended water.
  - .3 Slow drying sealer.

## 1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to asbestos, provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
  - .2 Safety Requirements: worker and visitor protection.
    - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area includes:
      - .1 Air purifying full face-mask respirator powered air purifying respirator (PAPR) or Supplied air respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

- .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and is to be repaired or replaced if torn.  
Requirements for each worker:
  - .1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters that have been tested as satisfactory, clean coveralls and head covers before entering Equipment and Access Rooms or Asbestos Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.
  - .2 Remove gross contamination from clothing before leaving work area then proceed to Equipment and Access Room and remove clothing except respirators. Place contaminated work suits in receptacles for disposal with other asbestos - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. Still wearing the respirator, proceed naked to showers. Using soap and water wash body and hair thoroughly. Clean outside of respirator with soap and water while showering; remove respirator; remove filters and wet them and dispose of filters in container provided for that purpose; and wash and rinse inside of respirator. When not in use in work area, store work footwear in Equipment and Access Room. Upon completion of asbestos abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from work area or from Equipment and Access Room.
  - .3 After showering and drying off, proceed to clean change room and dress in street clothes at end of each day's work, or in clean coveralls before eating, smoking, or drinking. If re-entering work area, follow procedures outlined in paragraphs above.
  - .4 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers must not use this system as means to leave or enter work area.
- .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .3 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual asbestos abatement.

- .4 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.
- .5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
- .6 Visitor Protection:
  - .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
  - .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
  - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .4 Fold up metal banding, flatten and place in designated area for recycling.
- .5 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.
- .6 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

## **1.8 EXISTING CONDITIONS**

- .1 Results of tests of asbestos containing materials to be handled, removed, or otherwise disturbed and disposed of during this Project are available within the reference reports. These are representative of asbestos containing materials covered within scope of this Project.
- .2 Notify NCC representative / Consultant of suspect 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 NCC representative / Consultant.
- .3 The wall construction and cafeteria layout will be provided on architectural drawing A-1 (cafeteria).

## **1.9 SCHEDULING**

- .1 Before beginning Work on this Project, notify following in writing:
  - .1 Provincial Department of Labour.
  - .2 Disposal Authority.
- .2 Inform sub-trades of presence of asbestos containing materials identified in Existing Conditions.
- .3 Submit to NCC representative / Consultant copy of notifications prior to start of Work.



- .4 Hours of Work: perform work involving asbestos removal or any site preparation located in the cafeteria during normal working hours (7 am to 5 pm). It is noted that hours may have to be altered with short notice in the event on site constraints/security/visitors.

## **1.10 OWNER'S INSTRUCTIONS**

- .1 Before beginning Work, provide to NCC representative / Consultant satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene including dress and showers, in entry and exit from Asbestos Work Area, in aspects of work procedures including glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
  - .1 Proper fitting of equipment.
  - .2 Inspection and maintenance of equipment.
  - .3 Disinfecting of equipment.
  - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Polyethylene: minimum 0.15 mm thick unless otherwise specified; in sheet size to minimize joints.
- .2 FR polyethylene: minimum 0.15 mm thick, woven fibre reinforced fabric bonded both sides with polyethylene.
- .3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.
- .4 Wetting agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether, or other material approved by NCC representative / Consultant, mixed with water in concentration to provide adequate penetration and wetting of asbestos containing material.
- .5 Waste Containers: contain waste in two separate containers.
  - .1 Inner container: 0.15 mm thick sealable polyethylene bag glove bag itself.
  - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
  - .3 Labelling requirements: affix pre-printed cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site. Label containers in accordance with Asbestos Regulations. Label in both official languages.
- .6 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.
- .7 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
- .8 Sealer: flame spread and smoke developed rating less than 50.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Work Areas:
  - .1 Pre-clean moveable furniture still present within proposed work areas using HEPA vacuum and remove from work areas to temporary location outside of such areas.
  - .2 Pre-clean fixed casework, plant, and equipment within proposed work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.
  - .3 Clean proposed work areas using, where practicable, HEPA vacuum cleaning equipment. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum equipment.
  - .4 The spread of dust from the work area to be prevented by:
    - .1 Using enclosures of polyethylene or other suitable material that is impervious to asbestos (including, if the enclosure material is opaque, one or more transparent window areas to allow observation of the entire work area from outside the enclosure). The window is not to be visible by the general public and should be limited to areas within Room 258.
    - .2 Using curtains of polyethylene sheeting or other suitable material that is impervious to asbestos, fitted on each side of each entrance or exit from the work area.
      - .1 The entrance to the work area is currently proposed to be constructed in room 258. A small polyethylene sheeting enclosure is to be constructed around the proposed wall entrance (on both sides of the wall) prior to cutting/opening the entry from room 258 to the cafeteria. The three room decontamination room is to be erected / set-up and approved prior to conducting any cuts. The whole in the wall is to be appropriately supported to mitigate any structural concerns.
      - .2 Once the entrance to the cafeteria is created and the small enclosure around the proposed wall cut is removed, the larger cafeteria space would form the Type 3 enclosure. Prior to removing the polyethylene tarps for the purpose of creating a larger asbestos work area, ensure that all current doorways/entrances/void spaces between the asbestos work area and occupied areas are sealed with two layers of polyethylene sheeting.
      - .3 Fill in void spaces around pipe conduits and/or within the small openings with duct tapes, foam or other suitable materials that will prevent migration of dust.
  - .5 Install negative pressure system and operate continuously from time first polyethylene is installed to seal openings until final completion of work including final cleanup and appropriate clearance inspections. Provide continuous monitoring of pressure difference using automatic recording instrument. The system is to maintain a negative air pressure of 0.02 inches of

water, relative to the area outside the enclosed area. The system is to be inspected and maintained by a competent person prior to each use.

- .6 Seal off openings such as windows, skylights, ducts, grilles, and diffusers in the asbestos work area, with polyethylene sheeting sealed with tape.
  - .1 Seal-off doorways and entrances to corridors with two layers of polyethylene sheeting.
  - .2 Create a seal from floor to ceiling around the main entrance to the cafeteria from hallway 372, 259 and 243
  - .3 Provide approximately 0.3 to 0.6 m of work-space between the cafeteria/hallway 372 wall and the seal. Due to potential falling debris from the expansion of the wall, all seals are to be reinforced with suitable materials (wood/press board) to ensure the seal is not punctured at any time.
- .7 Build airlocks at entrances to and exits from work area (cafeteria, washrooms, change room) so that work areas are always closed off by one curtained doorway when workers enter or exit.
- .8 At each access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used: "CAUTION ASBESTOS HAZARD AREA (25 mm) NO UNAUTHORIZED ENTRY (19 mm) WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)".
  - .1 For any asbestos signs that may be visible to public; place loose curtained doorway sheet approximately 0.6 m in front of the asbestos work entrance.
  - .2 Place construction safety / contractor entrance sign on loose curtained doorway to prevent visible access of asbestos work area to the building staff.
- .9 Before beginning mould work (following asbestos work), at each access to contaminated work area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used : 'CAUTION MOULD HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING MOULD DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'
- .10 After work area isolation, remove heating, ventilating, and air conditioning filters, pack in sealed plastic bags 0.15 mm minimum thick and treat as contaminated asbestos waste. Remove ceiling - mounted objects such as lights, partitions, other fixtures not previously sealed off, and other objects that interfere with asbestos removal, as directed by NCC representative / Consultant. Use localized water spraying during fixture removal to reduce fibre dispersal.
- .11 Maintain emergency and fire exits from work areas, or establish alternative exits.
- .12 Where application of water is required for wetting asbestos containing materials, shut off electrical power, provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.
- .13 After preparation of work area and Decontamination Enclosure Systems, remove brick wall that is covered in drywall and asbestos plaster that separates the

change room (room 258) from the cafeteria to create opening to cafeteria during the work program. Contractor to provide any supports or other systems to ensure structural stability of the work area. Following the completion of the wall opening and extension of the enclosure to the cafeteria expansion program, commence with the removal of asbestos-containing materials in the cafeteria, washrooms and/or room 258. Spray asbestos debris and immediate work area with amended water to reduce dust, as work progresses.

- .14 After preparation of work areas and Decontamination Enclosure Systems, for the removal of all other asbestos containing materials, remove within work area and dispose of as contaminated waste in specified containers. Spray asbestos debris and immediate work area with amended water to reduce dust, as work progresses.
- .3 Worker Decontamination Enclosure System:
  - .1 This enclosure system is currently proposed to be located within Room 258 and intended to allow for the safe removal of the wall separating Room 258 from the cafeteria and allow for the subsequent removal of the asbestos-containing materials in the cafeteria and the change room (room 258).
  - .2 Worker Decontamination Enclosure System includes Equipment and Access Room, Shower Room, and Clean Room, as follows:
    - .1 Equipment and Access Room: build Equipment and Access Room between Shower Room and work area, with three curtained doorways, one to Shower Room and two to work area (one to the proposed cafeteria opening and the other to allow for entry to the change room, which will become part of the cafeteria work area). Install waste receptor, and storage facilities for workers' shoes and protective clothing to be re-worn in work area. Build Equipment and Access Room large enough to accommodate specified facilities, other equipment needed, and at least one worker allowing him /her sufficient space to undress comfortably.
    - .2 Shower Room: build Shower Room between Clean Room and Equipment and Access Room, with two curtained doorways, one to Clean Room and one to Equipment and Access Room. Provide one shower for every five workers. Provide constant supply of hot and cold or warm water. Drains to common sewers are available at drain. Provide piping and connect to water sources and drains. Pump waste water through 5 micrometre filter system acceptable to NCC representative / Consultant before directing into drains. Provide soap, clean towels, and appropriate containers for disposal of used respirator filters.
    - .3 Clean Room: build Clean Room between Shower Room and clean areas outside of enclosures, with two curtained doorways, one to outside of enclosures and one to Shower Room. Provide lockers or hangers and hooks 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. Clean room is to be sealed directly to the entrance from the hallway to the change room. To be constructed in a manner to allow for door to be standard to be opened.
    - .4 No asbestos waste is to be transported through this system and through the building.
- .4 Container and Equipment Decontamination Enclosure System:

- .1 Container and Equipment Decontamination Enclosure System consists of Staging Area within work area, Holding Room, and Unloading Room. Purpose of system is to provide means to decontaminate waste containers, waste and material containers, vacuum and spray equipment, and other tools and equipment for which Worker Decontamination Enclosure System is not suitable. This area is to be constructed at the middle courtyard window.
  - .1 Staging Area: designate Staging Area in work area for gross removal of dust and debris from waste containers and equipment, labelling and sealing of waste containers, and temporary storage pending removal to unloading room.
  - .2 Unloading Room: build Unloading Room between Holding Room and outside (at courtyard window), with two curtained doorways, one to Holding Room and one to outside through the courtyard window.
  - .3 Waste is to be transported through this system at the end of the work day and immediately brought to the waste container (to be located at the ice rink area);
- .5 Construction of Decontamination Enclosures:
  - .1 Build suitable framing for enclosures and line with polyethylene sheeting sealed with tape. Use two layers of FR polyethylene on floors.
  - .2 Build curtained doorways between enclosures so that when people move through or when waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.
  - .3 Reinforce the decontamination enclosure system within Room 258/change room with plywood (or suitable) to ensure that material removals to occur above the enclosure will not damage the enclosure.
  - .4 Reinforce the polyethylene barrier near the cafeteria entrance from the hallway with plywood to ensure the disturbance of materials does not break through the polyethylene sheet.
- .6 Separation of Work Areas from Occupied Areas:
  - .1 Separate parts of building required to remain in use from parts of building used for asbestos abatement by means of airtight barrier system constructed as follows:
    - .1 Build suitable floor to ceiling lumber or metal stud framing, cover with polyethylene sheeting sealed with tape, and apply 9 mm minimum thick plywood barriers that are exposed to the public (hallway 243, 259). Seal joints between plywood sheets and between plywood and adjacent materials with surface film forming type sealer, to create airtight barrier.
    - .2 Cover plywood barrier with polyethylene sealed with tape, as specified for work areas.
- .7 Maintenance of Enclosures:
  - .1 Maintain enclosures in tidy condition.
  - .2 Ensure that barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.
  - .3 Visually inspect enclosures at beginning of each working period.
  - .4 Use smoke methods to test effectiveness of barriers when directed by NCC representative / Consultant.

- .8 Do not begin Asbestos Abatement work until:
  - .1 Arrangements have been made for disposal of waste.
  - .2 For wet stripping techniques, arrangements have been made for containing, filtering, and disposal of waste water.
  - .3 Work areas and decontamination enclosures are effectively segregated.
  - .4 Tools, equipment, and materials waste containers are on hand.
  - .5 Arrangements have been made for building security.
  - .6 Warning signs are displayed where access to contaminated areas is possible.
  - .7 Notifications have been completed and other preparatory steps have been taken
  - .8 Enclosures have been inspected by NCC representative/Consultant.

### **3.2 SUPERVISION**

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos containing materials.

### **3.3 ASBESTOS REMOVAL**

- .1 Before removing asbestos:
  - .1 Prepare site.
  - .2 Spray asbestos material with water containing specified wetting agent, using airless spray equipment capable of providing "mist" application to prevent release of fibres. Saturate asbestos material sufficiently to wet it to substrate without causing excess dripping. Spray asbestos material repeatedly during work process to maintain saturation and to minimize asbestos fibre dispersion.
- .2 Remove wall (portion of wall) separating Room 258 (change room) to the cafeteria within a smaller Type 3 enclosure. Once wall is removed, open up into larger Type 3 enclosure systems including the cafeteria and Room 258. Contractor to maintain structural integrity of the building/area during removal of wall / portion of wall.
- .3 Remove saturated asbestos material in small sections. Do not allow saturated asbestos to dry out. As it is being removed pack material in sealable plastic bags 0.15 mm minimum thick and place in labelled containers for transport.
  - .1 Contractor to be aware that portions of the walls may consists of plaster adhered directly to the stone. Mechanical chipping may be required to remove the plaster material from the stone.
- .4 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure that containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .5 After completion of stripping work, wire brushed and wet sponged surfaces from which asbestos has been removed to remove visible material. During this work, keep surfaces wet.
- .6 After wire brushing and wet sponging to remove visible asbestos, wet clean entire work area including Equipment and Access Room, and equipment used in process. After

inspection by NCC representative / Consultant, apply continuous coat of slow drying sealer to surfaces of work area. Allow at least 16 hours with no entry, activity, ventilation, or disturbance other than operation of negative pressure units during this period.

- .7 Work is subject to visual inspection and potential air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.
- .8 Cleanup:
  - .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
  - .2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste, wet and fold to contain dust and then place in waste bags.
  - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag. Remove the waste from the asbestos work area at the end of each work day through the courtyard window.
  - .4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
  - .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

### **3.4 MICROBIAL REMEDIATION (If mould is identified after asbestos removal)**

- .1 If remediation procedures are expected to generate dust or visible concentration of fungi is heavy (blanket as opposed to patchy coverage), ensure that work is completed within the Type 3 enclosure (using full containment).
- .2 Use sprayer (low-velocity, fine-mist) to mist (not wet) materials containing mould to be removed. Perform work to reduce dust creation to lowest levels practicable.
- .3 Non-porous and semi-porous materials can be cleaned using the cleaning solution and reused depending on depth to which microbial growth has penetrated substrate. Wood to be discarded if fungal growth has affected its soundness.
- .4 Porous materials with more than 1 square metre of mould contamination and/or dampness to be removed, discarded and replaced.
- .5 Porous materials identified as lightly contaminated that can be cleaned by HEPA vacuuming (if cannot be practically removed and/or not part of the proposed renovation), but to be discarded and replaced if possible.
- .6 Dispose of contaminated building materials as specified.
- .7 During mould remediation, should NCC representative / Consultant suspect contamination of areas outside enclosed Mould Contaminated Work Area, contractor to stop remediation work and immediately decontaminate affected areas. Eliminate causes of such contamination. Prohibit unprotected individuals from entering the contaminated area until a visual inspection determines area are free from contamination. Air testing may be conducted if deemed necessary.

- .8 Notify NCC representative / Consultant of mould contaminated material discovered during work to allow for review of the mould source. Do not disturb such material pending instructions from NCC representative / Consultant.

### 3.5 FINAL CLEANUP

- .1 Following the specified cleaning, and approval by NCC representative / Consultant, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible asbestos containing particles observed during cleanup, immediately, using HEPA vacuum equipment.
- .3 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .4 Include in clean-up Work areas, Equipment and Access Room, Washroom, Shower Room, and other contaminated enclosures.
- .5 Include in clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.
- .6 Conduct final check to ensure that no dust or debris remains on surfaces as result of dismantling operations. Repeat cleaning using HEPA vacuum equipment, or wet cleaning methods where feasible, in conjunction with sampling until levels meet this criteria.
- .7 As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled containers containing asbestos waste and dispose of to authorized disposal area in accordance with requirements of disposal authority. Ensure that each shipment of containers transported to dump is accompanied by Contractor's representative to ensure that dumping is done in accordance with governing regulations.

### 3.6 AIR MONITORING

- .1 From beginning of Work until completion of cleaning operations, Engineer/ Consultant to take air samples on regular basis outside of work area enclosure.
  - .1 If air monitoring shows that areas outside work area enclosures are contaminated, enclose, maintain and clean these areas, in same manner as that applicable to work areas.
- .2 During course of Work, Engineer / Consultant to measure fibre content of air outside work areas by means air samples analyzed by Phase Contrast Microscopy (PCM).
  - .1 Stop Work when PCM measurements exceed 0.1 f/cc and correct procedures.
- .3 Final air monitoring to be conducted as follows: After Asbestos Work Area has passed visual inspection and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period has passed, Consultant will perform air monitoring within Asbestos Work Area.
  - .1 Final air monitoring results must show fibre levels of less than 0.01 f/cc.
  - .2 If air monitoring results show fibre levels in excess of 0.01 f/cc, re-clean work area and apply another acceptable coat of lock-down agent to surfaces.
  - .3 Repeat as necessary until fibre levels are less than 0.01 f/cc.
- .4 If mould removal was conducted, **exp** may perform final air monitoring of Mould Contaminated Work Area depending on the extent of the mould removal program and



provided area has passed visual inspection and an appropriate settling period of 12 hours has passed. If air monitoring results are deemed unacceptable by Consultant, area are to be re-cleaned with HEPA vacuum and damp wiped until levels are found to be acceptable by Consultant.

### **3.7 INSPECTION**

- .1 Perform inspection of Asbestos Work Area to confirm compliance with specification and governing authority requirements. Deviations from these requirements that have not been approved in writing by NCC representative / Consultant may result in Work stoppage, at no cost to Owner.
- .2 NCC representative / Consultant will inspect Work for:
  - .1 Adherence to specific procedures and materials.
  - .2 Final cleanliness and completion.
  - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.
- .3 When asbestos (mould, if applicable) leakage from Asbestos Work Area has occurred or is likely to occur NCC representative / Consultant may order Work shutdown.
  - .1 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

**END OF SECTION**

## **Part 1            General**

**This section is associated with the scraping and removal of lead-based flaking paint from select areas associated with the cafeteria renovation. It is understood that the majority of the lead removal program will be conducted in conjunction with the asbestos removal program in Section 02 82 00.03. This section is for isolated removals that may be required after abatement work is complete or outside of the asbestos work area.**

### **1.1                SUMMARY**

- .1 Comply with requirements of this Section when performing following Work:
  - .1 Removal of flaking lead based paint by scraping or sanding using non-powered hand tools on select walls and window sills.
  - .2 Manual demolition of lead-painted plaster walls or building components by striking wall with sledgehammer or similar tool (as part of drywall / drywall compound removal program).

### **1.2                SECTION INCLUDES**

- .1 Requirements and procedures for abatement of lead based paints.

### **1.3                REFERENCES**

- .1 Department of Justice Canada
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .2 Health Canada
  - .1 Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).
- .3 Human Resources and Social Development Canada (HRSDC)
  - .1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.
- .4 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Underwriters' Laboratories of Canada (ULC)
- .6 Ontario Ministry of Labour,
  - .1 Lead on Construction Projects Guideline, April, 2011

### **1.4                DEFINITIONS**

- .1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Authorized Visitors: NCC representative / Consultant or designated representative[s] and representatives of regulatory agencies.

- .3 Occupied Area: areas of building or work site that is outside Work Area.
- .4 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.
- .5 Airlock: ingress or egress system, without permitting air movement between contaminated area and uncontaminated area. Consisting of two curtained doorways at least 2 m apart.
- .6 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another. Typically constructed as follows:
  - .1 Place two overlapping polyethylene sheets 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 secure other sheet along opposite vertical side of doorway.
  - .2 Reinforce free edges of polyethylene with duct tape and add weight to bottom edge to ensure proper closing.
  - .3 Overlap each polyethylene sheet at openings 1.5 m on each side.
- .7 Action level: employee exposure, without regard to usage of respirators, to an airborne concentration of lead of 50 micrograms per cubic meter of air calculated as 8 hour time-weighted average (TWA). Intermediate precautions for lead abatement are based on airborne lead concentrations greater than 0.05 milligrams per cubic meter of air within Work Area.
- .8 Competent person: NCC representative / Consultant capable of identifying existing lead hazards in workplace and taking corrective measures to eliminate them.

## **1.5 SUBMITTALS**

- .1 Provide proof satisfactory to NCC representative / Consultant that suitable arrangements have been made to dispose of lead based paint waste in accordance with requirements of authority having jurisdiction.
- .2 Provide: Provincial and local requirements for Notice of Project Form.
- .3 Provide proof of Contractor's General and Environmental Liability Insurance.
- .4 Quality Control:
  - .1 Provide NCC representative / Consultant necessary permits for transportation and disposal of lead based paint waste and proof that it has been received and properly disposed.
  - .2 Provide proof satisfactory to NCC representative / Consultant that employees have had instruction on hazards of lead exposure, respirator use, dress, entry and exit from Work Area, and aspects of work procedures and protective measures.
  - .3 Provide proof that supervisory personnel have attended lead abatement course, of not less than two days duration, approved by NCC representative / Consultant. Minimum of one supervisor for every ten workers.

## **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to lead paint, in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.

- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section [01 35 29.06 - Health and Safety Requirements] .
  - .2 Safety Requirements: worker and visitor protection.
    - .1 Protective equipment and clothing to be worn by workers and visitors in Work Area includes:
      - .1 Respirator NIOSH approved and equipped with filter cartridges with assigned protection factor of 50, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure in Lead Work Area. Provide sufficient filters so workers can install new filters following disposal of used filters and before re-entering contaminated areas.
      - .2 Disposable type protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.
    - .2 Requirements for workers:
      - .1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters, clean coveralls and head covers before entering Equipment and Access Rooms or Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.
      - .2 Remove gross contamination from clothing before leaving work area. Place contaminated work suits in receptacles for disposal with other lead - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. When not in use in Work Area, store work footwear in Equipment and Access Room. Upon completion of lead abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from Work Area or from Equipment and Access Room.
    - .3 Eating, drinking, chewing, and smoking are not permitted in Work Area.
    - .4 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual lead abatement.
    - .5 Ensure workers wash hands and face when leaving Work Area.
    - .6 Provide and post in the procedures described in this Section, in both official languages.
    - .7 Ensure no person required to enter Work Area has facial hair that affects seal between respirator and face.
    - .8 Visitor Protection:
      - .1 Provide protective clothing and approved respirators to Authorized Visitors to Work Areas.
      - .2 Instruct Authorized Visitors in use of protective clothing, respirators and procedures.

- .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Work Area.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling.
- .2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .3 Disposal of lead waste generated by removal activities must comply with Provincial and Municipal regulations. Dispose of lead waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.
- .4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

## **1.8 EXISTING CONDITIONS**

- .1 Reports and information pertaining to lead based flaking paint to be handled, removed, or otherwise disturbed and disposed of during this Project are included with the specification.
- .2 Notify NCC representative / Consultant of lead based paint discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by NCC representative / Consultant.

## **1.9 SCHEDULING**

- .1 Not later than two days before beginning Work on this Project notify the following in writing, where appropriate:
  - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
  - .2 Provincial Ministry of Labour.
  - .3 Disposal Authority.
- .2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.
- .3 Provide NCC representative / Consultant copy of notifications prior to start of Work.
- .4 Hours of Work: perform work involving lead-paint abatement located at Cafeteria within normal working hours. Changes in work schedule may be incurred due to site constraints (i.e. honorary visits).

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Polyethylene: 0.15 mm unless otherwise specified; in sheet size to minimize joints.
- .2 FR polyethylene: 0.15 mm woven fibre reinforced fabric bonded both sides with polyethylene.
- .3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.

- .4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for trapping residual lead paint residue.
- .5 Lead waste containers: type acceptable to dump operator with tightly fitting covers and 0.15 mm sealable polyethylene liners.
  - .1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

### **Part 3 Execution**

#### **3.1 SUPERVISION**

- .1 Approved Supervisor must remain within Lead Work Area during disturbance, removal, or other handling of lead based paints.

#### **3.2 PREPARATION**

- .1 Remove and wrap items to be salvaged or reused, and transport and store in area specified by NCC representative / Consultant.
- .2 Work Area:
  - .1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas.
  - .2 Isolate work area with caution tape and / or drop polyethylene sheeting.
  - .3 Pre-clean fixed casework, and equipment within work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.
  - .4 Clean work areas using HEPA vacuum. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum.
  - .5 Seal off ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.
  - .6 Cover floor surfaces in work area with FR polyethylene drop sheets to protect existing floor during removal.
  - .7 At point of access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used:
    - .1 CAUTION LEAD HAZARD AREA (25 mm).
    - .2 NO UNAUTHORIZED ENTRY (19 mm).
    - .3 WEAR ASSIGNED PROTECTIVE EQUIPMENT AND RESPIRATOR (19 mm).
    - .4 BREATHING LEAD CONTAMINATED DUST CAUSES SERIOUS BODILY HARM (7 mm).
  - .8 Maintain emergency and fire exits from work areas, or establish alternative exits satisfactory to Authority having jurisdiction.
  - .9 Where water application is required for wetting lead containing materials, provide temporary water supply by use of appropriately sized hoses for application of water as required.
  - .10 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24 volt safety lighting and ground fault interrupter circuits on

power source for electrical tools, in accordance with applicable CSA Standard.  
Ensure safe installation of electrical lines and equipment.

- .3 Worker Decontamination Enclosure System:
  - .1 Worker Decontamination Enclosure System includes Equipment and Access Room and Clean Room, as follows:
    - .1 Equipment and Access Room: construct between exit and work areas, with two curtained doorways, one to the rest of suite, and one to work area. Install waste receptor and storage facilities for workers' shoes and protective clothing to be re-worn in work areas. Build large enough to accommodate specified facilities, equipment needed, and at least one worker allowing sufficient space to change comfortably.
    - .2 Clean Room: Provide lockers or hangers and hooks 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.
- .4 Separation of Work Areas
  - .1 Barriers between around work areas not formed by permanent walls to be constructed as follows:
    - .1 Can be constructed using polyethylene sheeting extending from ceiling to the ground. Alternatively, a caution tape can be used in areas of low traffic or where air-flow is minimal.
- .5 Maintenance of Enclosures:
  - .1 Maintain enclosures in clean condition.
  - .2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately.
  - .3 Visually inspect enclosures at beginning of each work day.
  - .4 Use smoke test method to test effectiveness of barriers as directed by NCC representative / Consultant.

### **3.3 LEAD - BASE PAINT ABATEMENT**

- .1 Removal of flaking lead based paint to be performed by scraping or sanding using non-powered hand tools, or manual demolition of lead-painted plaster walls or building components by striking a wall with sledgehammer or similar tool.
- .2 Remove lead based paint in small sections and pack as it is being removed in sealable 0.15 mm plastic bags and place in labelled containers for transport.
- .3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .4 After completion of stripping work, wire brush and wet sponge surface from which flaking lead based paint has been removed to remove visible material. During this work keep surfaces wet.

- .5 After wire brushing and wet sponging to remove visible lead based paint, wet clean work area including equipment and access room, and equipment used in process. After inspection by NCC representative / Consultant. Do not disturb work for 8 hours.

### **3.4 INSPECTION**

- .1 Perform inspection to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by NCC representative Consultant will result in work stoppage, at no cost to Owner.
- .2 NCC representative / Consultant will inspect work for:
  - .1 Adherence to specific procedures and materials.
  - .2 Final cleanliness and completion.
  - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.
- .3 When lead dust leakage from Work Area occurs NCC representative / Consultant may order Work shutdown.
  - .1 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

### **3.5 FINAL CLEANUP**

- .1 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum equipment.
- .2 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .3 Clean-up Work Areas, Equipment and Access Room, and other contaminated enclosures.
- .4 Clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.
- .5 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

### **3.6 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS**

- .1 Repair or replace objects damaged in course of work to their original state or better, as directed by NCC representative / Consultant.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED WORK**

**1.2                RELATED STANDARDS**

1.        CSA Standards A23.1, A23.2, A23.3 Latest Editions.
2.        ASTM Standard A775-07. ASTM Test Method C114.
3.        Part 4, National Building Code of Canada Latest Edition.
4.        Ontario Building Code, Latest Edition.
5.        Occupational Health and Safety Act, Latest Edition.

**1.3                SUBMITTALS**

1.        Submit two copies of mix designs for normal concrete to achieve specified strengths and properties as per CAN/CSA-A23.1.
2.        Submit two copies of Manufacturers specifications for all epoxy products, concrete bonding agents and concrete modifiers.

**1.4                GUARANTEES**

1.        Contractor shall provide to NCC Representative a single source written guarantee of full faithful performance against deterioration or delamination of the concrete repair areas on the slab on grade floor slab for a period of three (3) years from the date of completion of the project as certified by NCC Representative.

**Part 2            Products**

**2.1                MATERIALS**

1.        Cement to be normal Portland cement 'Type 10' to CAN/CSA-A3000-08.
2.        Coarse aggregate to be non-reactive to alkalis, size to be less than 10mm for patch areas less than 50mm deep. Aggregate size of 20mm may be used in areas greater than 75mm depth.
3.        Non-shrink grout to be non-ferrous, high strength grout with a minimum 28 day compressive strength of 50 MPa.
4.        Reinforcing steel to conform to CSA G30.18-M billet steel bars Grade 400, ( $f_y=400$  MPa).
5.        Welded steel wire fabric: to CSA G30.5-M1983. Provide in flat sheets only.
6.        Chairs, bolsters, bar supports, spacers as per CAN/CSA A23.1: adequate for strength and support of reinforcing construction conditions.
7.        Concrete to be 25 MPa at 28 days; maximum slump = 75mm at point of delivery; maximum water/cement ratio to be 0.45. Design concrete with normal rate of hardening. The use of calcium chloride is prohibited.

## **2.2 PRODUCTS**

1. Polymer modified epoxy bonding agent/corrosion inhibitor for all exposed reinforcing steel, and sound concrete surfaces to be SikaTop110 Armatec EpoCem as manufactured by Sika Canada and/or approved equal.
2. Concrete epoxy-cement moisture barrier for all concrete surfaces to be Sikafloor 81 EpoCem as manufactured by Sika Canada and/or approved equal.
3. Epoxy-cement moisture barrier to be sealed with an epoxy coating Sikafloor 261 as manufactured by Sika Canada and/or approved equal.
4. Epoxy grout for threaded rods in existing masonry foundation wall to be Hilti HY 70 adhesive anchoring system as manufactured by Hilti Canada Inc and/or approved equal.

## **Part 3 Execution**

### **3.1 TOP OF SLAB REPAIRS**

1. To a minimum, intentionally roughen top of slab surface area to full amplitude of at least 5mm.
2. Clean the top of slab surface area to sound concrete using oil free compressed air.
3. Provide and install new reinforcing steel as shown on the design drawings.
4. Apply specified bonding agent to top of slab surface areas and exposed reinforcing steel in strict accordance with the manufacturer's recommendations. Thoroughly brush slurry into concrete.
5. Place new concrete on top of slab surface areas within one hour of application of bonding slurry.
6. Unless otherwise noted, use a steel trowelling to produce smooth burnished surface to within 3mm tolerance when measured in any direction using 3 m straight edge. On surfaces intended to support floor coverings, remove by grinding any defects of sufficient magnitudes that might interfere with the installation of the flooring.
7. Place wet burlap and polyethylene sheeting over surface area immediately after final trowelling. Maintain wet curing for three (3) days minimum.
8. Apply 3mm thick epoxy-cement moisture barrier to top surface of new concrete topping in strict accordance with the manufacturer's recommendations.
9. Apply two layers of 16 mils DFT on top of the moisture barrier in strict accordance with the manufacturer's recommendations.

### **3.2 SITE REVIEW AND TESTING**

1. Contractor is to provide a minimum of 24 hours' notice to NCC Representative for any site reviews or testing work on this project.
2. Ensure review by NCC Representative of concrete slab on grade surfaces and reinforcing steel prior to placement of concrete.

3. Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory retained by the Contractor in accordance with CAN/CSA-A23.1. Three (3) cylinders from each Day's pour for each 76.5m<sup>3</sup> of concrete, or for each 30.6 m<sup>3</sup> of concrete poured in small amounts on successive Days. Test will be made in accordance with CSA A23.2.
4. Remove defective materials and completed work which fails tests and replace as directed by NCC Representative.
5. Where work or materials fail to meet strength requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.

**1.2 REFERENCES**

- .1 Definitions:
  - .1 Low-pressure water soaking: less than 350 kPa (50 psi), measured at nozzle tip.
- .2 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide WHMIS MSDS - Material Safety Data Sheets documentation for cleaner and sealer product.
- .2 Provide proposed cleaning method and type of protection from cleaning residue for in-place conditions.
- .3 Samples:
  - .1 Provide samples of cleaning and sealer materials for approval of NCC Representative.
  - .2 Demonstrate machinery, tools and nozzles for approval by NCC Representative.

**1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: ensure work is performed in compliance with applicable Provincial regulations.
- .2 Comply with requirements of Workplace Hazardous Materials Information Sheet (WHMIS).
- .3 Mock-ups:
  - .1 Notify NCC Representative 48 hours before commencing cleaning and sealer of test patch.
    - .1 Obtain approval from NCC Representative before commencing test.
  - .2 Conduct tests on building to determine effectiveness of scrubbing with neutral pH detergent in warm water and low pressure wash cleaning methods.
  - .3 Locate test patches in inconspicuous places directed by NCC Representative.
  - .4 Apply sealer when test area is dry and to the manufacturers recommendations.
  - .5 Test patches: 1m<sup>2</sup>.
  - .6 Do not proceed with work without approval of mock-up.

- .7 Allow 24 hours for inspection of mock-up by NCC Representative.
- .8 Accepted mock-up will demonstrate minimum standard for work. Mock-up may remain as part of finished work.

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

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

### **1.6 AMBIENT CONDITIONS**

- .1 Do not use wet cleaning methods when there is threat of frost.
- .2 Do not use chemical cleaners when temperature is below 10 degrees C.
- .3 Follow manufacturer's written instructions on use of chemical cleaners in accordance with product's temperature range application.
- .4 Do not clean if there is risk of chemical spray being blown onto surrounding historic material, publicly accessible areas or plants.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Use clean potable water free from contaminants.
- .2 Treat water which has high metal content before use in cleaning.
- .3 Use air free from oil or other contaminants.
- .4 Use masking material polyethylene to approval of NCC Representative.
- .5 Acceptable cleaner product: Sure Klean 600 and/or approved equal.
- .6 Acceptable sealer product: Hydrozo Double 7 VOC Clear

### **2.2 HOT WATER**

- .1 Water temperature as recommended by cleaning product manufacturer.

### **2.3 TOOLS AND EQUIPMENT**

- .1 Use brushes with natural or soft plastic bristles.
- .2 Use scrapers of wood or plastic.
- .3 Use water pumps fitted with accurate pressure regulators and gauges capable of being preset and locked at maximum specified levels.
  - .1 Water pumps to have rating of less than 350 kPa.
- .4 Use application methods recommended by sealer manufacturer for application of sealer.

## **Part 3 Execution**

### **3.1 SITE VERIFICATION OF CONDITIONS**

- .1 Report to NCC Representative conditions of deteriorated masonry or pointing not noted on Contract Drawings found before and during cleaning.

- .2 Obtain written approval of NCC Representative before cleaning areas of deteriorated masonry.

### **3.2 PREPARATION**

- .1 Protect operatives and other site personnel from hazards.
  - .1 Ensure good ventilation in work area.
  - .2 Ensure workers wear eye, head, face protection, protective gloves, coveralls, boots, respirator to MSHA/NIOSH standard.
- .2 Place safety devices and signs near work areas as indicated and directed.
- .3 Seal or repair openings and joints where there is potential risk of water/chemical infiltration.
- .4 Provide a shelter around work area as directed by NCC Representative.
  - .1 Obtain approval of sheltering method from NCC Representative before commencing cleaning procedure.

### **3.3 PROTECTION OF IN-PLACE CONDITIONS**

- .1 Cover and protect surfaces and non-masonry finishes not to be cleaned.
  - .1 Obtain approval of protection method from NCC Representative before commencing cleaning procedure.
- .2 Protect vents, windows, and other openings, to prevent water entry.
  - .1 Protect masonry openings from water/chemical infiltration with polyethylene during cleaning.
- .3 Protect wood, glass, and metal adjacent to masonry.
- .4 Protect adjacent Work from spread of dust and dirt beyond work areas.

### **3.4 EXECUTION OF CLEANING**

- .1 Proceed with cleaning in accordance with written instructions of methods, systems, tools and equipment approved by NCC Representative.
  - .1 Dilute Sure Klean 600 four parts clean water to one part Sure Klean.
- .2 Dry brush or scrape accumulations from walls, ledges and cornices.
- .3 Pre-wet masonry surface when necessary. Work from bottom of wall upwards.
- .4 Do not exceed maximum pressure at nozzle or have nozzle closer to masonry than approved by NCC Representative at tests.
- .5 Stop work when cleaning has detrimental effect on surrounding material and plants.
- .6 Avoid prolonged wetting and excessive water penetration.
  - .1 Protect building envelope from water infiltration.
- .7 Use chemical cleaners approved by NCC Representative. Follow manufacturer's recommended dwell time.
- .8 Use brushing and scraping only to supplement water washing.
- .9 Low-Pressure Water Soaking:

- .1 Remove stains, accumulated dirt with low-pressure, maximum 350 kPa. kPa wash-down at flow rate of 0.25 L/s.
- .2 Hold nozzle minimum 450 mm from masonry surface.
- .3 Follow soaking by gentle scrubbing with natural bristle brushes.
- .10 Provide high ventilation rate, with maximum outside air, during cleaning, and for 48 hours after cleaning. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system.
- .11 Do not leave excess water from cleaning procedure to stand on floor, use vacuum method to remove water and dispose of water off site. vacuum water away during and at the end of cleaning procedure.

### **3.5 CLEANING**

- .1 Rinse off masonry until no indications of chemicals are present and to the satisfaction of NCC Representative.
- .2 Rinse from bottom to top and from top to bottom.
- .3 Clean up work area as work progresses. At end of each work day remove debris and waste from site.
- .4 Upon completion, clean and restore areas used for work to condition equal to that previously existing.

### **3.6 SEALER APPLICATION**

- .1 Apply sealer to manufacturers printed recommendations.

### **3.7 PROTECTION OF WORK**

- .1 Protect finished Work from damage until take-over.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED SECTIONS**

**1.2            REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM A 36/A36M-05, Specification for Structural Steel.
  - .2 ASTM A 193/A193M-07, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
  - .3 ASTM A 307-76, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
  - .4 ASTM A 325-07a, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - .5 ASTM A 325M-07a, Specification for High-Strength Bolts for Structural Steel Joints.
  - .6 ASTM A 490M-08a, Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA)
  - .1 CISC/CPMA 1-73b, Quick-Drying, One-Coat Paint for Use on Structural Steel.
  - .2 CISC/CPMA 2-75, Quick-Drying, Primer for use on Structural Steel.
- .4 Canadian Standards Association (CSA International)
  - .1 CAN/CSA G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CAN/CSA-S16-01(05), Limit States Design of Steel Structures.
  - .4 CAN/CSA-S136-07, Cold Formed Steel Structural Members.
  - .5 CSA-S136.1-07, Commentary on CSA Standard S136.
  - .6 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel Structures.
  - .7 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .8 CSA W55.3-1965(R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
  - .9 CSA W59-M1989(R2001), Welded Steel Construction (Metal Arc Welding).
- .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.

### **1.3 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 and 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 Ontario, Canada for non standard connections.
- .4 Do Welding to CSA W59-M1989 (R2001).

### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Division 1.
  - .1 Verify site conditions and dimensions on site before shop drawing preparation. Show all on shop drawings.
  - .2 Shop drawings must be original. Reproduction of Engineer's design drawings is not acceptable.
- .2 Erection drawings: indicate details and information necessary for assembly and erection purposes including:
  - .1 Description of methods.
  - .2 Sequence of erection.
  - .3 Type of equipment used in erection.
  - .4 Temporary bracings.
  - .5 Connections.
- .3 Ensure Fabricator drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the province of Ontario, Canada.

### **1.5 QUALITY ASSURANCE**

- .1 Submit 5 copies of mill test reports 4 weeks prior to fabrication of structural steel.

- .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
- .2 Provide mill test reports certified by metallurgists qualified to practice in province of Ontario, Canada.
- .2 Provide structural steel Fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Structural steel: to CAN/CSA-G40.20/G40.21 Grade 350W and CAN/CSA-S136.
- .2 Anchor bolts: to CAN/CSA-G40.20/G40.21, Grade 300W (A307) (unless otherwise noted on drawings).
- .3 High strength anchor bolts: to ASTM A 325M.
- .4 Bolts, nuts and washers: to ASTM A 325M.
- .5 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .6 Shop paint primer: to CISC/CPMA 2.
- .7 HSS Sections: to CAN/CSA-G40.21-M01, Type 350W (Class H).

**2.2 FABRICATION**

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and CAN/CSA-S136 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by intermittent welds and plastic filler, unless otherwise indicated. Grind smooth.

**2.3 SHOP PAINTING**

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16 and CAN/CSA-S136.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC-SP-6.
- .3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 0.065 to 0.080 mils, except:
  - .1 Interior Steel: Concealed
    - .1 Surface preparation: to SSPC SP 3-89.
    - .2 Primer: One coat iron oxide type: to CAN/CGSB-1.40-M89 (or equivalent).
  - .2 Interior Steel: Exposed
    - .1 Surface preparation: to SSPC SP 6-89 commercial blast cleaning using mechanical shot blast techniques. Hand cleaning not permitted.
    - .2 Primer: One coat applied in accordance with architectural finish schedules.

- .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.

**Part 3 Execution**

**3.1 GENERAL**

- .1 Structural steel work: in accordance with CAN/CSA-S16 and CAN/CSA-S136.
- .2 Welding: in accordance with CSA W59
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

**3.2 CONNECTION TO EXISTING WORK**

- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to NCC Representative for direction before commencing fabrication.

**3.3 ERECTION**

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and CAN/CSA-S136 in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of NCC Representative in writing.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.
- .5 Use erection techniques and equipment that will not mark or abrade surfaces of exposed structural steel.

**3.4 FIELD QUALITY CONTROL**

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by NCC Representative.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by NCC Representative.
- .3 Submit test reports to NCC Representative within 1 week of completion of inspection.

**3.5 FIELD PAINTING**

- .1 Paint in accordance with Division 9.
  - .1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC-SP-6 except as specified otherwise. Apply in accordance with CAN/CGSB 85.10.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI A208.2-09, Medium Density Fibreboard (MDF) for Interior Applications.
  - .2 ANSI/HPVA HP-1-2004, American National Standard for Hardwood and Decorative Plywood.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  - .1 Architectural Woodwork Quality Standards, 1st edition, 2009.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-11.3-M87, Hardboard.
- .4 CSA International
  - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
  - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA O121-08, Douglas Fir Plywood.
  - .4 CSA O141-05, Softwood Lumber.
  - .5 CSA O151-09, Canadian Softwood Plywood.
  - .6 CSA O153-M1980(R2008), Poplar Plywood.
- .5 Forest Stewardship Council (FSC)
  - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
  - .2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.
  - .3 FSC Accredited Certified Bodies.
- .6 National Lumber Grades Authority (NLGA)
  - .1 NLGA Standard Grading Rules for Canadian Lumber [2008].
- .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for plywood, particleboard, OSB, MDF and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS.

- .2 Shop Drawings:
  - .1 Indicate details of construction, profiles, jointing, fastening and other related details.
  - .2 Indicate materials, thicknesses, finishes and hardware.
- .3 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Submit duplicate 300 x 300 mm samples of millwork panel materials.
- .4 Certifications: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.

#### **1.4 QUALITY ASSURANCE**

- .1 Lumber by grade stamp of agency certified by Canadian Lumber Standards Accreditation Board (CLSAB).
- .2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.

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

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

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Natural Quartz and Resin Composite Countertops: Non-porous blend of natural quartz, 93 percent, and polyester resin, 7 percent, formed into flat slabs, self-supporting over structural members. Slab thickness 19mm, edge profile flat.
  - .1 Acceptable manufacture: Caesarstone Canada, and/or approved equal.
- .2 Phenolic solid plastic laminated panels: acceptable manufacture Trespa North America and or approved equal.
- .3 Softwood lumber: S4S, moisture content 19% or less in accordance with following standards:
  - .1 CSA O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.
  - .3 AWMAC premium grade, moisture content as specified.
  - .4 Machine stress-rated lumber is acceptable.
  - .5 Hardwood lumber: moisture content 9 % or less in accordance:

- .1 National Hardwood Lumber Association (NHLA).
- .2 AWMAC premium grade, moisture content as specified.
- .4 Panel Material: Urea-formaldehyde free
  - .1 FSC certified.
  - .2 Douglas fir plywood (DFP): to CSA O121, standard construction.
  - .3 Canadian softwood plywood (CSP): to CSA O151, standard construction.
  - .4 Hardwood plywood: to ANSI/HPVA HP-1.
  - .5 Medium density fibreboard (MDF): to ANSI A208.2, density 640-800 kg/m<sup>3</sup>.
- .5 Hardwood lumber: moisture content 8% or less in accordance with following standards:
  - .1 National Hardwood Lumber Association (NHLA).
  - .2 AWMAC custom grade, moisture content as specified.

## **2.2 ACCESSORIES**

- .1 Nails and staples: to CSA B111; galvanized to CAN/CSA-G164 for exterior work, interior humid areas and for treated lumber.
- .2 Wood screws: type and size to suit application.
- .3 Splines: wood.
- .4 Adhesive and Sealants: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.
- .5 Metal Utility Coat Hook: acceptable product Richelieu #2375SCV and/or approved equal.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for wood products installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of NCC Representative.
  - .2 Inform NCC 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 NCC Representative.

### **3.2 INSTALLATION**

- .1 Do finish carpentry to Quality Standards of (AWMAC), premium grade.
- .2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.
- .3 Form joints to conceal shrinkage.

### **3.3 CONSTRUCTION**

- .1 Fastening:
  - .1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.
  - .2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
  - .3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round smooth cut hole and plug with wood plug to match material being secured.
  - .4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.
- .2 Standing and running trim:
  - .1 Butt and cope internal joints of baseboards to make snug, tight, joint. Cut right angle joints of casing and base with mitred joints.
  - .2 Fit backs of baseboards and casing snugly to wall surfaces to eliminate cracks at junction of base and casing with walls.
  - .3 Make joints in baseboard, where necessary using a 45 degrees scarf type joint.
  - .4 Install door and window trim in single lengths without splicing.
- .3 Shelving:
  - .1 Install shelving as indicated.

### **3.4 INSTALLATION OF TRIM**

- .1 Standing and running trim:
  - .1 Interior:
    - .1 Grade: paint.
    - .2 Solid stock: pine species.
    - .3 Baseboard: 16 mm x 90 mm nominal size.

### **3.5 INSTALLATION OF COAT HOOK**

- .1 Coat Hook installation: wall mounted as detailed.

### **3.6 CLEANING**

- .1 Leave Work area clean at end of each day.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.
- .2 Section 09 21 16 – Gypsum Board Assemblies.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E136-11, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees, C.
  - .2 ASTM C665-11, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - .3 ASTM E84-12, Standard Practice for Surface Burning Characteristics of Building Materials.
  - .4 ASTM C423-09a, Standard Test Method for Sound Absorption Coefficients by the Reverberation Room Method.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10 Method of Test for Surface for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S114-05 Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .3 CAN/ULC-S702-09 Mineral Fiber Thermal Insulation for Buildings.
  - .4 CAN/ULC-S129-06 Standard Method of Test for Smoulder Resistance of Insulation (Basket Method).

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet.
- .2 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

**1.4 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.



## **1.5 WASTE MANAGEMENT AND DISPOSAL**

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

## **Part 2 Products**

### **2.1 INSULATION**

- .1 Batt sound and fire insulation, chemically inert, non-combustible (melting point 1177°C) mineral fibre (stone wool) type: CAN/ULC S702.
  - .1 Type: 1.
  - .2 Thickness: as indicated.
  - .3 Size: to suit application.
  - .4 Flame spread =0 smoke developed =0 to CAN/ULC S102
  - .5 Smoulder resistance 0.09% to CAN/ULC S129
  - .6 Density 40kg/m<sup>3</sup>
  - .7 Based on Safe'n'Sound Fire & Soundproofing Insulation by Roxul Inc and / or approved equal.

### **2.2 ACCESSORIES**

- .1 Nails: galvanized steel, length to suit insulation plus 25 mm, to CSA B111.
- .2 Tape: as recommended by manufacturer.

## **Part 3 Execution**

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

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

### **3.2 INSULATION INSTALLATION**

- .1 Install insulation as recommended by manufacturer. Do not tear or cut vapour barrier.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Do not enclose insulation until it has been inspected and approved by NCC Representative.

### **3.3 SCHEDULE**

- .1 Sound and fire insulation: install in floor and partition assemblies as indicated

**3.4 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Read and be governed by conditions of the contract and sections of Division 1

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 ULC-S115-05 Fire Tests of Fire stop Systems.
- .3 National Building Code of Canada 2010.

**1.3 DEFINITIONS**

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
  - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

**1.4 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit fire resistance rating test listings for firestopping and smoke seal systems.
  - .3 Manufacturer's engineering judgement identification number and shop drawing details when no ULC or cUL or Warnock Hersey system is available for an application. Engineered judgement must include both *project* name and *Subcontractor's* name who will install firestop system as described in shop drawing.
  - .4 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.

- .2 Quality assurance submittals: submit following.
  - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
    - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping 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 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

## **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: person competent in fire stopping installations trained and recognized by fire stopping manufacturer.
- .2 Pre-Installation:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Single source responsibility for firestopping and smoke seal materials:
  - .1 Obtain firestopping and smoke seal materials from single manufacturer for each different product required.
  - .2 Manufacturer shall instruct applicator in procedures for each material.
- .4 Regulatory Requirements:
  - .1 Firestop system installation must meet requirements of ULC S115-05 and ASTM E1966-07 tested assemblies that achieve a fire rating equal to that of construction being penetrated.
  - .2 Proposed firestopping and smoke seal materials and methods shall conform to applicable governing codes having local jurisdiction.

## **1.6 SYSTEM DESCRIPTION**

- .1 Provide firestop and smoke seal systems consisting of a material, or combination of materials installed to retain the integrity of fire-rated construction by effectively impeding the spread of flame, smoke, and/or hot gases through penetrations, blank openings or gaps, membrane penetrations, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.
- .2 Provide also smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke.

- .3 Provide fire-resistance rating equivalent to the rating of the adjacent floor, wall or other fire separation assembly.
- .4 Provide firestopping and smoke sealant system assemblies as practical and as required to coordinate with the schedule and sequencing of the Work.
- .5 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces with Departmental Representative prior to application.

## **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 the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

## **1.8 PROJECT CONDITIONS**

- .1 Environmental Limitations:
  - .1 Do not proceed with installation of joint sealants under following conditions:
    - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
    - .2 When joint substrates are wet.

## **1.9 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 firestop sealants including special conditions governing use.

## **Part 2 Products**

### **2.1 ACCEPTABLE MANUFACTURERS / INSTALLATION SPECIALISTS**

- .1 General: Manufacturers of firestopping and smoke seal system Products and installation specialists for the work of this section are limited to applicable assemblies as required for the Work and having ULC or cUL or Warnock Hersey labelled packaging.
- .2 Acceptable manufactures:

- .1 3M Canada Inc.
- .2 A/D Fire Protection Systems Inc.
- .3 Hilti Canada Corp.
- .4 Nuco – Self-Seal Firestopping Products
- .5 Tremco Canada Ltd.

## 2.2 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
  - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
  - .2 Fire stop system rating: 1 Hour, unless noted otherwise.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .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 Fire stopping and smoke seals at openings around fire-resistance rated assemblies for combustible pipes: firestop collar purpose designed to suit application.
- .8 For combustible pipe penetrations through a fire separation required to have a fire resistance rating, provide firestop system with a "F" Rating equal to fire resistance rating of the construction being penetrated.
- .9 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems).
- .10 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .11 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .12 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.
- .13 Sealants for vertical joints: non-sagging.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 PREPARATION**

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
  - .1 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.

**3.3 INSTALLATION**

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Coordinate with other sections to assure that pipes, conduit, cable and other items that penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
- .3 Schedule the Work to assure that penetrations and other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.
- .4 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.
- .5 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .6 Tool or trowel exposed surfaces to neat finish.
- .7 Remove excess compound promptly as work progresses and upon completion.

**3.4 SEQUENCES OF OPERATION**

- .1 Proceed with installation only when submittals have been reviewed by Departmental Representative.
- .2 Mechanical pipe insulation:
  - .1 Ensure pipe insulation installation precedes fire stopping.

**3.5 FIELD QUALITY CONTROL**

- .1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

**3.6 CLEANING**

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

**3.7 SCHEDULE**

- .1 Fire stop and smoke seal at:
  - .1 Penetrations through first layer of gypsum board ceiling membrane.

END OF SECTION



**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        Materials, preparation and application for caulking and sealants.
- .2        Text to complete other various Sections containing sealant or caulking specifications.

**1.2            RELATED SECTIONS**

- .1        Read and be governed by conditions of the contract and sections of Division 1.

**1.3            REFERENCES**

- .1        Canadian General Standards Board (CGSB)
  - .1        CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
  - .2        CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
  - .3        CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
  - .4        CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
  - .5        CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .2        Department of Justice Canada (Jus)
  - .1        Canadian Environmental Protection Act, 1999 (CEPA).
- .3        Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).

**1.4            SUBMITTALS**

- .1        Submit manufacturer's product data to describe.
  - .1        Caulking compound.
  - .2        Primers.
  - .3        Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .2        Submit duplicate samples of each type of material and colour.
- .3        Cured samples of exposed sealants for each color where required to match adjacent material.
- .4        Submit manufacturer's instructions.

**1.5            PROJECT CONDITIONS**

- .1        Environmental Limitations:

- .1 Do not proceed with installation of joint sealants under following conditions:
  - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
  - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
  - .1 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:
  - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

## **1.6 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.

## **Part 2 Products**

### **2.1 SEALANT MATERIALS**

- .1 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.
- .2 Where sealants are qualified with primers use only these primers.

### **2.2 SEALANT MATERIAL DESIGNATIONS**

- .1 Acrylic Latex One Part. (Type 1).
  - .1 To CAN/CGSB-19.17.

### **2.3 SEALANT SELECTION**

- .1 Perimeters of interior frames: Sealant type: 1.
- .1 Top of baseboard: Sealant Type 1.

### **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.

**Part 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.
  - .1 Apply sealant in accordance with manufacturer's written instructions.
  - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - .3 Apply sealant in continuous beads.
  - .4 Apply sealant using gun with proper size nozzle.
  - .5 Use sufficient pressure to fill voids and joints solid.
  - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing.
  - .1 Cure sealants in accordance with sealant manufacturer's instructions.
  - .2 Do not cover up sealants until proper curing has taken place.
- .3 Cleanup.
  - .1 Clean adjacent surfaces immediately and leave Work neat and clean.
  - .2 Remove excess and droppings, using recommended cleaners as work progresses.
  - .3 Remove masking tape after initial set of sealant.

**END OF SECTION**

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 07 92 00 - Joint Sealants.
- .2 Section 08 71 00 - Door Hardware.
- .3 Section 09 91 99 - Interior Painting.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A 653/A 653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM B 29-03, Specification for Refined Lead.
  - .3 ASTM B 749-03, Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA).
  - .2 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door and Frame Manufacturers' Association, (CSDMA).
  - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
  - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.

### **1.3 DESIGN REQUIREMENTS**

- .1 Design door frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating finishes.
- .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
- .3 Submit test and engineering data, and installation instructions.

## **2 Products**

### **2.1 MATERIALS**

- .1 Hot dipped galvanized steel sheet: to ASTM A 653M, ZF75, minimum base steel thickness in accordance with CSDFMA Table 1 - Thickness for Component Parts.
- .2 Composites: balance of core materials used in conjunction with lead: in accordance with manufacturers' proprietary design.
- .3 The manufacturing process must adhere to Lifecycle Assessment Standards as per CAN/CSA-ISO 14040 (R2011).

## **2.2 PRIMERS**

- .1 Touch-up prime CAN/CGSB-1.181-99.

## **2.3 ACCESSORIES**

- .1 Metallic paste filler: to manufacturer's standard.

## **2.4 FRAMES FABRICATION GENERAL**

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Interior frames: 1.6 mm welded type construction.
- .4 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .5 Protect mortised cut-outs with steel guard boxes.
- .6 Manufacturer's nameplates on frames and screens are not permitted.
- .7 Conceal fastenings except where exposed fastenings are indicated.
- .8 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

## **2.5 HOLLOW STEEL CONSTRUCTION**

- .1 Form face sheets for interior doors from 1.6mm sheet steel.
- .2 Flush closing channel at top and bottom welded continuously to door face.

## **2.6 FRAME ANCHORAGE**

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm o.c. maximum.

## **2.7 FRAMES: WELDED TYPE**

- .1 Welding in accordance with CSA W59-03 (R2008).
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.
- .7 Securely attach lead to inside of frame profile from return to jamb soffit (inclusive) on door side of frame only.

**3 Execution**

**3.1 INSTALLATION GENERAL**

- .1 Install doors and frames to CSDMA Installation Guide.

**3.2 FRAME INSTALLATION**

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1150 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.

**3.3 DOOR INSTALLATION**

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and thresholds as follows.
  - .1 Hinge side: 1.0 mm.
  - .2 Latchside and head: 1.5 mm.
  - .3 Thresholds: 13 mm.
- .3 Adjust operable parts for correct function.

**3.4 FINISH REPAIRS**

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.
- .2 Section 07 92 00 – Joint Sealing.
- .3 Section 08 80 50 – Glazing.

**1.2 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 Designation System for Aluminum Finishes (2003).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.
  - .2 CAN/CGSB-79.1-M91, Insect Screens.
- .3 CSA International
  - .1 CSA-A440-00/A440.1-00(R2008), A440-00, Windows / Special Publication A440.1-00, User Selection Guide to CSA Standard A440-00, Windows. CAN/CSA-A440.2-09, Fenestration Energy Performance.
  - .2 CAN/CSA-Z91-02(R2008), Health and Safety Code for Suspended Equipment Operations.
- .4 Forest Stewardship Council (FSC)
  - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
  - .2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.
  - .3 FSC Accredited Certified Bodies.
- .5 Green Seal Environmental Standards (GS)
  - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
  - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for windows and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
  - .1 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim, elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes, fasteners, and caulking.
- .3 Test and Evaluation Reports:



- .1 Submit test reports from approved independent testing laboratories, certifying compliance with specifications, for:
  - .1 Windows classifications.
  - .2 Insect screens.
  - .3 Air tightness.
  - .4 Water tightness.
  - .5 Wind load resistance.
  - .6 Condensation resistance.
  - .7 Safety drop - vertical sliding windows only.
  - .8 Block operation - sliding windows only.
  - .9 Ease of operation - windows with operable lights.
  - .10 Forced entry resistance.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for windows for incorporation into manual.

#### **1.5 QUALITY ASSURANCE**

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

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

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect windows from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .3 Develop Waste Reduction Workplan related to Work of this Section.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

### **Part 2 Products**

#### **2.1 MATERIALS – WOOD WINDOWS**

- .1 Materials: to CSA-A440/A440.1 supplemented as follows:
- .2 All wood windows by same manufacturer.
  - .1 Acceptable product and manufacturer: Wood Ultimate Double Hung Windows by Marvin Windows and doors and/or approved equal.
- .3 Sash: solid wood, 41mm thickness.
- .4 Main frame, head and jamb: solid wood, 17mm thickness.
- .5 Wood species: Vertical grain Douglas Fir for paint finish.
  - .1 FSC certified.

- .6 Glass: sealed units, in accordance with Section 08 80 50 - Glazing.
- .7 Screens: to CAN/CGSB-79.1.
  - .1 Type: removable.
  - .2 Style: low profile.
  - .3 Insect screening mesh: Black fiberglass mesh with 18 x 16 count.
  - .4 Fasteners: tamper proof.
  - .5 Screen frames: aluminum, white colour.
  - .6 Mount screen frames for interior replacement.
- .8 Exterior wood brickmould: custom profiled to match existing wood windows.
- .9 Isolation coating: alkali resistant bituminous paint.
- .10 Sealants:
  - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.

## **2.2 WINDOW TYPE AND CLASSIFICATION**

- .1 Types:
  - .1 Sliding: vertical, single operating with double glazing insulating glass.
  - .2 Screens: over operable sash only.
- .2 Classification rating: to CSA-A440/A440.1.
  - .1 Performance Grade – 40.

## **2.3 FABRICATION**

- .1 Fabricate in accordance with CSA-A440/A440.1 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 380 g/m<sup>2</sup> zinc coating to ASTM A123/A123M.

## **2.4 ISOLATION COATING**

- .1 Primers, paints, coatings: in accordance with manufacturer's recommendations for surface conditions.
  - .1 Primer: VOC limit 100 g/L maximum to SCAQMD Rule 1113.
  - .2 Coating: VOC limit 100 g/L maximum to SCAQMD Rule 1113.
  - .3 Paint: VOC limit 150 g/L maximum to SCAQMD Rule 1113.
- .2 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.
  - .3 Wood.

## **2.5 GLAZING**

- .1 Glaze windows in accordance with CSA-A440/A440.1.

## **2.6 HARDWARE**

- .1 Hardware: Satin chrome sash locks and aluminum handles to provide security and permit easy operation of units. Provide factory installed window opening control device.
- .2 Locks: provide operating sash with spring loading locking device, to provide automatic locking in closed position.
- .3 Include special keyed opening device for windows normally locked.

## **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 Rough opening (wood) should be prepared with Bakor Blue Skin or Soprema equivalent. Windows shimmed, fastened and then foam insulation sprayed into shim space.
  - .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 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of NCC Representative.
  - .2 Inform NCC 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 NCC Representative.

### **3.2 INSTALLATION**

- .1 Window installation:
  - .1 Install in accordance with CSA-A440/A440.1.
  - .2 Arrange components to prevent abrupt variation in colour.
- .2 Sill installation:
  - .1 Cut sills to fit window opening.
  - .2 Secure sills in place with anchoring devices located at ends and evenly spaced 200 mm on centre in between.
- .3 Caulking:
  - .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 upstand and window-frame. Caulk butt joints in continuous sills.
  - .2 Apply sealant in accordance with Section 07 92 00 - Joint Sealants. Conceal sealant within window units except where exposed use is permitted by NCC Representative.

**3.3 PAINTING**

- .1 Windows shall arrive un-primed from factory/manufacture. Window installer shall fully dismantle windows in shop, prime and pain with 2 top coats to all exposed and concealed surfaces and reassemble windows prior to installation.

**3.4 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**3.5 PROTECTION**

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

**END OF SECTION**

**1 General**

**1.1 RELATED WORK**

- .1 Read and be governed by conditions of the contract and sections of Division 1
- .2 Section 08 11 00 – Metal Doors & Frames

**1.2 REFERENCE STANDARDS**

- .1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .2 CAN/CGSB-69.18-M90/ANSI/BHMA A156.1-2000, Butts and Hinges.
- .3 ANSI/BHMA A156.2-2003, Bored and Pre-assembled Locks and Latches.
- .4 CAN/CGSB-69.22-M90/ANSI/BHMA A156.6-2005, Architectural Door Trim.
- .5 CAN/CGSB-69.32-M90/ANSI/BHMA A156.16-2002, Auxiliary Hardware.
- .6 CAN/CGSB-69.34-93/ANSI/BHMA A156.18-2006, Materials and Finishes.
- .7 ANSI/BHMA A156.19-2002, Power Assist and Low Energy Power-Operated Doors

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturers instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Hardware List:
  - .1 Submit contract hardware list.
  - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .2 Brief maintenance staff regarding proper care, cleaning, and general maintenance.

**1.4 MAINTENANCE MATERIALS**

- .1 Supply two sets of wrenches for door closers, locksets.

**1.5 DELIVERY AND STORAGE**

- .1 Store finishing hardware in locked, clean and dry area.
- .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

## **2 Products**

### **2.1 HARDWARE ITEMS**

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

### **2.2 DOOR HARDWARE**

- .1 Locks and latches:
  - .1 Bored and pre-assembled mortise locks and latches: to ANSI/BMHA A156.2, grade 1, designed for function and keyed to base building standard.
  - .2 Lever handles: Plain flat face design with return to 12 mm from door face
  - .3 Roses: Plain, max 54 mm diameter round design.
  - .4 Normal strikes: box type, lip projection.
  - .5 Finished to 630
  - .6 Acceptable Manufacture: Sargent and/or approved equal.
- .2 Butts and hinges:
  - .1 Butts and hinges: to CAN/CGSB-69.18/ BHMA A156.1, Grade 2
  - .2 All hinges to be supplied complete with flat button tips.
- .3 Door Closers and Accessories:
  - .1 Door controls (closers): to CAN/CGSB-69.20/ BHMA A156.4, Grade 1
- .4 Architectural door trim: to CAN/CGSB-69.22/BHMA A156.6
  - .1 Door protection plates: kick plate and push plates 1.27 mm thick, Tape, Stainless Steel.
- .5 Auxiliary hardware: to CAN/CGSB-69.32/BHMA A156.16
- .6 Power Assist Operated Doors: to ANSI/BHMA A156.19, Acceptable Product Horton Automatics Series 700 and/or approved equal.
- .7 Sliding Glass Door Hardware: Acceptable manufacture K.N Crowder Mfg. Inc and/or approved equal.

### **2.3 FASTENINGS**

- .1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .2 Exposed fastening devices to match finish of hardware.
- .3 Use fasteners compatible with material through which they pass.

### **2.4 KEYING**

- .1 All locksets to be keyed differently and/or keyed alike in groups, master keyed, grand master keyed to existing system as directed. Prepare detailed keying schedule in conjunction with Departmental Representative.

- .2 Provide keys in duplicate for every lock in this Contract.
- .3 Provide three master keys for each MK or GMK group.
- .4 Stamp keying code numbers on keys and cylinders.

**3 Execution**

**3.1 INSTALLATION INSTRUCTIONS**

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

**3.2 SCHEDULE**

.1	Door D001			
.1	(3) Hinges	A8112 114 x 114 x 3.2mm, NRP, MSP		630
.2	(1) Privacy set	Sargent Model 8268 Heavy duty mortise privacy lock, lever style		630
.3	(2) Kickplate	J102 305mm x WTS-self adhesive		630
.4	(1) Floor stops	L02161		630
.2	Door D002 (sliding glass)			
.1	(1) track	4800mm length, Crowder C-104 Track		
.2	(4) hanger	Crowder CGH-038C-4HD (4 hangers) continuous x 2400		
.3	(2) Pull – back to back	30mm dia x 1200mm high-40mm standoff		630
.4	(2) door stop	Crowder C-100HD		
.5	(1) guide channel	Crowder CGC-914-038 X 2400		
.6	(3) floor guide	Crowder C-913		
.3	Door D003			
.1	(3) Hinges	A8112 114 x 114 x 3.2mm, NRP, MSP		630
.2	(1) Lockset	Sargent Model 8206 Heavy duty mortise, lever style		630
.3	(2) Kickplate	J102 305mm x WTS-self adhesive		630
.4	(1) Floor stops	L02161		630
.4	Door D004			
.1	(6) Hinges	A8112 114 x 114 x 3.2mm, NRP, MSP		630
.2	(1) Lockset	Sargent Model 8206 Heavy duty mortise		

		storeroom function	630
.3	(4) Kickplate	J102 305mm x WTS-self adhesive	630
.4	(1) Floor stops	L02161	630
.5	(1) Flush bolts	Dorma HZ 43-F	630
.5	Door D005		
.1	(6) Hinges	A8112 114 x 114 x 3.2mm, NRP, MSP	630
.2	(2) Push	CBH 943 100 x 450mm,	630
.3	(1) Lockset	Sargent Model 8206 Heavy duty mortise (lever on pull side only, blank off other side)	630
.4	(4) Kickplate	J101 x 900mm high self adhesive	630
.5	(2) Wall Stops	Dorma TZ 5012	630
.6	(1) Flush bolts	Dorma HZ 43-F	630
.6	Door D006		
.1	(3) Hinges	A8112 114 x 114 x 3.2mm, NRP, MSP	630
.2	(1) Push	CBH 943 100 x 450mm,	630
.3	(1) Pull	30mm x 1200mm high-40mm standoff	630
.4	(2) Kickplate	J101 x 900mm high self adhesive	630
.5	(1) automatic operator	Horton Automatics series 7000	628
.7	Door D007		
.1	(3) Hinges	A8112 114 x 114 x 3.2mm, NRP, MSP	630
.2	(1) Push	CBH 943 100 x 450mm,	630
.3	(1) Pull	30mm x 1200mm high-40mm standoff	630
.4	(2) Kickplate	J101 x 900mm high self adhesive	630

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.
- .2 Section 08 11 00 – Metal Doors and Frames.
- .3 Section 08 50 00 – Windows.

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM D790-07e1, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - .2 ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness.
  - .3 ASTM E84-10, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .4 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  - .5 ASTM F1233-08, Standard Test Method for Security Glazing Materials and Systems.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
  - .2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
  - .3 CAN/CGSB-12.8-97, Insulating Glass Units.
  - .4 CAN/CGSB-12.8-97, (Amendment), Insulating Glass Units.
  - .5 CAN/CGSB-12.11-M90, Wired Safety Glass.
- .3 Environmental Choice Program (ECP)
  - .1 CCD-045-95(R2005), Sealants and Caulking Compounds.
- .4 Glass Association of North American (GANA)
  - .1 GANA Glazing Manual - 2008.
  - .2 GANA Laminated Glazing Reference Manual - 2009.
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

- .3 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
  - .2 Low-Emitting Materials:
    - .1 Submit listing of adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restrictions requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

#### **1.5 QUALITY ASSURANCE**

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

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

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
  - .3 Protect prefinished aluminum surfaces with wrapping.
  - .4 Replace defective or damaged materials with new.

#### **1.7 AMBIENT CONDITIONS**

- .1 Ambient Requirements:
  - .1 Install glazing when ambient temperature is 10 degrees 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**

- .1 Design Criteria:
  - .1 Ensure continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
    - .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 to ASTM E330.

- .3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
- .2 Flat Glass:
  - .1 Safety glass (interior glazing): to CAN/CGSB-12.1, transparent, 6mm and 10mm thickness.
    - .1 Type 2-tempered.
    - .2 Class B-float.
  - .2 Silvered mirror glass (washroom mirrors): 4 mm thick.
    - .1 Type 1A-float glass for normal use.
- .3 Insulating Glass Units:
  - .1 Insulating glass units: to CAN/CGSB-12.8, double unit, 13 mm overall thickness.
    - .1 Glass: to CAN/CGSB-12.1
    - .2 Glass thickness: 3 mm each light.
    - .3 Inter-cavity space thickness: 6 mm between lights with low conductivity spacers.
    - .4 Glass coating: surface number 3, low "E".
    - .5 Inert gas fill: argon.
- .4 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

## **2.2 ACCESSORIES**

- .1 Setting blocks: neoprene, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight 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.
- .3 Glazing tape:
  - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; sized to suit application; black colour.
- .4 Glazing clips: manufacturer's standard type.
- .5 Lock-strip gaskets: to ASTM C542.
- .6 Mirror attachment accessories:
  - .1 Stainless steel clips.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
  - .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 Inform Consultant of unacceptable conditions immediately upon discovery.

- .4 Proceed with installation only after unacceptable conditions have been remedied.

### **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.

### **3.3 INSTALLATION: EXTERIOR - DRY METHOD (PREFORMED GLAZING)**

- .1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Perform work in accordance with GANA Glazing Manual for glazing installation methods.
- .3 Cut glazing tape to length; install on glazing light. Seal corners by butting tape and sealing junctions with sealant.
- .4 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .5 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- .6 Install removable stops without displacing glazing tape. Exert pressure for full continuous contact.
- .7 Trim protruding tape edge.

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

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

### **3.5 INSTALLATION: MIRRORS**

- .1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions.
- .2 Set mirrors with clips. Anchor rigidly to wall construction.
- .3 Set in frame.
- .4 Place plumb and level.

### **3.6 CLEANING**

- .1 Progress Cleaning:

- .1 Leave Work area clean at end of each day.
  - .1 Remove traces of primer, caulking.
  - .2 Remove glazing materials from finish surfaces.
  - .3 Remove labels.
  - .4 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

### **3.7**

#### **PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
  - .1 Do not mark heat absorbing or reflective glass units.
- .3 Repair damage to adjacent materials caused by glazing installation.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1        Read and be governed by conditions of the contract and sections of Division 1.

**1.2            REFERENCES**

- .1        ASTM International
  - .1        ASTM C475/C475M-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .2        ASTM C557-03(2009)e1, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
  - .3        ASTM C840-11, Standard Specification for Application and Finishing of Gypsum Board.
  - .4        ASTM C954-11, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .5        ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .6        ASTM C1047-10a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .7        ASTM C1178/C1178M-11, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
  - .8        ASTM C1396/C1396M-11, Standard Specification for Gypsum Wallboard.
- .2        Association of the Wall and Ceilings Industries International (AWCI)
  - .1        AWCI Levels of Gypsum Board Finish-97.
- .3        Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
  - .2        CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .4        Green Seal Environmental Standards (GS)
  - .1        GS-11-2008, 2nd Edition, Paints and Coatings.
- .5        South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1        SCAQMD Rule 1113-A2007, Architectural Coatings.
  - .2        SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .6        Underwriters' Laboratories of Canada (ULC)
  - .1        CAN/ULC-S102.2-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store gypsum board assemblies materials level off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
  - .3 Protect from weather, elements and damage from construction operations.
  - .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
  - .5 Replace defective or damaged materials with new.

### **1.4 AMBIENT CONDITIONS**

- .1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Gypsum board: to ASTM C1396/C1396M regular, 12.7 mm thick and firecode 16mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.
- .2 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .3 Resilient clips drywall furring : 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .4 Steel drill screws: to ASTM C1002.
- .5 Laminating compound: as recommended by manufacturer, asbestos-free.
- .6 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, zinc-coated by electrolytic process 0.5 mm base thickness, perforated flanges, one piece length per location.
- .7 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.
  - .2 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .8 Polyethylene: to CAN/CGSB-51.34, Type 2.

- .9 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.
- .10 Joint compound: to ASTM C475, asbestos-free.
- .11 Stainless steel corner guard: 75mm x 75mm x .91mm x 910mm high, No 4 finish.

## **2.2 FINISHES**

- .1 Primer: VOC limit 200 g/L maximum to GS-11.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.
  - .1 Inform NCC Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 ERECTION**

- .1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C1280.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.
- .4 Install work level to tolerance of 1:1200.
- .5 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .6 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .7 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .8 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .9 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .10 Erect drywall resilient furring transversely across studs between the layers of gypsum board, spaced maximum 400 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.
- .11 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.



### **3.3 APPLICATION**

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
- .2 Apply single or double layer gypsum board to wood or metal furring or framing as indicated using screw fasteners for first and layer. Maximum spacing of screws 300 mm on centre.
- .3 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .4 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .5 Install gypsum board with face side out.
- .6 Do not install damaged or damp boards.
- .7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

### **3.4 INSTALLATION**

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Splice corners and intersections together and secure to each member with 3 screws.
- .6 Install access doors to electrical and mechanical fixtures specified in respective sections.
  - .1 Rigidly secure frames to furring or framing systems.
- .7 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .8 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
  - .1 Levels of finish:
    - .1 Level 2 – locations to receive tile finish: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.
    - .2 Level 4 – all other areas: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints,

angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

- .9 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .10 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .11 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .12 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .13 Mix joint compound slightly thinner than for joint taping.
- .14 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .15 Allow skim coat to dry completely.
- .16 Remove ridges by light sanding or wiping with damp cloth.
- .17 Install corner guards at locations indicated on floor plan.

### **3.5 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

### **3.6 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1            RELATED SECTIONS**

- .1    Read and be governed by conditions of the contract and sections of Division 1.
- .2    Section 09 21 16 - Gypsum Board Assemblies.

**1.2            REFERENCES**

- .1    American Society for Testing and Materials International, (ASTM).
  - .1    ASTM C645-00, Specification for Non-structural Steel Framing Members.
  - .2    ASTM C754-00, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2    Canadian General Standards Board (CGSB).
  - .1    CAN/CGSB-1.40-97, Primer, Structural Steel, Oil Alkyd Type.
- .3    Environmental Choice Program (ECP).
  - .1    CCD-047a -98, Paints - Surface Coatings.
  - .2    CCD-048-98, Surface Coatings - Recycled Water-borne.

**1.3            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.

**1.4            WASTE MANAGEMENT AND DISPOSAL**

- .1    Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2    Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site for recycling in accordance with Waste Reduction Work Plan.
- .3    Divert unused metal materials from landfill to metal recycling facility.
- .4    Divert unused gypsum materials from landfill to recycling facility approved by Consultant or authorities having jurisdiction.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Non-load bearing channel stud framing: to ASTM C645, stud size as indicated, roll formed from 0.45 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.
- .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
- .3 Metal channel stiffener: 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .4 Asphalt saturated felt: to CSA A123.3, No.15 organic felt.
- .5 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

**Part 3 Execution**

**3.1 ERECTION**

- .1 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .3 Place studs vertically at 400 mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .4 Erect metal studding to tolerance of 1:1000.
- .5 Attach studs to track using screws.
- .6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .9 Install heavy gauge single jamb studs at openings.
- .10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

- .12 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .13 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .14 Extend partitions to ceiling height except where noted otherwise on drawings.
- .15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
- .16 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .17 Install asphalt saturated felt building paper between studs and concrete surfaces. Space studs 10mm from face of concrete wall surface.
- .18 Install two continuous beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.

### **3.2 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 26: Trim for Recessed Light Fixtures.

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM C635/C635M-07, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-2007, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for ceiling panels and ceiling suspension system and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Shop Drawings:
  - .1 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, change in level details, and acoustical unit support at ceiling fixture lateral bracing and accessories.
- .3 Samples:
  - .1 Submit duplicate 300 x 30 samples of acoustical units.
  - .2 Submit duplicate sample of exposed tee bar grids.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed instructions.

- .3 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.
- .4 Store and protect acoustic ceiling materials from nicks, scratches, and blemishes.
- .5 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 COMPONENTS**

- .1 Acoustic units for suspended ceiling system: to ASTM E1264-08e1.
  - .1 Metal ceiling panel: perforated and non perforated pre-finished painted metal with acoustic sound backer. Acceptable product: "Celebration panels" and "Acoustibond" sound backer by (USG) and/or approved equal.
  - .2 Noise Reduction Coefficient (NRC) designation of 0.65.
  - .3 Metal panel colour: flat white.
  - .4 Size: various widths and lengths, as indicated on reflected ceiling plan.
  - .5 Shape: flat with profiled edge.
  - .6 Pattern: perforated and non perforated. Perforated -round 3mm holes at 9mm on centre at 45 deg alignment, 17% open.
  - .7 Acoustic backer colour: white
- .2 Acoustical Suspension:
  - .1 Acceptable product: USG brand "DXF/DXLF Fineline " and/or approved equal.
  - .2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated.
  - .3 Suspension system: non fire rated, two directional.
  - .4 Hanger wire: galvanized soft annealed steel wire, 3.6 mm diameter for access tile ceilings.
  - .5 Hanger inserts: purpose made.
  - .6 Accessories: splices, clips, wire ties, retainers, to complement suspension system components, as recommended by system manufacturer.
  - .7 Edge Trim: 58mm high x 14mm wide pre-finished metal. Acceptable product: "Compasso Standard" by USG and/or approved equal.
- .3 Performance/Design Criteria:
  - .1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

### **2.2 ACCESSORIES**

- .1 Touch-up paint: in accordance with manufacturer's recommendations for surface conditions:
  - .1 Paint: VOC limit 250 g/L maximum to GS-11 SCAQMD Rule 1113.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions prior to acoustical ceiling installation.

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

### **3.2 INSTALLATION**

- .1 Installation: in accordance with ASTM C636 except where specified otherwise.
- .2 Suspension System:
  - .1 Secure hangers to overhead structure using attachment methods acceptable to ceiling manufacture.
  - .2 Install hangers spaced at maximum 1200mm centres and within 150mm from ends of main tees.
  - .3 Lay out system according to reflected ceiling plan.
  - .4 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, diffuser with filter system, grilles and speakers.
  - .5 Interlock cross member to main runner to provide rigid assembly.
  - .6 Ensure finished ceiling system is square with adjoining walls and level within 1:1000.
- .3 Acoustic Panels:
  - .1 Install acoustical panels and tiles in ceiling suspension system.
  - .2 Co-ordinate ceiling work with work of other sections such as interior lighting, fire protection communication, and intrusion and detection systems.
- .4 Accessories:
  - .1 Install pre-finished edge trim around perimeter of suspended ceiling panels.
- .5 Maintenance tools: provide 10 removal tools for ceiling panels, deliver to NCC Representative.

### **3.3 CLEANING**

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

### **3.4 PROTECTION**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Read and be governed by conditions of the contract and sections of Division 1.

**1.2                REFERENCES**

- .1            American Society for Testing and Materials International (ASTM)
  - .1            ASTM F1066-04, Standard Specification for Vinyl Composition Floor Tile.
  - .2            ASTM F710-11 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
  - .3            ASTM F-1869-11, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- .2            Canadian General Standards Board (CGSB)
  - .1            CAN/CGSB-25.20-95, Surface Sealer for Floors.
  - .2            CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.
- .3            Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1            Material Safety Data Sheets (MSDS).
- .4            South Coast Air Quality Management District (SCAQMD), California State
  - .1            SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Provide samples:
  - .1            Submit duplicate tile in size specified.
- .2            Closeout Submittals:
  - .1            Provide maintenance data for resilient flooring for incorporation into manual.

**1.4                ENVIRONMENTAL REQUIREMENTS**

- .1            Maintain air temperature and structural base temperature at flooring installation area above 20 degrees C for 48 hours before, during and for 48 hours after installation.

**1.5                MAINTENANCE**

- .1            Extra Materials:
  - .1            Provide 2 m<sup>2</sup> of each colour, pattern and type flooring material required for this project for maintenance use.
  - .2            Extra materials from same production run as installed materials.
  - .3            Identify each container of floor tile and each container of adhesive.
  - .4            Deliver to NCC Representative upon completion of the work of this section.
  - .5            Store where directed by NCC Representative.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Vinyl composition tile: to ASTM F1066, Composition 1 - non asbestos, Class 2 - through pattern tile, 3.2 mm, 305 x 610 mm size: acceptable product Armstrong Raffia, #55801 Platinum Dust and/or approved equal.
- .2 Primers and adhesives: waterproof, recommended by flooring manufacturer for specific material on applicable substrate for below grade concrete slab.
  - .1 Flooring adhesives:
    - .1 Adhesive: maximum VOC limit 60 g/L to SCAQMD Rule 1168.
- .3 Sub-floor filler and leveller: as recommended by flooring manufacturer for use with their product.
- .4 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- .5 Sealer: to CAN/CGSB-25.20, Type 2-water based and type recommended by flooring manufacturer.
  - .1 Sealant:
    - .1 Sealant: maximum VOC limit 50 g/L to SCAQMD Rule 1168.
- .6 Wax: type as recommended by flooring 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 datasheets.

**3.2 INSPECTION**

- .1 Ensure concrete floors are dry, by using the Anhydrous Calcium Chloride test method.
- .2 Conduct one test for every 50 square meters of floor area (conduct three tests).
- .3 Report test results to NCC Representative.

**3.3 SUB-FLOOR TREATMENT**

- .1 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .3 Prime, Seal, concrete to flooring manufacturer's printed instructions.
- .4 The concrete slab must be dry, clean, smooth, structurally sound and free of foreign materials that might prevent adhesive bond as described in ASTM F 710, "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring."
- .5 Before installation of the finished flooring, moisture, alkali and bond testing must be conducted, report to NCC Representative the results of tests:

- .1 Moisture testing must be performed in accordance ASTM F-1869, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride."
- .2 The surface of the concrete must have a pH of 9 or less when tested according to the method described in ASTM F-710.
- .3 Bond testing must be performed to determine compatibility of the adhesives to the concrete slab.

### **3.4 TILE APPLICATION**

- .1 Commence tile application only after sub-floor treatment and test results are reviewed and accepted by the NCC Representative.
- .2 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
- .3 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
- .5 Install flooring with pattern grain parallel for units and parallel to length of room.
- .6 As installation progresses, and after installation, roll flooring in 2 directions with 45 kg minimum roller to ensure full adhesion.
- .7 Cut tile and fit neatly around fixed objects.
- .8 Install feature strips and floor markings where indicated. Fit joints tightly.
- .9 Install flooring in pan type floor access covers. Maintain floor pattern.
- .10 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .11 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .12 Install metal edge strips at unprotected or exposed edges where flooring terminates.

### **3.5 CLEANING**

- .1 Remove excess adhesive from floor, base and wall surfaces without damage.
- .2 Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.

### **3.6 PROTECTION**

- .1 Protect new floors from time of final set of adhesive until final waxing and final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.

**1.2 REFERENCES**

- .1 Green Seal Environmental Standards (GS)
  - .1 GS-11-2008, 2nd Edition], Paints and Coatings.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS.
- .2 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Submit duplicate 200 x 300 mm sample panels of each paint finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Submittals:
  - .1 Low-Emitting Materials:
    - .1 Submit listing of paints and coatings used in building, comply with VOC and chemical component limits or restriction requirements.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Provide and maintain dry, temperature controlled, secure storage.
  - .2 Store painting materials and supplies away from heat generating devices.

- .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .3 Fire Safety Requirements:
  - .1 Supply 1 9 kg Type ABC fire extinguisher adjacent to storage area.
  - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
  - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

## 1.5 **SITE CONDITIONS**

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
  - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
  - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
  - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.
  - .1 Use MPI listed materials having E2 rating where indoor air quality requirements exist.
  - .2 Primer: VOC limit 100 g/L maximum to GS-11.
  - .3 Paint: VOC limit 100 g/L maximum to GS-11.
- .4 Colours:
  - .1 Submit proposed Colour Schedule to NCC Representative for review.
  - .2 Base colour schedule on selection of 5 base colours and 3 accent colours.
- .5 Mixing and tinting:

- .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from NCC Representative for tinting of painting materials.
  - .2 Use and add thinner in accordance with paint manufacturer's recommendations.
    - .1 Do not use kerosene or similar organic solvents to thin water-based paints.
  - .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
  - .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .6 Gloss/sheen ratings:
- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

<b>Gloss Level-Category</b>	<b>Gloss @ 60 degrees</b>	<b>Sheen @ 85 degrees</b>
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated.
- .7 Exterior painting:
- .1 Dressed Lumber: window and window frames, casings, battens, smooth facias, etc.
    - .1 EXT 6.3B - Alkyd G5 finish.
- .8 Interior Painting:
- .1 Metal Doors and Frames:
    - .1 INT 5.3A latex - G5 finish.
      - .1 One (1) coat bonding primer – MPI#26.
      - .2 Two (2) coats latex– MPI#54 (G5).
  - .2 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:
    - .1 INT 6.3A - Latex G5 finish. New wood windows to be painted by the window trade.
  - .3 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
    - .1 INT 9.2A - Latex G1 (ceilings) G3 (walls) finish (over latex sealer).
      - .1 One (1) coat bonding primer – MPI#50.

- .2 Two (2) coats latex– MPI#52 (G3), MPI#53(G1).

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual except where specified otherwise.

#### **3.2 EXAMINATION**

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to NCC Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

#### **3.3 PREPARATION**

- .1 Protection of in-place conditions:
  - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by NCC Representative.
  - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
  - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
  - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
  - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
  - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of NCC Representative.
  - .4 Clean and prepare existing exterior surfaces to be repainted in accordance with MPI Maintenance Repainting Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
    - .1 Remove dust, dirt, and surface debris by brushing, wiping with dry, clean cloths, or compressed air.
    - .2 Wash surfaces with a biodegradable detergent (and bleach where applicable) and clean warm water using a stiff bristle brush to remove dirt, oil and surface contaminants.

- .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- .4 Use trigger operated spray nozzles for water hoses.
- .5 Allow surfaces to drain completely and to dry thoroughly.
- .6 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.
- .7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or such organic solvents to clean up water-based paints.
- .5 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual specific requirements and coating manufacturer's recommendations.
- .6 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .7 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
  - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
  - .2 Apply wood filler to nail holes and cracks.
  - .3 Tint filler to match stains for stained woodwork.
- .8 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .9 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
- .10 Touch up of shop primers with primer as specified.

**3.4 EXISTING CONDITIONS**

- .1 Prior to commencing work, examine site conditions and existing exterior substrates to be repainted and report in writing to NCC Representative damages, defects, unsatisfactory or unfavourable conditions of surfaces that will adversely affect this work.
- .2 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to NCC Representative. Maximum moisture content not to exceed specified limits.
- .3 No repainting work to commence until such adverse conditions and defects have been corrected and surfaces and conditions are acceptable to Painting Subcontractor and Inspection Agency.
- .4 Degree of surface deterioration (DSD) to be assessed using MPI Identifiers and Assessment criteria indicated in the MPI Maintenance Repainting Manual. MPI DSD ratings and descriptions are as follows:

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

### 3.5

#### APPLICATION

- .1 Paint only after prepared surfaces have been accepted by NCC Representative.
- .2 Use method of application approved by NCC Representative.
  - .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
  - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.
- .6 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .7 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .8 Finish closets and alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .10 Mechanical/Electrical Equipment:
  - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
  - .2 Do not paint over nameplates.
  - .3 Keep sprinkler heads free of paint.
  - .4 Paint fire protection piping red.
  - .5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
  - .6 Paint natural gas piping yellow.
  - .7 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
    - .1 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

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

**3.6 CLEANING**

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Place paint, stains, primer defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

**END OF SECTION**

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.

### **1.2 WORK INCLUDED**

- .1 The work of this Section includes the provision of all labour, materials, equipment and services required to fabricate and install metal toilet partitions, as indicated on the drawings, as specified herein and as required for a complete project.

### **1.3 RELATED WORK**

- .1 Section 10 28 10 – Toilet and Bath Accessories.

### **1.4 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM A167-99, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM A 653/A 653M-99a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
  - .2 CAN/CGSB-1.104-M91, Semi-gloss Alkyd Air Drying and Baking Enamel.

### **1.5 SUBMITTALS**

- .1 General: Submit each item in this Article according to the Conditions of the Contract and the applicable Division 01 Specification Sections.
- .2 Shop Drawings: Indicate fabrication details, plans, elevations, hardware, and installation details.
- .3 Maintenance Instructions: Provide manufacturer's printed maintenance instructions for toilet partitions.

## **2 Products**

### **2.1 GENERAL**

- .1 This specification is based on metal toilet partitions as manufactured by Hadrian Manufacturing Inc., (888) 817-7701 or approved equal.
- .2 Subject to compliance with the specification requirements, alternative products by the following manufacturers are acceptable alternatives:
  - .1 GSS - "Medallion" series.

- .2 Ontario Accurate Partitions Ltd. - "Empire" series.
- .3 Bobrick Washroom Equipment of Canada Ltd.
- .4 Ampco Products Inc.

## **2.2 METAL TOILET PARTITIONS**

- .1 Sheet steel: commercial quality to ASTM A 653/A 653M, with ZF075 galvanized coating with mill phosphated pretreatment.
- .2 Minimum base steel thickness:
  - .1 Panels and doors: 0.8 mm.
  - .2 Pilasters: 1.0 mm
  - .3 Reinforcement: 3.0 mm
  - .4 Headrails: 25 mm x 40 mm x 0.9 mm thick, tubular or channel shaped steel or aluminum, with formed steel or aluminum end brackets.
- .3 Stainless steel sheet metal: to ASTM A167, Type 304, with satin finish.

## **2.3 HARDWARE**

- .1 Hinges:
  - .1 Heavy duty, self lubricating, steel pins, nylon cams.
  - .2 Material/finish: chrome plated non-ferrous casting.
  - .3 Swing: as indicated on the drawings.
  - .4 Return movement, adjustable to hold door open at any angle up to 90 deg.
- .2 Latch set: surface mounted, slide bolt and keeper, chrome plated non-ferrous extrusion or casting, emergency access feature.
- .3 Wall and connecting brackets: chrome plated non-ferrous extrusion or casting.
- .4 Coat hook: combination hook and rubber door bumper, chrome plated non-ferrous casting.
- .5 Pilaster shoe: Minimum 100 mm high, 0.8 mm thick stainless steel.
- .6 Door pull: type suited for inswinging doors, stainless steel.
- .7 Headrail: extruded aluminum channel with anodized finish of anti-grip design.
- .8 Attachment: stainless steel tamperproof type screws and bolts.

## **2.4 FABRICATION**

- .1 Doors and panels:
  - .1 25 mm thick, fabricated with two sheets of 0.81 mm thick zinc coated steel, formed and welded together before capping.
  - .2 Continuous roll-formed mouldings on all four edges. Corners mitred, welded and ground smooth.
  - .3 Core: paper honeycomb expanded to a 25 mm maximum cell size and glued to the interior under pressure.

- .4 Sizes as indicated on the drawings and as required to comply with barrier-free access requirements of the National Building Code.
- .2 Pilasters: 32 mm thick, constructed same as door, approx. 2200 mm high, to widths required.
- .3 Provide formed and closed edges for doors, panels and pilasters. Miter and weld corners and grind smooth.
- .4 Provide internal reinforcement at areas of attached hardware and fittings. Temporarily mark location of reinforcement for tissue holders and grab bars.

## **2.5 SHOP FINISHING**

- .1 Clean, degrease and neutralize steel components with phosphate or chromate treatment.
- .2 Spray apply primer to CAN/CGSB-1.81, 1 coat.
- .3 Spray apply finish enamel to CAN/CGSB-1.104 Type 2, semi- gloss, 2 coats and bake to smooth, hard finish 0.025 mm thick.
- .4 Colour to be selected by the Consultant from the manufacturer's complete colour range.

## **3 Execution**

### **3.1 PARTITION ERECTION**

- .1 Install partitions secure, plumb and square.
- .2 Leave 12 mm space between wall and panel or end pilaster and between panel and panel or end pilaster.
- .3 Anchor fixing brackets to masonry/concrete surfaces using screws and shields: to hollow walls using bolts and toggle type anchors, to steel supports with bolts in threaded holes.
- .4 Attach panel and pilaster to brackets with through type sleeve bolt and nut.
- .5 Equip each door with hinges, latch set, and each stall with coat hook mounted on door, Adjust and align hardware for easy, proper function. Set door open position at 30 deg. to front.
- .6 Replace enamel surfaces damaged during shipment or installation. Touch-up painting is not acceptable.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Read and be governed by conditions of the contract and sections of Division 1.
- .2 Section 09 21 16 – Gypsum Board Assemblies.

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM B456-03, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
  - .3 ASTM A653/A653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A924/A924M-09, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
  - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
  - .3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .3 CSA International
  - .1 CAN/CSA-B651-04, Accessible Design for the Built Environment.
  - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
  - .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.
- .3 Sustainable Standards Certification:
  - .1 Low-Emitting Materials: submit listing of laminate adhesives used in building, verifying that they contain no urea-formaldehyde.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for toilet and bath accessories for incorporation into manual.

## **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Tools:
  - .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.
  - .2 Deliver special tools to NCC Representative.

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

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

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 This specification is based on toilet and bath accessories by Bobrick Washroom Equipment of Canada Ltd., (416) 298-1611.
- .2 Acceptance of products by other manufacturers is subject to the approval of NCC Representative.

### **2.2 MATERIALS**

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 304, with no.4 finish.
- .3 Sustainability Characteristics:
  - .1 Laminate Adhesives:
    - .1 Urea Formaldehyde Free.
- .4 Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness.
- .5 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

### **2.3 COMPONENTS**

- .1 Grab Bars: Bobrick B-5806x24 & Bobrick B5806-36

- .2 Toilet Tissue: Bobrick B-2840
- .3 Soap Dispenser: supplied and installed by NCC.
- .4 Mirror: to section 08 80 50 - Glazing. Sizes and locations as indicated on the drawings.
- .5 Paper Towel Dispenser and Waste Receptacle: Bobrick #B-43944 Contura Series satin finish stainless steel, (455 x 1430 x 100mm recess), 56.8 litre waste capacity.

## **2.4 FABRICATION**

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.
- .2 Inform NCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from NCC Representative.

### **3.2 INSTALLATION**

- .1 Install and secure accessories rigidly in place as follows:



- .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
- .2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.
- .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
- .4 Toilet and shower compartments: use male to female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.
- .5 Install mirrors in accordance with Section 08 80 50 - Glazing.

### **3.3 ADJUSTING**

- .1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

### **3.4 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

### **3.5 PROTECTION**

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

### **3.6 SCHEDULE**

- .1 Locate accessories where indicated. Exact locations determined by NCC Representative.

**END OF SECTION**

**PART 1 - GENERAL**

- |     |   |    |   |
|-----|---|----|---|
| 1.1 | <u>Examining of Site and Documents</u>    | .1 | Refer to General Conditions, Specifications and Drawings  |
|     |   | .2 | Read and conform to instructions to tenders, supplementary conditions and General Requirements Division, which applies to and forms part of all sections of the work  |
| 1.2 | <u>Cooperation with other Contractors</u> | .1 | Examining Plans of all related Work   |
|     |   | .2 | Coordinating all work prior to and during installation with related trades.   |
|     |   | .3 | Attending group site inspections where required and/or requested at no cost to client.  |
|     |   | .4 | Reporting any defects in related work or special scheduling requirements for food service equipment installation.   |
|     |   | .5 | Implementing of any approved adjustments to the work schedule whenever possible, must not affect the completion date.   |
|     |   | .6 | The successful Foodservice Equipment Contractor must follow the coordination efforts of the project representative to ensure orderly and expedient performance and completion of the project as a whole.  |
|     |   | .7 | The successful Foodservice Equipment Contractor shall allow within the offer a liaison to coordinate with the Principal Contractor or any other person nominated by the Employer. The liaison shall be responsible for coordinating specifically the inter-related positioning of items of work such as conduits, pipes, ducts, etc to insure the work proceeds smoothly and without undue delay. |
| 1.3 | <u>Quality Assurance</u>                  | .1 | Work of this section must be executed by a contractor with at least five years experience in food service equipment supply and installation. References must be submitted with tender submission to support such experience. Failure to do so may prejudice the Tenderer as being submitted by an inexperienced specialist contractor   |
|     |   | .2 | Work of this section includes assuring that shop and site contracting personnel are compatible and that no costs or delays occur due to disputes.   |
| 1.4 | <u>Trade Names and Alternatives</u>       | .1 | The drawings and specifications name specific manufacturers materials & work to establish the standard and use requirements. This is not to prohibit/ eliminate competitive materials.  |

- .2 Tender submission is based on supplying all items called for specifically.
  - .3 The Contractor may propose alternatives of products, materials, or equipment which are equivalent to those specified.
  - .4 Proposed alternatives shall be submitted in the form of a proposal, on which the alternative is completely specified, the reason for substitution is given, the differences between specified and proposed alternative are defined, and the amount by which Tendered Price will be increased or decreased.
  - .5 Alternatives proposed by the Contractor shall be equal to or superior to the performance criteria and physical characteristics of the specified product. Contractor shall prove equivalency. Contractor shall verify alternative products will fit surrounding construction.
  - .6 Tenderers finding discrepancies, omissions, or having questions about the specifications or other documents, must notify the Construction Manager at once, then written instructions or explanations will be issued to all tenderers.
  - .7 If the Consultants are not notified of discrepancies or omissions 7 days or more before tender close date, the Consultant will decide on the materials or work to be supplied.
- 1.5 Dimensions
- .1 It shall be understood that wall thicknesses shown on the drawings are nominal only. In each case the Foodservice Equipment Contractor shall check actual site dimensions and limiting conditions in areas affecting his work and shall make necessary allowances on his shop drawings any noted site discrepancies. It shall be his responsibility to detect and report to the Consultant all noted discrepancies and/or limitations between issued drawings, specifications, mechanical and electrical rough-in requirements and actual site conditions.
  - .2 In a case where dimensions are not available, and before equipment fabrication commences, the dimensions required shall be agreed upon in writing between the various contractors concerned and the Consultant.
  - .3 Under no circumstances shall the Foodservice Equipment Contractor proceed with the performance of any work which is an uncertainty regarding dimensions, services, and site conditions, or for any other reason(s) whatsoever.
  - .4 The Foodservice Equipment Contractor shall check and verify all dimensions shown on the drawings before commencing work. He will be held responsible for errors resulting from his failure to comply with this requirement.

- 1.6     Shop Drawings
- .1     All items of equipment to be manufactured under this section must be completely illustrated by shop drawings, or catalogue sheets and detailed description. All illustrations must be amended to conform to specifications. Attaching a submittal sheet marked "As Specified" is not acceptable.
  - .2     Unless otherwise directed, prepare all services and shop drawings which show connections and construction. Minimum scale 1: 25 with details and sections in larger scale for clarification.
  - .3     Include all dimensions, materials, components, joint details, assembly methods, finishes, mechanical and electrical characteristics.
  - .4     Provide fully dimensioned mechanical and electrical services drawings which show final connection points which are clearly and acceptably identified. Provide fully dimensioned slab depression/ insulation drawings for coolers and freezers where required. Provide dimensioned backing drawings for reinforcement required in walls. Identify all special requirements to assure a practical installation in co-ordination with the work under all relevant sections.
  - .5     All parts and assembly of each item must support loads without deflection detrimental to function, appearance, or safety.
  - .6     Explain in writing any variations from requirements (drawn or specified) shown on shop drawings.
  - .7     Ensure all shop drawings have been checked and signed by a qualified Officer of the Company.
  - .8     Clearly identify conditions which limit or adversely affect the intent of design and provide proposed adjustments.
  - .9     Review applied to general design only. Errors in dimensions, quantity, or interference will not in any way relieve the Contractor from responsibility to complete the work within the design intent.
  - .10    Carefully examine the drawing and specifications in all sections for information affecting work under this section. Promptly notify the Consultant of any conditions which will adversely affect the proper completion of the work.
- 1.7     Demonstration
- .1     A competent representative must be available on a mutually agreeable date to demonstrate proper function, operation and maintenance of all equipment. The demonstrating representative will be on-site the first day of service.

- 1.8 Operations and Maintenance
- .1 Provide five (5) bound and labeled manuals incorporating operating and maintenance instructions for all custom fabricated and purchased equipment. Every item must be numbered to agree with drawings, arranged in numerical sequence, and identified with detailed shop drawing, catalogue data, model, serial number and Warranty Contact information.
  - .2 A draft copy of the Manual shall be submitted for consultant review prior to commissioning of equipment.
- 1.9 Warranty
- .1 Warranty on all work begins on the date the installation is accepted and will normally coincide with Base Building Substantial Completion. Any delay in construction etc., that extends the time between installation and acceptance must be covered by co-ordination between contractor, representative and manufacturer. All parties must be informed of the date the Warranty begins.
  - .2 Furnish a written Warranty for all new purchased and fabricated equipment, which covers repairs of any defects which may develop within a period of one (1) year from the date of acceptance. Replace any equipment that cannot be repaired. All work and materials for repair or replacement will be provided at no extra cost.
  - .3 Furnish a written Warranty for all compressors which covers repairs of any defects which may develop within a period of five (5) years from the date of acceptance. Replace any compressors that cannot be repaired. All work and materials for repairs or replacements shall be provided at no extra cost.
- 1.10 Work Included
- .1 Furnish all labour and materials, tools, plant and services for the supply and installation of all the work of this section.
  - .2 Supply and delivery to the site of ISO or other approved and equivalent standards all inserts, anchors, bolts, sleeves, ferrules and similar items for attaching to or building into masonry, concrete and other work for the proper anchorage and fixing of the equipment installed under this section. This includes necessary templates, instructions, directions and/or assistance in the location and installation of all such items by other sections.
  - .3 Supply all motors complete with starters and disconnect switches; receptacles complete with outlet boxes and stainless steel cover plates, fuse boxes or circuit breaker panels where specified for individual items.
  - .4 Supply and install adequate low water cut-off protection for all equipment that would be damaged by a low water condition.
  - .5 Supply loose, all faucets with replaceable seats and low flow 1.8

- gpm aerators, and all drain fittings with suitable crumb cup and tailpiece.
- .6 Supply of any pressure reducing and/ or regulating devices on water, steam, and gas or air services required for equipment supplied under the work of this section.
  - .7 Supply and install chrome plated brass blow down extensions on all units equipped with safety valves (directed to the back of units). Extension to end within 25mm above nearest hub drain at the back of units.
  - .8 Suitably recess or otherwise protect all controls, valves and switches on items of equipment where they protrude.
  - .9 Supply all hardware normally part of the equipment.
  - .10 Supply all refrigeration equipment and systems as specified including the services of a refrigeration contractor for the correct installation/ connection of remote systems.
  - .11 Apply rubber button feet or other approved protective devices on all items positioned on counters to protect finishes.
  - .12 Supply finishes described for items of equipment of this section.
  - .13 Caulk and seal equipment to walls, base pads, curbs and adjacent equipment where required.
  - .14 Deliver, unpack, and locate all equipment ready for connection of services. Where no service connections are required, locate the equipment correctly. All equipment to be installed and leveled and to be true, plumb and square.
  - .15 Test, clean, and adjust all equipment and apparatus installed under this section. Refinish and repair any painted and finished surfaces damaged during erection and installation.
  - .16 Conform to all laws, bylaws and requirements of authorities having jurisdiction.
  - .17 Ensure all electrical equipment is accompanied by label or certification of approval by governing Standards Association, Hydro Electrical Power Commissions or local authorities.
  - .18 Ensure steam pressure equipment is accompanied by a "Certificate of Boiler" to satisfy authorities having jurisdiction and local authorities.
  - .19 Ensure gas equipment is accompanied by label or certification of approval by governing Gas Association or Local Authority as necessary for approval.

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**FOODSERVICE EQUIPMENT  
SPECIFICATIONS**

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- .20 Ensure equipment design complies with National Sanitation Foundation and Provincial or Local Municipal Health Department requirements. In cases where contradiction occurs between specifications, local codes, and Federal requirements, the most stringent shall apply.
- .21 Obtain permits or special inspections, as required.
- .22 Identify equipment with metal or lamacoid plates or labels permanently secured which include, where applicable: Manufacturer's name or recognized trademark; Complete model identification including serial number; Recognized listing/ approvals identification; Electrical and Mechanical characteristics; Warranty Contact Information.
- 1.11 Related Work by Electrical Contractor
- .1 Final electrical connection of food service equipment including all necessary electrical cable and conduit required for the proper installation and operation of the food service equipment.
- .2 Wiring from the source of power through disconnect switches, starter and the like to the equipment. All disconnect switches, starters, etc., required by local codes shall be supplied by electrical contractors.
- 1.12 Related Work by Plumbing Contractor
- .1 Final connection of all food service equipment for water, gas and drains required for the completed operation of the Foodservice Equipment.
- .2 Installation of in-line filters and back flow preventers in coordination with Coffee Equipment and Beverage Equipment provided by other suppliers
- .3 Provide hub drains/ open drains, and/or floor sinks in accessible areas to allow foodservice equipment contractor to run drain lines from equipment to local drains.
- .4 Run drain lines from cooler and freezer evaporators to local hub drains. Coordinate with Div. 16 to connect heated tracer cable provided by foodservice equipment contractor for freezer drain line applications. Coordination required between Div. 16, Div. 15, and foodservice equipment contractor.
- 1.13 Related Work by General Contractor
- .1 Site Coordination as specified within the Contract Documents including scheduling and coordination of the Foodservice Equipment Contractor.
- .2 Provide plywood backing in walls as indicated on the dimensioned Foodservice Equipment Contractor's plans.
- .3 Provide opening/ leave-out/ depression in kitchen floor to receive

walk-in coolers and freezers, drain pan and floor grates as provided by Foodservice Equipment Contractor. Epoxy coat trenches as indicated

- .4 Provide access to necessary site equipment, including but not limited to elevators and lifts, to allow the Foodservice Equipment Contractor reasonable schedules to locate and connect the equipment within the Facility.
  - .5 Ensure reasonable care is taken within the facility to protect foodservice equipment while it is being stored.
  - .6 Coordinate the scheduling of Electrical, Ventilation, and plumbing Contractors to allow for the final connection of equipment as outlined above in Sections 1.11, 1.12, and 1.13
- 1.14 General Definitions
- .1 Accessible: Capable of being exposed for cleaning and inspection with the use of simple tools such as a screwdriver, pliers, or open-ended wrench.
    - .1 Readily Accessible: Exposed or capable of being exposed for cleaning without the use of tools.
  - .2 Cleaning: The physical removal of residues of foods, ingredients or other soiling materials.
    - .1 Easily Cleanable: Readily accessible, and of such material and finishes and so fabricated that cleaning can be accomplished by normal kitchen methods
  - .3 Closed: Having an opening of not more than 0.79mm in width.
  - .4 Corrosion Resistant: Capable of maintaining original surface characteristics under such prolonged influence of the use environment, including the expected food contact and the normal use of cleaning compounds and sanitizing (bactericidal) solutions.
  - .5 Food: Any raw, partially cooked, cooked, or processed edible substance, beverage, or ingredient used or intended for use in whole, or in part, for human consumption.
  - .6 Foodservice Equipment Contractor: Contractor responsible for supply, fabrication, delivery, off-loading, uncrating, setting-in-place, testing, and commissioning all foodservice equipment. Also referred to as FEC, Kitchen Equipment Contractor, and KEC
  - .7 Removable: Capable of being detached from the main unit with the use of simple tools such as a screwdriver, pliers, or open-ended wrench.
    - .1 Readily (or easily removable): Capable of being detached from the main unit without the use of tools



- .8 Sanitizing: The effective bactericidal treatment of clean surfaces of equipment and utensils by a process, which is proven effective and leaves no toxic residue.
- .9 Sealed: Having no openings that will permit the entry of dirt or liquid seepage.
- .10 Smooth: A surface free from pits and cracks having a cleanability equal to the following:  
Food contact surfaces, No. 4 (180 grit) finish to sst.  
Non-food contact surfaces, commercial grade, hot rolled steel, free of visible scale
- .11 Toxic: Having an adverse physiological effect on humans
- .12 Zones (Contact Surfaces)
  - .1 Food Zone: Those surfaces of the equipment with which the food normally comes into contact, and those surfaces with which the food is likely, in the course of normal operations, to come into contact with food
  - .2 Splash Zone: Those surfaces which are subject to routine splash, spillage, or other soil during normal use.
  - .3 Non-food Zone: All exposed surfaces other than food and splash contact surfaces.

**PART 2 - PRODUCTS**

- 2.1 Services
- .1 Refer to the drawings and specifications for the nature and location of waste, gas, electrical and other services which will be provided for the operation of the equipment for this section.
  - .2 Hot water shall be supplied at a temperature of 60° C (140° F) from the building system.
  - .3 The electricity supply system shall be three-phase, 4 wire, 60Hz alternating current with grounded neutral at nominal voltage of 208 volts.
    - .1 The voltage may, however, vary within a range of 95% to 105% of the nominal and all equipment installed shall be suited for rated operation at any voltage within this range.
  - .4 Verify the service locations and assure that the equipment provided under this contract has mechanical and electrical connection locations within reasonable limits.
- 2.2 Materials and Construction Methods
- .1 Stainless Steel is designated throughout this specification by the abbreviation sst, analysis 18-8, type 304 No. 4 finish, 180 grit, free from pits and imperfections. All sst. shall be austenitic stainless steel of ASTM 304L, or 304 quality material.
  - .2 Galvanized iron shall be copper bearing sheet, hot dipped and finished with one (1) coat of primer and one (1) coat of grey hammerloid airdry enamel.
  - .3 Gauges of materials specified refer to U.S. standard gauge for sheets and stub gauge for tubing. All tubing shall be 1.6 wall, unless otherwise specified.
  - .4 Adhere to methods of construction, reinforcement, anchorage, finish, jointing, components and the like shown on approved shop drawings. Finished equipment shall be absolutely rigid with the requirements of the details and specifications being a minimum.
  - .5 All fastenings and fittings such as bolts, wood and metal screws, lock washers, nuts, cotter pins and mounting brackets shall be sst. with polished heads where exposed. Wherever possible, conceal fastenings, but where necessary at exposed or inaccessible surfaces, use truss or countersunk flat heads.
  - .6 Workmanship shall be the best grade of modern shop and field practice known to recognized manufacturers specializing in this work.

- .7 Welding shall be performed by competent personnel using the electrical, seamless heliarc method with filler rods of such a composition so as to leave a completed and ductile butt weld of the same composition as the original metal. Workmanship shall be free from pits, cracks, discoloration and other mechanical imperfections and shall be ground smooth and polished to match original finish and be invisible.
- .8 All straight lengths shall be one (1) piece with all seams welded, field joints to be welded and finished as per paragraph 2.2.7 above.
- .9 Edges are as shown on drawings.
- .10 Backsplashes as shown on drawings.
- .11 Legs and Braces  
All of 38mm outside diameter tube.  
Leg spacing maximum 1525 mm apart. 760 mm front to back.  
Braces continuous fillet weld to legs, polished with minimum reduction in volume.  
Cross brace legs in pairs and longitudinal brace at front center or back to suite requirements. All set at 250mm above floor.  
Legs continuously welded to sst. saddles of inverted 'U' shaped 100mm W x 19mm deep. Flanges angled back or rounded each end.  
Leg sets bolted to equipment using saddles or continuously welded sst. sockets. Seal joint of saddles to equipment with specified sealant.  
Feet as specified secured to floor on equipment with connected services using sst. dowels set and sealed with acid proof grout.  
Feet to be of non-rusting material.  
Kickplates to be of 1.6 sst. and secured to equipment, easily removed. Sealed at floor.
- .12 Shelves  
All of 1.6 sst. construction.  
Boxed edge four (4) sides, solid.  
Boxed edge four (4) sides, perforated. Perforations 13mm diameter holes on 25mm centers.  
Boxed edge three (3) sides up and fold back. Solid or perforated.  
Slotted, half rolled front and back edges, flat ends. Open slots die stamped down, running front to back, 16mm wide on 50mm centers.  
Wire, main frame 9.5mm diameter rod, lateral wires 50mm diameter on 25mm centers heavy duty chrome plated after welding.  
Removable sections maximum 610mm long.  
Wall, table, or counter mount shelf supports to be sst. tube.

- .13 Angle Slides  
All of 1.6 sst. minimum, construction.  
Slides of 50mm x 50mm section, length to suit. Leading corners rounded. Fully welded to supports on vertical edge.  
Supports of 38mm sst. bar, located in units on keyhole slot and sst. plug.  
Back stops must be provided to limit travel of pans.  
Ensure that pans or trays will not turn and fall between universal slides.
- .14 Drawers  
Average size 510 x 510 x 125, 150 or 200 deep.  
Double pan front 1.2 sst. all welded and sound deadened, with integral pull.  
Carrier frame, 1.6 sst. channel sides and back weld to front.  
Sheaves are 4 x 30mm O.D. nylon type roller bearing.  
Safety catches of sst. to prevent assembly separating.  
Housing of all 1.2 sst., open top, solid back sides and bottom.  
Corners weld and polished. Front opening with box edges.  
Stainless steel liners to be removable with drawer fully extended.  
Locks and pulls as specified
- .15 Work Tables  
Top of 1.6 sst. cut out for sink bowls, etc., reinforced as required with 2.0 sst. channels.  
Work tables with sinks have bowls and boxed edge unless specified otherwise.  
Reinforcing channels or saddles not to be exposed below edges.  
Legs and shelves as specified.
- .16 Sink Bowls and Drain Troughs  
All of 1.8 sst. polished inside and outside, weld integral with tops.  
Round corners of 19mm rad. in all vertical and horizontal corners, all welded - no solder.  
Bottoms drawn, not creased to drain hole.  
Drain hole at lowest point to suit type of waste specified for item.  
Sound deadening compound on underside of basins.  
Sinks to have 1.2 sst. cladding on all sides.  
Faucets as specified to be pre-fitted, shipped loose.
- .17 Cupboards  
All of 1.2 sst., one piece or continuous weld.  
End gables boxed vertically.  
Fixed bottom shelf.  
Adjustable intermediate shelf.  
Wall mounted to be 380mm deep x 914mm high located 455mm above counter or table, or to dimensions indicated.  
Enclosed units have shelves of lengths removable through one door opening.

- .18 Sliding and Hinged Doors  
Construct of 1.2 sst. double pan 19mm thick filled with fiberglass to act as sound deadening compound. Not to exceed 914mm long.  
Sliding doors self closing on sst. track. Adjustable hangers with nylon tired sst. roller bearing sheaves.  
Bottom guides sst., easily moved from removing doors without use of tools.  
Recessed or integral sst. pulls.  
Hinged doors hung on continuous sst. piano hinge.  
Bumper buttons and H.D. catches as specified.
- .19 Heated Counters (60 - 74° Celsius)  
Top 1.6 sst. box edges.  
Cupboard fully insulated with fiberglass 13mm thick, sst. enclosed.  
Sliding doors.  
Fixed bottom shelf.  
Removable intermediate shelf - perforated.  
Heater strips, protected.  
Control and pilot light in recessed panel, identified.  
Legs and adjustable feet.
- .20 Refrigerated Counters (3° Celsius)  
Top 1.6 sst. box edges.  
Body 1.2 sst. exterior and interior, all welded. Inside horizontal corners formed on 19mm radius.  
Insulate with 50mm thick continuous closed cell type to completely fill cavity.  
Thermal separating breaker strips effectively concealed. Provide heater wires as necessary.  
Blower coil or fin strip of required capacity. Conceal drain line or provide evaporator pan as indicated.  
Adjustable wire shelves or tray slide units as specified.  
Interior light, door activated switch.  
Doors, 1.2 sst. double pan fully welded with 50mm thick continuous closed cell insulation.  
Door hardware with natural closing tendency.  
Refrigeration system as described. Remote or self-contained, as indicated.  
Refrigerants used must meet guidelines and conditions as set out in the Montreal Protocol environmental guidelines.  
Compressor housing for self-contained units to be 1.6 sst. Open construction for maximum air movement and access.  
Ventilated access panel of sst. louvers in 1.0 sst. channel frame with welded and polished corners. Set in top channel with locating studs at bottom.
- .21 Wall Paneling  
To be 1.0 sst, patterned as shown and specified  
Affix to surfaces using concealed fasteners or adhesive.  
Provide corner guards for sections returning 90 degrees.  
Foodservice Equipment Contractor responsible for sealing of

paneling to top of finished floor or floor coving.

.22 Enclosure and Trim Panels

To be of same gauge, composition and colour as adjoining equipment unless specified otherwise.

Grain direction of panels to match adjoining equipment.

Foodservice Equipment Contractor to install Panels in concealed and secure manner, seal where required.

.23 Sneezeguards

Constructed as per drawings.

All glass to be 9.5mm, hardened/ tempered glass resistant to heat, cold, humidity.

Glass sections to be removable for cleaning.

Lights (as required) to be enclosed, vapour proof as shown.

Heat lights/ strips (as required) to be installed with minimum 25mm clearance from top shelf, or as per manufacturer.

Enclosures to be sst/ steel/ metal as shown, painted/ finished as indicated.

Services required through uprights/ concealed conduit as indicated to switches and junction boxes for final connection.

.24 Kickplates

All of 1.6 sst. or as indicated.

Kickplates to be coved, installed after final connection of all required services.

Kickplates to be removable

Kickplates to be attached to legs.

.25 Casters

Casters to be heavy-duty plate mounted, 100, 125, 152 mm swivel or fixed as indicated, non-marking

Provide matching, locking casters where indicated.

Provide wash-safe casters where indicated.

Low-profile casters for undercounter equipment as indicated.

.26 Hardware

.1 All hardware must be highly polished chrome plated, heavy duty.

.2 Handles integral with structure are of 1.6 sst. 130mm long rounded as detailed.

.3 Catches must be concealed self-aligning floating magnet, or friction type, solid brass with satin nickel finish, rustproof steel balls and springs with set screws for adjustable tension. Magnet holding power of 35lb.(16kg) minimum.

.27 Refrigerated Door Hardware

.1 Positive latch heavy-duty edge mount type zinc die cast with adjustable striker. Hinges adjustable with position stop and snap on cover.

.2 Supply and install tamper proof cylinder locks for all custom made and standard refrigeration.

.28 General Hardware

- .1 Five disc tumbler cylinder locks type with non-ferrous satin chromium barrel and case and rust proof steel bolt. All locks shall be common keyed.
- .2 Pilaster strips, sst. 19mm wide, slots for 13mm adjustment.
- .3 All control valves and faucets, pipe fittings, waste and tail pieces, etc., must be brass chrome plated bright finish, new, best quality and comply with applicable codes.
- .4 Valve handles must be of non-conductive materials.
- .5 Faucets, inlet size 19mm IPS.  
Deck Mount, Inlet centers 102mm, Spout 152mm  
Deck Mount, Inlet centers 203mm, Spout 203mm,279mm or Gooseneck.  
Wall Mount, Inlet centers 203mm, Spout 203mm or 279mm.
- .6 Pre rinse units, Inlet centers 203mm with all attachments including wall brackets for splash mount units.
- .7 Wastes, 38mm or 51mm IPS.  
Center type, with removable basket strainers and tailpiece.  
Lever type with one piece connected overflow assembly, 'snap-in' strainer and tailpiece.  
Corner type, with sst. overflow, removable strainer and tailpiece.

### **PART 3 - EXECUTION**

#### **3.1**

#### **Installation**

- .1 Install all equipment plumb with cabinets and counters level to 02%.
- .2 Equipment to be fabricated in sizes to fit through existing building openings.
- .3 Level base cabinets by adjusting leveling shims or bullet/ flanged feet to height shown on drawings.
- .4 Scribe and fit stainless steel filler strips to irregularities of adjacent surfaces, maximum gap opening 0.5mm.
- .5 Secure equipment to floor and wall construction using fasteners spaced as specified.
- .6 Fasten shelves as indicated using toggle bolts.
- .7 Fastening and sealing: where stationary or fixed and matching items butt against one another, join with concealed stainless steel fasteners. Seal joints. Where joints cannot be sealed with single pass, use stainless steel filler strip in conjunction with sealant. Where items are against or through walls or partitions, seal resultant joint.
- .8 After installation, fit and adjust operating hardware.
- .9 Manufacturer to demonstrate equipment capabilities, operation, safety and minor user maintenance.



**PART 4 – ITEMIZED EQUIPMENT SPECIFICATION**

<b>Item No.:</b> 1.01	<b>SST COUNTER w/ HAND SINK</b>
Quantity	01
Manufacturer:	CUSTOM
Dimensions:	Approx. 2,613mm W x 762mm D x 914mm H.
Top:	Countertop to be all sst. as shown with 38mm boxed edges. Provide integral 152mm backsplash along back and right walls as shown. Hand sink basin to measure approx. 254mm x 357mm x 254mm D. Basins to be drawn to drain hole at center and include removable crumb cup for drain. All coved corners. Provide deck mounted swivel spout with HW and CW wrist action taps.
Base:	Base cabinet shall be 16 gauge (1.6mm) stainless steel framework construction. Provide three cabinets with sst. doors as shown, all lockable with magnetic hold close hardware. Interior of cabinet base shall be all sst. with midshelf and lower shelf where shown, complete with boxed edges. Counter shall have 152mm adjustable legs, with removable coved sst. kick plate on front and left side. KEC to verify dimensions and clearances on site.
<b>Item No.:</b> 1.02	<b>SST UPPER CABINETS</b>
Quantity	03
Manufacturer:	CUSTOM
Dimensions:	Approx. 723mm W x 305mm D x 745mm H, mounted at height indicated on drawings, and not to impede function of equipment on table below.
Description:	All sst construction w/ sst. door cabinets. Doors shall be double pan sst, with recessed pulls. Provide interior adjustable midshelf and lower shelf. Add door exterior finishes over sst. panels applied with laminate as selected by Interior Designer/Architect. Cabinet shall be firmly secured to wall, coordinate with GC necessary wall backing required.
<b>Item No.:</b> 1.03	<b>TWO DOOR REACH-IN COOLER</b>
Quantity	01
Manufacturer:	TRUE and/or approved equal
Model:	T-49
Description:	Two door reach-in cooler with oversized factory balanced 0.5HP compressor, shall maintain temperature of .5°C – 3.3°C Stainless steel doors and front. Doors shall be self-closing with positive seal. Unit shall have recessed door handles, 102mm diameter casters, interior lighting and six (6) heavy duty PVC coated adjustable interior shelves.
<b>Item No.:</b> 1.04	<b>FOLD-DOWN WORK SHELF</b>
Quantity	01
Manufacturer:	DELFIELD / CUSTOM and/or approved equal
Dimensions:	Approx. 1,270 mm L x 254mm W.
Description:	Work shelf to be 254mm wide constructed of 16ga. stainless steel, mounted flush with top surface of the counter Item 1.11 as shown. Unit shall be mounted on stainless steel fold-down support brackets. Provide alignment and leveling lock. Coordinate required support with millwork.

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<b>Item No.: 1.05</b>	<b>FOLD-DOWN WORK SHELF</b>
Quantity	01
Manufacturer:	DELFIELD / CUSTOM and/or approved equal
Dimensions:	Approx. 1880 mm L x 254mm W.
Description:	Work shelf to be 254mm wide constructed of 16ga. stainless steel, mounted flush with top surface of the counter Item 1.11 as shown. Unit shall be mounted on stainless steel fold-down support brackets. Provide alignment and leveling lock. Coordinate required support with millwork. Coordinate center support so that it does not interfere with drop-in control panels.
<b>Item No.: 1.06</b>	<b>POS TERMINAL - NIC</b>
Quantity	01
Description:	Provide power and data connections as required.
<b>Item No.: 1.07</b>	<b>SNEEZE GUARD, OPERATOR SERVE TYPE w/ SERVICE SHELF</b>
Quantity	02
Manufacturer:	CUSTOM and/or approved equal
Description:	Operator serve type sneeze guard with fully adjustable glass panels. Unit to include three (3) brushed aluminum posts (one (1) center) 25mm in diameter. Posts to be 584mm H and shall be under-mount below top and firmly secured to millwork hat channels. Coordinate location and installation of posts with millwork. Front glass panel to be 9.5mm tempered glass measuring 406mm in Height x unit length. Glass corners shall have a 25mm radius. Panel to be fully adjustable up and down with easy turn thumb screw. Top mounted service shelf to be 9.5mm tempered glass measuring 406mm in width x unit length. Glass corners to have 25mm radius. Service shelf shall be installed at 560mm above countertop.
Consisting of:	Two (2) unit approx. 1,902mm W x 560mm H.
<b>Item No.: 1.08</b>	<b>DROP-IN HOT WELL</b>
Quantity	01
Manufacturer:	WELLS and/or approved equal
Model:	MOD-500TDM-AF
Description:	Fully insulated 6200 Watt built-in modular warmer shall accommodate five (5) deep-drawn, stainless steel NSF construction wells. Unit shall have individual thermostatic controls on each well, and manifold drain. Provide unit with autofill option. Coordinate location and installation of drop-in unit and controls with millwork.
Provide:	Drain valve extension kit, Drain Screen, Individual thermostat and drain connected to manifold.
<b>Item No.: 1.09</b>	<b>SPARE NUMBER</b>
<b>Item No.: 1.10</b>	<b>DROP-IN COLD PAN</b>
Quantity	01
Manufacturer:	WELLS and/or approved equal
Model:	RCP-300
Description:	Sst self-contained refrigerated drop-in insulated cold pan shall accommodate three (3) pans. Unit shall have an ON/OFF switch and cordset provided. Each well shall have individual thermostatic controls, recessed top edge to lower inset pans and integrated drain. Unit shall

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Provide: meet NSF requirements.  
Perforated bottom strainer plate.  
KEC to ensure suitable ventilation in millwork cabinets.

**Item No.: 1.11 SST SERVERY COUNTER**

Quantity: 01  
Manufacturer: Custom  
Dimensions: Approx. 5,125mm W x 1,067mm D x 860mm H.  
Top: Countertop to be all sst. as shown with 38mm boxed edges. Coordinate cut-outs for drop-in equipment as shown. Provide openings in top to allow for passage of sneeze guard uprights to hat channel mounted to substrate below counter.  
Base: Base cabinet shall be 16 gauge (1.6mm) stainless steel framework construction. Provide sst. cabinet doors with louvers as shown to provide ventilation to refrigerated equipment. All doors lockable with magnetic hold close hardware. Mount drop-in equipment controls, utility receptacles and drain valves in skirts where shown. Counter shall have 152mm adjustable legs, with removable coved sst kickplate on all sides. Right cabinet to be used for electrical load centre to provide services to all equipment located in the servery casework. KEC to verify dimensions and clearances on site.  
Provide: All electrical services pre-wired to J Box below countertop, for final connection by electrical trades.  
Three (3) NEMA 5-15P receptacles 120V – 1Ph – 15Amps as shown.  
One (1) NEMA 5-20P Receptacle for merchandiser item # 1.12

**Item No.: 1.12 REFRIGERATED SELF-SERVICE CASE**

Quantity: 01  
Manufacturer: STRUCTURAL CONCEPTS and/or approved equal  
Model: HMBC3  
Description: Dual service display case, with top portion being serviced and completely convertible baffle system between dry display and refrigerated display, while bottom portion shall be self-service and refrigerated. Top shall have clear glass rear sliding doors and curved single pane lift-up front glass, and adjustable clear glass lighted mid-shelf. Lower refrigerated section shall have single display level with bottom sheet metal deck and top light. Unit shall have two full end panels with mirror interiors. Interior colour to be black, exterior to be black. Unit is self-contained with evaporator pan (rear air intake and front air discharge at toe kick).  
Note: 865mm minimum door clearance required (without shipping skid).  
Provide: Electrical receptacle shall be provide in millwork counter, Item # 1.11  
102mm display Riser, Night curtain, & Casters.

**Item No.: 1.13 SST MOBILE CONDIMENT COUNTER**

Quantity: 01  
Manufacturer: CUSTOM  
Dimensions: Approx. 1,830mm W x 762mm D x 860mm H.  
Top: Countertop to be all sst. as shown with 38mm boxed edges. Provide integral 152mm backsplash along back as shown.  
Base: Base cabinet shall be 16 gauge (1.6mm) stainless steel framework construction. Provide sst. cabinet doors as shown, all lockable with magnetic hold close hardware. Counter shall have 152mm swivel casters with removable coved sst kick plate on all sides. Kick plate shall have a

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minimum 25mm clearance from floor. KEC to verify dimensions and clearances on site.

**Item No.: 1.14**                    **WASTE BIN**  
Quantity                    02  
Manufacturer:            RUBBERMAID and/or approved equal  
Model:                    2620 Brute  
Description:              Unit to be all plastic, professional-grade construction with built in handles to allow easy, non-slip lifting and anti-jam nesting. Unit to have double-ribbed base to increase stability and dragging capacity. Unit dimensions shall be 495mm Dia. x 581mm height with a capacity of 75.5 Liters.  
  
Provide:                    container lid.  
Note:                        Ensure bins fit below millwork as shown.

**Item No.: 1.15**                    **SPARE NUMBER**

**Item No.: 1.16**                    **TRAY RACK**  
Quantity                    03  
Manufacturer:            LAKESIDE and/or approved equal  
Model:                    155  
Description:              Unit shall be all-welded construction and shall accommodate 457mm x 660mm pans or 355mm x 457mm trays. Corner upright legs, and top and bottom frame shall be of 19mm x 317mm angle stainless steel. Pan/Tray ledges shall be of 16 ga. stainless steel and shall be welded to upright legs front and back. Top and bottom corner frame joints shall have 20 ga. reinforcing gussets welded in place for extra rigidity. Unit shall have a 16 ga. x 13mm x 13mm angle steel horizontal brace welded to upright legs at open ends front and back. Casters shall be 102mm dia. swivel stem type, corner mounted to corner legs for upright stability. Unit shall be NFS listed.  
  
Note:                        KEC to confirm required tray sizes prior to ordering or manufacturing

**Item No.: 1.17**                    **COMMERCIAL MICROWAVE OVEN**  
Quantity                    02  
Manufacturer:            PANASONIC and/or approved equal  
Model:                    NE-1054  
Description:              Unit shall have an output power of 1000 watts, stainless steel front, bottom energy feed & see through oven door. 10 programmable memory pads, braille keypad, 20-memory capability, double quantity key, 6 power levels, 2- and 3- stage cooking, and programmable lock. Unit shall be NSF listed.

**Item No.: 1.18**                    **MILLWORK COUNTER w/ HAND SINK**  
Quantity                    01  
Manufacturer:            CUSTOM  
Dimensions:              L-Shape, Approx. 3,827mm L + 2,566mm L x 762mm D x 860mm H.  
Top:                        Countertop & backsplash to be solid surface material, colour to be selected by NCC representative on plywood substrate complete with 460mm high backsplash to underside of upper cabinets along walls as shown. Provide cut-out in top to receive undermount sink basin in location shown. Sink basin to measure approx. 254 x 355 x 254mmD. Basin to be drawn to drain hole at center and include removable crumb cup for drain. All coved corners. Provide ADA compliant deck mounted

swivel spout with HW and CW wrist action taps. Provide substrate support of top as recommended by manufacturer. Provide cut out for waste bin below and 152mm waste chute ring as shown.

Base: Provide millwork base constructed of finished 19mm plywood with plam finish, colour to be selected by NCC representative. Interior of cabinet base shall be white plam. Provide millwork cabinet doors as shown, all lockable. Coordinate opening below countertop to accommodate microwaves item # 1.17. Cabinet accommodating waste / recycle bins item # 1.14 shall be flush with floor for ADA accessibility compliance. Waste bins to sit on floor. Provide lockable swing doors from skirt to 25mm above finished floor to match cabinets as shown on plan. Provide an accessible opening below the counter at the hand sink section approx. 750mm wide x 680mm high as shown. Counter shall have 102mm adjustable legs, with removable sst kickplate on all exposed sides where shown on drawings. KEC to verify dimensions and clearances on site.

**Item No.: 1.19**

**MILLWORK UPPER CABINET**

Quantity  
Manufacturer:  
Dimensions:  
Description:

04  
CUSTOM  
Approx. 761mm L x 304mm D x 829mm H.  
Millwork upper cabinet, bottom, top, and sides constructed of 19mm plywood c/w adjustable mid shelf. Provide lockable millwork swing doors to match. Provide white interior laminate. Exterior cabinet finish to be plam, colour as selected by NCC representative. Mount wall cabinets at heights indicated and ensure they do not impede equipment below. Coordinate required backing with general contractor.

**Item No.: 1.20**

**SPARE NUMBER**

**Item No.: 1.21**

**SPECIALTY COFFEE DISPENSER**

Quantity  
Manufacturer:  
Model:  
Description:

01  
BUNN-O-MATIC and/or approved equal  
SLCA-7  
Unit shall dispense two coffees from liquid concentrate plus milk and chocolate powders and accommodate two (2) 1.9L liquid coffee bibs and two (2) 3.63kg hoppers. Unit shall serve (7) drink sets. Unit shall have 15.4L hot water tank, front of machine access for service, spring loaded auger drive system & key lock on door.

Provide:

Provide unit with suitable water filter as recommended.

**Item No.: 1.22**

**CUBELET ICE / WATER DISPENSER**

Quantity  
Manufacturer:  
Model:  
Description:

01  
HOSHIZAKI and/or approved equal  
DCM-270BAH  
Air-cooled countertop ice and water dispenser with Sst construction cabinet, 282 lb. daily production capacity of cublet ice. Unit shall have separate ice and water chutes and shall include antimicrobial product protection and H-Guard for sanitation purposes. Dispenser shall have automatic bin level control to start and stop ice machine.

Provide:

Provide unit with suitable water filter.

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<b>Item No.: 1.23</b>	<b>3 in 1 VENDING MACHINE, N.I.C</b>
Quantity	01
Description:	Provide services as required.

**END OF SPECIFICATION**

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing.

### 1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 National Research Council Canada
  - .1 NRCC NBCC-2010, National Building Code of Canada 2010.

### 1.3 GENERAL

- .1 This section covers items common to all sections of Divisions 22, 23 & 25.
- .2 Coordinate location & installation of all equipment with all trades to ensure the equipment is serviceable.
- .3 Prime mechanical contractor shall be responsible to ensure that all requirements of Divisions 22, 23 & 25 are met and comply with all other divisions and contract documents.
- .4 The word "provide" shall mean "supply and install".
- .5 Conform to the requirements of Division 00 & Division 01.
- .6 It is a requirement of this Contract that there be a single prime mechanical Sub-contractor who shall retain sub-sub-contractors for all the other mechanical sub-contractors work as defined with contract documentation. There shall not be more than one prime mechanical trade sub-contractor directly retained by the Contractor. Sub-sub mechanical contractor shall include but not limited to, insulation, plumbing, HVAC, controls, refrigerations, service, welding, seismic, acoustic, and specialties, etc. The contractor shall not be the mechanical prime sub-contractor.

### 1.4 EQUIPMENT

- .1 General:
  - .1 Mechanical equipment that is not regulated by the Green Energy Act, shall carry a permanent label installed by the manufacturers stating the equipment complies with the requirement of ANSI/ASHRAE/IESNA 90.1.
  - .2 The minimum equipment efficiency, standard rating and operating conditions shall be as per ANSI/ASHRAE/IESNA 90.1, superceded by Ontario Building Code (OBC) Supplementary Standard SB -10, unless indicated otherwise on contract documents. The higher of the energy efficiencies of the listed equipment shall prevail.
  - .3 Provide new materials and equipment of proven design, quality and of current models with published ratings for which replacement parts are readily available.
  - .4 Uniformity: Use product of one manufacturer unless otherwise specified, for equipment or material of the same type of classification.
- .2 Installation:
  - .1 Unions, flanges and/or couplings: provide for ease of maintenance and disassembly.
  - .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer, Code or as indicated; whichever is the more stringent.
  - .3 Equipment drains: pipe to floor drains in a manner which is non-obstructing.

- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.
- .5 Unless otherwise specified, follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs.
- .6 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems without interference with building structure or other equipment.
- .7 Lubrication: Provide accessible lubricating means for bearings, including permanent lubrication "Lifetime" bearings. Extended grease nipples to be supplied.

## **1.5 ANCHOR BOLTS AND TEMPLATES**

- .1 Supply anchor bolts and templates for installation by other divisions.

## **1.6 PROTECTION OF OPENINGS**

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

## **1.7 ELECTRICAL**

- .1 Electrical work to conform to Division 26 including the following:
  - .1 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems. Refer to Division 26 for quality of materials and workmanship.
- .2 Any costs associated with deviation of mechanical equipment rating affecting electrical Division 26 shall be carried by this contract.
- .3 All control wiring & conduit associated with Building Automation System & HVAC controls shall be provided by Divisions 22, 23 & 25 including power wiring to all control panels & other field mounted control devices.

## **1.8 PREPARATION FOR FIRESTOPPING**

- .1 Firestopping material and installation within annular space between pipes, ducts, insulation and adjacent fire separation: specified in Section 07 84 00 - Fire Stopping.
- .2 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.

## **1.9 PAINTING**

- .1 To Section 09 91 99 - Painting.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original. Use primer or enamel to match original. Do not paint over nameplates.
- .4 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.
- .5 Hangers, supports and equipment fabricated from ferrous metals shall be given at least one coat of corrosion resistant primer paint before shipment to job site.
- .6 Touch-up damaged surfaces of all mechanical equipment and materials, to the satisfaction of NCC Representative. Use primer or enamel to match original. Do not paint over nameplates.



### **1.10 SPARE PARTS**

- .1 Furnish spare parts, indicated in various section, and as follows:
  - .1 One casing joint gasket for each size pump.
  - .2 One head gasket set for each heat exchanger.
  - .3 One glass for each gauge glass.
  - .4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

### **1.11 SPECIAL TOOLS**

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers.

### **1.12 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS**

- .1 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.
- .2 Where specified elsewhere in Divisions 22, 23 & 25, manufacturers to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, NCC Representative may record these demonstrations on video tape for future reference.
- .6 Furnish trained instructors to instruct NCC Representative in the operation, maintenance and adjustment of all mechanical equipment; and, instruct personnel on any changes to or modifications of any equipment made under terms of the guarantee.
- .7 The instructions shall take place during regular working hours before systems are accepted and turned over to NCC Representative.
- .8 Ensure that the NCC Representative's operating personnel have received and been given opportunity to review the Operating and Maintenance Manuals prior to commencing instruction. Allow two full days on site for review of these manuals with NCC Representative and for their instruction in operation and maintenance of all mechanical equipment.

### **1.13 CLOSEOUT SUBMITTALS**

- .1 Submit operation and maintenance data for incorporation into manual in accordance with Div. 01 - General Requirements.
- .2 Operation and maintenance manual (O&M) to be approved by, and final copies deposited with, NCC Representative before final inspection.
- .3 For all equipment listed in O&M manuals provide a schedule detailing the supplied component, name, address & phone no. of equipment vendor, parts supplier and warranty agent.
- .4 Operation data to include:
  - .1 Control schematics for each system including environmental controls.
  - .2 Description of each system and its controls.

- .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for each system and each component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
  
- .5 Maintenance data shall 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.
  
- .6 Performance data to include:
  - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified elsewhere.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing.
  
- .7 Approvals:
  - .1 Submit electronic format (pdf) copy of draft Operation and Maintenance Manual to NCC Representative for approval. Submission of individual data will not be accepted unless so directed by NCC Representative.
  - .2 Make changes as required and re-submit as directed by NCC Representative.
  - .3 Upon acceptance by NCC Representative submit one (1) electronic format (pdf) and three (3) hardcopies of O&M manuals .
  
- .8 Additional data:
  - .1 Prepare and insert additional data into operation and maintenance manual when the need becomes apparent during demonstrations and instructions specified above.

#### **1.14 ACCEPTABLE PRODUCTS**

- .1 Design is based on first manufacturer's name under acceptable products. Subsequent manufacturer's names indicate that those named are acceptable providing they meet specifications and space limitations and are subject to acceptance by Shop Drawing Review.

#### **1.15 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit single electronic (pdf) copy of shop drawings and product data along with transmittal, in accordance with Section 01 00 01 - General Requirements. Hard copy shop drawings shall not be accepted.
  
- .2 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances. eg. access door swing spaces.
  
- .3 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on full equipment performance curves.
  - .4 Manufacturer to certify as to current model production.
  - .5 Certification of compliance to applicable codes.

- .4 The information to be indicated on manufacturers' shop drawings submitted for review shall include the following:
  - .1 General arrangement drawings showing component parts. Where the equipment proposed, or a component part thereof, includes modifications to a manufacturers' standard to meet the requirements of a specification, a complete assembly drawing must be submitted.
  - .2 Overall dimensions, roughing-in dimensions and clearance dimensions of all major components.
  - .3 Mounting details and dimensions.
  - .4 Complete certified performance data for the specified application with particular reference to rate of flow, operating pressure and temperatures, entering and leaving conditions of air or fluid, operating weights, operating limitation, electrical characteristics and BHP requirements.
  - .5 Gauge of fabricated material and finish specification.
  - .6 Vibration isolators and resilient hangers stating locations and weight distribution.
  - .7 Electrical wiring diagrams, control panel boards, motor test data, motor starters and controls for electrically-operated equipment furnished by mechanical trades.
- .5 Review of shop drawings or detail drawings will not relieve the obligation of ensuring that the equipment, materials, or layouts meet the functional requirements of the specifications, and that all necessary mounting space and clearance requirements are met. Thus, the NCC Representative's review is for assistance only.
- .6 No equipment will be accepted on the job site without shop drawings having been reviewed by the NCC Representative.

#### **1.16 CLEANING**

- .1 Prior to turnover to client, clean interior and exterior of all new systems. Replace all air & hydronic filters on new & modified systems. Vacuum interior of new and modified ductwork and air handling units.

#### **1.17 AS-BUILT DRAWINGS**

- .1 Site records:
  - .1 Mechanical sub-contractor shall mark all changes as work progresses and as changes occur.
  - .2 On a weekly basis, transfer information to record set of documents, revising to show all work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing (TAB), 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 copies of as-built drawings for inclusion in final TAB report.

#### **1.18 FEES AND PERMITS**

- .1 Pay all fees and obtain all permits, taxes relating to the mechanical scope of work.

### **1.19 WARRANTY**

- .1 Unless indicated otherwise provide one (1) year warranty starting at substantial completion for all new systems including materials, equipment & labour.

### **1.20 LOCATION OF MECHANICAL EQUIPMENT**

- .1 Allow for 1500 mm of adjustment for exact location of air handling units, pumps, ducts, piping, etc. at no extra cost or credit.

### **1.21 CUTTING, PATCHING & CORING**

- .1 Provide cutting, patching and coring of all walls, ceiling & concrete slabs and other surfaces as required for mechanical work. Check with NCC Representative prior to core drilling and cutting of structure regarding building requirements and policies. Provide notification, clearance & protection.
- .2 The following procedure shall be followed for cutting & core drilling:
  - .1 Contractor to coordinate and summarize all new cores and openings in building structure. Contractor to investigate on site and locate any existing available hole which may be re-used for new systems.
  - .2 Contractor to prepare a layout sketch showing all existing openings & holes and required new openings & holes, with size and locations to the closest grid line in both directions, and submit for review and approval by the NCC Representative.
  - .3 NCC Representative to provide written report outlining acceptance of the openings, as well as specific requirements for reinforcing at each location.
  - .4 Contractor to proceed with reinforcing tracing as per report and scanning for electrical conduit. Scanning to be completed using ground penetrating Radar (GPR) technology.
  - .5 Contractor shall identify at each location prior to coring and cutting the location, direction and layer of each reinforcing bar and conduit.
  - .6 Any core or opening where reinforcing steel was cut during the cutting & coring process must be retained on site, and the Contractor must inform the engineer with the following information: size of the reinforcing bar, reinforcing layer location (top steel or bottom slab steel) and direction of the bar (east - west or north - south).
- .3 Patch and make good surfaces cut, damaged or disturbed, to NCC Representative's approval. Match existing material, colour, finish and texture or as indicated otherwise.
- .4 Provide dust tight screens or partitions to localize dust generating activities and for protection of finished areas of work, workers and public.

### **1.22 FINAL INSPECTION**

- .1 Do not request final inspection until:
  - .1 Deficiencies are less than 25 items.
  - .2 All systems have been tested and are ready for operation.
  - .3 All air & water balancing has been completed as applicable.
  - .4 The NCC Representative's operating personnel have been instructed in the operation of all systems and equipment.
  - .5 The complete operation and maintenance data books have been delivered to the NCC Representative.
  - .6 All inspection certificates have been furnished including but not limited to seismic certification, City's final plumbing inspection.
  - .7 All record drawings have been completed and approved.
  - .8 All fire extinguishers have been installed.
  - .9 All spare parts and replacement parts have been provided and receipt of same acknowledged.
  - .10 The cleaning up is finished in all respects.

- .11 Upon completion of above, contractor to request in writing for final site review with a minimal 72 hour notification.
- .2 Final installation shall be subject to the approval of the NCC Representative.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 00 - Mechanical General Requirements.

### **1.2 REFERENCES**

- .1 National Fire Prevention Association (NFPA)
  - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2013 Edition.
- .2 Underwriter's Laboratories of Canada (ULC).

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

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements and 21 05 00 - Mechanical General Requirements.
- .2 Submit shop drawings and product data in accordance with Section 21 05 00 - Mechanical General Requirements and in accordance with NFPA (Fire) 13, working plans and design requirements.
- .3 Pipe layout shall be the Contractors responsibility and fully coordinated with other trades.

### **1.4 DRAWING PREPARATION**

- .1 Review architectural, structural, mechanical & electrical drawings to determine interferences affecting the distribution layout prior to shop drawing submission.

### **1.5 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in Section 21 05 00 - Mechanical General Requirements.

### **1.6 MAINTENANCE MATERIALS**

- .1 Provide maintenance materials in accordance with Section 21 05 00 - Mechanical General Requirements.
- .2 Provide spare sprinklers and tools as required by NFPA (Fire) 13.

### **1.7 ACCEPTABLE SPRINKLER CONTRACTORS**

- .1 Contractors shall be members of Canadian Automatic Sprinkler Association (CASA).

### **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 00 01 - General Requirements and with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
  - .1 Store materials indoors in dry location.
  - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

## Part 2 - Products

### 2.1 PIPE, FITTINGS AND VALVES

- .1 Pipe:
  - .1 Ferrous: to NFPA (Fire) 13.
  - .2 Ferrous hot dipped galvanized: to NFPA (Fire) 13 in corrosive or damp environments.
- .2 Fittings and joints to NFPA (Fire) 13:
  - .1 Ferrous: screwed, welded, flanged or roll grooved.
  - .2 All exposed piping shall be rigid piping.
- .3 Flexible sprinkler drops:
  - .1 Braided flexible stainless steel sprinkler drops, cULus listed for fire protection service for installation on suspended ceiling grids, wood or metal stud/joist or furring channels.
  - .2 25 mm (1") nominal ID braid hose & fitting made of 304 stainless steel, 1206 kPa (175 psi) maximum working pressure, 178 mm (7") minimum bending radius within length of 750 mm to 1800 mm as per cULus. The maximum amount of allowable bends as per cULus are as follows: 750 mm (36") (5 bends); 1200 mm (48") (8 bends); 1500 mm (60") (10 bends); 1800 mm (72") (12 bends).
  - .3 Inlet nipple 25 mm (1") NPT with straight or 90° reducer for 13 mm (1/2") or 20 mm (3/4") NPT sprinkler.
  - .4 A steel bracket with square bar, adjustable centre bracket & adjustable end brackets suitable for ceiling types. End bracket shall have permanent securement to ceiling system.
  - .5 Acceptable material: Victaulic Model VicFlex AH2; Viking model VKFD28B.
- .4 Valves:
  - .1 ULC listed for fire protection service.
  - .2 Up to NPS 2: bronze, screwed ends, OS&Y rising stem gate or ball valve.
  - .3 NPS 2-1/2 and over: cast iron, flanged or roll grooved ends, OS&Y rising stem gate or butterfly type.
  - .4 Check valves: swing type as above.
  - .5 Ball drip check valve.
- .5 Pipe hangers:
  - .1 ULC listed for fire protection services.
- .6 Sprinkler system shall be rated at 1380 kPa (200 psi).

### 2.2 SPRINKLERS

- .1 General: to NFPA (Fire) 13 and ULC listed for fire services.
- .2 Provide wire guards in all mechanical rooms, storage areas, electrical rooms, and elevator machine room.
- .3 All sprinklers shall have low zinc content (less than 10%) brass alloy and metal to metal sealing mechanism in the water ways.
- .4 Acceptable materials: Viking, Grinnell, Victaulic & Tyco.

### **2.3 CONCEALED SPRINKLER**

- .1 Fully concealed pendant, quick response for hazard coverage as indicated, 5.6 K factor, enclosed escutcheon, separate two-piece design of mounting cup & coverplate, internal threaded closure, 68°C (155°F) rated, 13 mm (½") adjustment, FM approved, white enamel chrome finish, glass bulb type and white finish cover.

### **2.4 UPRIGHT SPRINKLER**

- .1 Upright bronze, quick response for hazard coverage as indicated, 5.6 K factor, FM approved, chrome finish, glass bulb type c/w wire guard; 68°C (155°F) rated, 13 mm (½") orifice.

## **Part 3 - Execution**

### **3.1 INSTALLATION**

- .1 Install, inspect and test to acceptance in accordance with Factory Mutual's requirements and NFPA (Fire) 13.
- .2 Testing to be witnessed by Authority having jurisdiction.
- .3 Install and test equipment to manufacturers' standards.

### **3.2 TESTING**

- .1 Pressure test all piping systems as required by NFPA and provide pressure test verification documents.



## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 21 05 00 - Mechanical General Requirements.
- .2 Section 23 05 05 - Installation of Pipework
- .3 Section 23 05 23.01 - Valves.

### 1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
  - .1 ANSI/ASME B16.15-2013, Cast Bronze Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 ASTM International Inc.
  - .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
  - .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 National Research Council (NRC)/Institute for Research in Construction
  - .1 NRCC NPCC-2010, National Plumbing Code of Canada (NPC) - 2010.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## Part 2 - Products

### 2.1 PIPING

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

### 2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: roll grooved to CSA B242.

### 2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 lead free solder.
- .4 Teflon tape: for threaded joints.

### 2.4 VALVES

- .1 Refer to Section 23 05 23.01 - Valves.

## Part 3 - Execution

### 3.1 APPLICATION

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

### 3.2 INSTALLATION

- .1 Install in accordance with NPC, Provincial Plumbing Code and local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .4 Assemble piping using fittings manufactured to ANSI standards.

- .5 Install DCW piping below and away from DHW and DHWR and other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

### **3.3 PRESSURE TESTS**

- .1 Conform to requirements of Section 21 05 00 - Mechanical General Requirements.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

### **3.4 FLUSHING AND CLEANING**

- .1 Flush system for 8 h.

### **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 DISINFECTION**

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of NCC Representative.

### **3.7 START-UP**

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.

### **3.8 OPERATION REQUIREMENTS**

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

### **3.9 CLEANING**

- .1 Clean in accordance with Section 01 00 01 - General Requirements.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 00 01 - General Requirements.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 00 - Mechanical General Requirements.

### **1.2 REFERENCES**

- .1 ASTM International Inc.
  - .1 ASTM D2235-04(2011), Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .2 ASTM D2564-12, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B1800-11, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

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

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 30 - Health and Safety.

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

- .1 Deliver, store and handle in accordance with Section 01 00 01 - General Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.

## Part 2 - Products

### 2.1 PIPING AND FITTINGS

- .1 DWV PVC (Polyvinyl Chloride):
  - .1 Application: below grade sanitary, storm & vent piping & fittings.
  - .2 Pipe and Fittings: Drain, waste and vent pipe and fittings shall be certified to CSA B181.2. When combustible pipe and fittings are used in buildings required to be of noncombustible construction, they shall be listed by ULC to the Standard CAN/ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25.
  - .3 Acceptable material: IPEX System 15 DWV.
- .2 Fire & smoke resistant coated DWV PVC (Polyvinyl Chloride) piping & fittings:
  - .1 Application: Above grade sanitary, storm & vent piping & fittings where combustible piping is permitted including OBC 3.2.6 High-rise applications and within ceiling plenums.
  - .2 Pipe and Fittings: Drain, waste and vent pipe and fittings shall be certified to CSA B181.2 and when used in noncombustible construction, high-rise buildings and air plenums, they shall be tested and listed in accordance with CAN/ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25 and a smoke-developed classification not exceeding 50.
  - .3 Acceptable material: IPEX System XFR 15/50 PVC-DWV.
- .3 Firestopping Devices:
  - .1 All combustible pipe penetrations shall comply with the requirements described in the O.B.C. 3.1.9.4.(1) through (8) and provide a firestop system that has been Tested and Listed to the test Standard CAN/ULC S115 with a pressure differential of 50 Pa. In addition, the manufacturer shall provide a documentation confirming compliance with the Listed system.
- .4 Solvent Welding:
  - .1 Solvent cements shall be CSA certified and meet the requirements of ASTM D2564. One-step cement may be used for sizes from NPS 40 to 150. Two-step cement must be used in conjunction with primer on larger pipe sizes. Proper solvent cementing procedures must be followed at all times.
  - .2 The manufacturer, shall be consulted prior to installation for proper solvent welding procedures and proper solvent cement requirements.
- .5 Expansion/Contraction:
  - .1 Compensation shall be made to accommodate expansion/contraction on the drainage system. It is recommended that there be compensation on every second floor for the vertical piping system. Consult pipe system manufacturer for specific details regarding approved compensation methods.
- .6 Compatibility:
  - .1 To ensure compatibility, performance and material quality, all pipe and fitting drainage system shall be produced by the same manufacturer.
- .7 Quality Control:
  - .1 The manufacturer of the pipe and fitting system shall be contacted prior to the installation to obtain precise installation instructions. Site meetings shall be arranged and include, the Contractor, Manufacturer and Building Inspector.

## Part 3 - Execution

### 3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
- .2 Bedding and backfilling should be in accordance with City of Ottawa standards and specifications. Install buried pipe on 150 mm (6") bed of compacted clean Granular A bedding compacted to 95% (min.) dry proctor density, shaped to accommodate hubs and fittings, to line and grade as indicated. The material should be placed in maximum 300 mm thick lifts. (If trench bottom is unstable, bring to NCC Representative attention before bedding is laid). Limit vertical deflection and increase pipe support by compacting soil in both directions away from the pipe toward trench walls. Initial backfill to begin at springline of pipe to 300 mm (12") above pipe using compacted clean Granular A bedding compacted to 95% (min.) dry proctor density. Final backfill shall be in accordance with Geotechnical Report and as minimum utilize clean Granular A compacted to 95% dry proctor density in 300 mm thick lifts. Bedding and backfill shall be provided by this division and in accordance with Div. 02 - Site Work. representative

### 3.2 TESTING

- .1 Test in accordance with OBC Part 7 requirements.
- .2 Pressure test buried systems before backfilling.
- .3 Hydraulically test to verify grades and freedom from obstructions.
- .4 Video Testing:
  - .1 Provide video scanning of underground sanitary and storm piping for contractor's review and approval prior to pouring of concrete. Repair deficiencies and re-scan as required. Submit final video to Engineer for record.
  - .2 Flush & video scan sanitary and storm piping for contractor's review and approval prior to building turnover. Repair deficiencies and re-scan as required. Submit final video to Engineer for record.

### 3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system and effectively vented.

### 3.4 CLEANING

- .1 Clean in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
  - .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 00 01 - General Requirements.

## Part 1 - General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
  - .1 CSA B79-08 (R2013), Acceptable material: Watts, J.R. Smith & Zurn Z-1700. ackflow Preventers and Vacuum Breakers.
- .2 Plumbing and Drainage Institute (PDI)
  - .1 PDI WH201-2010, Water Hammer Arresters Standard.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 00 01 - General Requirements.
- .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 Manufacturers' Field Reports: manufacturers' field reports specified.
- .4 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list.

### 1.3 QUALITY ASSURANCE

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 00 01 - General Requirements.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Divert unused metal materials from landfill to metal recycling facility as approved by NCC 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 and trench drains: to CSA B79.
- .2 FD1: Medium duty; cast iron body round, adjustable head, 5" (125 mm) dia. nickel bronze strainer, integral seepage pan, trap priming connection and clamping collar.
  - .1 Acceptable material: Watts, Mifab, Zurn ZZN-415-B5P.
- .3 FD2: combination funnel floor drain concrete floor; cast iron body round with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel and trap priming connection.

### 2.2 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access covers:
  - .1 Wall access: face or wall type, or stainless steel square or round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor access: round cast iron body and frame with adjustable secured nickel bronze top, and
    - .1 Plugs: bolted bronze with neoprene gasket.
    - .2 Cover for unfinished concrete floors: nickel bronze round or square, gasket, vandal-proof screws. Acceptable material: Watts, Zurn ZX-1612-BP.
    - .3 Cover for terrazzo finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws. Acceptable material: Watts, Zurn ZX-1400-BP-Z.
    - .4 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws. Acceptable material: Watts, Zurn ZZN-1612-BP-VP.

### 2.3 TRAP SEAL PRIMERS

- .1 Type 4: Electronic Trap Primer - B.A.S. Type
  - .1 Electronic activated type, all brass construction with "O" ring seals, 12 mm (NPT ½) female inlet & 12 mm (NPT ½) female outlet drip line connection with air gap, viewing holes, and removable filter screen. Trap primer shall have no flow adjustment. Operating range shall be 138 kPa (20 psi) to 861 kPa (125 psi). Unit shall have 120 V or 24 V solenoid valve and calibrated manifold for equal water distribution. One (1) to ten (10) drain taps per unit.
  - .2 Valve to be wired to BAS for remote timed operation.
  - .3 Identify on as-built drawings the location of each trap seal primer.
  - .4 Ensure all trap seal primers are accessible for maintenance purposes and are connected to cold water line. Trap line shall be from top of cold water line and include a service valve. All to be installed in steel cabinet and serviceable from access doors.
  - .5 Acceptable material: Watts, Mifab MI-200, Zurn Z-1020 (1 to 5) for 10 - 2 distribution units will be required.

### 2.4 WATER HAMMER ARRESSTORS

- .1 Copper construction, bellows or piston type: to PDI-WH201.
- .2 Acceptable material: Watts, J.R. Smith & Zurn Z-1700.



## **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 FLOOR DRAINS**

- .1 Floor drains to be installed at lowest point in floor and placed to ensure floor finishing is flush/slightly higher than strainer. Contractor to chip concrete around drains, lower assembly, patch concrete and provide floor finish should the installed elevation be unacceptable to Engineer.
- .2 Contractor to provide suitable means of protecting floor drains and cleanouts from damage during construction. Contractor to be responsible for turning over facility to Owner with floor drains and strainers in new condition. Damaged material shall be replaced with new at contractor's expense.

### **3.3 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.

### **3.4 CLEANOUTS**

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

### **3.5 WATER HAMMER ARRESTORS**

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

### **3.6 TRAP SEAL PRIMERS**

- .1 Install for floor drains and elsewhere, as indicated.
  - .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of NCC Representative.
  - .3 Install soft copper tubing to floor drain.
  - .4 Identify on as-built drawings the location of each trap seal primer.
  - .5 Ensure all trap seal primers are accessible for maintenance purposes. Install access doors if required.
-

### 3.7 TESTING AND ADJUSTING

- .1 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, removeability of strainer.
  - .5 Clean out baskets.
  
- .2 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
  
- .3 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.

## Part 1 - General

### 1.1 RELATED SECTIONS

- .1 Section 21 05 00 - Mechanical General Requirements.
- .2 Section 22 13 18 - Drainage Waste and Vent - Plastic.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA B45 Series-02 (R2013), Plumbing Fixtures (Consists of B45.0-02, B45.1-02, B45.2-02, B45.3-02, B45.4-02, B45.5-02, B45.6-02, B45.7-02, B45.8-02 and B45.9-02), Includes Updates No. 1, No. 2, No. 3, and No. 4 (2007).
  - .2 CSA B125-01, Plumbing Fittings.
  - .3 CSA B651-12, Accessible Design for the Built Environment.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Indicate, for all fixtures and trim:
  - .1 Dimensions, construction details, roughing-in dimensions.
  - .2 Factory-set water consumption per flush at recommended pressure.
  - .3 (For water closets, urinals): minimum pressure required for flushing.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 21 05 00 - Mechanical General Requirements.
- .2 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

## Part 2 - Products

### 2.1 MANUFACTURED UNITS

- .1 Fixture piping.
  - .1 Hot and cold water supplies to each fixture:
    - .1 Stops supplies shall be all brass with full turn brass seams and replaceable washer attachment shall be IPS inlet x compression OD outlet to fixture. All fixture stop valves shall be screw driver type.
    - .2 Chrome plated in all exposed places.
  - .2 Waste:
    - .1 Cast brass adjustable style P-trap with cleanout on each fixture not having integral trap.
    - .2 Chrome plated in all exposed places.

- .3 Sink and lavatory heavy gauge P-traps shall be cast brass adjustable style with 17 ga. seamless brass wall bend. Attachment nuts shall be brass, no zinc allowed. P-traps to be removable/union type or to include cleanout.
  - .4 Lavatory strainers shall be chrome plated cast brass with 17 ga. seamless brass tailpiece.
  - .5 All barrier-free lavatories and sinks shall have chrome plated offset tail piece in addition to P-trap with cleanout. Insulate P-trap and hot & cold water pipes with pre-formed & finished surface insulation. Armaflex insulation and tape not acceptable.
- .2 Fixtures:
    - .1 Manufacture in accordance with CSA B45.
    - .2 All products, where applicable, shall be marked with manufacturer's name or product #.
  - .3 Trim, fittings: manufacture in accordance with CSA B125.
  - .4 Number, locations: Architectural drawings to govern.
  - .5 Fixtures in any one location to be product of one manufacturer and of same type.
  - .6 Trim in any one location to be product of one manufacturer and of same type unless otherwise indicated.
  - .7 Reference drawing schedule for configuration and type.

## **2.2 CARRIERS**

- .1 Provide for all wall mounted plumbing fixtures.

## **2.3 ROUGHING-IN OF FIXTURES**

- .1 Rough-in for equipment supplied by other to be complete with valved supplies, wastes and vents, capped and associated fitting piping & reducers.

## **2.4 PLUMBING FIXTURES**

- .1 Reference fixture schedule on Drawings.

## **Part 3 - Execution**

### **3.1 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Wall-hung fixtures: as indicated on architectural elevations.
  - .3 Physically handicapped: to comply with most stringent of either NBCC, OBC or CAN/CSA B651.

### **3.2 URINALS**

- .1 Urinal waste pipe & fittings shall be DWV PVC equivalent to IPEX System 15 in accordance with specification Section 22 13 18 - Drainage Waste and Vent - Plastic. Extend plastic piping up to combined waste from adjacent lavatory or other plumbing fixtures allowing dilution of waste.

### 3.3 ADJUSTING

- .1 Conform to water conservation requirements specified in this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates and sensors.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
  - .3 Adjust flush valves to suit actual site conditions.
- .3 Checks:
  - .1 Water closets: flushing action.
  - .2 Aerators: operation, cleanliness.
  - .3 Vacuum breakers, backflow preventers: operation under all conditions.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 00 - Mechanical General Requirements.
- .2 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

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

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.

## **Part 2 - Products**

### **2.1 NOT USED**

- .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, maintenance and as recommended by manufacturer.
  - .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer as indicated without interrupting operation of other system, equipment, components.
-

### **3.4 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
  - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.5 AIR VENTS**

- .1 Install automatic air vents to at high points in piping systems.
- .2 Install isolating ball valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.
- .4 Air units must have minimum connect of 13 mm (½").

### **3.6 DIELECTRIC COUPLINGS**

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

### **3.7 PIPEWORK INSTALLATION**

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Weldolets, sockolets, saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle. Provide isolation valves at each branch connection.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, 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 and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .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 unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
  - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .8 Install plug cocks or ball valves for glycol service.
- .15 Check Valves:
  - .1 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### **3.8 SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .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.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for firestopping.
    - .2 Maintain 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.

### **3.9 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.



### **3.10 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.
- .3 Provide test results upon completion and return within report on status after completion .

### **3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise NCC Representative 48 hours minimum prior to performance of pressure tests.
- .2 Piping: test to 1½ times operating pressure to a maximum of the piping systems working pressure including devices (i.e. valves, fittings, accessories). Minimum test pressure to be 862 kPa (125 psi).
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .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 NCC Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. NCC Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by NCC Representative.

### **3.12 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by NCC Representative .
- .2 Request written approval by NCC Representative 10days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

### **3.13 CLEANING**

- .1 Clean in accordance with Section 01 00 01 - General Requirements.
  - .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 00 01 - General Requirements.

## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Electrical motors, drives and guards for mechanical equipment and systems.
  - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
  - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.
- .2 Related Requirements:
  - .1 Section 21 05 00 - Mechanical General Requirements.

### 1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 National Electrical Manufacturers' Association (NEMA)
  - .1 ANSI/NEMA MG 1-2011, Motors and Generators.
- .4 Ontario Regulation
  - .1 ONTARIO OBC-2006, 2006 Ontario Building Code Compendium.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Closeout Submittals
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## Part 2 - Products

### 2.1 GENERAL

- .1 Motors to be premium efficiency, in accordance with NEMA 1 premium motor standards and the requirements of ANSI/ASHRAE/IESNA 90.1 unless superseded by Ontario Building Code (OBC) Supplementary Standard SB-10.

**2.2 MOTORS**

- .1 Provide premium efficiency motors for mechanical equipment to NEMA MG 1 Part 30 & 31 and as specified.
- .2 Motors efficiency must exceed the following:

Open Drip-Proof (ODP) Type

Motor Size	Speed (RPM)		
HP	1200	1800	3600
	NEMA Premium Nominal Efficiency		
1 & below	82.5%	85.5%	77.0%
1.5	86.5%	86.5%	84.0%
2	87.5%	86.5%	85.5%
3	88.5%	89.5%	85.5%
5	89.5%	89.5%	86.5%
7.5	91.0%	91.0%	88.5%
10	91.7%	91.7%	89.5%
15	91.7%	93.0%	90.2%
20	92.4%	93.0%	91.0%
25	93.0%	93.6%	91.7%
30	93.6%	94.1%	91.7%
40	94.1%	94.1%	92.4%
50	94.1%	94.5%	93.0%
60	94.5%	95.0%	93.6%
75	94.5%	95.0%	93.6%
100	95.0%	95.4%	93.6%
125	95.0%	95.4%	94.1%
150	95.4%	95.8%	94.1%
200	95.4%	95.8%	95.0%

Totally Enclosed Fan-Cooled (TEFC) Type

Motor Size	Speed (RPM)		
HP	1200	1800	3600
	NEMA Premium Nominal Efficiency		
1 & below	82.5%	85.5%	77.0%
1.5	87.5%	86.5%	84.0%
2	88.5%	86.5%	85.5%
3	89.5%	89.5%	86.5%
5	89.5%	89.5%	88.5%
7.5	91.0%	91.7%	89.5%
10	91.0%	91.7%	90.2%
15	91.7%	92.4%	91.0%
20	91.7%	93.0%	91.7%
25	93.0%	93.6%	91.7%
30	93.0%	93.6%	91.7%
40	94.1%	94.1%	92.4%
50	94.1%	94.5%	93.0%
60	94.5%	95.0%	93.6%
75	94.5%	95.4%	93.6%
100	95.0%	95.4%	94.1%
125	95.0%	95.4%	95.0%
150	95.8%	95.8%	95.0%
200	95.8%	96.2%	95.4%

- .3 Motors under 373 W (½ HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

- .4 Motors 373 W (½ HP) to 14.92 kW (20 HP): EEMAC Class B/F, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 45°C/60°C over ambient of 30°C, 3 phase, 600 V, unless otherwise specified or indicated.
- .5 Motors 18.65 kW (25 HP) and larger: EEMAC Class B/F, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 45°C/60°C over ambient of 30°C, 3 phase, 600 V, c/w integral thermistor protection, unless otherwise specified or indicated. Thermistors shall be factory installed, copper RTD type, one on each phase, wired to identified terminals in motor terminal box and wired to starter/VFD (wiring, conduit & connections by Div. 26).
- .6 Two speed motors shall be double winding type.
- .7 Motors coupled with VFD shall be premium efficiency, inverter duty type to NEMA MG 1 Part 31 and shall have as a minimum EEMAC Class F insulation. There shall be no restrictions on the cable length between the VFD and the motor. Inverter ready motors shall not be acceptable.

## **2.3 TEMPORARY MOTORS**

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

## **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 Make removable for servicing, easily returned into, and positively in position.

### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 00 - Mechanical General Requirements.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA).
- .2 National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA MG 1-2011, Motors and Generators, Part 31.
- .3 Underwriters Laboratories (UL).

### **1.3 SCOPE**

- .1 Provide Variable Frequency Drives (VFD's) for the equipment listed on Drawing Schedules.
- .2 Provide on-site commissioning (start-up) of the Variable Frequency Drives by factory trained service personnel. Adequate time must be allowed to thoroughly and safely start, program, and test run the VFD with the building management system. A separate site visit to be provided for training of operation and maintenance personnel.
- .3 The contractor is responsible for ensuring that the existing equipment is in top operating condition before the commissioning of the VFD's occur. Any additional work required to bring the equipment into top operating condition should be brought to the Engineers attention.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 All bid submittals must include the following:
  - .1 A detailed description of all components in the VFD package, including line and load reactor impedance ratings and or filter design type, VFD current, HP, and voltage rating.
  - .2 A list of any exceptions to this specification.
  - .3 Harmonic specification compliance calculations.
- .3 All approval submittals shall include the following and approvals must be received prior to delivery of any goods:
  - .1 Schematic wiring diagram showing all VFD package component connections and all serial, digital and analog inputs and outputs to be connected to the control system.
  - .2 Mechanical dimensional drawings with mounting details.
- .4 On completion of the installation, the supplier shall provide the following:
  - .1 Full commissioning report documenting all programmable settings, AC input voltage, DC Bus voltage, current draw at maximum speed, amp vs speed curve and a description of ambient conditions.
  - .2 One operators manual for each VFD installed.
  - .3 One 216 mm x 279 mm wiring diagram for each VFD installed.
- .5 Closeout Submittals
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.5 GENERAL DESIGN CHARACTERISTIC**

- .1 The VFD shall be of the Pulse Width Modulated (PWM) voltage source type, utilizing fixed diode bridge input rectification and Insulated Gate Bipolar Transistor (IGBT) / Intelligent Power Module (IPM) technology.
- .2 The VFD's digital electronic control board(s) shall be manufactured using Surface Mount Technology (SMT).
- .3 The VFD shall be dual rated for variable torque applications, with the continuous duty output current on the nameplate. The overload rating shall be 110% for 60 seconds. The VFD shall be selected such that the continuous duty current rating shall be equal to or greater than the connected motor full load current rating.
- .4 All VFD's shall be factory CSA/CUL certified.
- .5 All packaged drive systems shall be CSA certified.
- .6 The VFD shall have the capability of operating multiple motors. The minimum VFD continuous current rating shall be the sum of the full load current ratings of the connected motors.
- .7 The VFD shall be capable of operating in an open circuit mode i.e. with the motor(s) disconnected, for start-up and test purposes.
- .8 The VFD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.
- .9 The VFD and all options (e.g. line and load reactors, filters, bypass, etc.) must be manufacturer wired & warrantied as an assembly in NEMA 1 enclosures. The enclosures may be of a Wall or Floor mount design, depending on the rating, and be supplied with forced ventilation complete with cleanable air filters in enclosures where components produce excessive heat.
- .10 Warranty of the VFD System shall be for 24 months from the date of start-up or thirty months from date of delivery, which ever is sooner. The warranty shall include all parts and repair labour. The VFD manufacturer shall have the ability to repair the system within 24 hours of notification.

## **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 00 01 - General 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 00 01 - General Requirements.

## Part 2 - Products

### 2.1 ACCEPTABLE MATERIALS

- .1 Hitachi, ABB, Danfoss, Yaskawa.

### 2.2 STANDARD VFD DESIGN FEATURE

- .1 Microprocessor Logic: The VFD shall include a 32 bit microprocessor and DSP (Digital Signal Processor). A digital display keypad shall be provided for input of parameter setting and operating commands. The digital display shall indicate output frequency, motor RPM, output current, as well as fault history information.
- .2 Digital Inputs: The VFD shall include a minimum of five (5) digital inputs programmable for function. Each input shall also be programmable to operate as a normally open (n/o) or normally closed (n/c) contact.
- .3 Analog Inputs: The VFD shall accept an analog speed reference input signal of 0-5 V DC, 0-10 V DC, and/or 4-20 ma). If both inputs are active, the 0-10V DC (or 0-5 V DC) or 4-20 mA signals shall be selectable by a digital input.
- .4 Digital Outputs: The VFD shall include two(2) digital outputs each programmable for drive run, frequency arrival (at set speed) or over torque. Each output shall also be programmable to operate as a normally open (n/o) or normally closed (n/c) contact.
- .5 Analog Output: The VFD shall provide an analog pwm output signal (0-10 V DC, @ 1 ma) proportional to the output frequency or output current.
- .6 Alarm Relay Outputs: The VFD shall provide an alarm relay which activates during a fault condition. The relay contacts shall include a set of normally open/normally closed (form c) contacts.
- .7 Auto Restart: The VFD shall have the capability to automatically restart the motor after an interruption in input power.
- .8 Critical Frequency Rejection: The VFD shall provide a minimum of three(3) selectable jump frequency points used to avoid critical resonance of the mechanical system. Frequency bandwidth for each jump frequency shall be programmable from 0 to +/- 9.9 Hz.
- .9 DC Injection Braking: The VFD DC braking control shall be capable of automatic initiation prior to all start commands to stop a "wind-milling" fan motor before issuing a run command. The duration and amplitude of this setting is to be programmable through the operator interface.
- .10 Acceleration/Deceleration Control: The VFD shall provide independent programmable settings for accel/dec l time (0-999 seconds). The VFD shall also include a setting to allow the motor to coast to a stop. Acceleration and deceleration shall be programmable for linear, S-Curve, U-Curve or Reverse-U-Curve output.
- .11 Carrier Frequency: The carrier frequency shall be programmable from 3 kHz up to a maximum of 16 kHz in 0.1 increments.
- .12 Energy Savings:
  - .1 The VFD shall be programmable for variable torque V/F curves to optimize energy consumption.
  - .2 The VFD shall include an Automatic Energy Savings feature to further reduce energy consumption by minimizing the current demand of the motor for a given load, automatically.
- .13 Automatic Voltage Regulation: The VFD shall maintain the rated starting torque independent of the input voltage tolerance of +/-10%.

- .14 Power Loss Ride-through: The VFD shall have a ride-through capability during an intermittent loss of power for up to 15 mSec.
- .15 Min/Max Speed: Minimum and maximum speed settings shall be adjustable from 0 - 100%.
- .16 Fault Log: A fault log will record the total number of faults and display details of the last three faults, including reason for fault, frequency at time of fault, current at time of fault, and DC Bus Voltage at time of fault.
- .17 Pre-set Speeds: Using the digital inputs a minimum of 7 programmable pre-set speeds shall be selectable.
- .18 Safety Interlocks: Terminals to be provide for connection of safety interlocks such as [motor thermistors] Fire-stat and Freeze-stat. These interlocks shall shutdown operation in either the Drive or Bypass operating modes.
- .19 Door Mounted Operator Controls/Indicators: The basic operator controls shall consist of the following:
  - Hand - Off - Auto Selector Switch
  - Potentiometer for setting speed in "Hand"
  - Indicating Lights for:
    - Power On
    - Run
    - Fault
  - Drive Keypad for setting parameters, control and viewing of Speed, Current, and Alarms
  - Bypass

## 2.3 OUTPUT RATINGS

- .1 The VFD shall operate within the following rated values.
  - .1 Output Frequency Range: 0.1 to 400 Hz.
  - .2 Frequency Accuracy: +/- 0.01% with respect to digital input setting.
  - .3 Overload Rating: VT - 125% for 60 seconds.

## 2.4 INPUT POWER

- .1 Voltage: 3 phase (3 wire) 600V +/- 10%
- .2 Frequency: 60 Hz +/- 5%

## 2.5 ENVIRONMENTAL RATINGS

- .1 The VFD shall operate within the following parameters without the need for derating:
  - .1 Temperature: -10 to 40°C.
  - .2 Humidity: 20 - 90% RH non-condensing.
  - .3 Altitude: up to 1,000 meters.
  - .4 Vibration of 0.2 G or less.

## 2.6 PROTECTIVE FEATURES

- .1 The VFD shall be designed to include the following protective functions and displays for maintainability:
  - .1 All control circuits (5, 12, & 24 V DC) shall be physically and electrically isolated from the power circuit voltages to ensure safety to maintenance personnel.
  - .2 Instantaneous Over Current Protection: The output of the VFD shall automatically be turned off if the operating current exceeds the specified level.
  - .3 Motor Overload Protection: The VFD shall include electronic thermal overload protection for automatic reduction of the overload limit at reduced operating speed. Overload protection shall be provided in



both VFD and bypass operation. The output of the VFD shall be disabled if the motor's thermal rating is exceeded.

- .4 External Trip: The VFD shall have the capability to accept an external trip input and the input shall be programmable for either N/O or N/C operation.
- .5 Phase Loss Protection: Phase loss detection shall be provided to prevent single phasing of the VFD input.
- .6 Unattended Start Protection: The VFD shall include a user selectable function to prevent an automatic restart after an interruption in input power.
- .7 Over Voltage Protection: The output of the VFD shall be automatically cut off if the DC Bus voltage exceeds the specified level due to regenerative energy from the motor.
- .8 Ground Fault Protection: The VFD shall have the capability to sense current imbalance during motor start-up for protection of the power circuit in the event of a ground fault.
- .9 Software Lock The VFD shall include a software function which prevents changes to the user defined settings.
- .10 Power Module Protection: The IPM shall incorporate thermal and short circuit protection circuits.
- .11 CPU or EEPROM Error: VFD shall automatically be turned off in the event of an error in the CPU or EEPROM.
- .12 Option board communication error: VFD will automatically be turned off in the event of an option board error.

## **2.7 RELIABILITY**

- .1 A complete description of the manufacturer's quality assurance and testing program shall be provided.
- .2 Printed Circuit Boards / Pre-assembly: All blank circuit boards shall be checked for appearance, dimensions and continuity as per specification. All electronic components shall be subjected to a visual and functional test. Circuit board components shall be stored at 15-30°C @ 5 % humidity.
- .3 Printed Circuit Board Inspection: All surface-mount devices shall be subjected to microscopic inspection for component alignment and solder joint integrity. All completed circuit boards shall undergo a thermal stress test with temperatures cycled between -5 to 65°C.
- .4 All VFD's of a series shall use one common logic printed circuit board for all units supplied.

## **2.8 INPUT FILTERING**

- .1 All VFD's shall be furnished with the following protective devices as a minimum: All 600V systems require 5% impedance harmonically compensated Line reactors rated to carry 150% total RMS current continuously for the reduction of line harmonics and to limit line voltage transients.

## **2.9 OUTPUT FILTERING**

- .1 All VFD's shall be furnished with LRC Sine wave output filter to match load.

## **2.10 INTEGRAL BYPASS**

- .1 Provide Bypass package in a NEMA 1 enclosure. Bypass shall include three (3) contactors for manual switching from the VFD to line and from Line to VFD. Control Transformer, Class J fuses relay and:
  - .1 Provide an Operator station consisting of:
    - Hand-OFF-Auto Selector Switch
    - VFD-Off-Bypass Selector Switch
    - Auto Bypass Enable Switch
    - Test Mode Switch
    - Manual Speed Potentiometer

- Power On Light
  - External Trip On Light
  - Hand Operation Light
  - Auto Operation Light
  - VFD On Light
  - VFD Run Light
  - VFD Fault Light
  - Frequency Arrival (at set speed) Light
  - Bypass On Light
  - Bypass Fault Light
  - Auto Bypass Enable Light
  - Test Mode Light
- .2 When in Bypass Mode the VFD shall be isolated from the line and motor to enable servicing by qualified personnel. The Drive output contactor and the bypass contactor must be mechanically interlocked to prevent simultaneous closure.
  - .3 Provide dry contacts for Fault, Run Status, and Frequency arrival to the building automation system.
  - .4 Provide a 24 VDC power supply.
  - .5 The Drive output contactor and the bypass contactor must be mechanically interlocked to prevent simultaneous closure.
  - .6 Provide overload protection in the bypass circuit.

## **2.11 DISCONNECT SWITCH**

- .1 Provide fusible Input Disconnect complete with Class J 200 kA interrupt fuses (sized per CEC tables), for all VFD installations. The Fusible disconnect shall be integrally mounted and wired within the enclosure and be provided with a door interlock mechanism to prevent unauthorized entry with the power on. In addition the disconnect must have provision for padlocking in the off position. Service personnel shall be able to open the door when the system is operating.

## **2.12 DIGITAL KEYPAD**

- .1 Provide a multi-line display (minimum 4 lines) (68 characters) digital backlit keypad that employs words and numbers for easy operator interface. Keypad shall be capable of monitoring, programming, and operating the VFD.

## **2.13 OVERLOAD RELAY**

- .1 Provide a separately mounted Class 20 overload relay for each motor. Provide door mounted overload reset buttons.

## Part 3 - Execution

### 3.1 START-UP AND COMMISSIONING SERVICES

- .1 The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer site. Sales personnel and other agents who are not factory certified technicians for drive repair shall not be acceptable as commissioning agents. The manufacturer shall have the ability to repair his products within 24 hours of notification of failure.
- .2 Start-up services shall include checking for verification of proper operation and installation of the VFD, its options and its interface wiring to the building automation system. Included in this service shall be as a minimum:
  - .1 Verification of contractor wire terminations and conduit runs to and from the VFD.
  - .2 One hour of customer operator training on the operation and service diagnostics at the time of commissioning.
  - .3 Measurement for verification of proper operation of the following:
    - .1 Motor voltage and frequency. Verification of proper motor operation.
    - .2 Control input for proper building automation system interface and control calibration.
    - .3 Calibration check for the following set-points:
      - .1 minimum speed
      - .2 maximum speed
      - .3 acceleration and deceleration rates.
- .3 Commissioning agent to verify the programming of the VFD and to provide a written copy of the settings to the engineer.
- .4 Commissioning agent to lock out critical frequencies throughout the operating curve of the equipment as identified and required by the engineer. The agent shall record amperages at six (minimum) different frequencies from minimum to maximum speed.

### 3.2 EXAMINATION

- .1 The contractor is to verify that the job site conditions for installation meet the factory recommended and code required conditions for the VFD installation prior to start-up. These shall include as a minimum:
  - .1 Clearance spacing.
  - .2 Compliance with environmental ratings of the VFD system.
  - .3 Separate conduit installation of the input wiring, the motor wiring, and control wiring. At no time does any of this wiring run in parallel with each other.
  - .4 All power and control wiring is complete.
- .2 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD system shall not be operated while the unit is covered.
- .3 Power shall not be applied until the manufacturer has started up his equipment.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 00 - Mechanical General Requirements.
- .2 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Data to include:
    - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

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

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

## **Part 2 - Products**

### **2.1 FLEXIBLE CONNECTION**

- .1 Application: to suit motion.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
- .3 Inner hose: bronze corrugated.
- .4 Braided wire mesh stainless steel outer jacket.
- .5 Diameter and type of end connection: as indicated.
- .6 Operating conditions:
  - .1 To match system requirements.

### **2.2 EXPANSION JOINTS, PIPE GUIDES AND PIPE ANCHORS**

- .1 Expansion compensator for pipe size NPS 3/4 up to NPS 3, bronze model bellow-two ply, stroke 75 mm compression, 6 mm extension. Rated for 1034 kPa maximum working pressure. All bronze construction for copper pipes; steel construction for steel pipes. Acceptable material: Flexonics, Hyspan, Pathway.
- .2 Expansion joint NPS 4 and NPS 6, controlled flexing expansion joint, Class 150, steel flanged ends, single type, rate for 1034 kPa maximum working pressure, maximum temperature range -28°C to 454°C, axial and

lateral movement, 8 corrugations, 304 stainless steel bellows. Acceptable material: Flexonics, Hyspan, Pathway.

### **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 expansion joints and flexible connections in accordance with manufacturer's instructions.

#### **3.3 PIPE CLEANING AND START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

#### **3.4 CLEANING**

- .1 Clean in accordance with Section Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 00 01 - General Requirements.

## Part 1 - General

### 1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-2010, Power Piping.
  - .2 ANSI/ASME B31.3-2010, Process Piping.
  - .3 ANSI/ASME Boiler and Pressure Vessel Code-2010:
    - .1 BPVC 2010 Section I: Power Boilers.
    - .2 BPVC 2010 Section V: Nondestructive Examination.
    - .3 BPVC 2010 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C206-11, Field Welding of Steel Water Pipe.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
  - .2 CSA B51-14, Boiler, Pressure Vessel and Pressure Piping Code.
  - .3 CSA-W117.2-12, Safety in Welding, Cutting and Allied Processes.
  - .4 CSA W178.1-14, Certification of Welding Inspection Organizations.
  - .5 CSA W178.2-14, Certification of Welding Inspectors.

### 1.2 QUALIFICATIONS

- .1 Welders:
  - .1 Welding qualifications in accordance with CSA B51.
  - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
  - .3 Submit welder's qualifications to NCC Representative.
  - .4 Each welder to possess identification symbol issued by authority having jurisdiction.

### 1.3 INSPECTOR QUALIFICATIONS

- .1 Inspectors qualified to CSA W178.2.

### 1.4 WELDING PROCEDURES

- .1 Registration of welding procedures in accordance with CSA B51.
- .2 Copy of welding procedures available for inspection.
- .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

## Part 2 - Products

### 2.1 WELDING CONSUMABLES

- .1 Certified to ASME SFA specifications.

### 2.2 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

## 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 QUALITY OF WORK

- .1 Welding: in accordance with ANSI/ASME B31.1, ANSI/ASME B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to ASME BPVC, Section IX.

### 3.3 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.

### 3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with NCC Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with NCC 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 pipe joint fit-up and preparation, and welding of circumferential pipe welds after each pass deposited in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

### 3.5 SPECIALIST EXAMINATIONS AND TESTS

- .1 General.
  - .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by NCC Representative.
  - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
  - .3 Inspect and test 100% of pipe welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and by the NDE methods below.

- .2 The required NDE will be done on weld joints on all glycol piping welds.
  - .1 NDE will be as follows.
    - .1 Piping Welds: All welds in piping will be visually inspected during pipe joint fit-up, and preparation and welding of circumferential pipe welds. Visual welding inspection shall be performed after each pass deposited. All glycol piping welds will be examined by radiographic test.
    - .2 The acceptance criteria for radiographic particle test and PT is ASME Section V.
- .3 Hydrostatically test all other piping welds to requirements of ANSI/ASME B31.1.
- .4 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .5 Failure of visual examinations:
  - .1 Upon failure of any weld by visual examination, perform additional testing as directed by NCC Representative of a total of up to 20% of all welds, selected at random by the NCC Representative by radiographic particle tests.

### **3.6 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense as described in ANSI/ASME B31.1 and ASME BPVC.



## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 00 - Mechanical General Requirements.

### **1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B40.100-2013, Pressure Gauges and Gauge Attachments.
  - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

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

- .1 Submittals in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
  - .1 Thermometers.
  - .2 Pressure gauges.
  - .3 Ball valves.
  - .4 Syphons.
  - .5 Wells.

### **1.4 HEALTH AND SAFETY**

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

## **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, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4 & ASME B40.200.

### **2.3 THERMOMETER WELLS**

- .1 Copper pipe: copper or bronze.
  - .2 Steel pipe: brass.
-

## **2.4 PRESSURE GAUGES**

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale, steam mounting.
- .2 Provide ball valve and snubber for pulsating operating (pumps).

## **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 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of heat exchangers.
- .3 Use extensions where thermometers are installed through insulation.

### **3.3 PRESSURE GAUGES**

- .1 Install in following locations:
  - .1 Suction and discharge of pumps.
  - .2 In other locations as indicated.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 21 05 00 - Mechanical General Requirements.

### 1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.34-2013, Valves Flanged, Threaded and Welding End
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A193/A193M-14, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - .2 ASTM A194/A194M-14, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
  - .3 ASTM A216/A216M-14, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
  - .4 ASTM A351/A351M-14, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
  - .5 ASTM A564/A564M-13, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
  - .6 ASTM B16/B16M-10, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
  - .7 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS SP-61-2011, Pressure Testing of Valves.
  - .2 MSS SP-68-2013, High Pressure Butterfly Valves with Offset Design.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit data for valves specified in this section.

### 1.4 CLOSEOUT SUBMITTALS

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

### 1.5 DELIVERY, STORAGE AND HANDLING

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

## Part 2 - Products

### 2.1 GENERAL

- .1 All valves of the same type to be from one manufacturer.
- .2 All valves to have CRN registration numbers.

### 2.2 BUTTERFLY VALVES - Class 150

- .1 Sizes: NPS 2 and over.
- .2 Style: Lug body for end of line service in either direction.
- .3 Pressure rating: Class 150.
- .4 Bolting: ASME Class 150 steel flanges.
- .5 Operators: Worm gear operator.
- .6 Valves shall be High Performance Butterfly type with offset seat in conformance with MSS SP-68. Valve body shall be Class 150 in conformance with ASME B16.34. Valve seat shall be rated for bubble tight shut-off up to the full body rating (1,965 kPa at 38 degrees C) of the valve with either downstream flange removed.
- .7 Valves shall have internal stop to prevent disc over-travel.
- .8 Valves shall have retained top and bottom low friction bearings.
- .9 Valve shall be equipped with stainless steel nameplate indicating:
  - .1 Valve make
  - .2 Valve model
  - .3 Valve serial number
  - .4 CRN number
  - .5 Bi-directional, end-of-line cold water pressure rating
- .10 Construction:
  - .1 Body: ASTM A216 Gr. WCB Cast steel
  - .2 Disc: ASTM A351 Gr. CF8M
  - .3 Shaft: ASTM A564 type 630 H1150
  - .4 All other materials selected by manufacturer for the specified performance rating.

### 2.3 CHECK VALVES

- .1 NPS 2½ and over, cast steel:
  - .1 Body and multiple-bolted cap: cast steel to ASTM A216/A216M WCB.
  - .2 Cap studs: to ASTM A193/A193M Type B7.
  - .3 Cap nuts: to ASTM A194/A194M Type 2H.
  - .4 Body/cap joint: male-female face with corrugated metallic gasket.
  - .5 Disc: heat treated corrosion and heat resistant 13% chromium steel.
  - .6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.
  - .7 Provide Class 150 valve.

## 2.4 BALL VALVES

- .1 NPS 4 and under:
  - .1 Body and cap: cast high tensile bronze to ASTM B62 or brass to ASTM B16/B16M C36000.
  - .2 Stem: tamperproof ball drive.
  - .3 Stem packing nut: external to body.
  - .4 Ball and seat: replaceable chrome plated brass solid full port ball and teflon seats.
  - .5 Stem seal: TFE with external packing nut.
  - .6 Operator: removable lever handle.
  - .7 Provide Class 150 valve.

## 2.5 CIRCUIT BALANCING VALVES (CBV)

- .1 General:
  - .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports for connection to differential pressure meter.
- .2 Accuracy:
  - .1 Readout to be within plus or minus 2% of actual flow at design flow rate.
- .3 Pressure die-cast dezincification resistant copper alloy construction, Teflon disc, screw-in bonnet.
  - .1 Flow control: At least four 4 full turns of handwheel with digital handwheel and tamperproof concealed mechanical memory.
- .4 Insulation:
  - .1 Use prefabricated shipping packaging of 5.4 R polyurethane as insulation.
- .5 Drain connection:
  - .1 NPS 3/4 valved and capped, suitable for hose socket.
  - .2 Incorporated into valve body or provided as separate item.

## Part 3 - Execution

### 3.1 PREPARATION

- .1 Valve and mating flange preparation.
  - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
  - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
  - .3 Install butterfly valves with disc in almost closed position.
  - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

### 3.2 INSTALLATION OF VALVES

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.

- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

### **3.3 TESTING, INSPECTION AND CERTIFICATION**

- .1 Valve shall be certified in writing by the manufacturer as been tested in conformance to hydrostatic shell and seat tests of ASME B16.34 and MSS SP-61 and shall state that its shutoff rating for cold water service is up to 1,965 kPa for Class 150 with either downstream flange removed.

### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Clean installed products in accordance to manufacturer's recommendation.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 00 01 - General Requirements

## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Hangers and supports for mechanical piping.
- .2 Related Requirements:
  - .1 Section 21 05 00 - Mechanical General Requirements.

### 1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1-2014, Power Piping.
- .2 ASTM International
  - .1 ASTM A563-07a(2014), Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- .5 Underwriter's Laboratories of Canada (ULC)

### 1.3 SYSTEM DESCRIPTION

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by MSS SP-58, ASME B31.1.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP-58.

### 1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Submit shop drawings and product data for following items:
  - .1 Hangers.

- .4 Quality assurance submittals: submit following in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 NCC Representative will make available 1 copy of systems supplier's installation instructions.

## 1.5 QUALITY ASSURANCE

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 00 01 - General 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 00 01 - General Requirements.

## Part 2 - Products

### 2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ASME B31.1 and MSS SP-58.

### 2.2 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 epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP-58.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP-58.
- .5 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies.
  - .2 Steel brackets.



- .6 Hanger rods: threaded rod material to MSS SP-58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP-58:
  - .1 Attachments for steel piping: carbon steel galvanized.
- .8 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 58.
- .10 U-bolts: carbon steel to MSS SP 58 with 2 nuts at each end to ASTM A 563.
  - .1 Finishes for steel pipework: black galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 58.

### Part 3 - Execution

#### 3.1 MANUFACTURER'S INSTRUCTIONS

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

#### 3.2 INSTALLATION

- .1 Install in accordance with:
  - .1 manufacturer's instructions and recommendations.
- .2 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .3 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .4 Use approved constant support type hangers where:
  - .1 vertical movement of pipework is 13 mm or more,
  - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .5 Provide steel saddle for insulated pipe to protect insulation.

#### 3.3 HANGER SPACING

- .1 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m

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2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

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- .2 Pipework greater than NPS 12: to MSS SP 58.

### 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:
  - .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.

## **Part 1 - General**

### **1.1 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Building Code of Canada.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 00 01 - General Requirements.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 01 - General Requirements. 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 00 01 - General Requirements.
  - .2 Submit shop drawings in accordance with Section 01 00 01 - General Requirements.
    - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
  - .3 Quality assurance submittals: submit following in accordance with Section 01 00 01 - General Requirements.
    - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .2 Instructions: submit manufacturer's installation instructions.
      - .1 NCC Representative will make available 1 copy of systems supplier's installation instructions.
    - .3 Manufacturer's Field Reports: manufacturer's field reports specified.

### **1.3 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 00 01 - General 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 00 01 - General Requirements.

## Part 2 - Products

### 2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

### 2.2 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.

### 2.3 SPRING MOUNT

- .1 Cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M1 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene acoustic pad; built-in resilient limit stops, removable spacer plates.
- .3 Performance: to suit application.

### 2.4 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .3 Performance: to suit application.

### 2.5 SEISMIC CONTROL MEASURES

- .1 General:
  - .1 Provide seismic restraints for all new work required.
  - .2 Seismic control systems to work in every direction.
  - .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
  - .4 Drilled or power driven anchors and fasteners not permitted.
  - .5 No equipment, equipment supports or mounts to fail before failure of structure.
  - .6 Supports of cast iron or threaded pipe not permitted.
  - .7 Seismic control measures not to interfere with integrity of firestopping.
- .2 Static equipment:
  - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
  - .2 Seismic restraints:
    - .1 Cushioning action gentle and steady.
    - .2 Never reach metal-like stiffness.

- .3 Vibration isolated equipment:
  - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
  - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
- .4 Piping systems:
  - .1 Piping systems: hangers longer than 300 mm; brace at each hanger.
  - .2 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
  - .1 Approved by NCC Representative.
  - .2 Structural angles or channels.
  - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

### **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 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
  - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

#### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

## Part 1 - General

### 1.1 SUMMARY

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

### 1.2 REFERENCES

- .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.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 00 01 - General Requirements.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - 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 00 01 - General 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 00 01 - General Requirements.

## **Part 2 - Products**

### **2.1 EXISTING IDENTIFICATION SYSTEMS**

- .1 Apply existing identification system to new work.

### **2.2 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.

### **2.3 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.

### **2.4 LANGUAGE**

- .1 Identification in English and French.
- .2 Use one nameplate and label for both languages.

## **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 TIMING**

- .1 Provide identification only after insulating and painting.

### **3.3 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Identify systems, equipment to conform to PWGSC PMSS.

### **3.4 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS**

- .1 On long straight runs in open areas in chiller plant: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
  - .2 Adjacent to each change in direction.
-

- .3 On both sides of visual obstruction or where run is difficult to follow.
- .4 On both sides of separations such as walls, floors, partitions.
- .5 At beginning and end points of each run and at each piece of equipment in run.
- .6 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .7 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.5 VALVES, CONTROLLERS**

- .1 Valves and operating controller: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted where directed by NCC Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

### **3.6 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.



## **Part 1 - General**

### **1.1 SUMMARY**

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

### **1.2 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel to perform TAB to NCC Representative within 30 days of award of contract.
- .2 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-1998.
  - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .3 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .4 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .5 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .6 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .7 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
  - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

### **1.3 PURPOSE OF TAB**

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

#### **1.4 EXCEPTIONS**

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

#### **1.5 CO-ORDINATION**

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

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

- .1 Review contract documents before project construction is started and confirm in writing to NCC 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 NCC 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.

#### **1.7 START-UP**

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

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

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

#### **1.9 START OF TAB**

- .1 Notify NCC Representative 14 days prior to start of TAB.
- .2 Start TAB when new work is essentially completed.
- .3 Provisions for TAB installed and operational.
- .4 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Correct fan rotation.
    - .5 Fire, smoke, volume control dampers installed and open.

- .6 Coil fins combed, clean.
- .7 Access doors, installed, closed.
- .8 All outlets installed, volume control dampers open.
- .3 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolating and balancing valves installed, open.
  - .5 Calibrated balancing valves installed, at factory settings.

#### **1.10 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 Hydronic systems: plus or minus 10%.
  - .2 All HVAC systems: plus 5%, minus 5%.

#### **1.11 ACCURACY TOLERANCES**

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

#### **1.12 INSTRUMENTS**

- .1 Prior to TAB, submit to NCC 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 NCC Representative.

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

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

#### **1.14 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of NCC 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.

#### **1.15 TAB REPORT**

- .1 Format in accordance with Associated Air Balancing Council (AABC/CAABC)
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.

- .3 Submit 2 copies of TAB Report to NCC Representative for verification and approval, in English in D-ring binders, complete with index tabs.

#### **1.16 VERIFICATION**

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

#### **1.17 SETTINGS**

- .1 After TAB is completed to satisfaction of NCC 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.

#### **1.18 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by NCC Representative.

#### **1.19 SYSTEMS**

- .1 Hydronic Systems: Include both specified and measured data.
  - .1 Air Systems: Include both specified and measured data.
    - .1 Air Handling Equipment:
      - .1 Maximum air flow volume.
      - .2 Fan total pressure.
      - .3 Motor volts, amps and power.
      - .4 Minimum outside air volume.
      - .5 Fan rotational speed.
      - .6 Fan Power, calculate fan efficiency.
      - .7 Inlet and outlet dry bulb, wet bulb and dewpoint temperatures.
      - .8 Equipment static pressure profile.
      - .9 Noise.
      - .10 Vibration.
    - .2 Air Outlets:
      - .1 Outlet location and designation.
      - .2 Manufacturers catalogue identification and type.
      - .3 Air outlet flow factors. Use 1.0 when flow hood is used.
      - .4 Air flow volumes.
      - .5 Deflector vane or diffuser cone settings.
  - .2 Hydronic Systems: Include both specified and measured data..
    - .1 Air Heating and Cooling Coils:
      - .1 Coil type and identification, location and designation.
      - .2 Entering and leaving air dry and wet bulb temperatures.
      - .3 Air static pressure drop.
      - .4 Air flow volume.

- .5 Barometric pressure.
- .6 Air side heat transfer rate.
- .7 Fluid used. Identify fluid used; water, % water/ethylene glycol mixes, steam, etc.
- .8 Fluid flow rate.
- .9 Fluid Specific Heat, at mean temperature.
- .10 Fluid Specific Gravity, at mean temperature.
- .11 Fluid entering and leaving temperatures and pressures.
- .12 Fluid side heat transfer rate.
- .2 Radiant Heaters:
  - .1 Fluid flow rate.

## **1.20 POST-OCCUPANCY TAB**

- .1 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

## **Part 2 - Products**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 - Execution**

### **3.1 BALANCING AND ADJUSTING PREPARATION**

- .1 Perform testing, adjusting and balancing work after equipment and systems starting procedures have been properly completed.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 21 05 00 - Mechanical General Requirements.

### 1.2 REFERENCES

- .1 Definitions:
  - .1 For purposes of this section:
    - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
    - .2 "EXPOSED" - means "not concealed" as previously defined.
    - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
  - .2 TIAC Codes:
    - .1 CRD: Code Round Ductwork,
    - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
  - .1 ASTM International Inc.
    - .2 ASTM C335/C335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3 ASTM C449-07(R2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .4 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-51.10-92, Mineral Fibre Board Thermal Insulation.
    - .2 CAN/CGSB-51.11-92, Mineral Fibre Thermal Insulation Blanket.
    - .3 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .3 Manufacturer's Trade Associations: Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
  - .4 Underwriters Laboratories (UL)
    - .1 UL 723, Tests for Surface Burning Characteristics of Building Materials.
  - .5 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements and Section 21 05 00 - Mechanical General Requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

### 1.4 SAMPLES

- .1 Submit samples in accordance with Section 21 05 00 - Mechanical General Requirements, if requested by Consultant.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on ½" plywood board. Affix typewritten label beneath sample indicating service.

## **1.5 MANUFACTURER'S INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with Section 21 05 00 - Mechanical General Requirements, if requested by Engineer.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

## **1.6 QUALIFICATIONS**

- .1 Installer to be specialist in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards.

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

- .1 Deliver, store and handle in accordance with Section 01 00 01 - General Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Protect from weather and construction traffic.
- .4 Protect against damage from any source.
- .5 Store at temperatures and conditions required by manufacturer.

## **Part 2 - Products**

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

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

### **2.2 INSULATION**

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.
- .3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB-51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/CGSB-51.11.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/CGSB-51.11.
  - .4 Density: 24 kg/m<sup>3</sup>.

## 2.3 JACKETS

- .1 Canvas: 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.
- .4 Acrylic Adhesive (Indoor Applications only):
  - .1 Thickness: 0.18 mm.
  - .2 Finish: Stucco embossed.
  - .3 Peel Adhesion: 18N/25 mm (65 oz./in.)
  - .4 Puncture: 130N (30 lbs.).
  - .5 UL 723 listed (10/20 flame/smoke rating).
  - .6 Acceptable material: VentureClad 1577CW.

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive: Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm (3/4") wide, 0.5 mm thick stainless steel.
- .10 Facing: 25 mm (1") galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .11 Fasteners: 2 mm diameter pins with 38 mm (1½") diameter clips, length to suit thickness of insulation.

## Part 3 - Execution

### 3.1 PRE-INSTALALTION REQUIREMENTS

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

### 3.2 INSTALALTION

- .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 thickness exceeds 75 mm (3").
-



- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Bases, Hangers and Supports
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm (12") oc in horizontal and vertical directions, minimum two rows each side.

### 3.3 DUCTWORK INSULATION SCHEDULE

Thickness	TIAC	Vapour Code	Retarder mm (in.)
Rectangular cold and dual temperature supply & return air ducts in exposed areas including silencers (mechanical room, open ceiling, etc.)	C-1	yes	25 (1")
Cold and dual temperature supply air ducts in concealed ceiling space and all round cold ducts including silencers	C-2	yes	25 (1")
Outside air ducts to mixing plenum	C-1	yes	50 (2")
Exhaust ducts within 3 m from roof/ exterior wall penetration	C-1	yes	50 (2")
Acoustically lined ductwork inside building	none		

- .1 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
  - .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
- .2 Finishes: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/1	CRD/2

## Part 1 - General

### 1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE Standard 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 ASTM International Inc.
  - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
  - .2 ASTM C335/C335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C547-12, Standard Specification for Mineral Fiber Pipe Insulation.
  - .5 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .6 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings

### 1.2 DEFINITIONS

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

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 00 01 - General Requirements
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 01 - General Requirements. 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 00 01 - General Requirements.

## Part 2 - Products

### 2.1 FIRE AND SMOKE RATING

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

### 2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 & ASTM C547.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 & ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C547.

### 2.3 INSULATION SECUREMENT

- .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.

### 2.4 CEMENT

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

### 2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

### 2.6 INDOOR VAPOUR RETARDER FINISH

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

## 2.7 JACKETS

- .1 PVC:
  - .1 Ontario Building Code compliant for 25/50 flame spread and smoke developed.
  - .2 Minimum thickness 0.038 mm
  - .3 Colour white unless otherwise specified.
  - .4 Non yellowing UV stabilized.
  - .5 Minimum service temperatures: -20°C.
  - .6 Maximum service temperature: 65°C.
  - .7 Moisture vapour transmission: 0.02 perm.
  - .8 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.

## Part 3 - Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 PRE-INSTALLATION REQUIREMENT

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

### 3.3 INSTALLATION

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

### 3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at 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: PVC .

**3.5 INSTALLATION OF ELASTOMERIC INSULATION**

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

**3.6 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
  - .1 Securements: SS bands at 300 mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
  - .1 Securements: SS bands at 300 mm on centre.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.

Applica- tion	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)				
			Run out	to 1	1-1/4 to 2	2-1/2 to 4	5 to 6
Glycol Heating	350 - 94	A-1	25	25	38	38	38
Glycol switch- over	5 - 59	A-3	25	25	38	38	38
Domestic Hot Water		A-1	25	38	38	38	38
Domestic Cold Water		A-3	25	25	25	25	25
Condensate		A-1	38	50	50	50	50

- .4 Finishes:
  - .1 Exposed indoors: PVC jacket.
  - .2 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
  - .3 Finish attachments: SS bands, at 150 mm on centre. Seals: wing or closed.
  - .4 Installation: to appropriate TIAC code CRF/1 through CPF/5.

**3.7 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

### 1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E202-12, 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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 00 01 - General Requirements.
  - .1 Instructions: submit manufacturer's installation instructions.
    - .1 NCC Representative will make available 1 copy of systems supplier's installation instructions.

### 1.4 QUALITY ASSURANCE

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

### 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 00 01 - General Requirements.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 00 01 - General 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 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 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.
- .5 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.
- .6 Report on Completion of Cleaning:
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
  - .1 Fill system with water, ensure air is vented from system.
  - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

- .3 Use water metre to record volume of water in system to +/- 0.5%.
  - .4 Add chemicals under direct supervision of chemical treatment supplier.
  - .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .6 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.
  - .7 Add chemical solution to system.
  - .8 Establish circulation, raise temperature slowly to maximum design 82 degrees C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees 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).
- .8 Glycol Systems:
- .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

### 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 Check glycol level in expansion tank with cold glycol with circulating pumps OFF and again with pumps ON.
  - .7 Repeat with glycol at design temperature.
  - .8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .9 Bring system up to design temperature and pressure slowly over a 24 hour period.
  - .10 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .11 Adjust pipe supports, hangers, springs as necessary.
  - .12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .13 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
  - .14 Check operation of drain valves.
  - .15 Adjust valve stem packings as systems settle down.
  - .16 Fully open balancing valves (except those that are factory-set).
  - .17 Check operation of over-temperature protection devices on circulating pumps.
  - .18 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 00 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.



## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Materials and installation for piping, valves and fittings for gas fired equipment.

### 1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME A120.1-2008, Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance.
  - .2 ASME B16.5-2013, Pipe Flanges and Flanged Fittings.
  - .3 ASME B16.20-2007, Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.
  - .4 ASME B16.21-2011, Nonmetallic Flat Gaskets for Pipe Flanges.
  - .5 ASME B18.2.1-2012, Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA B149.1-10, Natural Gas and Propane Installation Code Handbook.
  - .2 CAN/CSA B149.2-10, Propane Storage and Handling Code.
  - .3 CSA W47.1-00, Certification of Companies for Fusion Welding of Steel.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 00 01 - General Requirements.
- .2 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## Part 2 - Products

### 2.1 PIPE

- .1 Above ground steel pipe: to ASME A120.1 or ASTM A53/A53M, Schedule 40, seamless as follows:
  - .1 NPS ½ to 2, screwed outside, with socket welded fittings inside building.
  - .2 NPS 2½ and over, welded.

### 2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: to ASME B16.21 or ASME B16.20.

## **2.3 FITTINGS**

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

## **Part 3 - Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections recommended by equipment manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer installation instruction for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 All equipment, venting and gas assembly work shall be installed & certified by a provincially certified gas fitter I Level mechanic.

### **3.2 PIPING**

- .1 Install in accordance with applicable Provincial/Territorial Codes.
- .2 Install in accordance with CSA B149.1 and CSA B149.2.
- .3 Assemble piping using fittings manufactured to ASME standards.
- .4 Slope piping down in direction of flow to low points as per Gas Utilization Code.
- .5 Use eccentric reducers at pipe size change installed to provide positive drainage.
- .6 Provide clearance for access and for maintenance.
- .7 Ream pipes, clean scale and dirt, inside and out.
- .8 Install piping to minimize pipe dismantling for equipment removal.

### **3.3 TESTING**

- .1 Test system in accordance with CSA B149.1 and CSA B149.2.
- .2 On existing natural gas services, contractor shall commission TSSA to provide a field inspection of the work. Contractor shall pay all fees & costs, and make application to TSSA fuel branch division. Contractor shall submit Inspection Report to Owner for record. Any orders or non-compliance relating to existing conditions, not relating to the proposed scope of work shall be deemed additional to the contract.

### **3.4 PURGING**

- .1 Purge after pressure test in accordance with CSA B149.1 and CSA B149.2.

### **3.5 CLEANING AND START-UP**

- .1 In accordance with requirements of CSA B149.1 & CSA B149.2.

## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Copper piping valves and fittings for hydronic systems.
- .2 Related Requirements:
  - .1 Section 21 05 00 - Mechanical General Requirements.
  - .2 Section 23 05 23.01 - Valves.
  - .3 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
  - .4 Section 23 21 14 - Hydronic Specialites.
  - .5 Section 25 01 11 - Commissioning - Mechanical Systems.

### 1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
  - .1 AWS A5.8/A5.8M:2011, Specification Filler Metals for Brazing and Bronze Welding.
- .2 American National Standards Institute (ANSI) American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.15-2013, Cast Bronze Threaded Fittings: Classes 125 and 250.
  - .2 ASME B16.18-2012, Cast Copper Alloy, Solder Joint Pressure Fittings.
  - .3 ASME B16.22-2013, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 American Society for Testing and Materials (ASTM)
  - .1 ASTM B32-08, Specification for Solder Metal.
  - .2 ASTM B88M-13, Specification for Seamless Copper Water Tube Metric.
  - .3 ASTM E202-12, Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 01 - General Requirements. 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 00 01 - General Requirements.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 00 01 - General Requirements.
    - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **Part 2 - Products**

### **2.1 PIPING**

- .1 Type L hard drawn copper tubing: to ASTM B88M.

### **2.2 FITTINGS**

- .1 Cast bronze threaded fittings: to ASME B16.15.
- .2 Wrought copper and copper alloy solder joints pressure fittings: to ASME B16.22.
- .3 Cast copper alloy solder joint pressure fittings: to ASME B16.18.

### **2.3 DI-ELECTRIC COUPLINGS**

- .1 Provide wherever pipes of dissimilar metals are jointed.
- .2 For pipe sizes 2 NPS and under, provide di-electric unions or couplings.

### **2.4 JOINTS**

- .1 Solder, tin-antimony, 95:5: to ASTM B32.
- .2 Silver solder BCUP: to AWS A5.8.
- .3 Brazing: as indicated.

### **2.5 VALVES**

- .1 Refer to Section 23 05 23.01 - Valves.

## **Part 3 - Execution**

### **3.1 PIPING INSTALLATION**

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .7 Assemble piping using fittings manufactured to ASME standards.

- .8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .9 Install all pipe wells or other devices supplied by Section 25 01 11 - Commissioning - Mechanical Systems.

### **3.2 FLUSHING AND CLEANING**

- .1 As per Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **3.3 FILLING OF SYSTEM**

- .1 Refill system with clean water adding water treatment as specified and/or glycol as per Section 23 21 14 - Hydronic Specialites.

### **3.4 TESTING**

- .1 Test system in accordance with Section 21 05 00 - Mechanical General Requirements.
- .2 For glycol systems, retest with specified quality of glycol after cleaning. Repair any leaking joints, fittings or valves.

### **3.5 BALANCING**

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Refer to Section 23 05 93 - Testing Adjusting and Balancing of Systems for applicable procedures.

### **3.6 GLYCOL CHARGING**

- .1 Provide mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E202 after cleaning.
- .3 Provide report to NCC Representative.

### **3.7 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes.
  - .1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.
- .2 Related Requirements
  - .1 Section 23 05 05 - Installation of Pipework.
  - .2 Section 23 05 17 - Pipe Welding.
  - .3 Section 23 05 23.01 - Valves.
  - .4 Section 23 05 53.01 - Mechanical Identification.
  - .5 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .6 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
  - .7 Section 23 21 13.01 - Copper Piping and Fittings - Hydronic Systems.
  - .8 Section 23 21 14 - Hydronic Specialites.

### 1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B16.1-2010, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - .2 ASME B16.3-2011, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .3 ASME B16.5-2013, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
  - .4 ASME B16.9-2012, Factory-Made Wrought Butt welding Fittings.
  - .5 ASME B18.2.2-2010, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A105/ASTM 105M-11, Standard Specification for Carbon Steel Forgings for Piping Applications.
  - .4 ASTM A139/A139M-04(2010), Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
- .3 American Water Works Association (AWWA).
  - .1 AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

### 1.3 QUALITY ASSURANCE

- .1 Health and Safety.
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 00 01 - General Requirements.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site 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 PIPE

- .1 Steel pipe: to ASTM A53/A53M & ASTM A139/A139M, welded, Grade B carbon steel, as follows:
  - .1 NPS 2-1/2 to 10, Schedule 40.
- .2 Provide openings & wells for new accessories including thermometers, pressure gauges, BAS sensors, drain/test connections, etc.
- .3 Provide pipe identification with flow arrows for all new condenser and chilled water piping in accordance with Section 23 05 53.01 - Mechanical Identification.

### 2.2 PIPE JOINTS

- .1 Application: glycol systems: NPS 2½ and over; NPS 2 and under shall be copper piping only - no steel piping.
  - .1 NPS 2 and under: shall be copper - refer to Section 23 21 13.01 - Copper Piping and Fittings - Hydronic Systems.
  - .2 Heating and glycol systems NPS 2½ and over: welded or flanged. Grooved joints are not accepted. All underground piping to be welded.
  - .3 Welding fittings and flanges to CSA W47.1. Reference Section 23 05 17 - Pipe Welding.
  - .4 Flanges: full face, weld neck, bored to suit pipe to ASTM A105/105M.
  - .5 Flange gaskets: to AWWA C111/A21.11.
  - .6 Pipe thread: taper.
  - .7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
  - .8 Grooved mechanical couplings as manufactured by Victaulic are acceptable as listed. Style 07; ZeroFlex for rigid connections. Style 77 for flexible connections.

### 2.3 FITTINGS AND ACCESSORIES

- .1 Pipe flanges and flanged fittings:
  - .1 Cast iron: to ASME B16.1.
  - .2 Steel: to ASME B16.5.
- .2 Butt-welding fittings: steel, to ASME B16.9.
- .3 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
- .4 Steel pipe gaskets, fanges and flanged fittings: to ASME B16.5.
- .5 Couplings, caps, plugs:
  - .1 NPS 1/2 to 1-1/2: Class 3000, 20 MPa, socket weld ends, to ASTM.
- .6 Nipples for drains, vents, pressure gauges, similar items:
  - .1 NPS 1/2 to 1-1/2: Schedule 80, screwed, to ASTM A53/A53M, Grade A.

### 2.4 VALVES

- .1 Connections:
  - .1 NPS 2 and smaller: Screwed ends.
  - .2 NPS 2-1/2 and larger: Flanged ends.
- .2 Refer to Section 23 05 23.01 - Valves.



### **Part 3 - Execution**

#### **3.1 PIPING INSTALLATION**

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

#### **3.2 FLUSHING AND CLEANING**

- .1 As per Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

#### **3.3 TESTING**

- .1 Test system in accordance with Section 23 05 05 - Installation of Pipework.

#### **3.4 BALANCING**

- .1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

## Part 1 - General

### 1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A278/A278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 degrees F (350 degrees C).
  - .2 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 01 - General Requirements.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

## Part 2 - Products

### 2.1 AUTOMATIC AIR VENT

- .1 System vents (glycol):
  - .1 Industrial float vent: cast iron body and NPS 3/4 connection and rated at 1034 kPa working pressure.
  - .2 Float: solid material suitable for 115°C working temperature.

### 2.2 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B62, Class 250 screwed connections.
- .2 NPS 2-1/2 to 12: cast steel body to ASTM A278M, Class 250, flanged connections.
- .3 Blowdown connection: NPS 1.
- .4 Screen: stainless steel brass with perforations between 5 mm and 6 mm.
- .5 Working pressure: 1034 kPa (150 psi).
- .6 Provide contact for output to BAS for system alarm.

### 2.3 ETHYLENE GLYCOL

- .1 Provide pre-mixed ethylene glycol in 50% concentration by weight as specified in schedules on drawings for glycol system.

### **Part 3 - Execution**

#### **3.1 GENERAL**

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.
- .5 Check shop drawings for conformance of all tapings for ancillaries and for equipment operating weights.

#### **3.2 STRAINERS**

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

#### **3.3 AUTOMATIC AIR VENTS**

- .1 Install automatic air vents at high points of piping systems.
- .2 Install full port ball at each automatic air vent.
- .3 Air vents must have minimum connection of 13 mm ( $\frac{1}{2}$ ").

#### **3.4 PRESSURE SAFETY RELIEF VALVES**

- .1 Glycol run discharge pipe to terminate at glycol tank.

#### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 00 01 - General Requirements.
  - .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 00 01 - General Requirements.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

### **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 A653/A653M-13, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA).
  - .1 NFPA (Fire) 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems, 2012 Edition.
  - .2 NFPA (Fire) 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems, 2012 Edition.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

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

- .1 Submit shop drawings and product data in accordance with Section 01 00 01 - General Requirements.

### **1.4 QUALITY ASSURANCE**

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

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

- .1 Protect on site stored or installed absorptive material from moisture damage.

## Part 2 - Products

### 2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
500	A
250	A
125	A

- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.

### 2.2 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 22°F to plus 200°F.  
.1 Acceptable material: Duro Dyne S-2.

### 2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

### 2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.  
.1 Rectangular: standard radius Centreline radius: 1.5 times width of duct.  
.2 Round: smooth radius five piece. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:  
.1 To 400 mm: with single thickness turning vanes.  
.2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:  
.1 Rectangular main and branch: with 45 degrees entry on branch.  
.2 Round main and branch: enter main duct at 45 degrees with conical connection.  
.3 Provide volume control damper in branch duct near connection to main duct.  
.4 Main duct branches: with splitter damper.
- .5 Transitions:  
.1 Diverging: 20 degrees maximum included angle.  
.2 Converging: 30degrees maximum included angle.
- .6 Offsets:  
.1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.  
.1 Maximum included angles: as for transitions.

## 2.5 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A 653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

## 2.6 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
    - .1 Maximum size duct supported by strap hanger: 500 mm.
  - .2 Hanger configuration: to SMACNA.
  - .3 Hangers: black galvanized steel angle with black steel rods to SMACNA following table:

Duct Size	Angle Size	Rod Size
(mm)	(mm)	(mm)
up to 750	25 x 25 x 3	6

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.

## Part 3 - Execution

### 3.1 GENERAL

- .1 Do work in accordance with NFPA (Fire) 90A, NFPA (Fire) 90B and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with ASHRAE and SMACNA .
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

### 3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000

### **3.3 SEALING AND TAPING**

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

## Part 1 - General

### 1.1 REFERENCES

- .1 ASTM International
  - .1 ASTM C177-13, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  - .2 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .3 ASTM C916-14, Standard Specification for Adhesives for Duct Thermal Insulation.
  - .4 ASTM C1071-12, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .5 ASTM C1338-14, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .6 ASTM G21-13, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2012 Edition.
  - .2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air Conditioning Systems, 2012 Edition.
- .3 North American Insulation Manufacturers Association (NAIMA)
  - .1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.
- .4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
  - .1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible-2013.
- .5 Underwriters' Laboratories of Canada
  - .1 CAN/ULC S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 01 - General Requirements.

## Part 2 - Products

### 2.1 DUCT LINER

- .1 General:
  - .1 Mineral Fibre duct liner: air surface coated mat facing.
  - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102 and NFPA 90A & NFPA 90B.
  - .3 Recycled Content: EcoLogo certified with minimum 35% by weight recycled content.
  - .4 Fungi resistance: to ASTM C1338 & ASTM G21.
- .2 Rigid:
  - .1 Use on flat surfaces where indicated.
  - .2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.
  - .3 Density: 48 kg/m<sup>3</sup> minimum.



- .4 Thermal resistance to be minimum  $0.76 \text{ (m}^2 \cdot \text{degrees C)/W}$  for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
- .5 Maximum velocity on faced air side: 20.3 m/s.
- .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.
- .7 Recycled Content: EcoLogo certified containing minimum 45% by weight recycled content.

## **2.2 ADHESIVE**

- .1 Adhesive: to NFPA (Fire) 90A, NFPA (Fire) 90B and ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

## **2.3 FASTENERS**

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

## **2.4 JOINT TAPE**

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

## **2.5 SEALER**

- .1 Meet requirements of NFPA (Fire) 90A and NFPA (Fire) 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

## **Part 3 - Execution**

### **3.1 GENERAL**

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standard, NAIMA AH116 and as indicated except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

### **3.2 DUCT LINER**

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C916.
    - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
  - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres, to compress duct liner sufficiently to hold it firmly in place.

- .2 In systems, where air velocities exceeds 20.3 m/s, install galvanized sheet metal nosing to leading edges of duct liner.

### **3.3 JOINTS**

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
  - .1 Bed tape in sealer.
  - .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Departmental Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 - General Instructions.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 - General Instructions.

## Part 1 - General

### 1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 00 01 - General Requirements.
- .2 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## Part 2 - Products

### 2.1 GENERAL

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

### 2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 100 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m<sup>2</sup>.

### 2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .5 Hold open devices.

## 2.4 INSTRUMENT TEST

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

## 2.5 SPIN-IN COLLARS

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

## Part 3 - Execution

### 3.1 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 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 300 x 300 mm for viewing.
  - .2 Location as indicated.
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Install insulation port extensions as required.
  - .4 Locations:
    - .1 For traverse readings:
      - .1 Inlets and outlets of other fan systems.

## **Part 1 - General**

### **1.1 REFERENCES**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.3 CLOSEOUT SUBMITTALS**

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

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

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

## **Part 2 - Products**

### **2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

### **2.2 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").
- .3 For rectangular ducts adjustable lever with shaft extension to accommodate insulation thickness.
- .4 For round branch ducts adjustable lever with shaft extension to accommodate insulation thickness.
- .5 Inside and outside nylon end bearings.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

### **2.3 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").
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage : 0.07% at 750 Pa.

### **Part 3 - Execution**

#### **3.1 INSTALLATION**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Ensure damper operators are observable and accessible.

## **Part 1 - General**

### **1.1 RELATED SECTIONS**

- .1 Section 23 33 00 - Air Duct Accessories.
- .2 Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

### **1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

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

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

### **1.4 CLOSEOUT SUBMITTALS**

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

## **Part 2 - Products**

### **2.1 ACCEPTABLE MANUFACTURER**

- .1 Tamco.
- .2 Nailor.
- .3 Ruskin.
- .4 Ventex.

### **2.2 MULTI-LEAF DAMPERS**

- .1 Opposed blade type as indicated.
  - .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
  - .3 Pressure fit self-lubricated bronze bearings.
  - .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
-

- .5 Control Damper Operators:
  - .1 Electronic:
    - .1 Push-pull proportional type as indicated.
    - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
    - .3 Operator: size so as to control dampers against maximum pressure or dynamic closing pressure (whichever is greater).
    - .4 Power requirements: as required for application.
    - .5 Operating range: 0 - 20 V DC.
  - .1 Refer to Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.
- .6 Performance:
  - .1 Leakage Class: 1A.
  - .2 Pressure drop: at full open position to be less than 4 Pa differential across damper at 5 m/s.
- .7 Insulated aluminum dampers - Exhaust & intake dampers:
  - .1 Frames: insulated with extruded polystyrene foam with R factor of 2.3.
  - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 2.3.
- .8 Acceptable material:
  - .1 Exhaust & Intake: Tamco 9000, Ventex.
  - .2 Return: Tamco 1000, Ventex.

### **2.3 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted, as indicated.

## **Part 3 - Execution**

### **3.2 INSTALLATION**

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



## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Fans, motors, accessories and hardware for commercial use.
- .2 Related Requirements
  - .1 Section 23 05 13 - Motors, Drives and Guards
  - .2 Section 23 05 48 - Vibration Isolation and Seismic Control.
  - .3 Section 23 33 00 - Duct Accessories.

### 1.2 REFERENCES

- .1 Air Movement and Control Association (AMCA)
  - .1 AMCA 99-10, Standards Handbook.
  - .2 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.
  - .3 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American Bearing Manufacturers Association (ABMA)
  - .1 ANSI/ABMA 9:1990 (R2008), Load Ratings and Fatigue Life for Ball Bearings.
  - .2 ANSI/ABMA 11:1990 (R2008), Load Ratings and Fatigue Life for Roller Bearings.
- .3 ASHRAE/Air Movement and Control Association
  - .1 ANSI/ASHRAE/AMCA 51-2007, Laboratory Methods of Testing Fans for Rating.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 01 - General Requirements. 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 00 01 - General Requirements.
- .2 Provide:
  - .1 Fan performance curves showing point of operation, BHP kW and efficiency.
  - .2 Sound rating data at point of operation.
- .3 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### 1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

## 1.5 MAINTENANCE

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Spare parts to include:
      - .1 Matched sets of belts.
  - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
    - .1 Bearings and seals.
    - .2 Addresses of suppliers.
    - .3 List of specialized tools necessary for adjusting, repairing or replacing.

## Part 2 - Products

### 2.1 FANS GENERAL

- .1 Capacity: flow rate, total static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .2 Statically and dynamically balanced. Constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51, unit to bear AMCA certified rating seal.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
- .6 Bearings: sealed lifetime oilite ball bearings heavy duty grease lubricated ball or roller bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 h in accordance with ABMA L50 life standard. Bearings to be rated and selected in accordance with ABMA 9 and ABMA 11.
- .7 Motors:
  - .1 In accordance with Section 23 05 13 - Motors, Drives and Guards supplemented as specified herein.
  - .2 Sizes as indicated.
- .8 Factory primed before assembly in colour standard to manufacturer.
- .9 Scroll casing drains: as indicated.
- .10 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .11 Vibration isolation: to Section 23 05 48 - Vibration Isolation and Seismic Control.

### 2.2 CABINET FANS DIRECT DRIVE

- .1 Fan shall have true centrifugal wheel (or wheels).
- .2 Fans shall have acoustically insulated housings c/w eggcrate type inlet grille and shall have air deliveries and Sone levels as indicated. All fans shall bear the AMCA Certified Ratings Seal and the UL label. Manufacturer shall submit vibration amplitudes and magnetic motor hum levels in decibels.
- .3 Integral backdraft damper shall be totally chatter-proof with no metal to metal contact.

- .4 Entire fan, motor, and wheel assembly shall be easily removable without disturbing the housing. Motor speeds shall not exceed 1500 RPM and all fan motors shall be suitably grounded, and mounted on rubber-in-shear vibration isolators.
- .5 Fans shall be equipped with disconnect switches.
- .6 Supply variable speed controller and turn over to Div. 26 for installation where indicated.
- .7 Performance: as indicated on drawing schedule.

### **2.3 DWDI AIRFOIL CENTRIFUGAL FANS**

- .1 Fan wheels: Fan wheels shall have tapered spun wheel cones or shrouds, providing stable flow and high rigidity. Wheels shall be of the non-overloading type. Airfoil wheels shall be die-formed airfoil blade type, continuously welded to the rim and back plate. Blades shall be designed for maximum efficiency and quiet operation. Partial welding will not be acceptable on airfoil blades. Wheels shall be statically and dynamically balanced. The complete fan assembly shall be test balanced at the operating speed prior to shipment.
- .2 Bearings: Heavy duty, anti-friction grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals.
- .3 Housings:
  - .1 Heavy-gauge, continuously welded construction suitably braced to prevent vibration or pulsation. Housings with lock seams or partially welded construction are not acceptable.
  - .2 Aerodynamically designed, spun inlet venturies for smooth airflow into the wheels.
- .4 Shafts: Shafts shall be manufactured of AISI 1040 or 1045 hot rolled steel, accurately turned, ground, polished, and ring gauged for accuracy. Shafts are to be sized for the first critical speed of at least 1.43 times the maximum speed for the class.
- .5 Drives: Cast-iron, fixed pitch motor sheaves for applications 15 HP and larger; variable pitch sheaves for applications of less than 15 HP. Drives should be selected to provide a minimum 1.5 service factor for 30 HP and larger motors.
- .6 Motors: Refer to Section 23 05 13 - Motors, Drives and Guards for Mechanical Systems.
- .7 Performance: as indicated on drawing schedule.
- .8 Acceptable material: Loren Cook, Greenheck, Penn, Twin City Fan.

### **2.4 POWER ROOF EXHAUSTER**

- .1 Tiered aluminum, low profile, roof mounted exhaust fans shall be belt drive or direct type as per equipment schedule. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure and a birdscreen.
- .2 Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Drive frame assembly shall be constructed of heavy gauge steel. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment through a large space between the fan shroud and the motor cover. Motors and drives shall be readily accessible for maintenance.

- .3 Precision ground a polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts.
- .4 Motor pulleys shall be adjustable for final system balancing. A conduit chase shall be provided through the base to the motor compartment for ease of electrical wiring.
- .5 All fans shall come with prefabricated insulated roof curb and backdraft damper.
- .6 All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
- .7 Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.
- .8 Performance: as indicated on drawing schedule.
- .9 Acceptable material: Loren Cook, Greenheck, Penn, Twin City Fan.

### **Part 3 - Execution**

#### **3.1 INSTALLATION**

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

#### **3.2 ANCHOR BOLTS AND TEMPLATES**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 - Seismic Restraint System.

#### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial use.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 01 - General Requirements. 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 00 01 - General Requirements.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.

### 1.3 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 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board and as specified.
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.

### 2.2 SUPPLY GRILLES AND REGISTERS

- .1 Type SG1: steel construction, double deflection, horizontal face bars c/w integral balancing damper, off-white baked enamel finish. Size: as indicated.

## **2.3 EXHAUST GRILLES AND REGISTERS**

- .1 Type EG1: steel construction, 45° deflection, fixed louvres, 13 mm (½") spacing c/w integral balancing damper, off-white baked enamel fin Size 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 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.

#### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .2 Section 23 05 14 - Variable Frequency Drives.
- .3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .4 Section 23 34 00 - HVAC Fans.

### 1.2 REFERENCES

- .1 Air Movement and Control Association (AMCA)
  - .1 AMCA 300-08, Reverberant Method for Sound Testing of Fans.
  - .2 AMCA 301-06 - Method for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 Air-Conditioning, Heating, and Refrigeration Institute (formerly ARI)
  - .1 ARI 260-2011 - Sound Rating of Ducted Air Moving and Conditioning Equipment.
  - .2 ARI 410-2001 - Forced Circulation Air-Cooling and Air-Heating Coils.
  - .3 ARI 430-2009 - Central Station Air Handling Units.
  - .4 ARI 1060-2011 - Performance Rating of Air-To-Air Heat Exchangers for Energy Recovery Ventilation Heat Equipment
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 68-1997 - Laboratory Method of Testing to Determine the Sound Power in a Duct.
- .4 American Society for Testing and Materials International (ASTM)
  - .1 ASTM B117-11 - Standard Practice for Operation Salt Spray (Fog) Apparatus.
- .5 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .6 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA MG 1-2011, Motors and Generators, Revision 1.
- .7 National Fire Protection Association (NFPA)
  - .1 NFPA (Fire) 90A - Installation of Air Conditioning and Ventilation Systems, 2012 Edition
  - .2 NFPA (Fire) 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems, 2012 Edition.
- .8 Underwriters Laboratories (UL)
  - .1 UL 900 - Test Performance of Air Filter Units.
  - .2 UL 1995 - Heating and Cooling Equipment.
- .9 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- .10 SMACNA - HVAC Duct Construction Standards.

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

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

### **1.4 CLOSEOUT SUBMITTALS**

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

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 1 spare sets of filters.

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

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

### **1.8 ACCEPTABLE MATERIALS**

- .1 Approved manufacturer:
  - .1 Daikin Vision or equal from Trane, Carrier, McQuay or York.

## **Part 2 - Products**

### **2.1 GENERAL**

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated in plans, schedule & specification.
- .2 Horizontal type, having air tight modular components, consisting of double wall insulated casing, fan section motor and drive, cooling coil, heating coil, filters, mixing box & low leakage outdoor & return air dampers. Return fan and mixing modules shall be mounted separately.
- .3 Provide unit mounting legs to support all sections of unit and raise unit for proper trapping. Contractor will be responsible for providing a housekeeping pad when unit mounting device is not of sufficient height to properly trap unit. Unit mounting devices not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel.



## 2.2 CASING

- .1 General:
  - .1 Factory manufactured solid double wall galvanized steel casing construction of 1.3 mm thick steel. Perforated inner casing in fan sections. Reinforced and braced for rigidity and flanged for bolted sub-assemblies, all to withstand a pressure differential from -4" wg to +6" wg.
  - .2 Provide instrument test ports in each section to allow measurement of static pressures after each damper, filters, coil, etc.
    - .1 Instrument Test Ports: 1.6 mm thick steel zinc plated after manufacture c/w Neoprene mounting gasket, Cam lock handles with neoprene expansion plug and handle chain. 28 mm minimum inside diameter. Length to suit insulation thickness.
  - .3 Provide access doors to allow access to internal parts and component removal.
    - .1 Access doors: insulated sandwich panel construction of same material and thickness as casing, of sizes as indicated and complete with 3 hinges, two-way latches and neoprene gaskets as indicated. Hinge doors to open against air pressure complete with hold open devices.
  - .4 Where steel is not galvanized, or where galvanized steel sheet is cut, paint over with corrosion resistant paint to CAN/CGSB-1.181. Finish inside and out, over prime coat, with enamel paint.
  - .5 Internally insulate casing with 50 mm thick, 72 kg/m<sup>3</sup> density, neoprene coated rigid acoustic duct liner with metal nosings at all edges, pinned and cemented in place.
  - .6 Openings and bolted sections to be gasketed.

## 2.3 FANS

- .1 DWDI backwater inclined type to Section 23 34 00 - HVAC Fans.
- .2 Fans shall be mounted on isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment. Flexible canvas ducts shall be installed between fan and unit casing to ensure complete isolation. Flexible canvas ducts shall comply with NFPA (Fire) 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.
- .3 Fan modules shall have a minimum of one access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components.
- .4 Provide associated variable frequency drive where indicated on schedule in accordance with Section 23 05 14 - Variable Frequency Drives.
- .5 Motors & drives shall be provided in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

## 2.4 COILS

- .1 General:
  - .1 Cleanable tube type: steel or cast iron headers and straight tubes.
  - .2 Coils shall be manufactured with plate fins to minimize water carry over and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.
  - .3 All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the

- manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carry over.
  - .4 Maximum tube length: 3.6 m unless specified otherwise.
  - .5 Factory proof tested to 300 psig and leak tested to 200 psig with air under water.
  - .6 Provide 20 mm $\phi$  threaded & capped ports at the top & bottom of each coil header expected through the AHU casing for drawing and blowing out of coil with compressed air.
- .2 Ratings: ARI Certified . Submit with shop drawings actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
    - .1 Unless otherwise indicated, dehumidifying coils shall be rated for 2.5 m/s face velocity.
    - .2 Unless otherwise indicated, preheat coils to be rated for 3.5 m/s.
    - .3 Pressure drop through heating coils: as indicated.
    - .4 Pressure drop through cooling coils: as indicated.
    - .5 Water velocity: 1.2 m/s maximum. Under 0.6 m/s, turbulators may be used if manufacturer's standard practice.
- .3 Coil casings:
    - .1 Mounting: designed for bolting to other sections.
    - .2 Steel: die formed 1.6 mm thick galvanized zinc coated steel sheet.
    - .3 Tube supports: allow for expansion and contraction.
    - .4 Supports: steel channel or double angle frames or other approved support. Provide brass supports for copper coils.
    - .5 Blank-off plates: of similar material as casing to prevent air bypass. Seal openings where pipes pass through casing using methods recommended by SMACNA.
- .4 Heating and chilled water glycol coils: cleanable fins.
    - .1 Tubes: copper.
    - .2 Fins: aluminum.
    - .3 Headers: cast iron steel cast brass.
    - .4 Pressure tests: 1.7 Mpa.
    - .5 Supply and return header connections shall be clearly labeled on outside of units such that direction of coil water-flow is counter to direction of unit air-flow.
    - .6 Capacities: as indicated.

## 2.5 DRAIN PANS

- .1 Construction: stainless steel. Rounded corners.
- .2 Insulation: external foam type, minimum 13 mm thick.
- .3 Drain connection: in bottom at low point.
- .4 Drain pan shall slope in three directions without sag minimum 1% to ensure no standing water at any time or at any point.
- .5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include all return bends and headers.
- .6 Provide intermediate drain pans with piped drain to bottom pan whenever coils are stacked.
- .7 The contractor is responsible to ensure the drain pan is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

## 2.6 FILTER BOX

- .1 Casing as per Clause 2.2.
- .2 Holding frames: galvanized steel or extruded aluminum to suit filter sizes for front servicing.
- .3 Seals: to ensure leakproof operation.
- .4 Blank-off plates: as required, to fit all openings and of same material as holding frames.

## 2.7 FILTERS

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 120°F.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.
- .4 Pre filters: disposable, extended surface pleated panel type with welded wire support grid, 2" thick, 30% average efficiency as per ASHRAE 52.
- .5 Secondary filters: disposable, 12" deep Cartridge type 80-85% average efficiency as per ASHRAE 52.
- .6 Size to be 600 x 600 (24" x 24") or 600 x 300 (24" x 12") only.
- .7 Acceptable materials: AAF, Airguard, Farr.

## 2.8 DAMPERS

- .1 Dampers: opposed blade, low leakage, proportioning type, extruded aluminum blades, 150 mm (6") maximum width, locked to steel rods in rustproof bushings.
  - .1 Performance:
    - .1 Leakage Class: 1A.
    - .2 Pressure drop: at full open position to be less than 4 Pa differential across damper at 5 m/s.
  - .2 Seals: Neoprene on damper edges, top, bottom, sides of framing.
  - .3 Acceptable material: Outdoor Intake & Exhaust Damper: TAMCO 9000 or equal. Return & Bypass Damper: Tamco 1000 or equal.

## 2.9 VIBRATION ISOLATION

- .1 Flexible Connections:
  - .1 Frame: galvanized sheet metal frame 100 mm thick with fabric clenched by means of double locked seams.
  - .2 Material: 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 Vibration Isolator on Supply Fan:
  - .1 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
  - .2 Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

## 2.10 ACCESSORIES

- .1 Provide air tight 12 mm diameter sleeves for control wiring to sensors in fan plenum, coil section, across filter section, and mixing box sections. Provide additional 38 mm diameter sleeve in the fan plenum for power wiring to fan. All locations will be selected by engineer on shop drawings and installed in contractor's shop.
- .2 Provide factory mounted Dwyer 2000 magnehelic pressure gauges, accurate to +2% full range sensing, complete with sensing probes and shut-off valves, one per filter bank.
- .3 All control functions to be executed by networked PLC provided by Controls Contractor.
- .4 Provide factory mounted freeze-stat on downstream side of heating coil.

## 2.12 SOUND POWER LEVELS (dB)

- .1 Schedule

System	Fan	Location	63	125	250	500	1000	2000
FC-1	Supply	Discharge	80	80	77	70	78	75
	Return	Inlet	77	77	73	71	72	69

## Part 3 - Execution

### 3.1 INSTALLATION

- .1 Unit shall be shipped to site in sections no larger than 1,200 mm to fit door openings.
- .2 Provide manufacturer representative to supervise the field assembly by the contractor.
- .3 Assemble to provide smooth air flow through all components. Limit air leakage to 1% of rated air flow at 2.5 kPa suction pressure.
- .4 Apply sealer into all seams prior to assembly. Secure toe angles on 300 mm centres for full length of casing.
- .5 Paint inside casing surfaces with zinc coating to CAN/CGSB-1.181, 0.075 mm minimum thickness when dry.

### 3.2 FANS

- .1 Provide sheaves and belts required for final air balance.
- .2 Install flexible connections at fan inlet. Ensure metal bands of connectors are parallel and not touching when fan is running and when fan is stopped. Ensure that fan inlet and duct are aligned when fan is running.
- .3 Install spring isolators on supply fan with 2" deflection.

### **3.3 DRIP PAN**

- .1 Install deep seal P trap on drain pan discharge. Trap size and depth to be sized to manufacturer's recommendations and reviewed by Engineer prior to installation.

## Part 1 - General

### 1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.2 CLOSEOUT SUBMITTALS

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

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 01 - General Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect 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, on drawing section.
- .2 Maximum pressure drop per zone: 12.9 kPa (4 ft.)

### 2.2 RADIATORS

- .1 Contractor shall refer to architectural and mechanical drawings to determine location, quantity, detail, size and performance of radiators.
- .2 Provide steel panel radiator elements of lengths and in locations as indicated, and of capacities, style and having accessories as scheduled. The wall hung heating panel radiation shall be of one-piece all-welded steel construction, consisting of flattened water tubes welded to headers at each end. The radiator shall include an integral heavy gauge (0.09" minimum) all-welded perforated top grille. RF models to have steel corrugated fins welded to the rear side of the water tubes to increase the convective output of the unit. There shall be no less than 106 fins per metre (32 fins per foot). Fins shall start within 25 mm (1" ) of the headers, and shall be spot-welded three times per tube.
- .3 The radiator's headers shall include all necessary inlet, outlet and vent connections as required. Standard connection sizes are 12.7 mm (½" NPT) tapered thread for supply and return piping, and 3.2 mm (1/8") for the vent connection. Internal baffling is provided where required for proper water flow. Optional 3/4" connections shall be available at an additional cost.

- .4 The radiant heating panels shall be available in lengths from 0.6 m to 9 m (2'-0" to 29'-6") in 50 mm (2") even increments without the need for splicing. The panel radiation shall be capable of being mounted to typical stud wall construction without additional blocking or strapping. Appropriate top wall mounting brackets and bottom locking bracket shall secure panel to wall or optional floor post mounting shall be provided with the radiation. Panel radiation expansion shall not exceed 0.5 mm per metre (1/64" per foot) of radiation at 101°C (215°F). The installer shall provide adequate expansion compensation for each radiator.
- .5 Pressure Ratings:
  - .1 Pressure ratings for the radiation shall be as follows:
    - .1 Working pressure-85 PSI maximum, Test Pressure-110 PSI maximum
- .6 Finishes:
  - .1 The panel radiation shall be cleaned and phosphatized in preparation for the powder coat finish. The radiation is then finish painted with a gloss powder coat finish, for a total paint thickness of 2-3 mils (0.002" - 0.003"). The color shall be selected from the manufacturer's standard colors; final colour selection by Architect.
- .7 Warranty:
  - .1 Radiators shall have a 5-Year Limited Warranty.
- .8 Ribbed pipe cover trims, finished to match the radiators shall be provided with the radiation including full centre trim, full end trim, full end cap, full inside or outside corner trims as required to maintain continuous wall to wall element.
- .9 The radiation manufacturer shall provide combination shutoff valve/union fitting of less than 50 mm (2") in width for the supply and return to each panel radiator and chrome plated NPT-MV manual air vents on each panel, to be field installed by mechanical contractor.
- .10 Supply flex connectors between radiator panels to provide expansion compensation for the radiators.
- .11 Acceptable materials: Runtal TT series.

### **Part 3 - Execution**

#### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout and reviewed 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 Engineer if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 - EMCS: General Requirements.

### **1.2 DEFINITIONS**

- .1 For additional 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 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 00 01 - General Requirements.
- .2 Final Report: submit report to NCC 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 NCC 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 NCC Representative 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.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of NCC Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

### **1.5 COMMISSIONING**

- .1 Do commissioning of all control systems associated with new fan coil system, exhaust fan and radiant heaters.
- .2 Carry out commissioning under direction of NCC Representative and in presence of NCC Representative.



- .3 Inform, and obtain approval from, NCC Representative in writing at least 14 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of NCC Representative 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 tests as required.

## **1.6 COMPLETION OF COMMISSIONING**

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by NCC Representative.

## **1.7 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. Provide two-way radios.
- .2 Instrumentation accuracy tolerances : higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to 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 Commission each system using procedures prescribed by a qualified commissioning professional and approved by NCC Representative.
- .3 Commission integrated systems using procedures prescribed by a qualified commissioning professional and approved by NCC Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

### **3.2 FIELD QUALITY CONTROL**

- .1 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 Verify each A-to-D convertor.
    - .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 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 NCC Representative . This document will be used in final startup testing.
  - .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of NCC Representative and provide:
    - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
    - .2 Detailed daily schedule showing items to be tested and personnel available.
    - .3 NCC Representative's acceptance signature to be on executive and applications programs.
    - .4 Commissioning to commence during final startup testing.
    - .5 O&M personnel to assist in commissioning procedures as part of training.
    - .6 Commissioning to be supervised by qualified supervisory personnel and NCC Representative.
    - .7 Commission systems considered as life safety systems before affected parts of the facility 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 NCC Representative to verify reported results.

### **3.3 ADJUSTING**

- .1 Final adjusting: upon completion of commissioning as reviewed by NCC Representative, set and lock devices in final position and permanently mark settings.

### **3.4 DEMONSTRATION**

- .1 Demonstrate to Commissioning Manager NCC Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 00 01 - General Requirements.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 25 05 54 - EMCS: Identification.
- .2 Section 25 90 01 - EMCS: Site Requirements, Applications and Systems.

### 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 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE 260.1-2004, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 Canadian Standards Association (CSA International).

### 1.3 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 wired 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 25character 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 field 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 IEEE 260.1.
  - .2 Refer also to Section 25 05 54 - EMCS: Identification.

## 1.5 SYSTEM DESCRIPTION

- .1 Refer to Section 25 90 01 - EMCS: Site Requirements, Applications and Systems.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
  - .1 Building Controllers.
  - .2 Control devices as listed in I/O point summary tables.
  - .3 OWS(s).
  - .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.
- .3 General Requirements:
- .1 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 NCC Representative prior to installation.
  - .3 Location of controllers as reviewed by NCC Representative prior to installation.
- .4 Language Operating Requirements:
- .1 Provide English and French operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English and French.
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and French.
  - .4 System manager software: include in English and French 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 Include, in English and French:
    - .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 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 00 01 - General Requirements.
- .2 Submit for review:
  - .1 Equipment list and systems manufacturers at time of tender within 48 h 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
  - .4 In lieu of such evidence, submit certificate from testing organization, approved by NCC 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 certificate of acceptance from authority having jurisdiction to NCC Representative.
  - .8 Existing devices intended for re-use: submit test report.

## **1.7 QUALITY ASSURANCE**

- .1 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .2 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .3 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

## **1.8 EXISTING - CONTROL COMPONENTS**

- .1 All building automation controls shall be performed by Siemens Building Technologies.
- .2 All new material and equipment to be compatible with the existing BAS (Siemens Apogee System).
- .3 Coordinate all work with new electrical room work. Connect all points to a common controller in adjacent electrical room and connect controller back to Room 0334.

## **Part 2 - Products**

### **2.1 EQUIPMENT**

- .1 All materials must be selected to ensure full compatibility with existing BAS system.
- .2 Complete list of equipment and materials to be used on project and forming part of bid 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.

## **Part 3 - Execution**

### **3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: to manufacturer's recommendations.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 - EMCS: General Requirements.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.1-12, The Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.

### **1.3 DEFINITIONS**

- .1 For 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 and French.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 00 01 - General Requirements. supplemented and modified by requirements of this Section.
- .2 Submit to NCC Representative for approval samples of nameplates, identification tags and list of proposed wording.

## **Part 2 - Products**

### **2.1 NAMEPLATES FOR PANELS**

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 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 NCC Representative.
- .3 Letter size: to suit, clearly legible.

### **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 NCC Representative's.

### **2.5 WIRING**

- .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**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with NCC 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 during Work.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 23.01 - Valves.
- .2 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
- .3 Section 25 05 01 - EMCS: General Requirements.
- .4 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
- .5 Section 26 05 00 - Common Work Results for Electrical.

### **1.2 REFERENCES**

- .1 National Electrical Manufacturer's Association (NEMA).
- .2 Canadian Standards Association (CSA International).

### **1.3 DEFINITIONS**

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 00 01 - General Requirements.

### **1.5 EXISTING CONDITIONS**

- .1 Cutting and Patching: in accordance with Section 01 00 01 - General Requirements.
- .2 Repair surfaces damaged during execution of Work.

## **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, heat resistant, assembly.
  - .3 Operating conditions: - 40 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
  - .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
  - .5 Transmitters and sensors to be unaffected by external transmitters including 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 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

## 2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
  - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
  - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
  - .3 Sensing element: hermetically sealed.
  - .4 Stem and tip construction: copper or type 304 stainless steel.
  - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
  - .6 Immersion wells: NPS 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 for access to zone bus.
    - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
    - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
    - .6 Stability 0.02 degrees C drift per year.
    - .7 Separate mounting base for ease of installation.
- .3 Duct temperature sensors:
  - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm.
  - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 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 4 enclosure.

## 2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
  - .1 Input circuit: to accept 3-lead, 100 ohm at 0°C, platinum resistance detectors type sensors.
  - .2 Power supply: 575 ohms at 24 V DC into load of 575 ohms. Power supply effect less than 0.01°C per volt change.
  - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .4 Input and output short circuit and open circuit protection.
  - .5 Output variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.
  - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.
  - .7 Maximum current to 100 ohm RTD sensor: not to exceed 25 mA.
  - .8 Integral zero and span adjustments.
  - .9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50°C.

- .10 Long term output drift: not to exceed 0.25% of full scale/ 6 months.
- .11 Transmitter ranges: Select narrowest range to suit application from following:
  - .1 Minus 50°C to plus 50°C, plus or minus 0.5°C.
  - .2 0 to 100°C, plus or minus 0.5°C.
  - .3 0 to 50°C, plus or minus 0.25°C.
  - .4 0 to 25°C, plus or minus 0.1°C.
  - .5 10 to 35°C, plus or minus 0.25°C.

## **2.4 ELECTRICAL RELAYS**

- .1 Requirements:
  - .1 Double voltage, DPDT, plug-in type with termination base.
  - .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
  - .3 Contacts: rated at 5 amps at 120 V AC.
  - .4 Relay to have visual status indication.

## **2.5 CONTROL VALVES**

- .1 Requirements:
  - .1 Construction: reference Section 23 05 23.01 - Valves.
  - .2 Two or three port as indicated. Normally Open.
  - .3 Flow characteristics: linear or equal percentage as indicated.
  - .4 Rangeability: 50:1 minimum.
  - .5 Performance: refer to drawings for capacities.
  - .6 Minimum shut-off pressure: refer to drawings and valve specifications.
  - .7 Size for 25% of system pressure drop or 5 psi, whichever is less.
  - .8 Two position valves shall be line size.

## **2.6 ELECTRONIC VALVE ACTUATORS**

- .1 Requirements:
  - .1 Construction: steel, cast iron, aluminum.
  - .2 Control signal: 4-20 mA DC.
  - .3 Return to normal position on loss of communication.
  - .4 Positioning time: to suit application (90 seconds maximum).
  - .5 Size actuator to meet requirements and performance of control valve specifications.
  - .6 Scale or dial indication of actual control valve position.

## **2.7 DIFFERENTIAL PRESSURE TRANSMITTERS**

- .1 Requirements:
  - .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 ohm maximum load.
  - .3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.
  - .5 Integral zero and span adjustment.
  - .6 Temperature effects: not to exceed plus or minus 1.5% full scale/50 degrees 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 N.P.T. conduit connection. Enclosure to be integral part of unit.

## 2.8 CURRENT / PNEUMATIC (I/P) TRANSDUCERS

- .1 Requirements:
  - .1 Input range: 4 to 20 mA.
  - .2 Output range: proportional 20-104 kPa or 20-186 kPa as applicable.
  - .3 Housing: dustproof or panel mounted.
  - .4 Internal materials: suitable for continuous contact with industrial standard instrument air.
  - .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2% of full scale over entire range.
  - .6 Integral zero and span adjustment.
  - .7 Temperature effect: plus or minus 2% of full scale/ 50 degrees C or less.
  - .8 Regulated supply pressure: 206 kPa maximum.
  - .9 Air consumption: 16.5 ml/s maximum.
  - .10 Integral gauge manifold c/w gauge (0-206 kPa).

## 2.9 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
  - .1 Direct mount proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .4 Power requirements: 5 VA maximum at 24 V AC.
  - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
  - .6 For VAV box applications floating control type actuators may be used.

## 2.10 FREEZESTATS

- .1 Install freezestats on fan coil. Freezestat to be equipped with local LED indicating light.
  - .1 Upon detection of low temperature, the freezestats shall stop the associated supply and exhaust fans. Provide manual reset.

## 2.11 WIRING

- .1 Wiring must be continuous without joints.
- .2 All wiring to be in EMT conduits.
- .3 Sizes:
  - .1 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
  - .2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.

## 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, 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 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.
- .6 Electrical:
  - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3 Trace existing control wiring installation and provide updated wiring schematics including additions and deletions to control circuits 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 Maximum conduit fill not to exceed 40%.
    - .4 Design drawings do not show conduit layout.
  - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

### 3.2 ELECTRICAL WIRING AND MATERIALS

- .1 Install, connect and wire the items included under this Section. This work includes providing required conduit, wire, fittings, and related wiring accessories. All conduit, wiring and equipment to conform to Div. 26 specifications.
- .2 Provide wiring between thermostats, aquastats and unit heater motors, all control and alarm wiring for all control and alarm devices for all Sections of Specifications. Controls Contractor shall be responsible for all controls and interlock wiring not covered by Div. 26, including but not limited to air proving switches, end switches, alarm devices and other control components.
- .3 All 120V power shall be provided by Div. 26 (hired by BAS contractor) to BAS equipment.
- .4 Provide status function conduit and wiring for equipment covered under this Section.
- .5 Contractor shall provide conduit where wiring is exposed (e.g. mechanical & electrical rooms, penthouse, garage, etc.), otherwise FT-6 plenum rated wiring shall be used.
- .6 Provide conduit and wiring between the BAS panels and the temperature, humidity, or pressure sensing elements, including low voltage control wiring in conduit.
- .7 Provide conduit and control wiring for devices specified in this Section.

- .8 Provide conduit and signal wiring between motor starters in motor control centers and high and/or low temperature relay contacts and remote relays in BAS panels located in the vicinity of motor control centers.
- .9 Provide conduit and wiring between the PC workstation, electrical panels, metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contractors, and BAS panels, as shown on the drawings or as specified.
- .10 All wiring to be compliant to local building code and the NEC.
- .11 Provide electrical wall box and conduit sleeve for all wall mounted devices.

### **3.3 TEMPERATURE SENSORS**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 To be readily accessible and adaptable to each type of application so as to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
  - .1 Protect from solar radiation and wind effects by stainless steel shields.
  - .2 Install in NEMA 12 enclosures.
- .4 Thermowells: install for piping installations. Where pipe diameter is less than well insertion length, locate well in elbow. Thermowell to restrict flow by less than 30%.

### **3.4 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 SUMMARY

- .1 Section Includes:
  - .1 At minimum provide detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
  - .1 Control Description Logic (CDL) for each system.
  - .2 Input/Output Point Summary Tables for each system.
  - .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

### 1.2 SEQUENCING

- .1 Sequencing of operations for system as follows:
  - .1 Air Handling Unit FC-1
    - .1 BAS will control the system based on time of day schedule. During unoccupied period the system will be duty cycled in 100% recirculating mode to maintain unoccupied space temperature setpoint. Exhaust and outdoor air dampers to be closed.
    - .2 When the unit is enabled to occupied mode, the sequence of operation is as follows:
      - .1 The fresh air damper, return air damper, chilled water cooling coil and hot water heating coil control valves to modulate in sequence to maintain space temperature setpoint. The fresh air and return air damper to modulate to maintain a maximum CO<sub>2</sub> level of 800 ppm (adjustable).
      - .2 Unit Status Report: The BAS shall provide an operating status summary of the following information to provide the operator with critical AHU operating data:
        - .1 Unit data.
        - .2 Operating mode.
        - .3 Active cooling/heating mode.
        - .4 Supply air temperature.
        - .5 Supply and exhaust fan status.
        - .6 Heating & cooling valve position.
        - .7 Dirty filter.
        - .8 Mixed air temperature.
        - .9 Supply & exhaust fan modulation.
        - .10 CO<sub>2</sub> level.
        - .11 Supply air duct pressure.
        - .12 Outside air enthalpy.
        - .13 Return air enthalpy.
      - .3 Free cooling will be enabled/disabled using differential enthalpy sensors between return and outdoor air. When the main chilled water system has been disabled (below 10°C OA), free cooling shall also be enabled when required.
      - .4 Supply air fan on FC-1 is modulated via VSD to maintain end of line duct static pressure (adjustable) to provide a flow of 707 L/s.
      - .5 The diverting valve shall divert water to the heating coil when the geothermal loop is heating and divert to the cooling coil when the geothermal loop is in cooling.
      - .6 Exhaust fan EF1 to modulate the airflow via VSD proportionally to the intake damper. The intake damper and VSD to be calibrated during testing & airflow balancing to determine airflow at various VSD frequencies and damper position. Space shall be positive pressurized by 47 L/s.
      - .7 Safety:
        - .1 The unit shall be c/w with freezestat on hydronic coil. Upon detection of water temperature below 5°C (adjustable) on a low return water temperature sensor on the hydronic heating coil de-energizes the system & announces critical alarm.



- .2 A current switch is installed in the supply and exhaust fan starter. The DDC system uses this switch to confirm the fan is in the desired state (i.e. on or off) and generates an alarm if status deviates from DDC start/stop control.
- .3 A suction sensor & discharge sensor in FC-1 will prevent over or under pressurization of system.
- .2 Radiant Panels:
  - .1 Hot water heating control valves to turn ON/OFF to maintain space temperature setpoint. When FC-1 is in cooling, hot water heating control valves shall be closed.
- .3 Ballroom Fan Coils:
  - .1 Provide DDC control valves to existing fan coils. Provide electronic-pneumatic transducers to connect to existing controls. Provide feedback to BAS to indicate if fan coil is in heating or cooling.

## **Part 2 - Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 - Execution**

### **3.1 NOT USED**

- .1 Not Used.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

### 1.2 REFERENCES

- .1 Definitions:
  - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
  - .1 CSA Group
    - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with project general requirements.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .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 Submit drawings and product data to authority having jurisdiction.
  - .6 If changes are required, notify NCC Representative of these changes before they are made.
- .4 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.
  - .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 report as described in PART 3 - LOAD BALANCE.
  - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to NCC Representative.
- .5 Manufacturer's Field Reports: submit to NCC Representative 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.

## 1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with project requirements.
- .2 Operation and Maintenance Data: submit operation and maintenance data for for incorporation into manual.
  - .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.
  - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with project requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with project requirements.

## Part 2 - Products

### 2.1 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 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.

- .4 Use one nameplate or label for each language.

## 2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with project requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

## 2.3 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

## 2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matt white finish face, black 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 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by NCC Representative 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 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. [\_\_\_\_\_]" as directed by NCC Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

## 2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .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.

## 2.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Telephone	Green	
Other	Green	Blue
Communication Systems		
Fire Alarm	Red	
Other	Red	Yellow
Security Systems		

## 2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint indoor switchgear and distribution enclosures light gray.

## Part 3 - Execution

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of NCC Representative.
  - .2 Inform NCC 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 NCC Representative.

### **3.2 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

### **3.3 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

### **3.4 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, 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 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 In mechanical rooms: 1200 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 400 mm.
  - .5 Wall mounted telephone and interphone outlets: 1200 mm.
  - .6 Fire alarm stations: 1200 mm.
  - .7 Fire alarm bells: 2300 mm.
  - .8 Television outlets: 400 mm.

### **3.6 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### 3.7 FIELD QUALITY CONTROL

- .1 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 balance report as directed in PART 1 - ACTION AND INFORMATIONAL 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.
- .2 Conduct following tests in accordance with project requirements.
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: fire alarm.
  - .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.
- .3 Carry out tests in presence of NCC Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### 3.8 SYSTEM STARTUP

- .1 Instruct NCC 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.

### 3.9 CLEANING

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

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with project requirements.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.



## **Part 1 - General**

### **1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Electrical General Requirements.

### **1.2 DEFINITIONS**

- .1 SRS: acronym for Seismic Restraint System.

### **1.3 GENERAL DESCRIPTION**

- .1 This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project by Division 26. This includes, but is not limited to, electrical light fixtures, transformers, MCC's, UPS, diesel generators, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.
- .2 Cable restraint systems, rod stiffener clamps and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.

### **1.4 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA S832-14, Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.
- .2 National Research Council Canada
  - .1 NRCC NBCC-2010, National Building Code of Canada 2010.

### **1.5 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Submit seismic restraint shop drawings, c/w seal of Professional Engineer registered in Province of Ontario, clearly identifying equipment/systems reviewed and the equipment/systems requiring restraint. Shop drawings must clearly show all forces transferred to structure.
- .3 Seismic Design Engineer shall provide a spreadsheet identifying all equipment and systems requiring or not requiring seismic restraints and include all circulations.
- .4 Submit additional copy of shop drawings and product data to project Structural Engineer for review of connection points to building structure.

## 1.6 MAINTENANCE DATA

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 26 05 00 - Electrical General Requirements.

## 1.7 SEISMIC FORCE

- .1 The Importance Factor for this project is:
  - .1 I = 1.0 - All other buildings i.e.: Office & General Buildings.

Note: As per NBCC.

## Part 2 - Products

### 2.1 SRS MANUFACTURER

- .1 SRS to be from one manufacturer regularly engaged in production of same, 5 years experience.

### 2.2 GENERAL

- .1 Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Division 26 to include all costs associated with this work as it relates to Division 26 installations.
- .2 SRS to be fully integrated into, compatible with:
  - .1 Noise and vibration controls specified elsewhere in this project specification, telecommunications.
  - .2 Structural, mechanical, electrical design of project.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury, interfering with other systems, and from moving from normal position.
- .4 Design and installation in accordance with NBCC, CSA S832.
- .5 SRS to provide gentle and steady cushioning action and avoid high impact loads
- .6 SRS to restrain seismic forces in all directions.
- .7 Fasteners and attachment points to resist same load as seismic restraints.
- .8 SRS of conduit systems to be compatible with:
  - .1 Expansion, anchoring and guiding requirements.
  - .2 Equipment vibration isolation and equipment SRS.
- .9 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .10 Attachments to RC structure:
  - .1 Use high strength mechanical expansion anchors.
  - .2 Drilled or power driven anchors not permitted.
- .11 Seismic control measures not to interfere with integrity of firestopping.

## 2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
  - .1 Anchor equipment to equipment supports.
  - .2 Anchor equipment supports to structure.
  - .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Install tight to structure.
    - .2 Cross-brace in all directions.
    - .3 Brace back to structure.
    - .4 Slack cable restraint system.
  - .2 SRS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
  - .3 Hanger rods to withstand compressive loading and buckling.

## 2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Floor mounted equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Vibration isolators with built-in snubbers.
    - .2 Vibration isolators and separate snubbers.
    - .3 Built-up snubber system approved by NCC Representative, consisting of structural elements and elastomeric layer.
  - .2 SRS to resist complete isolator unloading.
  - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
  - .4 Cushioning action to be gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Slack cable restraint system.
    - .2 Brace back to structure via vibration isolators and snubbers.

## Part 3 - Execution

### 3.1 INSTALLATION

- .1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.
- .2 Install SRS at least 25 mm from all other equipment, systems, services.
- .3 Co-ordinate connections with all disciplines.

### **3.2 INSPECTION AND CERTIFICATION**

- .1 SRS to be inspected and certified by Manufacturer upon completion of installation.
- .2 Seismic Design Engineer shall provide written report to NCC Representative certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

### **3.3 COMMISSIONING DOCUMENTATION**

- .1 Upon completion and acceptance of certification, hand over to NCC Representative complete set of construction documents, revised to show "as-built" conditions.

## Part 1 - General

### 1.1 REFERENCES

- .1 CSA International
  - .1 CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2 CAN/CSA-C22.2 No. 65-13, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 National Electrical Manufacturers Association (NEMA)

## Part 2 - Products

### 2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
  - .1 Connector body and stud clamp for copper conductors.
  - .2 Clamp for copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.
  - .5 Sized for conductors as required.
- .4 Clamps or connectors for armoured cable, flexible conduit, as required to: CAN/CSA-C22.2 No. 18.

## Part 3 - Execution

### 3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
  - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
  - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No. 65. Replace insulating cap.
  - .3 Install bushing stud connectors in accordance with NEMA.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

## **Part 2 - Products**

### **2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

### **2.2 ARMoured CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

## **Part 3 - Execution**

### **3.1 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring to be 2-wire circuits only, i.e. common neutrals not permitted.

### **3.2 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

### **3.3 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.

## **Part 2 - Products**

### **2.1 EQUIPMENT**

- .1 Grounding conductors: bare stranded copper, tinned, soft annealed, size as required.
- .2 Insulated grounding conductors: green, copper conductors, size as required.
- .3 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 Bonding jumpers, straps.
  - .5 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 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 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.
- .7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

### **3.2 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, cable trays.



### **3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of NCC Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

## Part 1 - General

### 1.1 NOT USED

- .1 Not used.

## Part 2 - Products

### 2.1 SUPPORT CHANNELS

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

## Part 3 - Execution

### 3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 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.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of NCC Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

## **Part 2 - Products**

### **2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

### **2.2 JUNCTION AND PULL BOXES**

- .1 Construction:welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

## **Part 3 - Execution**

### **3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to 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 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.
-

### 3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

## Part 1 - General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

## Part 2 - Products

### 2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

### 2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 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.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

### 2.3 CONDUIT BOXES

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

### 2.4 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

### Part 3 - Execution

#### 3.1 INSTALLATION

- .1 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. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

## Part 1 - General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .3 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
  - .4 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.

## Part 2 - Products

### 2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .3 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.
  - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

### 2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

### 2.4 FISH CORD

- .1 Polypropylene.

### 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 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use electrical metallic tubing (EMT) except in cast concrete.
- .4 Use flexible metal conduit for connection to motors in dry areas.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .6 Minimum conduit size for lighting and power circuits: 19 mm.
- .7 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm diameter.
- .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Install fish cord in empty conduits.
- .11 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
  - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .12 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

#### 3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on 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.

### **3.4 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.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

### 1.2 REFERENCES

- .1 CSA International
  - .1 CSA C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA C22.2 No. 42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA C22.2 No. 55-M1986(R2012), Special Use Switches.
  - .4 CSA C22.2 No. 111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

## Part 2 - Products

### 2.1 SWITCHES

- .1 15, 20 A, 120 V, 347 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 toggle.
- .3 Switches of one manufacturer throughout project.

### 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 rivetted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.

## 2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

## 2.4 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

## 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 for 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 for Electrical as indicated.
  - .3 Install GFI type receptacles.
- .3 Cover plates:
  - .1 Install suitable common cover plates where wiring devices are grouped.
  - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

### 3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

## **Part 1 - General**

### **1.1 REFERENCES**

- .1 CSA International
  - .1 CSA C22.2 No. 5-13, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2013).

## **PART 2 - PRODUCTS**

### **2.1 BREAKERS GENERAL**

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 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 as indicated.

### **2.2 THERMAL MAGNETIC BREAKERS**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

## **Part 3 - Execution**

### **3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.

### **1.2 REFERENCES**

- .1 CSA Group
  - .1 CAN/CSA-C22.2 No. 4-04(R2014), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
  - .2 CSA C22.2 No. 39-13, Fuseholder Assemblies.

## **Part 2 - Products**

### **2.1 DISCONNECT SWITCHES**

- .1 Fusible and non-fusible disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No. 4 size as indicated.
- .2 Provision for padlocking in off switch position.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated.
- .5 Fuseholders: to CSA C22.2 No. 39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

### **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .2 Indicate name of load controlled on size 4 nameplate.
-

**Part 3 - Execution**

**3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

### 1.2 REFERENCES

- .1 International Electrotechnical Commission (IEC)
  - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

## Part 2 - Products

### 2.1 MATERIALS

- .1 Starters: to IEC 947-4 with AC4 utilization category.

### 2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 One overload heater, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Toggle switch: heavy duty labelled as indicated.
  - .2 Indicating light: heavy duty type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

### 2.3 FULL VOLTAGE 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 Motor overload protective device 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 Pushbuttons Selector switches: heavy duty labelled as indicated.
  - .2 Indicating lights: heavy duty type and color as indicated.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

## **2.4 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

## **2.5 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 7 engraved as indicated.

## **Part 3 - Execution**

### **3.1 INSTALLATION**

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

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.



## **Part 1 - General**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International).
- .2 Underwriters' Laboratories of Canada (ULC).

## **Part 2 - Products**

### **2.1 LAMPS**

- .1 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid-start, 4100 K, 30,000 hour lamp life, 2 lumens, CRI 85; or as indicated.

### **2.2 BALLASTS**

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic.
  - .1 Rating: voltage as indicated, for use with 2-32W, rapid start lamps.
  - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .3 Power factor: minimum 95% with 95% of rated lamp lumens.
  - .4 Current crest factor: 1.7 maximum.
  - .5 Harmonics: 10% maximum THD.
  - .6 Operating frequency of electronic ballast: 20 kHz minimum.
  - .7 Total circuit power: 62 Watts.
  - .8 Ballast factor: greater than 0.90.
  - .9 Sound rated: Class A.
  - .10 Mounting: integral with luminaire.

### **2.3 FINISHES**

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

### **2.4 OPTICAL CONTROL DEVICES**

- .1 As indicated in luminaire schedule.

### **2.5 LUMINAIRES**

- .1 As indicated in luminaire schedule.

### **Part 3 - Execution**

#### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

#### **3.2 WIRING**

- .1 Connect luminaires to lighting circuits:
  - .1 Install flexible or rigid conduit for luminaires as indicated.

#### **3.3 LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations support luminaires independently of ceiling.

#### **3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Section 26 05 21 - Wires and Cables (0-1000 V).

### 1.2 REFERENCES

- .1 CSA International
  - .1 CSA C22.2 No. 141-10, Emergency lighting equipment

### 1.3 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.

## 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: 12 V DC.
- .4 Operating time: 30 minutes c/w spare capacity.
- .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 0.01 V 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.
- .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 Auxiliary equipment:
  - .1 Ammeter.
  - .2 Voltmeter.

- .3 Test switch.
- .4 Time delay relay.
- .5 Battery disconnect device.
- .6 AC input and DC output terminal blocks inside cabinet.
- .7 Bracket.
- .8 Cord and plug connection for AC.
- .9 RFI suppressors.

## **2.2 WIRING OF REMOTE HEADS**

- .1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: RW90 type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

## **Part 3 - Execution**

### **3.1 INSTALLATION**

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

### **3.2 PROTECTION**

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

## Part 1 - General

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No. 141-10, Unit Equipment for Emergency Lighting.
  - .2 CSA C860-11, Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA).

## Part 2 - Products

### 2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: extruded aluminum housing, white finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: LED-12W.
- .5 Letters: 150 mm high x 19 mm, with 13 mm thick stroke, red on die-cast aluminum face, reading EXIT and SORTIE.
- .6 Face plate to remain captive for relamping.

### 2.2 DESIGN

- .1 Wall, end to wall, ceiling mounting.
- .2 Single, double face with die-cast face plate to remain captive for relamping.
- .3 Arrow: right left knock-outs.

## 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 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.

- .3 Ensure that exit light circuit breaker is locked in on position.

## Part 1 - General

### 1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

### 1.2 REFERENCES

- .1 Treasury Board of Canada Secretariat (TBS), Occupational Safety and Health (OSH)
  - .1 Fire Protection Standard-10.
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S524-14, Standard for the Installation of Fire Alarm Systems.
  - .2 CAN/ULC-S529-09, Smoke Detectors for Fire Alarm Systems.
  - .3 CAN/ULC-S530-91(R1999), Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .4 CAN/ULC-S537-13, Standard for the Verification of Fire Alarm Systems.

## Part 2 - Products

### 2.1 DESCRIPTION

- .1 Existing System is Simplex 4100U.
- .2 Audible signal devices: to CAN/ULC-S524.
- .3 Thermal detectors: to CAN/ULC-S530.
- .4 Smoke detectors: to CAN/ULC-S529.
- .5 Regulatory Requirements:
  - .1 To TBS Fire Protection Standard.
  - .2 Subject to Fire Commissioner of Canada (FC) approval.
  - .3 Subject to FC inspection for final acceptance.
  - .4 System components: listed by ULC and comply with applicable provisions of NBC, and meet requirements of local authority having jurisdiction.

### 2.2 INITIATING/INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit.
- .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.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

## **2.3 ALARM OUTPUT CIRCUITS**

- .1 Alarm output circuit: connected to signals, wired in class A configuration to central control unit.
  - .1 Signal circuits' operation to follow system programming; capable of sounding bells, 24 VDC.

## **2.4 WIRING**

- .1 Twisted copper conductors: rated 600 V.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

## **2.5 AUTOMATIC ALARM INITIATING DEVICES**

- .1 Heat detectors, fixed temperature, non- restorable, rated 57 degrees C.
- .2 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 degrees C, rate of rise 8.3 degrees C per minute.
  - .1 Electronics to communicate detector's status to addressable module/transponder.
  - .2 Detector address to be set on detector base in field.
- .3 Addressable smoke detector.
  - .1 Ionization type.
  - .2 Electronics to communicate detector's status to addressable module/transponder.
  - .3 Detector address to be set on detector base head in field.

## **2.6 AUDIBLE SIGNAL DEVICES**

- .1 Bells: surface mounted, single stroke,, 24 V dc, 90 db.

## **Part 3 - Execution**

### **3.1 INSTALLATION**

- .1 Install systems in accordance with CAN/ULC-S524 and TB Fire Protection Standard.
- .2 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .3 Connect alarm circuits to main control panel.
- .4 Install bells and connect to signalling circuits.
- .5 Connect signalling circuits to main control panel.
- .6 Splices are not permitted.



- .7 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .8 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .9 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
- .2 Fire alarm system:
  - .1 Test such device and alarm circuit to ensure, thermal and smoke detectors transmit alarm to control panel and actuate alarm.
  - .2 Check annunciator panels to ensure zones are shown correctly.
  - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
  - .4 Addressable circuits system style DCLA:
    - .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    - .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
  - .5 Addressable circuits system style DCLB:
    - .1 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals on line side of single open-circuit fault condition imposed near electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    - .2 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .3 Provide final PROM program re-burn for system NCC Representative incorporating program changes made during construction.

### **3.3 PROTECTION**

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