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**THIS DOCUMENT CONTAINS A SECURITY REQUIREMENT**

# Specifications | Devis

**Project Name | Nom du projet :** HR26 HVAC Upgrades

**DND Project File :** PF 500540682

**DCC Project File :** KN229909

**Drawing Number | Numéro du projet :** L-B35-8900

**Date | Date :** November 21, 2025

**Location | Emplacement :**

32 Lundy's Lane
Address | Adresse

Kingston
City | Ville

ON
Province | Province

**Project Manager | Chargé de projet :**

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Limin Pan, Mechanical Engineer

**Base Fire Chief | Chef des pompiers de la base :**

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Steve St. John, Chief Fire Inspector

**Approved by | Approuvé par :**

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# PART 1 GENERAL

## 1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises the furnishing of all labour, materials and equipment required for general construction and renovation of the proposed building, located at 32 Lundy's Ln, Kingston, ON; and further identified as Batoche Community Centre or Kingston Military Family Resource Centre (KMFRC).

.2 The project work generally includes the replacement of major HVAC equipment, replacement and rework of significant sections of the distribution ductwork to enable VAV airflow control, new grilles and diffusers, the addition of new hydronic heating control valves, along with replacement and expansion of the building automation system to integrate the new and existing systems for better building control and occupant comfort.

.3 The work will need to be completed in phases and requires the contractors assistance to enable the moving for these phases as outlined in the documents.

.4 There will also be collateral impact to the finishes, structural elements, electrical and sprinkler work that will need to be coordinated and addressed as outlined in the documents.

## 1.2 CODES

.1 Perform work in accordance with National Building Code of Canada (NBC), Ministry of Labour guidelines and regulations, applicable codes and standards and any other National Defence standard procedures that may be specified, (all latest editions). In any case of conflict or discrepancy, the more stringent requirement shall apply.

.2 Meet or exceed requirements of:
- .1 contract documents,
- .2 specified standards, codes and referenced documents.
- .3 all of the above documents are latest issue, regardless of data shown in the specification.

## 1.3 DEFINITIONS

.1 DCC Representative is Defence Construction Canada Ltd. DCC, as referenced in DCC General Conditions. DCC is the tendering agency and the Coordinator for the projects. DCC is the sole project authority representing National Defence and the Designer of Record for the project, during and after tender award.
- .1 DCC Representative is the sole project authority. The Designer of Record is to have the DCC Representative approval for making any changes to the design or specification.
- .2 The Contractor shall cooperate fully with the DCC Representative order that the DCC Representative and the Designer of Record may properly review the progress of the work during its execution.

## 1.4 SITE CONDITIONS AND INQUIRIES AT TENDER

.1 It is highly recommended that Contractors attend the site visit to familiarize themselves with existing conditions and project intent during the tender. Bidders site briefing, if conducted, is not comprehensive and is not a substitute for a thorough review of the

tender package by the Contractor.

**1.5 SETTING OUT OF WORK**

.1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

.2 Provide everything needed to lay out and construct work.

.3 Supply any devices and or templates required to facilitate DCC Representative or authorized testing agencies inspection of work.

.4 Location of non-base controlled services are the responsibility of the contractor to obtain. These are typically natural gas, telephone, cable and local utility controlled electrical. Base will locate services as follows: Base controlled electrical, sewer, steam, water and communications.

.5 Saturday and Sunday work or work on specified Statutory Holidays is NOT permitted unless approved by the DCC Representative. Refer to Appendix B for anticipated weekend work .

.6 Contractor is to provide a qualified and competent superintendent and is to be present at the job site when work is being performed.

**1.6 WORK SEQUENCE**

.1 Construct Work in stages to accommodate Owner's continued use of premises during construction, as applicable. Refer to Appendix B and Drawing L-B35-8900-300.

.2 Provide detailed construction schedule and phasing plan prior to construction for review with DCC Representatives and KMFRC.

.3 Maintain fire access/control.

**1.7 CONTRACTOR USE OF PREMISES**

.1 Use of DND Property:

.1 Contractor, sub-contractor(s) and all personnel of this contract shall not use any tools, equipment, materials, buildings, structures or any other or any other property owned, rented leased by the Department of Nation Defence (DND) unless authorized in writing by the DCC Representative.

.2 Contractor's Use of Site:

.1 The contractor is advised that they will not have exclusive control of the Site. DND personnel will occupy and maintain facility operation within the boundaries of the work area and throughout the duration of the project.

.2 Use of site: Contractor will have exclusive access of the phased zone when construction is active in the corresponding zone, while maintaining owner occupancy and facility operation of adjacent zones, as approved by DCC.

.3 Zones for exterior storage area are indicated or are as directed by the DCC Representative.

.3 Co-ordinate use of premises with DCC Representative.

.4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by DCC Representative.

.6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

**1.8 LOCATION OF EQUIPMENT AND FIXTURES**

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

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendation for safety, assess and maintenance. Advise DCC Representative of conflicts and await clarification.

.3 Inform DCC Representative of impending installation and obtain their approval for actual location.

.4 Submit red line drawings to indicate relative position of various services and equipment.

**1.9 CONCEALMENT**

.1 Conceal pipes, duct and wiring in the floor, wall and ceiling construction of finished areas except where indicated otherwise.

**1.10 CUTTING AND PATCHING**

.1 Cut and patch as required to make work fit. Refer to appropriate sections and details. Where no detail is given advise DCC Representative and wait for direction.

.2 Make cuts with clean, true, smooth edges.

.3 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work or as indicated.

**1.11 ADDITIONAL DRAWINGS**

.1 DCC Representative may furnish additional drawings for clarification. These additional drawings have same meaning and intent as if they were included with plans referred to in Contract documents.

**1.12 RELICS AND ANTIQUTIES**

.1 Protect relics, antiquities, items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found during course of work.

.2 Give immediate notice to DCC Representative and await DCC Representative written instructions before proceeding with work in this area.

.3 Relics, antiquities and items of historical or scientific interest remain Crown property.

## 1.13 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

.2 Use of the elevators within the building for moving workers and material.
- .1 Protect walls of passenger elevators, to approval of DCC Representative prior to use.
- .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .3 Where security has been reduced by work of Contractor, provide temporary means to maintain security.
- .4 Provide and maintain temporary dust screens, barriers, hoarding, hazardous abatement enclosures, warning signs, drop cloths etc where work is adjacent to areas used by the public or National Defence personnel.

## 1.14 EXISTING SERVICES

.1 Notify DCC Representative of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give DCC Representative 5 working days notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by DCC Representative with minimum disturbance to pedestrian, vehicular traffic and tenant operations.

.3 Provide alternative routes for personnel, pedestrian and vehicular traffic.

.4 Submit schedule to and obtain approval from DCC Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.5 Provide temporary services when directed by DCC Representative to maintain critical building and tenant systems.

.6 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.

.7 Where unknown services are encountered, immediately advise DCC Representative and confirm findings in writing.

.8 Protect, relocate or maintain existing active services. When inactive services are encountered, notify DCC Representative.

.9 Record locations of maintained, re-routed and abandoned service lines on redline drawings.

.10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

## 1.15 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy each document as follows:
- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.

.4 Reviewed Shop Drawings.
.5 List of Outstanding Shop Drawings.
.6 Change Orders.
.7 Other Modifications to Contract.
.8 Field Test Reports.
.9 Copy of Approved Work Schedule.
.10 Health and Safety Plan and Other Safety Related Documents.
.11 Other documents as specified.
.12 Utility locate sheets.

**1.16 QUALITY ASSURANCE**

.1 The review of the work by the DCC Representative is to confirm adherence to the intent of the design. It does not release the Contractor from their responsibility for the proper execution of the work in accordance with the drawings and specifications and all governing regulations and good workmanship and established trade practices.

.2 The sampling inspection of material installations by testing agencies will not release the Contractor from their responsibility for the thorough execution of the work in accordance with the drawings and specifications and all governing regulations, good workmanship and established trade practices.

.3 The intermittent site reviews and subsequent reports by the Designer of Records do not constitute thorough inspection, blanket approval or comprehensive deficiency findings of the installations performed by the Contractor. They are limited to what has been witnessed and to establish adherence to the intent of the design. The Contractor is responsible for the proper execution of the work in accordance with the drawings and specifications and all governing regulations, good workmanship and established trade practices.

.4 The Contractor is responsible for securing timely written clarifications where the intent of the design may not be clear.

**1.17 COST BREAKDOWN**

.1 Within 10 working days of award submit breakdown of Contract price in detail as directed by DCC Representative and aggregating contract price. Cost breakdown will be used as basis for progress payment.

.2 Itemized separate line cost for each of the following general cost items as applicable.
.1 Performance and Payment Bonds.
.2 Field supervision and layout.
.3 Temporary Facilities and Controls.

.3 Itemize separate line item cost for work required by each Section of this Specification.

**1.18 PROJECT MEETINGS**

.1 Hold construction project meetings at times and locations approved by DCC Representative.
.1 For bidding purposes, assume Project Meetings to be held bi-weekly.

.2 DCC Representative will advise General Contractor of meetings. General shall be responsible for notifying sub-contractors and any other interested parties whose attendance is required.

.3 DCC Representative will assume responsibility for recording and distributing minutes to all interested parties.

## 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 ACCESS AND EGRESS

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

## 1.2 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with DCC Representative to facilitate work as stated.

.2 Maintain existing services to building and provide for personnel and vehicle access.

.3 Where security is reduced by work provide temporary means to maintain security, in accordance with section 01 35 15 Industrial Security.

.4 DCC Representative may, at their sole discretion assign sanitary facilities for use by Contractor's personnel. Keep facilities clean. For bidding purposes, assume that the Contractor provides sanitary facilities.

.5 Closures: protect work temporarily until permanent enclosures are completed.

## 1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

## 1.4 SPECIAL REQUIREMENTS

.1 Carry out Work Monday to Friday from 07:00 to 17:00 hours, except when other hours are approved by DCC Representative. No work on statutory holidays unless approved by DCC Representative. Where indicated in Appendix B – Move services, structural steel work to be completed after hours and weekends within Zone ‘I’ only upon approval by the DCC Representative.

.2 Interruptions and connections to the CFB Kingston Steam network will only be allowed during the period of June 1st to September 30th, unless directed otherwise by the DCC Representative.

.3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

.4 Keep within limits of work and avenues of ingress and egress.

.5 Limitations of Ingress and egress of Contractor vehicles at site shall be discussed with DCC Representative.

## 1.5 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. Smoking is not permitted.

# 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

## 1.0 CASH ALLOWANCES

1. Include in Contract Price specified cash allowances.

2. Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing Work.

3. Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.

4. Contract Price will be adjusted by written change order to provide for excess or deficit to each cash allowance.

5. Include progress payments on accounts of work authorized under cash allowances in DCC Representative's monthly certificate for payment.

6. Prepare schedule jointly with DCC Representative and Contractor, to show when items called for under cash allowances must be authorized by DCC Representative for ordering purposes so that progress of Work will not be delayed.

    a. All Work required under this cash allowance is included in the calendar days to reach Substantial Completion, as defined in the contract **Acknowledgement Document**.

7. Amount of allowance, for Work specified below and executed by various specification sections is as follows:

    **a. Additional Structural Support**

    Include in Contract Price for an allowance of **$35,000.00** to capture any labour & material costs, delivery charges and fees for additional structural support of AHU-1 and AHU-4 not indicated on the drawings and which is dependent on manufacturer selection for those two specific units. DCC will provide site instructions for additional work to Contractor after shop drawings submittal.

        i. Reference Specification Section 05 10 00 Structural Steel and Section 23 74 00 Packaged Outdoor HVAC Equipment.

        ii. Reference Drawing L-B35-8900-201 – Roof Framing Plan

    **b. Sprinkler System Modification Allowance**

    Include in Contract Price for an allowance of **$35,000.00** to capture any labour, materials, equipment, delivery charges, permits, and engineering fees associated with the temporary removal, modification, adjustment, relocation, and/or reinstatement of existing sprinkler system components required to facilitate the HVAC Work.

    For bidding purposes, the Contractor shall assume modifications will be required to

forty-four (44) sprinkler heads. The allowance includes for the removal and reinstatement of existing sprinkler heads at the same drop location, relocation of sprinkler heads with associated piping modifications, installation of new sprinkler heads with branch piping modifications, installation of new sprinkler heads requiring substantial rerouting of branch piping, threaded and grooved piping modifications, hydraulic calculations, stamped shop drawings, system draining and refilling, testing and recommissioning, fire watch requirements during system shutdowns, coordination with ceiling and related construction activities, and all work necessary to maintain a complete and operational sprinkler system in accordance with applicable codes and standards.

i. Reference Specification Section 23 05 53.01 Mechanical Identification and Section 23 08 01 Performance Verification Mechanical Piping

ii. Reference Drawing L-B35-8900-402 – Sprinkler Plans

## 2 PRODUCTS

### 2.01 NOT USED

.1 Not Used.

## 3 EXECUTION

### 3.01 NOT USED

.1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by DCC Representative are specified under sections as applicable.

## 1.2 APPOINTMENT AND PAYMENT

.1 DCC Representative will appoint and pay for services of testing laboratory except follows:
- .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
- .2 Inspection and testing performed exclusively for Contractor's convenience.
- .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
- .4 Mill tests and certificates of compliance.
- .5 Tests specified to be carried out by Contractor under supervision of DCC Representative.
- .6 Additional tests specified in paragraph 1.2.2.

.2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by DCC Representative to verify acceptability of corrected work.

## 1.3 CONTRACTOR'S RESPONSIBILITIES

.1 Provide labour, equipment and facilities to:
- .1 Provide access to Work for inspection and testing.
- .2 Facilitate inspections and tests.
- .3 Make good Work disturbed by inspection and test.
- .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify DCC Representative 3 working days minimum in advance of operations to allow for assignment of laboratory personnel and scheduling of test.

.3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and accepted by DCC Representative.

# PART 2 PRODUCTS

## 2.1 NOT USED

.1 Not Used.

# PART 3 EXECUTION

## 3.1 NOT USED

.1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

## 1.2 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.3 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days.

.4 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.5 Milestone: significant event in project, usually completion of major deliverable.

.6 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.7 Project Planning, Monitoring and Control System: overall system operated by DCC Representative to enable monitoring of project work in relation to established milestones.

## 1.3 REQUIREMENTS

.1 Ensure Project Schedules are practical and remains within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.4 Ensure that Award of Contract, Interim Certificate and Final Certificate dates are identified on the schedule.

## 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit to DCC Representative within 10 working days of Award of Contract, a detailed Project Schedule, capable of identifying, scheduling, monitoring and reporting activities related to the progress of work. Provide sufficient detail and degree of control in the schedule to the approval of the DCC Representative and such that the needs and objectives of the Contract are met.

### 1.5 PROJECT MILESTONES

.1 Project milestones form interim targets for Project Schedule. Contractor to identify milestones on project schedule. Contractor to include identified milestones from Tender Documents on Project Schedule.

### 1.6 PROJECT SCHEDULE

.1 Develop detailed Project Schedule in accordance with the phasing plan.

.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
- .1 Identification of work periods on a horizontal time scale, from date of award to completion. Indicated weekend or after hours work, if required.
- .2 Submission date, review times for shop drawings, product data and samples.
- .3 Anticipated progress of the work for each major activity by discipline. Duration of each task shall be a maximum of 10 days.
- .4 Identification of the most critical activities throughout the course of the project.
- .5 Major equipment/material deliveries.
- .6 Backfill of any utilities.
- .7 Planned shutdowns of existing systems for work requirements.
- .8 Proposed dates(s) for commissioning, if required.
- .9 Training for personnel on new systems.
- .10 Submission of Redline Drawings, updated Record Drawings and Operations and Maintenance Manuals.
- .11 Mobilization and demobilization.

.3 DCC Representative will review schedule and return review copy with comments or request for clarifications within 10 business days after receipt.

.4 Submit finalized schedule within 10 business days after return of review copy.

### 1.7 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on monthly basis reflecting activity changes and completions, as well as activities in progress.

### 1.8 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Submit progress update of activities against planned progress on a bi-weekly basis as requested by the DCC Representative. Progress update to reflect the next 2 weeks of work.

.3 Weather related delays with their remedial measures will be discussed and negotiated.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 45 00 - Quality Control.

## 1.2 ADMINISTRATIVE

.1 This section specifies general requirements and procedures for contractor submissions of shop drawings, product data, samples, mock-ups and certificates to DCC Representative for review. Additional specific requirements for submissions are specified in individual sections of the specification.

.2 Submit to DCC Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.3 Do not proceed with Work affected by submittal until review and acceptance by the DCC Representative.

.4 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.5 Where items or information is not produced in SI Metric units converted values are acceptable.

.6 Review submittals prior to submission to DCC Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not dated and identified as to specific project will be returned without being examined and considered rejected.

.7 Notify DCC Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.8 Verify field measurements and affected adjacent Work are co-ordinated.

.9 Contractor's responsibility for errors and omissions in submission is not relieved by DCC Representative's or Designer of Record review of submittals.

.10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by DCC Representative or Designer of Record review.

.11 Submitted shop drawings that do not consider the time requirement for review and or the time required to order, manufacture and deliver does not constitute justification or grounds for requesting an alternate material that is readily available for the project. Contractor shall bear all costs associated to provide the acceptable product to deliver the project on schedule.

.12 Keep one reviewed copy of each submission on site.

## 1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Allow 10 working days for DCC Representative's review of each submission.

.4 Make changes in shop drawings as DCC Representative may require, consistent with Contract Documents. When resubmitting, notify DCC Representative in writing of revisions other than those requested.

.5 Accompany submissions with transmittal letter, containing:
- .1 Date.
- .2 Project Title and Building Number.
- .3 DND Drawing Number
- .4 DND Project Number
- .5 DCC Project Number
- .6 Contractor's name and address.
- .7 Identification and quantity of each shop drawing, product data and sample.
- .8 Other pertinent data.

.6 Submissions include:
- .1 Date and revision dates.
- .2 Project Title and Building Number.
- .3 DND Drawing Number
- .4 DND Project Number
- .5 DCC Project Number
- .6 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .7 Signature by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .8 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.

.7 After DCC Representative's review, distribute copies.

.8 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as DCC Representative may reasonably request.

.9 Submit electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by DCC Representative where shop drawings will not be prepared due to standardized manufacture of product.

.10 Submit electronic copy of test reports for requirements requested in specification Sections and as requested by DCC Representative.
- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
- .2 Testing must have been within 3 years of date of contract award for project.

.11 Submit electronic copy of certificates for requirements requested in specification Sections and as requested by DCC Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
- .2 Certificates must be dated after award of project contract complete with project name.

.12 Submit electronic copy of manufacturer’s instructions for requirements requested in specification Sections and as requested by DCC Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.

.13 Submit electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by DCC Representative.

.14 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.15 Submit electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by DCC Representative.

.16 Delete information not applicable to project.

.17 Supplement standard information to provide details applicable to project.

.18 If upon review by DCC Representative, no errors or omissions are discovered or if only minor corrections are made, electronic acceptance copy will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

**1.4 SAMPLES**

.1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to DCC Representative.

.3 Notify DCC Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Make changes in samples which DCC Representative may require, consistent with Contract Documents.

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

**1.5 MOCK-UPS**

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

.2 Reviewed and accepted mock-ups will become standard of workmanship and materials against which installed work will be verified.

.3 Erect mock-ups at locations acceptable to DCC Representative.

**1.6 PHOTOGRAPHIC DOCUMENTATION**

.1 When called for inspections submit electronic copy of colour digital photography in .jpg format, standard resolution and as directed by DCC Representative.

.2 Project identification: name and number of project and date of exposure indicated.

**1.7 CERTIFICATES AND TRANSCRIPTS**

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

## PART 2 PRODUCTS

**2.1 NOT USED**

.1 Not Used.

## PART 3 EXECUTION

**3.1 NOT USED**

.1 Not Used.

## END OF SECTION

# Part 1 General

## 1.1 RELATED REQUIREMENTS

.1 **Precedence** - Division 1 sections take precedence over technical specifications in other Divisions of this project manual.

## 1.2 REFERENCES

.1 Definitions:

.1 Contract Security Program (CSP) - A division of Public Services and Procurement Canada (PSPC), which developed the Contract Security Manual and helps industry to participate in Government of Canada and foreign government contracts. CSP provides security screening services needed for contractors before their employees can work with Protected and Classified information and assets.

.2 Company Security Officer (CSO) - The CSO is the organization's official point of contact with the CSP. The CSO is responsible for monitoring the organization's security profile, addressing security issues, and is accountable to the CSP and to the organization's designated Key Senior Official on all industrial security matters.

.3 Contractor CSO - The employee of the Contractor’s company who is the CSO.

.4 Contract Security Manual (CSM) - The CSM is a ready and simple reference which tells Company Security Officers what they must know about Canadian government security standards and procedures and how to ensure that their organization meets these security requirements.

.5 Positive Control - Measures which guarantee that persons without appropriate clearance will not be left unattended to access the Department of National Defence/Canadian Armed Forces (DND/CAF) information, assets, resources, or locations.

.6 Request for Visit (RFV) - A form to be filled out by an individual who requires access to sensitive DND property, personnel, information, assets and resources because they must be security screened at the appropriate level before commencement of their duties.

.7 Restricted - Refers to a situation where authorized persons only, are allowed access to an area or information.

.8 Security Implementation Plan - A detailed document which outlines the company’s strategy and process to meet contract security requirements.

.9 Security Requirements Check List (SRCL) - The SRCL is a Treasury Board Secretariat (TBS) form used to define the security requirements for a contract. The SRCL represents an evaluation of security threats and risks that may arise through the contracting process.

.10 Sensitive - Records that are sensitive contain information that can cause different degrees of injury to an individual, a company, or the country if the information were disclosed in an unauthorized manner.

.2 Reference Sites:

.1 Defence Construction Canada (DCC)

.1 https://www.dcc-cdc.gc.ca/industry/security-requirements

.2 PSPC Contract Security Manual

.1 https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html

## 1.3 GENERAL

.1 Security requirements must form part of the contract between DCC and industry when defined by a SRCL.

.2 These security requirements apply but are not limited to:

.1 construction and material objects;

.2 contractual arrangements;

.3 professional service contracts;

.4 facility maintenance contracts; and

.5 environmental and UXO contracts.

.3 A SRCL is a form that is used to define the security requirements associated with each contract. The SRCL ensures that that the appropriate security clauses are identified so they may be incorporated into the contract, thereby legally binding the parties to meet the contract's security requirements. **The SRCL must accompany all contract documents including subcontracts that contain security requirements**.

.4 If multiple levels of screening are required, a Security Classification Guide may have been provided along with the SRCL as a contractual document. This document will provide further information related to security requirements when dealing with multiple levels of clearances within the contract.

## 1.4 PRIVATE SECTOR ORGANIZATION SCREENING AND CLEARANCES

.1 Companies who will need access to or who will retain controlled goods, protected or classified property, information, assets or resources must be cleared as follows:

.1 Companies must be cleared to safeguard the highest level of information and asset to be retained/accessed, meaning:

.1 Designated Organization Screening (DOS) is required for contracts involving access to information at the protected level and/or secure worksites (Reliability status);

.2 Facility Security Clearance (FSC) is required for contracts involving access to information at the protected and/or classified levels and/or secure worksites (Secret status);

.3 Document Safeguarding Capability (DSC) is required to work on protected and/or classified information at their own worksite; and

.4 Companies who will electronically process protected or classified information must have IT media clearance and processing capability commensurate with the security classification level of the information to be processed and must be cleared to the level commensurate with the information or asset to be accessed.

## 1.5 PERSONNEL SECURITY SCREENING

.1 Individuals requiring access to information and/or site must have their personnel security screening completed prior to submitting an RFV. As a part of the screening process, it is now a requirement for individuals to undergo a law enforcement inquiry through the RCMP, for electronic finger printing. Please refer to PSPC website for more information.

.2 Prior to Contract Award, personnel security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules to seek personnel security screenings as required by the contract.

.1 Reliability status processing is anticipated to take seven (7) business days per employee after a request has been properly submitted to CSP; and

.2 Secret clearance processing is anticipated to take seventy-five (75) business days per employee after a request has been properly submitted to CSP.

## 1.6 VISIT CLEARANCE REQUESTS (VCR) APPROVAL

.1 All individuals (including subcontractors) who will have access to sensitive DND or CAF property, personnel, information, assets, and resources, must be security screened at the appropriate level before the commencement of their duties in relation to the contract.

.2 Access to Operations Zones: security screening is not required for certain personnel if positive control of those individuals is maintained throughout their visit. Positive control measures must be outlined in the Security Implementation Plan. Positive control can be used for the following personnel:

.1 Logistics activities – material drop-off, waste removal, snow removal;

.2 Transit through an operations zone (no work); and

.3 Authorities having jurisdiction.

.3 The VCR process verifies that those who are permitted access onto DND property have the required clearance level as outlined within the SRCL for the contract.

## 1.7 POST AWARD PROCESS OVERVIEW

.1 The Contractor's CSO is provided a blank RFV form by the DCC Representative in order to obtain an approved VCR.

.2 All employees of the successful bidder who will be accessing restricted sites or sensitive information during the execution of the contract require a VCR. The Contractor's CSO must forward the completed form to the DCC Representative for processing.

.1 The CSO of each company completing an RFV form must submit a picklist from the Online Industrial Security Services (OLISS) portal instead of filling in the details of each visitor on the form. Only the employees of the company who require access to the restricted site or sensitive information for that contract shall be listed on the picklist.

.2 If the Contractor intends to use Union Hall members, the CSO will request the Union Hall to provide the CSO with a separate picklist for all members to be used on the contract. Only the individuals of the Union Hall who require access to the site for that contract shall be listed on the picklist.

.3 The CSO of the company will input "SEE ATTACHED PICKLIST" when completing Particulars of Visitors.

.3 It is the responsibility of the Prime Contractor to submit and receive an approved SRCL for each subcontract containing security requirements. This responsibility extends to all subcontracts held by subcontractors.

.1 Instructions on this process are in the CSM located at https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html

.2 Prior to Contract Award, subcontract SRCL security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules for subcontract SRCL approvals as required by the contract.

.1 When a Private Sector Organization Screening (PSOS) is **not** required, contractors shall allow 45 business days (from the date on which a complete and correct subcontract SRCL is received by CSP) for approval of a subcontract SRCL by CSP.

.2 When a PSOS **is** required:

.1 For sub-contractors to be sponsored to the level of DOS, contractors shall allow for 50 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP; and

.2 For sub-contractors to be sponsored to the level of FSC (Secret), contractors shall allow 124 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP.

.3 All security related pre-construction activities shall proceed immediately after award.

.4 For subcontracts, the RFV shall not be submitted until after the subcontract SRCL has been approved and permission to award the contract is granted by CSP.

.1 Contractor to allow a minimum of 15 business days for VCR processing.

.5 Personnel not meeting the required security clearances will not be allowed access to restricted sites or any sensitive information pertaining to the contract, except as permitted in 1.6.2.

.6 Approved VCRs are valid for the duration of the contract **or** one year less one day, whichever is less. Extension to VCRs will need to be requested as required, again allowing a minimum of 15 business days for processing.

## 1.8 SUBMITTALS

.1 Submit to the DCC Representative copies of the following documents, including updates issued:

.1 Security Implementation Plan

.2 Approved subcontract SRCLs

.3 Completed Request for Visit forms for all personnel working under the contract

.4 Incident reports within (1) working day

.5 Submit other data, information and documentation upon request by the DCC Representative.

## 1.9 RESPONSIBILITY

.1 It is the responsibility of the Contractor to have no security breaches while undertaking the work for this contract.

## 1.10 MEETINGS

.1 Prior to commencement of work, the Contractor will attend a pre-commencement meeting conducted by the DCC Representative. Ensure, as minimum, attendance by Contractor's site superintendent.

.1 The DCC Representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.

.2 If requested by the DCC Representative, the Contractor's CSO will be required to participate in the pre-commencement meeting.

.2 Conduct site specific security meetings as required to ensure the management of security is in accordance with the contract.

.1 Record and post minutes of all meetings as allowed by the security requirements of the contract.

## 1.11 SECURITY IMPLEMENTATION PLAN

.1 Contractors are required to have in place a contract specific Security Implementation Plan that addresses the security requirements outlined in the contract.

.2 Provide one copy of the Security Implementation Plan to the DCC Representative prior to the commencement of work.

.3 At a minimum, the plan shall contain details addressing:

.1 CSO name and contact information;

.2 Schedule for subcontract SRCLs and RFVs;

.3 Site Access and Control Monitoring including verification that all people entering secure areas on site have approved VCRs in accordance with contractual security requirements, or any planned positive control measures;

.4 Security Education (i.e. Restrictions on photographs); and

.5 Security Incident Reporting.

.4 The DCC Representative will coordinate review of the Security Implementation Plan by the DND Project Security Authority to be completed within 10 business days of receipt following which the DCC Representative shall confirm DND's acceptance or rejection with comments.

## 1.12 INCIDENT REPORTING

.1 Investigate and report any security incidents immediately to the DCC Representative.

.1 Immediately provide a copy of the incident/investigation reports to the DCC Representative.

.2 Refer to Chapter 5 of the CSM https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html for more information.

.2 For the purpose of this contract, immediately notify the DCC Representative of incidents that involve a security breach from the identified clauses on the SRCL or an interruption to adjacent and/or integral infrastructure operations with potential loss implications.

.3 In the investigation and reporting of incidents, the Contractor is required to respond in a timely fashion (within 5 working days) to correct the action that was deemed to have caused the incident and advise in writing on the action taken to prevent a re-occurrence of the incident.

## 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 CONSTRUCTION FIRE SAFETY

.1 The Contractor shall provide construction fire safety in accordance with the National Fire Code of Canada.

## 1.2 FIRE DEPARTMENT BRIEFING

.1 DCC Representative will co-ordinate arrangements for Pre-Commencement Meeting following contract award. Contractors will be briefed on Fire Safety by the Chief Fire Prevention Officer (CFPO) or his designated representative before work starts.

## 1.3 REPORTING FIRES

.1 The Contractor shall inform the DCC Representative and CFPO of all fire incidents at the construction site, regardless of size.

.2 Know location of nearest fire alarm pull station and telephone, including emergency phone number.

.3 Report immediately fire incidents to Fire Department as follows:
- .1 Activate nearest fire alarm pull station.
- .2 Call 911.
- .3 Call DCC Representative & Chief Fire Inspector by contacting 613-541-5010 x 5795 / Cell: 613-484-8166

.4 Person activating fire alarm pull station will remain at the front entrance to direct Fire Department to scene of fire.

.5 When reporting fire by telephone, give location of fire, name or number of building and (must give municipal address) be prepared to verify location.

## 1.4 FIRE SAFETY PLAN

.1 Submit fire safety for the construction site prior to commencement of construction work. The fire safety plan shall conform to the National Fire Code of Canada.

.2 The fire safety plan shall be limited to the area of construction only. Fire safety plan shall contain building-specific details for planned system impairments. Contractor is not responsible for amending fire safety plans in existing buildings.

.3 The fire safety plan shall be submitted to the DCC Representative for review by Chief Fire Inspector. Allow 10 working days for DND review. Any comments by CFB Kingston Chief Fire Inspector shall be implemented by the Contractor.

.4 Post the fire safety plan at entrance to the construction site or near construction site's health and safety board.

.5 The fire safety plan shall conform to the National Fire Code of Canada and shall contain, at minimum:
- .1 Emergency procedures to be used in case of fire, including:
  - .1 Sounding the fire alarm;
  - .2 Notifying the fire department;
  - .3 Instructing occupants on procedures to be followed when fire alarm

sounds;
.4 Evacuating occupants, including special provisions for persons requiring assistance; and
.5 Confining, controlling and extinguishing fires.
.2 The appointment and organization of designated supervisory staff to carry out fire safety duties.
.3 The training of supervisory staff and other occupants in their responsibilities for fire safety.
.4 Documents including diagrams, showing type, location and operation of building fire emergency systems.
.5 Holding of fire drills (where applicable).
.6 The control of fire hazards in the building.
.7 The inspection and maintenance of building facilities provided for the safety of occupants.

**1.5 FIRE WARNING SYSTEM**

.1 A fire warning shall be provided to notify construction personnel of a fire emergency in the construction area.

.2 The system used shall be capable of being heard throughout building.

**1.6 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS**

.1 Unless authorized by the DCC Representative and the CFPO, Fire protection and alarm system will not be:
.2 Obstructed.
.3 Shut-off.
.4 Left inactive at the end of working day or shift without prior written authorization from the CFPO

.2 Do not use Fire hydrants, standpipes or hose systems for other than fire-fighting purposes unless authorized by the CFPO.

**1.7 FIRE PROTECTION SYSTEM IMPAIRMENT**

.1 Notify the DCC Representative and the CFPO 48 hours prior to shutting down any active fire protection system, including water supply, fire suppression, fire detection and life safety systems.

.2 Where a fire protection system that provides fire alarm monitoring is impaired in an existing building, per the Contractor's fire safety plan a fire watch shall be required and provided by the Contractor.

.3 The quantity of personnel involved in the fire watch is to be adequate such that the Contractor's entire area of construction work is patrolled during the fire watch.

.4 The building shall be patrolled at least once per hour on a 24-hour basis until the fire alarm and or fire protection system has been restored to normal operation condition.

.5 Fire watch personnel are to be familiar with facilities and procedures for sounding an alarm in the event of a fire and have a means of notifying the Emergency Services. The person(s) performing fire watch are not permitted to perform any other duties at the same time.

.6 Fire watch personnel are to have fire-extinguishing equipment readily available and be trained in its use.

.7 Implement all fire protection system impairments in accordance with the National Fire Code of Canada and Base Fire Orders.

## 1.8 FIRE EXTINGUISHERS

.1 In addition to other requirements of this specification, supply fire extinguishers, as scaled by the CFPO, necessary to protect work in progress and contractor's physical plant on site.

.2 Fire extinguishers may be required in the following areas as directed by the CFPO.
- .1 Adjacent to hot works;
- .2 In areas where combustibles are stored;
- .3 Near or on any internal combustion engines;
- .4 Adjacent to areas where flammable liquids or gases are stored or handled;
- .5 Adjacent to temporary oil fired or gas fired equipment; and
- .6 Adjacent to bitumen heating equipment.

.3 Extinguishers shall be sized as 4-A: 40-B: C (20 lbs) unless otherwise directed by the CFPO.

.4 Extinguishers shall be of the dry chemical type unless otherwise required by the hazard being protected.

.5 The Contractor may assume the quantity of extinguishers based on a maximum travel distance between extinguishers of 75 feet.

## 1.9 INSTALLATION OR REPAIR OF ROOFS

.1 Notify the CFPO of location of asphalt kettles and dates that kettles will be in use. Ensure personnel use and take precautions as follows:
- .1 Use kettles equipped with thermometers or gauges in good working order.
- .2 Locate kettles in safe place outside of building or, if approved by CFPO, on non-combustible roof. Locate to avoid danger of igniting combustible material below.
- .3 Maintain continuous supervision while kettles are in operation and provide metal covers for kettles to smother flames in case of fire. Provide fire extinguishers as required in 1.08.
- .4 Prior to start of work, demonstrate container capacities to CFPO.
- .5 Use only glass fibre roofing mops.
- .6 Do not leave used roofing mops unattended on roof. Store mops away from building and combustible materials.
- .7 Store roofing materials no closer than 3.0 metres from structures.
- .8 Any flammable cylinder shall be secure to prevent accidental tip over.

## 1.10 ACCESS FOR FIRE FIGHTING

.1 Access for firefighting shall be provide in accordance with National Fire Code of Canada.

.2 Advise the CFPO of work that would impede fire apparatus response. This includes violation of minimum horizontal and overhead clearances, as prescribed by the CFPO, erecting of barricades and digging of trenches.

.3 Minimum horizontal clearance: clear width of not less than 5.0 meters or as defined by the CFPO.

.4 Minimum vertical clearance: overhead height of not less then 6.0 meters, or as defined by the CFPO.

## 1.11 SMOKING PRECAUTIONS

.1 Smoking is prohibited in all buildings. Observe posted smoking restrictions near existing buildings. Smoking areas will be IAW Base Fire Orders and will not be within 10 meters of any building entrance.

## 1.12 RUBBISH AND WASTE MATERIALS

.1 Keep rubbish and waste materials at minimum quantities.

.2 Burning of rubbish is prohibited.

.3 Remove rubbish from work site at end of work day or shift as directed.

.4 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.

.5 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove specified.

## 1.13 FLAMMABLE AND COMBUSTIBLE LIQUIDS

.1 Handle, store and use flammable and combustible liquids in accordance with National Fire Code of Canada.

.2 Keep flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Obtain written authorization from CFPO for storage of quantities of flammable and combustible liquids exceeding 45 litres on site.

.3 Do not transfer flammable or combustible liquids inside buildings or on jetties.

.4 Do not transfer flammable or combustible liquids in vicinity of open flames or any type of heat-producing devices.

.5 Do not use flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents.

.6 Store flammable and combustible waste liquids, for disposal, in approved containers located in safe ventilated area. Keep quantities to a minimum and notify CFPO when disposal is required.

## 1.14 HAZARDOUS SUBSTANCES

.1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, shall be in accordance with National Fire Code of Canada.

.2 Provide ventilation where flammable liquids, such as lacquers or urethanes are used. Eliminate all sources of ignition. Inform the CFPO prior to and at completion of such work.

## 1.15 HOT WORKS

.1 The Contractor shall implement a hot works program in accordance with the National Fire Code of Canada and NFPA 51 Standard for Fire Prevention during Welding, Cutting and Other Hot Work.

.2 The Contractor shall obtain through their DCC Representative from the CFPO a "Hot Work" permit for all hot works in the construction area. Frequency of renewal for hot works permits is at the discretion of the CFPO. Request to be submitted 48 hours in advance of any hot work.

.3 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the CFPO.

.4 Provide fire watch service for work on scale established and in conjunction with the CFPO as defined in the Fire Department Briefing. Fire watchers shall be trained in the use of fire extinguishing equipment. The person(s) performing fire watch are not permitted to perform any other duties at the same time.

.5 Area of hot works
- .1 Hot works shall be carried out in an area free of combustible and flammable content.
- .2 Where not possible,
  - .1 All flammable and combustible materials within 15m of the hot works shall be protected in accordance with the National Fire Code of Canada.
  - .2 A fire watch shall be provided during the hot work and for a period of not less than 60 minutes unless otherwise directed by the CFPO.
  - .3 A final inspection of the hot work area shall be conducted 1 hour after the completion of hot works unless otherwise directed by the CFPO.
- .3 Where there is a possibility of sparks leaking onto combustible materials in areas adjacent to the areas where the hot work is carried out:
  - .1 Openings in walls, floors or ceilings shall be covered or closed to prevent the passage of sparks to such adjacent areas.

.6 Protection of flammable and combustible materials.
- .1 Any combustible or flammable material, dust or residue shall be:
  - .1 Removed from the area where hot works is carried out; or
  - .2 Protected from ignition by non-combustible materials.

.7 Fire extinguisher
- .1 A fire extinguisher shall be provided within 3 m of all hot works. Minimum size shall be 20lbs ABC unless otherwise directed by CFPO.

.8 Temporary heating
- .1 No open flame heaters can be used on construction site.
- .2 Only forced air heaters ULC or CSA approved and rated for industrial or construction use shall be used.
- .3 All electric heaters shall be connected on a proper and individual circuit.

## 1.16 PARTIAL OCCUPANCY

.1 Implement partial occupancy procedures as defined in the drawings and specifications. Partial occupancy is where construction occurs adjacent to work areas occupied by the Departmental or Canadian Forces personal. This includes:
- .1 Phased new construction.
- .2 Early or partial occupancy of new construction.
- .3 New construction being added onto an existing building.
- .4 Renovation or recapitalization of an existing building.
- .5 Phased renovation or recapitalization of an existing building.

.2 Where partial occupancy occurs, Contractor shall implement requirements as found in the drawings and specifications. This may include construction of a rated fire separation between occupied and construction areas as required by National Fire Code.

.3 A watch, with tours at intervals of not more than one hour, shall be provided throughout demolition sites when there are occupants in the portion of the building not being demolished.

.4 Except where a building is provided with a fire alarm system equipment, a watch, with tours at intervals of not more than one hour, shall be provided when a portion of the building is occupied while construction operations are taking place.

**1.17 FALSE ALARM FEES**

.1 "False Alarm" is the activation of a Fire Alarm System or emergency system through a mechanical failure, equipment malfunction, improper installation of the system or failure to maintain the system as described by the Ontario Fire Code being O.Reg.388/97, under the Fire Protection and Prevention Act, 1997, S.O. 1997, c.4, as amended.

.2 The Contractor shall not undertake work on any Fire Alarm System that sends an alarm directly to the Kingston Fire & Rescue or a Fire Alarm Monitoring Service without the DCC Representative being notified 48 hours in advance first.

**1.18 QUESTIONS OR CLARIFICATION**

.1 Direct questions or clarification on Fire Safety in addition to above requirements to the DCC Representative.

.2 DCC Representative is responsible to obtain clarification from the CFPO. The Contractor is not to liaise directly with the CFPO for notification, authorization or any requests unless the situation constitutes an immediate emergency.

**1.19 FIRE INSPECTION**

.1 Co-ordinate site inspections by CFPO through DCC Representative.

.2 Allow CFPO unrestricted access to work site.

.3 Co-operate with CFPO during routine fire safety inspection of work site.

.4 Immediately remedy unsafe fire situations observed by CFPO.

**END OF SECTION**

# 1 References

## FEDERAL

.1 Applicable Base Standing Orders (BSOs) will be provided to the Contractor after award.

.1 Directorate Architecture and Engineering Services (DAES) Standard on Asbestos Containing Material (ACM) in Infrastructure. 31 March 2024.

.2 BSO 16.01 Emergency Environmental Response

.3 BSO 16.02 Environmental Assessment

.4 BSO 16.04 Halocarbon Management – Infrastructure

.5 BSO 16.06 Hazmat General Requirements

.6 BSO 16.07 Disposal of Hazardous Materials Waste

.2 Canadian Council of Ministers of the Environment (CCME). *Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life, Total Particulate Matter*, 2002.

.3 *Canadian Environmental Protection Act 1999*. Statutes of Canada 1999 Chapter 33.

.1 Federal Halocarbon Regulations, 2022. SOR/2022-110.

.2 PCB Regulations. SOR/2008-273.

.4 *Canada Occupational Health and Safety Regulations* (SOR/86-304). Canada Labour Code.

.5 *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (the Environment and Climate Change Canada "Refrigeration Code of Practice"). April 2015, Errata 2021.

.6 *Code of Practice for the Environmental Sound Management of End-of-Life Lamps Containing Mercury*. Environment and Climate Change Canada. 2017.

.7 *Transportation of Dangerous Goods Act* and pursuant regulations.

## PROVINCIAL

.8 *Ontario Water Resources Act*. Revised Statutes of Ontario 1990, Chapter O.40.

.9 *Technical Standards and Safety Act, 2000* and pursuant regulations, codes, and standards. Statutes of Ontario 2000, Chapter 16.

.10 *Environmental Protection Act*. Revised Statutes of Ontario 1990, Chapter E.19.

.3 Ontario Regulation 347. *General—Waste Management.* Revised Regulations of Ontario 1990

.4 Ontario Regulation 362. *Waste Management – PCB's*.

.5 Ontario Regulation 153/04. Records of Site Condition. Part XV.1 of the Act, as amended.

.11 *Occupational Health and Safety Act*. Revised Statutes of Ontario 1990, Chapter O.1.

.1 Ontario Regulation 490/09. *Designated Substances.*

.2 Ontario Regulation 278/05. *Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations*.

.12 Ontario Ministry of Labour. 2011. *Lead on Construction Projects*.

.13 Ontario Ministry of Labour. 2011. *Silica on Construction Projects.*

**MUNICIPAL**

.14 Corporation of the City of Kingston By-Law No. 2008-192 "*A By-Law to Provide for the Regulation of Waste Water Services and Discharges to Municipal Sewers for the City of Kingston*".

.15 City of Kingston By-Law No. 2004-52 "*A By-Law to Regulate Noise*".

## 2 Related Sections

.1 02 81 00 Hazardous Building Materials General Requirements

.2 02 82 00.3 Asbestos Abatement – Type 3 (Maximum Precautions)

.3 02 82 14 Mercury Packaging and Disposal

.4 02 82 17.2 Silica Operations -Type 2 (Intermediate Precautions)

.5 02 83 10 Lead – Type 1 Lead and LOPC Minimum Worker Precautions

.6 02 83 11 Lead – Type 2A Lead and LOPC Intermediate Worker Precautions

## 3 Submittals

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

.2 Prior to commencing construction activities submit an Environmental Protection Plan (EPP). The EPP must meet the intent of the contract and must be acknowledged as reviewed by the DCC Representative prior to work commencement.

.3 The Environmental Protection Plan to include the following sub-Plans:

.1 Spill Prevention Response Plan (SPRP).

.2 Hazardous Materials Abatement and Management Plan (HMAMP).

.3 Waste Management and Disposal Plan (WMDP).

.4 Records of abatement and as-built drawings identifying abatement completed, as identified in specification section(s).

.5 Submit other data, information and documentation upon request by the DCC Representative and as stipulated elsewhere in this section.

## 4 Designated Substances

.1 In accordance with Section 30 of Ontario's *Occupational Health and Safety Act*, the report completed by WSP entitled *Project Specific Designated Substances and Hazardous Materials Assessment, Support of the Building HR26 HVAC Upgrades at CFB Kingston, Ontario*, dated June 17, 2025 (WSP 2025), found in Appendix A, details designated substances present at the project site:

.1 Asbestos-containing materials are present in areas of the building. The following Asbestos Containing Materials (ACMs) require abatement for this project:

.1 Pipe Straight and Pipe Elbow Insulation and Debris (Friable) located in the ground floor washroom pipe chase and containing 25-75% Chrysotile. Estimated quantity of 12 $m^2$.

.2 Disturbance to asbestos-containing materials shall be conducted in accordance with Ontario Regulation 278/05 and Canada Labour Code – Canada Occupational Health and Safety Regulations SOR/86-304 (COHSR), and in accordance with,

.1 02 82 00.3 Asbestos Abatement – Type 3 (Maximum Precautions)

.3 Lead is present painted surfaces throughout the building. The follow lead-containing paints require abatement for this project:

.1 Lead-containing, non-leachate grey floor paint in basement mechanical room, for bidding purposes assume approximately 5$m^2$ requires abatement,

.2 Lead-containing, non-leachate white wall paint in basement mechanical room, for bidding purposes assume approximately 5$m^2$ requires abatement.

.3 Lead-containing beige duct paint in 2nd floor mechanical room, for bidding purposes assume approximately 15$m^2$.

.4 Lead-Containing yellow paint on corridor and stairwell walls, for bidding purposes assume approximately 5m2 requires abatement.

.4 Disturbances to lead painted surfaces shall be conducted in accordance with the Ministry of Labour Guideline "*Lead on Construction Projects*" (2011) and in accordance with,

.1 02 83 10 Lead – Type 1 Lead and LOPC Minimum Worker Precautions; or,

.2 02 83 11 Lead – Type 2A Lead and LOPC Intermediate Worker Precautions.

.5 For any materials not already tested, the Contractor is required to have painted surfaces sampled and analyzed for toxicity characteristic leaching procedure (TCLP) metals analysis in accordance with O. Reg. 347 to define the appropriate waste classification.

.1 For bidding purposes, lead-containing wastes are to be assumed to be non-leachate toxic, non-hazardous waste and will be transported and disposed of as regular waste.

.6 Silica is present in all concrete materials throughout the project site.

.1 Disturbance of materials containing silica shall be conducted in accordance with the Ministry of Labour Guidelines "*Silica on Construction Projects*" (2011) and in accordance with,

.2 02 82 17.2 Silica Operations -Type 2 (Intermediate Precautions)

.7 Mercury Containing Lamps and Thermostats:

.1 Mercury is present within lighting lamps and bulbs, thermostats, thermometers, manometers and mechanical controls throughout the building. Refer to the WSP 2025 report for details.

.8 Disturbance of mercury-containing lamps shall be conducted in accordance with Environment and Climate Change Canada's "*Code of Practice for the Environmentally Sound Management of End-of-Life Lamps Containing Mercury"* (2017), and in accordance with,

.1 02 82 14 Mercury Packaging and Disposal

.9 Lighting tubes contain mercury, must not be released to the environment. Therefore, the tubes must not be broken.

.10 Recycle all surplus mercury containing thermostats, lighting lamps and bulbs at a facility equipped to recover mercury.

.1 Contractor is to identify the facility and provide a receiver receipt of materials.

.2 Inform all workers and sub trades of the presence of designated substances and hazardous materials identified in the contract documents. Refer to the following historical environmental report in Appendix A for details on previously identified designated substances and hazardous materials.

.1 *Project Specific Designated Substances and Hazardous Materials Assessment, Support of the Building HR26 HVAC Upgrades at CFB Kingston, Ontario*, dated June 17, 2025 (WSP 2025).

.3 Immediately notify the DCC Representative of potential ACMs discovered during the work and not apparent from the drawings, specifications, or reports pertaining to the Work. Do not disturb such material.

## 5 General

.1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, including in sub-section 1.0 References, noted above.

.2 The Work site is subject to inspection by the Base Environment Officer, or designate, as well as, the DCC Representative, without prior notice.

.3 Failure to comply with environmental requirements may result in a stop work order or assessment of damages commensurate with repair of damage.

.4 All references to payment referred to in OPSS references are to be disregarded and do not apply to this contract.

.5 The Contractor will be unable to request extra funding to meet environmental requirements that are within the contract.

.6 It is the Contractor's responsibility to be aware of environmental requirements and the best management practices and pollution control measures necessary to meet them.

.7 Blasting is not permitted on DND property.

.8 Fires and burning of rubbish are not permitted on DND property.

.9 No fixed or temporary fuel storage tanks are permitted.

.10 In accordance with the City of Kingston Noise By-law, noise due to construction is not permitted from 7 p.m. through 7 a.m., and all day on Sundays and statutory holidays.

## 6 Spill Prevention and Response Plan

.1 A spill or release is an accidental discharge of a pollutant (solid, liquid or gas) into the environment. After a spill or release, always ensure human health and safety is protected above all else.

.2 Submit to the DCC Representative a project-specific Spill Prevention and Response Plan (SPRP) prior to work on-site.

.1 The SPRP shall include environmental response measures necessary to prevent and to mitigate a pollutant release on National Defence property.

.2 The SPRP is to include:

.1 Contact information for the designated qualified individual to be the Environmental Protection Coordinator (EPC).

.2 Roles and responsibilities including names of those responsible for managing the SPRP.

.3 List of all subcontractors including contact information to support the SPRP.

.4 Notification to the DCC Representative for any spill.

.5 Emergency spill response measures, see 6.6 below.

.6 Project and site-specific clean up measures for spills.

.7 Waste disposal, including disposal procedures for materials used to contain the spill and storage location for these materials.

.8 Procedure to escalate for spills beyond Contractor's ability to manage the spill.

.9 Refueling operations shall be conducted within a secondary containment area. Refuel equipment no closer than 30 metres from water bodies. SPRP shall identify equipment fueling location, the machinery to be refueled, location of transfer area, methodology and control measures during refueling.

.3 Identify storage locations of materials or wastes that may require emergency spill response. Identify spill control kit inventory and location(s).

.3 The SPRP is to be modified and updated as necessary. On-going assessments shall be performed during the progress of work identifying and documenting new or potential spill hazards and measures not previously known and identified.

.4 Prior to starting work, provide to the DCC Representative an inventory of hazardous material to be brought to the site, including volume or mass, and Safety Data Sheets (SDS).

.5 A CFB Kingston Pollution Incident Report Template (provided after award) shall be completed by the Contractor for all spill or release incidents and submitted to the DCC Representative.

.6 Emergency Response:

.1 With respect to liquid spills, contractor shall have on-site equipment to control a liquid spill of 110% of any material brought on to—or handled at—the site for one (1) hour.

.2 The on-site spill control kit required to include absorbent pads, absorbent granular, nitrile gloves, garbage bags and/or pails with lids, and shovels, and applicable to the chemical used.

.1 A spill control kit shall be located wherever quantities of materials or wastes that may require emergency spill response are used or stored.

.3 In the event of a spill, invoke Contractor's SPRP and make immediate notifications to the DCC Representative.

.4 In the event of a spill into the natural environment, do everything practicable to prevent, eliminate, and ameliorate adverse effects, and to restore the natural environment.

.5 Emergency response planning is to include measures to escalate the response in the event of an emergency that exceeds on-site equipment capabilities.

.7 Display an information placard on all such material and equipment containing liquid products that will be located overnight or longer on DND property.

.1 Information placards to include: Contractor's name and address, contact person, emergency telephone numbers, and liquid contents.

.2 Post the information placard either on the exterior of the container, or on the dashboard of the vehicle, where applicable.

## 7 Hazardous Materials Abatement and Management Plan

.1 Prior to work onsite contractor to create and submit to the DCC Representative a Hazardous Materials Abatement and Management Plan (HMAMP).

.2 The HMAMP will address the details of how designated substance(s) and hazardous material(s) will be abated and managed. HMAMP to include:

.1 Name and contact information of:

.1 The designated qualified individual to be the Environmental Protection Coordinator (EPC).

.2 All subcontractors who will support the HMAMP.

.2 A list of all municipal, provincial and federal permits and notifications required to complete the Work.

.3 A list of all hazardous materials to be brought to site.

.1 Include volumes and SDS, copy of placards and signage.

.4 Detail the approach to the execution of abatement work, including the equipment, tools, materials and actions to be employed for each type of designated substance or hazardous material.

.5 A drawing identifying existing conditions with the location of proposed enclosure(s), barricades and/or warning signs to restrict access, waste and personal decontamination facilities, and proposed location of waste bins.

.6 Proposed schedule accounting for calendar day(s) projected for enclosure set up, abatement work, cleaning and lockdown, and enclosure tear down.

.7 Identify number of calendar days for the shutdown of any building systems (e.g. HVAC, fire alarms, etc.).

.8 Detailed emergency procedures to be followed in the event of: fire, breach of the enclosure, injury or accident within the enclosure, detection of airborne asbestos fibers outside the enclosure, spilling asbestos debris on route to the waste bin.

.9 If not defined in other Plans, provide details of waste disposal procedures for materials stored, used or abated including locations on the work site.

.3 The contractor shall allow a third-party consultant, retained by DCC, to perform construction phase services for work relating to this project, including air monitoring, air clearance testing and visual inspections.

.4 Contractor shall provide DCC Representative a minimum of 48-hours notice prior to request for pre-contamination inspections, post abatement visual inspections and inspections prior to lockdown application (including both Moderate and High-Risk Abatement activities as defined of COHSR).

.1 Scheduling with the environmental consultant to be coordinated through the DCC Representative.

.5 Contractor shall allow a minimum of 48-hours to receive results from DCC Representative for all visual inspections and clearance air testing results prior to enclosure tear-down (including both Moderate and High-Risk Abatement activities as defined of COHSR).

.6 Inform all workers and sub trades of the presence of designated substances and hazardous materials identified in the contract documents.

.7 Immediately notify the DCC Representative of potentially containing asbestos material discovered during the work and not apparent from the drawings, specifications, or reports pertaining to the Work. Do not disturb such material.

.8 Fire alarm suspension can be coordinated on weekdays between 7:30am and 3:30pm daily.

.1 Notification to DCC Representative, via submission of completed Request for Fire Alarm Shut Down form, is required a minimum of 5 working days in advance of temporary fire alarm shut down.

.9 Written notification to DCC Representative required a minimum of 5 working days prior to request to disable the mechanical ventilation system servicing the work area.

## 8 Waste Management and Disposal Plan

.1 Submit a Waste Management and Disposal Plan (WMDP) to the DCC Representative before construction work begins at the site. The WMDP is to comply with legislation, best practices, and with the requirements of the specifications.

.2 The WMDP is to encompass:

.1 Regular waste,

.2 Construction waste,

.3 Hazardous materials used in the course of the work, and

.4 Hazardous materials and designated substance waste.

.5 The WMPD shall include items below in addition to 8.3 through 8.10.

.1 Name and contact information for the designated qualified individual to be the Environmental Protection Coordinator (EPC).

.2 A list of all contractors and Receiver Facilities for all waste types.

.1 Waste carriers' business name, address, telephone, email address, and MECP Certificate(s) of Approval listing the hazardous materials approved for transportation.

.3 The anticipated waste shipment frequency for all waste.

.4 Detailed procedures to be used to manage all waste products stored on site (petroleum, oil, lubricants and other hazardous waste to be detailed specifically). Include types of containers, labeling and segregation)

.5 A description of the types of waste materials and expected quantities for storage, transport and disposal. For leachate toxic waste include detailed compliance with O. Reg. 347 and Transportation of Dangerous Goods Act (TDGA).

.1 Include procedure for notifying DCC Representative of the transport of hazardous materials and/or designated substances (including asbestos) offsite.

.6 Procedures for storing and release of hazardous materials to be removed from site including manifest procedures.

.7 Procedures that detail requirements for the below Special Substances that detail what is contained in the specification.

.1 Mechanical Flushing Liquids to Sanitary Sewers including lab analysis report, notifications and contacts.

.2 Smoke detectors.

.3 Polychlorinated Biphenyls (PCBs).

.3 Waste Handling:

.1 Ensure that staff are properly trained and equipped, in accordance with regulatory requirements.

.2 Minimize handling and exposure to hazardous materials. Use control measures such as PPE and best practice procedures to address potential risks.

.3 All waste products will be placed in suitable containers and labeled clearly.

.1 Waste products are to be segregated by commodity and placed in separate containers based on class.

.2 Similar waste products are not to be mixed together without prior approval from the DCC Representative.

.4 Storage:

.1 Identify location(s) on site where wastes and hazardous materials wastes will be stored.

.2 Store all petroleum, oil, lubricants, and other hazardous materials within secondary containment, or in an appropriate metal clad storage building with containment.

.3 Store incompatible materials separated to prevent reaction.

.4 Access to hazardous waste storage areas must be controlled through appropriate physical barriers and limited to authorized personnel.

.5 Site is to be kept neat and orderly at all times.

.5 Transportation:

.1 Transportation of hazardous material must be in accordance with the *Transportation of Dangerous Goods Act*, by a licensed hauler, and in approved containers.

.2 Hazardous Materials Waste shall **not** be released from a work site to a carrier that is not registered as a carrier for the specific Hazardous Materials Waste, nor shall it be released for delivery to a consignee that is not registered as a receiver for the specific Hazardous Materials Waste.

.6 Disposal:

.1 Identify the proposed waste receiver facilities and the anticipated waste shipment frequency for all wastes.

.2 Contractor is required to have painted waste sampled and analyzed for toxicity characteristic leaching procedure (TCLP) metals analysis in accordance with O. Reg. 347.

.1 Sample(s) are to be taken by a Qualified Person (QP) (as defined in O. Reg. 153).

.2 Results are to be provided to DCC Representative for review prior to disposal off-site.

.3 Disposal of leachate toxic lead-based paint as hazardous materials must comply with legislation on transport and disposal.

.4 Dispose of all materials that are removed as asbestos-containing materials as asbestos waste.

.7 Transport and Disposal of Hazardous Waste and Designated Substances:

.1 Provide DCC Representative written notification of intent to transport of hazardous materials or designated substances off site, including but not limited to hazardous and liquid industrial waste (i.e. oils, solvents, waste fuels, used spill clean-up materials) or designated substance waste (i.e. asbestos, leachate toxic lead paint, mercury vapour in fluorescent light tubes).

.2 For shipments that require a waste generator number pursuant to O. Reg. 347, the Base waste generator number is required prior to removal offsite and will be provided by the DCC Representative.

.3 Submit the following to the DCC Representative for review 5 working days prior to transport:

.1 Description and approximate quantity of waste material, including substrate if applicable.

.2 Contractor proposed date and time for hazardous waste material shipment.

.3 Correspondence from the approved hazardous waste receiver, indicating agreement and intent to accept the specified hazardous materials waste on specified date.

.4 Contractor will complete a “Certificate of Content for Waste Disposal” provided in Item 12 of this specification.

.4 Coordinate with the DCC Representative so that the Base Hazardous Materials Officer or designate is present at the time of shipment to review, sign and document hazardous waste transport from the Base.

.5 Submit the following to the DCC Representative for review within 48 hours following transport from the Base:

.1 Landfill weigh scale receipt/ticket for the disposal of waste.

.8 Disposal of Mechanical Flushing Liquids:

.1 Mechanical flushing liquids and mechanical liquids include any mechanical systems (piping, units, etc.) such as HVAC, glycol and includes residual liquid in current systems, cleaning with chemical inhibitors or cleaners, and flushing of new piping.

.2 Mechanical flushing liquids are to be assumed for bidding purposes to be hazardous waste and shall be transported and disposed of at a licensed facility in accordance with O. Reg. 347, and as described in this specification for Shipment and Disposal of Hazardous Waste and Designated Substances.

.3 In the event the contractor wants to discharge to a sanitary sewer the contractor must undertake the following items:

.1 Provide DCC Representative written notification of intent to discharge mechanical flushing liquids to sanitary sewer.

.2 Submit a sample of the liquid for laboratory analysis of all parameters in the City of Kingston Sewer Bylaw Schedule A including pH to a licensed laboratory.

.3 Submit a report to DCC Representative confirming that all materials proposed to be disposed to sewers comply with all legislative requirements, including the City of Kingston Sewer Use Bylaw.

.4 Coordinate with the DCC Representative to involve the Hazardous Materials Officer to authorize results from testing and sanitary discharge. Allow a minimum of 48 hours for review and authorization.

.5 Mechanical flushing liquids and mechanical liquids that are not authorized to be discharged to sanitary sewer shall be transported and disposed of at a licensed facility in accordance with O. Reg. 347, and as described in this specification for Shipment and Disposal of Hazardous Waste and Designated Substances.

.9 Special Wastes:

.1 Smoke Detectors:

.1 Undamaged and intact commercial Canadian Standards Association (CSA) and Underwriters Laboratories (UL) approved smoke detectors containing less than 185 kilo-Becquerel's of Americium-241 may be disposed of using local waste collection systems.

.2 *Photoelectric* smoke detectors are **not** subject to this special procedure.

.3 *Ionization chamber smoke detectors* (ICSDs) contain radioactive sources, and **are** subject to this special procedure.

.4 If surplus ICSDs are not to be re-used, remove the ICSDs from walls, ceilings, etc., without breakage, and, dispose of ICSDs at an approved landfill.

.2 Polychlorinated Biphenyls (PCBs):

.1 Before beginning work, submit written procedures to DCC Representative for review. Do not begin work on PCB ballasts material until DCC has reviewed the written procedures.

.2 Fluorescent light ballasts considered to contain polychlorinated biphenyls (PCBs) are to be packaged and disposed of at a PCB storage facility off Base.

.3 Label containers with black and white serialized, "ATTENTION PCB" labels, in accordance with Environment and Climate Change Canada Manual for Spills of Hazardous Materials.

.10 Do not bury rubbish or waste materials on DND Property.

.11 Do not dispose of waste into any waterways, storm or sanitary sewers, drainage system, or onto land.

.12 Divert unused asphalt material from landfill to be reused offsite or recycled.

.13 All solid and liquid hazardous waste material generated by work are to be taken off Base and disposed of in a lawful manner and at appropriately accredited facilities.

.14 All expenses incurred for the handling, storage, analysis, transport and disposal/recycling of all wastes will be incurred by the Contractor.

## 9 Halocarbon Management

.1 Halocarbons are ozone-depleting substances that are used as refrigerants, solvents and for fire suppression.

.2 Comply with the:

.1 Federal Halocarbon Regulations (FHR), 2022. SOR/2022-110.

.2 *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (the Environment and Climate Change Canada "Refrigeration Code of Practice"). April 2015.

.3 Installation, servicing, operation must be completed by a certified person as defined in the FHR 2022.

.1 Provide copies of all technicians' certificates to the DCC Representative.

.4 For the purpose of this contract, the Responsible Person as defined in the FHR 2022 shall be the Contractor.

.5 The following are the only halocarbons that are acceptable as refrigerants (non-halocarbon refrigerants are also acceptable):

.1 HFC R32

.2 HFC 410A;

.3 HFC 134A;

.4 HFC 404A.

.5 HFC/HFO R454B

.6 Document **all** work—installation, maintenance, decommissioning, leak testing on refrigeration and air conditioning systems using CFB Kingston Halocarbon Service Log forms. An example form can be found in sub-section 10 of this specification. Obtain forms from DCC Representative. Mount forms upon equipment.

.7 Affix bar code tags to the equipment, as provided by the DCC Representative.

.8 Immediately report all releases of halocarbons to the DCC Representative.

.1 Complete Base incident reporting form, found in sub-section 11, and provide to DCC Representative within 24 hours.

.9 Leak-test all halocarbon-containing equipment within 24 hours of arrival at the Base, in accordance with the FHR 2022 and the *Refrigeration Code of Practice.*

.10 Leak-test all "empty" equipment within 24 hours of arrival at the Base, in accordance with the FHR 2022 and the *Refrigeration Code of Practice*.

.11 Leak-test halocarbon-containing equipment during Commissioning in accordance with the FHR 2022 and the *Refrigeration Code of Practice.*

.1 Complete Base activity log forms.

.12 After installation, leak-test factory-charged halocarbon-containing equipment in accordance with the FHR 2022 and the *Refrigeration Code of Practice*.

.1 Complete Base activity log forms.

.13 Comply with the following timelines for service activity log completions:

.1 Factory charged units containing more than 10 kg of halocarbon shall be leak tested within 2 (two) working days of delivery to site;

.2 Commissioning of units requires forms to be submitted to DCC Representative within 48 hours of service;

.3 Leak Test with "no leaks", submit forms to DCC Representative within 48 hours of service;

.4 Leak Test with "leak detected", submit forms to DCC Representative within 24 hours of service;

.5 Leak repaired and isolation or emptying of system, submit forms to DCC Representative within 5 working days of service;

.6 Release of halocarbons >10 kg and <100 kg, submit forms to DCC Representative within 24 hours of service;

.7 Release or potential release of halocarbons > 100 kg, submit forms to DCC Representative immediately; and

.8 Decommissioning of units requires forms to be submitted to DCC Representative within 48 hours of service.

# 10 Halocarbon Service Log Form

Sequential Form Number:

Annex B to

BSO 16.04 **Refrigeration and Air Conditioning Service Log (CFB Kingston)**

| *For this type of work...* | *...complete these items in these Sections* | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Commissioning | All | All | 1.0, 1.1, 1.2, 3.0 | 1 through 6, 13 |
| Leak Test | All | All | All | 1, 2, 3, 5, 6, 7, 13 |
| Servicing of Sealed Systems Only (Refrigerant Circuit) | All | All | All | 1 through 9, 13 |
| De-Commissioning | All | All | Not applicable | 1, 2, 5 through 13 |

*SECTION A.* ☐ **Commissioning** ☐ **Leak Test** ☐ **Servicing** ☐ **Decommissioning**

Building No. _____ Operator _____

Room No. _____ Owner _____

Owner Address _____

Equipment Description _____ DND Barcode No. _____

*SECTION B.*

Work Order No. _____ Service Date _____

Model Number _____ Serial Number _____

Contracting Company/Technician Employer _____

Technician/Contractor Name (print) _____

Technician's Trade Certificate No. _____ Expiry Date _____

*SECTION C.*

| ACTIVITY | YES | NO | COMMENTS |
|---|---|---|---|
| 1.0 Leak Test Performed | | | Date of Last Leak Test: |
| 1.1 Leak(s) Detected | | | |
| 1.2 Leak(s) Repaired | | | |
| 2.1 Halocarbon Recovered From System | | | |
| 2.2 Halocarbon Isolated in System | | | |
| 3.0 System Charged With Halocarbon | | | **FACTORY** ☐ **FIELD** ☐ |

*SECTION D.*

1. Technician's ODS Awareness Card No. _____ Expiry Date _____
2. Type of Halocarbon _____
3. Halocarbon Charge Capacity _____ (kg) (lb) (oz). Amount of Halocarbon Charged _____ (kg) (lb) (oz)
4. Charged by: ☐ Contractor ☐ Factory ☐ DND (give DND cylinder barcode No. _____)
5. Cooling Capacity of System _____ (tonnes) (BTU) (kW)
6. Halocarbon charged per circuit (1) _____ (2) _____ (3) _____ (4) _____ (5) _____ (kg) (lb) (oz)
7. Type of Halocarbon Recovered _____
8. Amount of Halocarbon Recovered _____ (kg) (lb) (oz)
9. Recovered into cylinder owned by: ☐ Contractor ☐ DND (give DND cylinder barcode No.)
10. Final Destination of Equipment _____
11. Final Destination of Halocarbon _____
12. Final Destination of Refrigerant Oil _____
13. Technician Signature _____

***Submit form to DCC Representative, 6 Moro St. Fax 546-5118.*** WHITE (Top) – Attach to equipment
YELLOW – RM Supervisor PINK – B Env O GOLDENROD -Technician

## 11 Halocarbon Incident Release Form

RELEASE REPORTING FORM FOR HALOCARBON REFRIGERATION, AIR CONDITIONING, FIRE EXTINGUISHING AND SOLVENT SYSTEMS

TO BE COMPLETED WITHIN 24 HOURS OF OCCURRENCE

Owner _____

Building No. _____

Room No. _____

Operator_____

Type of System* _____

Barcode No._____

Serial No._____

Type of Halocarbon Released _____

Estimated Quantity Released_____(kg) (lb) (oz)

Circumstances of Release _____

_____

Date Release Detected_____

Corrective Action Taken _____

_____

_____

Actions to Prevent Subsequent Release_____

_____

Release Reported YES NO

Date And Time Release Reported _____

Release Reported To _____ Phone No._____

Title_____

* Type of system: Refrigeration Air Conditioning Fire Extinguishing Solvent System Other

Name_____

Title_____

Signature _____

**Submit form to DCC Representative**

## 12 Certificate of Content for Waste

Date: _____

DCC/CE Project Number: _____

Site Location: _____

Contractor Name: _____

Address: _____

Contact Name: _____

Phone Number: _____

Brief Description of Materials Being Shipped (including quantity):

_____
_____
_____

This document is to certify that the materials being shipped are as described above.

Only materials indicated on this Certificate as described above will be shipped.
For materials requiring manifests a minimum of 48 hours notice is required to coordinate Base Environment sign-off prior to material transport from site.

If applicable indicate,

Manifest #: _____

Waste Classification#: _____

Contractor Signature (print and sign): _____

DCC/CE Contract Authority (print and sign):_____
Ref.
Ontario Regulation 347/558
Transportation of Dangerous Goods Act

**Submit form to DCC Representative**

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SUMMARY

.1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

## 1.2 RELATED REQUIREMENTS

.1 Perform Work in accordance with the latest National Building Code of Canada (NBC) including amendments up to tender closing date provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code

.1 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

## 1.3 BUILDING SMOKING ENVIRONMENT

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

## 1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: Except as otherwise specified, Contractor shall apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:

.1 Regulatory requirements and fees in force on date of Bid submission; and

.2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission

# PART 2 PRODUCTS

## 2.1 NOT USED

.1 Not Used.

## 2.2 EASEMENTS AND NOTICES

.1 Contractor to confirm with DCC Representative that surrounding infrastructure is owned and operated by DND.

.1 If true, DCC Representative to notify DND PM to contact Property Officer for their comments.

.2 Contractor is not permitted to work on any infrastructure owned by municipality, other government departments, or a third-party owner (for example, utility companies).

.3 Contractor is to get written permission from DCC Representative through DND PM and Base Property Officer if work is required on DND owned utilities that cross an easement.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 GENERAL

.1 Quality control remains the responsibility of the contractor. DCC Representative provides Quality Assurance.

.2 Contractor shall provide a contract specific Quality Control Plan to the DCC Representative for review and acceptance prior to first progress payment. The contract specific Quality Control Plan shall include specific and detailed responsibilities of the Contractor's staff to demonstrate how they will ensure that the Work meets the specifications and drawings of the Contract.

## 1.2 INSPECTION

.1 Allow DCC Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by DCC Representative instructions, or law of Place of Work.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 DCC Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, DCC Representative will pay cost of examination and replacement.

## 1.3 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies may be engaged by DCC Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by DCC Representative.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by DCC Representative at no cost to DCC Representative. Pay costs for retesting and reinspection.

## 1.4 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

**1.5 PROCEDURES**

.1 Notify appropriate agency and DCC Representative 3 business days in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

**1.6 REJECTED WORK**

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by DCC Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

**1.7 REPORTS**

.1 Submit 1 electronic copy of inspection and test reports to DCC Representative.

.2 Provide copies to Subcontractor of work being inspected or tested or manufacturer or fabricator of material being inspected or tested.

**1.8 TESTS AND MIX DESIGNS**

.1 Furnish test results and mix designs as requested.

**1.9 MOCK-UPS**

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.

.2 Construct in locations acceptable to DCC Representative.

.3 Prepare mock-ups for DCC Representative's review with reasonable promptness and in orderly sequence, to not cause delays in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 If requested, DCC Representative will assist in preparing schedule fixing dates for preparation.

**1.10 MILL TESTS**

.1 Submit mill test certificates as required of specification Sections.

**1.11 EQUIPMENT AND SYSTEMS**

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

.2 Refer to Sections for definitive requirements.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 REFERENCES

.1 Occupational Health and Safety Act (OHSA)
- .1 Ontario Regulation 213/91 for Construction Projects.

## 1.2 INSTALLATION REMOVAL

.1 Provide construction facilities in order to execute work expeditiously.

.2 Coordinate with governing authorities and obtain required permits.

.3 Remove from site all such work after use.

## 1.3 FUNCTIONAL REQUIREMENTS

.1 Provide all necessary hoists for work.

.2 Locate hoists where directed by DCC Representative.

## 1.4 DESIGN CRITERIA

.1 When required by code, scaffolding and scaffold enclosures shall be designed and certified by a Professional engineer, retained by contractor and licensed in the Province of Ontario. The same Professional engineer must approve, in writing, additions or modifications to scaffolding.
- .1 Scaffold and enclosure must be built to withstand, and all wind, rain and snow loads applicable to construction site in accordance with NBC and OBC.
- .2 Scaffold may be loaded up to 2.40 kPa. No more than 5 (five) working levels shall be loaded at one time.

.2 Where scaffolding must be supported by existing structures, DCC Representative shall provide on request, information from the Owner on the condition and capacity of the existing structure in sufficient detail to allow the Contractor to complete scaffolding design.

## 1.5 GENERAL REQUIREMENTS FOR SCAFFOLDING

.1 Power elevated platforms may be used as part of the access system for the work if suitable to complete the work and provide access for inspection. Use of elevated work platforms shall be subject to remaining within the load lifting limits of such machines, accommodating traffic required for operations (delivery, garbage, recycling trucks etc.) and providing ready access to both the DCC Representative and designated inspectors such that the work can be inspected while in progress and once complete. Design scaffolds as follows:
- .1 Platforms shall be prefabricated clip platforms, planks are not permitted.
- .2 Scaffolds shall have proper stairs; ladders and trap doors are not permitted.
- .3 Scaffolds shall be built of modular parts whenever possible.
- .4 Scaffold accessories including braces and jackscrews shall be compatible with the capacity of frames.
- .5 Provide internal horizontal x-bracing at all planking levels.
- .6 Platforms shall be wide enough to circulate and temporarily store materials.
- .7 Platforms shall be designed to support extra loads of removed materials.
- .8 Provide steel guardrails, including toe boards, intermediate rails and handrails, at perimeter and around openings of all work platforms.
- .9 Scaffold design and erection shall be in accordance with the "Occupational Health And Safety Act" and "Regulations For Construction Projects", and relevant municipal,

provincial and federal regulations.

.2 Scaffolding shall be tied back to the masonry using push-pull ties. Scaffolding shall be isolated from walls or surfaces with 12 mm thick rubber or neoprene pads. Show all anchor locations and ties on shop drawings. DCC Representative shall review anchor locations prior to installation.

.3 Scaffold roofs shall be waterproof and meet Design Criteria.

### 1.6 SHOP DRAWINGS

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

.2 Submit for review shop drawings of scaffold and weather enclosure system including:
- .1 Scaffold assembly drawings.
- .2 Scaffold anchoring.
- .3 Enclosure fabric with fastening and support system if applicable.
- .4 Waterproofing details for scaffold roof.
- .5 Indicate on drawings distance from platforms to wall surface to be worked on.

## PART 2 PRODUCTS

### 2.1 TUBULAR SCAFFOLD

.1 Tubular scaffold, scaffold bridge, stair, side brackets, work platforms, guardrails, barricades, and other accessories shall be an engineered type modular tubular scaffold system.

.2 Complementary 50 mm diameter tube and clamp assemblies may be used where structural reinforcement is required and/or irregular geometry prevents use of modular parts.

.3 All components shall be hot dip galvanized steel.

.4 Platforms shall be clip type prefabricated platforms; wood planks are not permitted.

### 2.2 ACCESSORIES

.1 Spacers and protection pads: rubber or neoprene spacers: 12 mm thick min.

.2 Pipe fasteners: 3 mm thick min. galvanized steel fasteners designed for 25 mm and for 50 mm exterior diameter tubing.

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 The erection of the scaffold cannot commence prior to review of the shop drawings.

.2 A competent worker shall supervise erection of the scaffold.

.3 Professional engineer that prepared shop drawings shall inspect the scaffold before it is used to ensure that it is erected in accordance with design drawings.

.4 Scaffolds:
- .1 Install engineered scaffold, stairs and aluminum track system in accordance with approved shop drawings and mock-ups.

.5 Enclosure and netting:
.1 Use plastic wrap ties to fasten netting securely to scaffolding where applicable.

**3.2 REMOVAL**

.1 Remove temporary scaffolding and enclosures when directed by DCC Representative.

.2 Coordinate removal work DCC Representative.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

## 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

## 1.3 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

## 1.4 DEWATERING

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

## 1.5 WATER SUPPLY

.1 Existing water supply may be used free of charge, for construction requirements with prior approval of DCC Representative. Make good any damage.

.2 DCC Representative will determine delivery points and quantitative limits. Written permission is required before any connection is made. All connections to be completed by licensed trade as required by regulatory and approval authorities.

.3 Provide at no cost to DND, all equipment and temporary lines to bring these services to project site.

.4 Supply of temporary services by DND is subject to DND requirements and may be discontinued by DND site representative at any time without notice, without acceptance of any liability for damage or delay, caused by such withdrawal of temporary services.

## 1.6 TEMPORARY HEATING AND VENTILATION

.1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.

.2 All equipment shall be in good working order and approved by a recognized certification agency.

.3 Prior to the use of any heating equipment the Chief Fire Inspector of the Base shall be notified and the equipment and installation inspected before any use.

.4 No temporary heating equipment utilizing an open flame will be allowed.

.5 Unless explicitly stated elsewhere in the specifications, the contractor is responsible for all heating cost, including equipment, fuel, electricity and maintenance personnel as required for the duration of the project.

.6 Construction heaters used inside building must be vented to outside or be flameless (vent free) type. Solid fuel salamanders are not permitted.

.7 Provide temporary heat and ventilation in enclosed areas as required to:
- .1 Facilitate progress of Work.
- .2 Protect Work and products against dampness and cold.
- .3 Prevent moisture condensation on surfaces.
- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for safe working environment.

.8 Maintain temperatures of minimum 10 degrees Celsius in areas where construction is in progress.

.9 Ventilating:
- .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.10 Permanent heating system of buildings should be used when available. Be responsible for damage to heating system if use is permitted.

.11 On completion of Work for which permanent heating system is used, heating system shall be cleaned, serviced and tested for complete operation. Depending on the system type this includes but is not limited to filter changes, flushing and cleaning of piping, duct cleaning.

.12 When authorized by the DCC Representative, Contractor may use existing building equipment for temporary heat source.

.13 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
- .1 Conform with applicable codes and standards.
- .2 Enforce safe practices.
- .3 Prevent abuse of services.
- .4 Prevent damage to finishes.
- .5 Vent direct-fired combustion units to outside.

.14 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

## 1.7 TEMPORARY POWER AND LIGHT

.1 Arrange and maintain temporary electrical power supply in accordance with governing regulations and ordinances.

.2 DND may provide, free of charge, temporary electrical power for construction purposes. Electrical power provided by DND is not to be utilized for temporary heating.

.3 DCC Representative will determine delivery points and quantitative limits. Written permission is required by DCC Representative before any connection is made. Connect to existing power supply in accordance with the Canadian Electrical Code. All connections to be completed by licenced trade as required by regulatory and approval authorities.

.4 Provide, at no cost to DND, all equipment and temporary lines to bring these services to project site.

.5 Supply of temporary services by DND is subject to DND requirements and may be discontinued by DND site representative at any time without notice, without acceptance of any liability for damage or delay, caused by such withdrawal of temporary services.

.6 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor based on General Conditions of Contract.

.7 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

.8 Standard 120V/1Ph/60Hz power is available throughout the building and will be provided for construction use at no cost. Connect to existing power supply in accordance with Canadian Electrical Code. Where different voltages are required, consult with DCC Representative for temporary installations provided by the Contractor.

.9 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of DCC Representative provided that guarantees are not affected.
- .1 Repair damage to electrical system caused by use under this Contract.
- .2 Replace lamps which have been used for more than 3 months.

**1.8 TEMPORARY COMMUNICATION FACILITIES**

.1 Provide and pay for temporary telephone, fax, data hook up, line[s] necessary for own use and use of DCC Representative.

## PART 2 PRODUCTS

**2.1 NOT USED**

.1 Not Used.

## PART 3 EXECUTION

**3.1 NOT USED**

.1 Not Used.

## END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 50 01 Scaffolding & Weather Protection

## 1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 1.189-[00], Exterior Alkyd Primer for Wood.
- .2 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.

.2 CSA Group (CSA)
- .1 CSA-A23.1/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA-0121-[M1978(R2003)], Douglas Fir Plywood.
- .3 CAN/CSA-S269.2-[M1987(R2003)], Access Scaffolding for Construction Purposes.
- .4 CAN/CSA-Z321-[96(R2001)], Signs and Symbols for the Occupational Environment.

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

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

## 1.4 INSTALLATION AND REMOVAL

.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.

.2 Identify areas which have to be gravelled to prevent tracking of mud.

.3 Indicate use of supplemental or other staging area.

.4 Provide construction facilities in order to execute work expeditiously.

.5 Remove from site all such work after use.

## 1.5 SCAFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2 and or Section 01 50 01.

.2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, and temporary stairs.

## 1.6 HOISTING

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

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

**1.7 SITE STORAGE/LOADING**

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

**1.8 CONSTRUCTION PARKING**

.1 Parking will be permitted on site within designated areas.

.2 Provide and maintain adequate access to project site.

**1.9 OFFICES**

.1 Provide marked and fully stocked first-aid kit in a readily available location.

**1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE**

.1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds when required by contractor for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

.3 Storage location to be approved by DCC Representative.

**1.11 SANITARY FACILITIES**

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances, if required.

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

.3 Permanent facilities may be used on approval of DCC Representative.

**1.12 CONSTRUCTION SIGNAGE**

.1 Provide and erect project sign, upon Contractor's mobilization to site, in a location designated by DCC Representative.

.2 No other signs or advertisements, other than warning signs, are permitted on site.

.3 Direct requests for approval to erect Contractor signboard to DCC Representative. For consideration general appearance of Contractor signboard must conform to project identification site sign. Wording in both official languages.

.4 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.

.5 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by DCC Representative.

**1.13 PROTECTION AND MAINTENANCE OF TRAFFIC**

.1 Provide access and temporary relocated roads as necessary to maintain traffic.

.2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by DCC Representative.

.3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.

.4 Protect travelling public from damage to person and property.

.5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.

.6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

.7 Construct access and haul roads necessary.

.8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.

.9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

.10 Dust control: adequate to ensure safe operation at all times.

.11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by DCC Representative.

.12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.13 Provide snow removal during period of Work for Contractor's Roads.

.14 Remove, upon completion of work, haul roads designated by DCC Representative.

**1.14 CLEAN-UP**

.1 Remove construction debris, waste materials, packaging material from work site daily.

.2 Clean dirt or mud tracked onto paved or surfaced roadways.

## PART 2 PRODUCTS

**2.1 NOT USED**

.1 Not Used.

## END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 52 00 Construction Facilities

## 1.2 PROTECTION OF PUBLIC TRAFFIC

.1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.

.2 When working on travelled way:
- .1 Place equipment in position to minimize interference and hazard to travelling public.
- .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
- .3 Do not leave equipment on travelled way overnight.

.3 Close lanes of road only after receipt of written approval from DCC Representative.
- .1 Before re-routing traffic erect suitable signs and devices to Ontario Traffic Manual, Book 7: Temporary Conditions.

.4 Keep travelled way graded, free from pot holes and of sufficient width for required number of lanes of traffic.
- .1 Provide 7 m wide minimum temporary roadway for traffic in two-way sections through Work and on detours.
- .2 Provide 5 m wide minimum temporary roadway for traffic in one-way sections through Work and on detours.

.5 Provide detours or temporary roads as indicated, and as approved by DCC Representative to facilitate passage of traffic around restricted construction area:

.6 Provide and maintain road access and egress to property fronting along Work under Contract and in other areas as indicated, except where other means of road access exist that meet approval of DCC Representative.

## 1.3 INFORMATIONAL AND WARNING DEVICES

.1 Provide and maintain signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response, as approved on traffic control plan by DCC Representative.

.2 Supply and erect signs, delineators, barricades and miscellaneous warning devices to Ontario Traffic Manual, Book 7: Temporary Conditions.

.3 Place signs and other devices in locations recommended in Ontario Traffic Manual, Book 7: Temporary Conditions.

.4 Meet with DCC Representative prior to commencement of Work to prepare list of signs and other devices required for project. If situation on site changes, revise list to approval of DCC Representative.

.5 Continually maintain traffic control devices in use:
- .1 Check signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.

.2 Remove or cover signs which do not apply to conditions existing from day to day.

### 1.4 OPERATIONAL REQUIREMENTS

.1 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified and approved by DCC Representative to protect and control public traffic.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

## END OF SECTION

# PART 1 GENERAL

## 1.1 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)
- .1 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.
- .2 CAN/CGSB 1.189-[00], Exterior Alkyd Primer for Wood.

.2 CSA Group (CSA)
- .1 CSA-O121-[M1978(R2003)], Douglas Fir Plywood.

## 1.2 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

## 1.3 HOARDING

.1 Erect temporary site enclosures using 38x89mm construction grade lumber framing at 600mm centers and 1200x2400x13mm exterior grade fir plywood to CSA O121.

.2 Apply plywood panels vertically.

.3 Provide lockable truck entrance and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.

.4 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.

.5 Paint public side of site enclosure in selected colours with one coat primer to CAN/CGSB 1.189 and one coat exterior paint to CGSB 1.59. Maintain public side of enclosure in clean condition.

.6 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

## 1.4 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.2 Provide as required by governing authorities.

## 1.5 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

### 1.6 DUST TIGHT SCREENS

.1 Provide dust control measures to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

### 1.7 ACCESS TO SITE

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

### 1.8 PUBLIC TRAFFIC FLOW

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

### 1.9 FIRE ROUTES

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

### 1.10 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred by Work, to previous or better condition.

### 1.11 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with DCC Representative locations and installation schedule at least 10 working days prior to installation.

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

### 1.12 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 35 43 - Environmental Protection.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 52 00 Construction Facilities

.2 Section 01 55 26 Traffic Control

## 1.2 REFERENCE STANDARDS

.1 Within text of each specifications section, reference may be made to reference standards.

.2 Conform to latest date of issue of referenced standards in effect on date of submission of Tender, except where specific date or issue is specifically noted.

.3 If there is question as to whether products or systems are in conformance with applicable standards, DCC Representative reserves right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing will be borne by DCC Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

## 1.3 QUALITY

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

.2 Within 7 Calendar days of written request by DCC Representative, submit following information for materials and equipment proposed for supply:
- .1 Name and address of manufacturer.
- .2 Trade name, model catalogue number.
- .3 Performance and test data.
- .4 Manufacturers installation instructions.
- .5 Evidence of arrangement to procure.

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

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with DCC Representative based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

## 1.4 CONTRACTOR'S OPTIONS FOR SELECTING MATERIALS FOR TENDERING

.1 Products specified by naming three or more, select any product named. Materials listed as "Acceptable Products" within the contents of this specification identify products known to meet the

specified criteria. Other products may exist which meet the requirements specified but have not been listed as "Acceptable Products".

.2 Where 3 products are listed, the Contractor will choose one of the listed products. If Contractor desires to use alternate products in lieu of the listed acceptable products, the Contractor will follow specified procedures for requesting the use of alternate products - DCL242. The term "Acceptable Product" is deemed to be a complete and working commodity as described by a manufacturer's name, catalogue number, trade name or any combination thereof.

**1.5 SUBSTITUTION**

.1 No substitutions will be permitted after tender award except under special circumstances described herein.

.2 A substitution request must include statements of respective costs of items originally specified and the proposed substitution and itemize any differences in quality, performance and warranty.

.3 A substitution request may be considered by the DCC Representative if:
- .1 materials selected from those specified are not available, discontinued; or
- .2 delivery date of materials selected from those specified would unduly delay completion of contract; and
- .3 alternative material to those specified is equivalent in quality, performance and warranty to the material specified and will result in a credit to the Contract amount.

.4 Should substitution be accepted either in part or in whole, assume full responsibility and cost when substitution affects other work on project. Pay for design or drawing changes required as result of substitution.

.5 Amounts of all credits arising from approval of substitution will be determined by DCC Representative and Contract Price will be reduced accordingly.

**1.6 STORAGE, HANDLING AND PROTECTION**

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

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

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

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber and other materials on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of DCC Representative.

.9 Touch-up damaged factory finished surfaces to DCC Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

**1.7 TRANSPORTATION**

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

.2 Products supplied by Owner will coordinated by DCC Representative, unless otherwise noted in Contract Documents.

**1.8 MANUFACTURER'S INSTRUCTIONS**

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

.2 Notify DCC Representative in writing, of conflicts between specifications and manufacturer's instructions, so that DCC Representative will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes DCC Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

**1.9 QUALITY OF WORK**

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

.2 Do not employ anyone unskilled in their required duties. DCC Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with DCC Representative, whose decision is final.

**1.10 CO-ORDINATION**

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

**1.11 CONCEALMENT**

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform DCC Representative if there is interference. Install as directed by DCC Representative.

**1.12 REMEDIAL WORK**

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

**1.13 LOCATION OF FIXTURES**

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform DCC Representative of conflicting installation. Install as approved by DCC Representative.

**1.14 FASTENINGS**

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

**1.15 FASTENINGS - EQUIPMENT**

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.16 PROTECTION OF WORK IN PROGRESS**

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

**1.17 EXISTING UTILITIES**

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by DCC Representative, with minimum of disturbance to Work, building occupants, pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered notify DCC Representative, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 SUBMITTALS

.1 Submit to the DCC representative copies of the following documents, including updates issued:

- .1 Health and Safety Policy & Program as indicated in paragraph 1.9, prior to commencement of work on the work site.
- .2 Reports or directions issued by authorities having jurisdiction, immediately upon issuance from that authority.
- .3 Accident or Incident Reports, within 24 hrs of occurrence.

.2 Submit other data, information and documentation upon request by the DCC representative as stipulated elsewhere in this section.

### 1.2 COMPLIANCE REQUIREMENTS

.1 Comply with the latest edition of the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.

.2 Observe and enforce construction safety measures required by:

- .1 National Building Code of Canada (latest edition).
- .2 The Ontario Workplace Safety & Insurance Board (WSIB).
- .3 Municipal statutes and ordinances.

.3 In event of conflict between any provisions of above authorities the most stringent provision shall apply.

.4 Provide and maintain WSIB worker's compensation coverage for all employees for the duration of the contract. Prior to commencement of the work, at the time of Interim Completion and prior to final payment, provide to the DCC representative a clearance certificate from the WSIB indicating that the Contractor's account is in good standing.

### 1.3 RESPONSIBILITY

.1 The Contractor is responsible for safety of persons and property on the work site and for protection of federal employees and the general public circulating adjacent to work site operations to extent that they may be affected by conduct of work.

.2 The Contractor is to enforce compliance by workers and other persons granted access to work site with safety requirements of Contract Documents, applicable federal, provincial, and local statues, regulations, and ordinances, and with the Contractor's Health and Safety Program.

.3 Should an unforeseen or peculiar safety related hazard or condition become evident during performance of work, immediately take measures to rectify the situation and

prevent damage or harm. Advise the DCC representative verbally and in writing of the hazard or condition.

## 1.4 SITE CONTROL AND ACCESS

.1 Delineate and isolate the work areas from adjacent and surrounding areas with floor to ceiling poly for interior work areas, and signage to maintain control of all work area access points so that access to the project site work areas are adequately delineated from the building occupants with access restricted to authorized (construction) personnel only. The public way site delineation requirements shall meet or exceed the prescribed requirements specified in the Ontario Occupational Health and Safety Act & Regulations, specifically Section 64-65 (O. Reg. 213/91).

.2 Make provisions for granting permission to access onto work site to all persons who require access. Procedures for granting permission to access are to be in accordance with the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act and the Contractor's Health and Safety Program.

.3 Ensure persons granted access to the work site are in possession of and wear the minimum personal protective equipment (PPE) designated by the Contractor's Health and Safety Program. Ensure persons granted access to the work site are provided with, trained in the use of, and wear, appropriate PPE that are required above and beyond the designated minimums previously noted and as specifically related to the work site activity that they are involved in. Be responsible for the efficacy of the PPE that is provided above and beyond the designated minimums.

.4 For the purpose of this contract, the following are activities that will be required to be performed on the work site by DND forces and other Contractor(s). Control of the work site access and activities remain the responsibility of the Contractor as detailed within this specification section.

.1 Real Property Operations Detachment Kingston, throughout the project where required (for example, base issued permits, service shut-downs, locates, WFE shop, etc.)

.5 Erect signage at access points and at other strategic locations around the work site clearly identifying the work site area(s) as being "off-limits" to non-authorized persons. Signage must be professionally made with well understood graphic symbols and is not to be used as advertising but for the specific use as related to site safety and key contact information.

.1 Information to be provided on the signage is as follows:

Project Name/Description:

Contractor Company Name:

Project Superintendent's Name/Phone No.:

DCC Point of Contact Name/Phone No.:

.6 Secure the work site at all times to protect against un-authorized access.

## 1.5 FILING OF NOTICE

.1 File Notice of Project and any other required Notices with the Ontario Ministry of Labour prior to commencement of the work. Provide the DCC representative with a copy of the filed Notice(s) prior to commencement of the work.

## 1.6 PERMITS

.1 Obtain permits, licenses and compliance certificates at appropriate times and frequencies as required by the authorities having jurisdiction, for example CFB Kingston Hot Work Permit.

.2 Post all permits, licenses and compliance certificates on work site and provide copies to the DCC representative.

## 1.7 PROJECT/SITE CONDITIONS

.1 DND has provided the following list of known hazardous substances and/or hazardous conditions at the work site which should be considered for inclusion on the Constructor's hazard assessment, as health or environmental hazards and shall be properly managed should they be encountered as part of the work:

- .1 General construction type hazards;
- .2 Working at heights;
- .3 Public safety hazards;
- .4 Electrical hazards;
- .5 Mechanical hazards;
- .6 Contractors are required to be aware of the known hazardous substances and/or hazardous conditions and are to include in their tender price all work associated in working with, in and around the hazards.

.2 The above lists shall not be construed as being complete and inclusive of all safety and health hazards encountered as a result of Contractor's operations during the course of work. Include above items into the hazard assessment program specified herein.

## 1.8 MEETINGS

.1 Prior to commencement of work attend a pre-commencement meeting conducted by the DCC representative. Ensure minimum attendance by contractor's site superintendent. The DCC representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.

.2 Conduct site specific occupational health and safety meetings as required by the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.

.3 Record and post minutes of all meetings in plain view on the work site. Make copies available to the DCC representative upon request.

## 1.9 HEALTH AND SAFETY POLICY & PROGRAM

.1 Contractors are required under the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act to have in place a Health and Safety policy and program to support the policy. Compliance requirements for the content, detail and implementation of the policy and program resides with the Ontario Ministry of Labour. For the purpose of this contract the Health and Safety policy & program shall include, a signed / dated (current) safety policy statement and a program to support the policy (safe work procedures & practices, etc.) a site-specific hazard assessment that acknowledges, assesses and addresses the hazardous substances and/or hazardous conditions known and identified in paragraph 1.7 above, and on-going hazard assessment(s) shall be performed during the progress of work identifying and documenting new or known & potential health risks and safety hazards not previously known and identified.

.2 Provide a copy of the Health and Safety Policy & Program to the DCC representative prior to commencement of work on the work site. The copy provided to the DCC representative is for the purpose of review against the contract requirements related to the known hazardous substances and/or hazardous conditions. The review is not to be construed to imply approval by the DCC representative that the program is complete, accurate and legislatively compliant with the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act, and shall not relieve the Contractor of their legal obligations under such legislation.

## 1.10 ACCIDENT REPORTING

.1 Investigate and report incidents and accidents as required by the Ontario Occupational Safety and Health Act, and the Regulations made pursuant to the Act.

.2 For the purpose of this contract immediately notify DCC representative, investigate and provide a report within 24 hours to the DCC representative on incidents and accidents that involve:

- .1 A resulting injury that may or may not require medical aid but involves lost time at work by the injured person(s).
- .2 Exposure to toxic chemicals or substances.
- .3 Property damage.
- .4 Interruption to adjacent and/or integral infrastructure operations with potential loss implications.

.3 In the investigation and reporting of incidents and accidents, the Contractor is required to respond in a timely fashion to correct the action that was deemed to have caused the incident and/or accident and advise in writing on the action taken to prevent a re-occurrence of the incident and/or accident.

## 1.11 RECORDS ON SITE

.1 Maintain on site a copy of the safety documentation as specified in this section and any other safety related reports and documents issued to or received from the authorities having jurisdiction.

.2 Upon request, make copies available to the DCC representative.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 73 00 Execution

## 1.2 REFERENCE STANDARDS

.1 Owner's identification of existing survey control points and property limits.

## 1.3 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practice in Place of Work.

## 1.4 SURVEY REFERENCE POINTS

.1 Use when applicable.

.2 Existing base horizontal and vertical control points are designated on drawings.

.3 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.

.4 Make no changes or relocations without prior written notice to DCC Representative.

.5 Report to DCC Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.6 Require surveyor to replace control points in accordance with original survey control.

## 1.5 EXISTING SERVICES

.1 Before commencing work, establish location and extent of service lines in area of Work, all Base and Provincial Locate must be in hand before work may commence.

.2 Remove abandoned service lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by DCC Representative.

.3 Notify DCC Representative 1 week prior to backfill or capping of any utilities below grade.

## 1.6 LOCATION OF EQUIPMENT AND FIXTURES

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

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform DCC Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment to DCC Representative.

## 1.7 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 Record locations of maintained, re-routed and abandoned service lines.

**1.8 SUBSURFACE CONDITIONS**

.1 Investigate and promptly notify DCC Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

**1.9 UTILITY LINE FOUND WITH DAMAGE**

.1 In General: If damage to any existing infrastructure/utility line occurs during excavation or is found to be damaged, including damage to any coating on the line itself, the excavator shall immediately stop work, leave the utility line exposed, barricade the area and contact the appropriate utility provider immediately and notify DCC Representative. When a utility line strike occurs after working hours in addition, notify the Central Heating Plant (613 541 5010 ext.4582).

.2 Damaged Electrical Line: If there are any flames or sparks originating from an exposed electric distribution line or other works, the excavator shall barricade the area off and keep the public and workers away. Call 911 and the local electric distribution utility immediately.

.3 Damaged Gas Line: If **ANY** gas line strike occurs, be it by mechanical equipment or by manual methods, the following actions must be taken immediately. If required, emergency responders will coordinate the evacuation of affected buildings.

a) Stop Work and shut off all tools, machinery or equipment.

b) Clear everyone from the area.

c) Call 911.

d) Contact the appropriate utility provider immediately; and

e) **DO NOT** attempt to control or stop the gas from escaping.

**1.10 UTILITY PROVIDER POINTS OF CONTACT**

.1 Enbridge Gas: 1-866-763-5427

.2 Utilities Kingston: 613-546-1181 ext.2151

## PART 2 PRODUCTS

**2.1 NOT USED**

.1 Not Used.

## PART 3 EXECUTION

**3.1 NOT USED**

.1 Not Used.

## END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 74 00 – Cleaning and Waste Management.

## 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit written request in advance of cutting or alteration which affects:
- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or separate contractor.

.3 Include in request:
- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Owner or separate contractor.
- .7 Written permission of affected separate contractor (if applicable).
- .8 Date and time work will be executed.

## 1.3 MATERIALS

.1 Required for original installation.

## 1.4 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

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

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

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which are to be exposed by uncovering work.

## 1.5 EXECUTION

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.7 Restore work with new products in accordance with requirements of Contract Documents.

.8 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.9 Provide firestopping in to maintain the integrity of fire separations, including:
- .1 Protecting penetrations at fire-resistance rated wall, ceiling or floor construction.
- .2 Using construction joint fire stops and building perimeter fire stops to protect gaps at fire separations and between fire separations and other construction assemblies.

.10 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection or as indicated in contract documents. Refinish assemblies by refinishing entire unit.

.11 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

### 1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

## END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 73 00 Execution

## 1.2 REFERENCE STANDARDS

.1 Conduct cleaning and disposal operations in accordance with all Federal, Provincial or Municipal regulatory requirements and guidelines for environmental protection. In the case of a discrepancy between regulations, the most stringent regulation shall apply.

.2 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.3 This section does not apply to cleaning associated with hazardous material removal and disposal operations. Cleaning of these areas is covered in other sections. Once certified as safe by DCC Representative cleaning methods specified herein are applicable.

## 1.3 PROJECT CLEANLINESS

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

.2 Clear snow and ice from access to building, bank/pile snow in designated areas only.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Dispose of waste materials and debris at regulated waste facility off site.

.6 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

## 1.4 FINAL CLEANING

.1 When Work is Substantially Completed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Do not burn waste materials on site.

.5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.6 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass if damaged by the Work.

.7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors, if caused by the Work.

.8 Clean lighting reflectors, lenses, and other lighting surfaces.

.9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.10 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.13 Remove dirt and other disfiguration from exterior surfaces.

.14 Clean and sweep roofs, gutters, areaways, and sunken wells.

.15 Sweep and wash clean paved areas.

.16 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.17 Clean roofs, downspouts, and drainage systems.

.18 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.19 Remove snow and ice from access to building.

### 1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Complete in accordance with 01 35 43 - ENVIRONMETAL PROTECTION section.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 DEFINITIONS

.1 Redline Drawings are those prepared by the Contractor as it constructs the project and upon which it documents the actual locations of the building components and site components and changes to the original contract.

.2 Record Drawings are prepared by the Consultant or Designer of Work based on information taken from the Contractors Redline Drawings, are not included in the scope of work unless stated in the contract documents.

## 1.2 GENERAL

.1 The following shall be submitted in the close out package for approval in folders described in this divisional section.
- .1 Scanned Redline Drawings
- .2 Field Survey Data
- .3 O&M Manual
- .4 Approved Shop Drawings
- .5 Warranty Information and if available;
- .6 Reports
- .7 Photos
- .8 Spare parts, special tools and maintenance materials, as indicated in contract documents.

## 1.3 FORMAT

.1 The main folder structure for the closeout package submittal is to be organized as follows;
- .1 910 - Redline Drawings
- .2 920 - Record Drawings
  - .1 921 - Field Survey Data
- .3 930 - O&M Manual
- .4 940 - Approved Shop Drawings
- .5 950 - Warranty Information
- .6 960 - Reports
- .7 970 – Photos
- .8 980 - Spare parts, special tools and maintenance materials, as indicated in contract documents.

.2 Only electronic format is to be submitted.

.3 Allow 10 working days for closeout package to be reviewed by DCC Representative and DND Project Manager.

.4 All Cover Sheets: Project Title, Building Number, Drawing Number, Project Number, DCC KN Number and identify subject matter of contents.

.5 Arrange content by Specification Section numbers and sequence of Table of Contents.

.6 Provide separate sections for each separate product and system, with typed description of product and major component parts of equipment.

.7 Submission is to provided using DCC’s electronic file transfer platform.

## 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Two weeks prior to Substantial Completion of the Work, submit to the DCC Representative, a DRAFT electronic copy of operating and maintenance manuals in English.

.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.4 Provide evidence, if requested, for type, source and quality of products supplied.

## 1.5 REDLINE DRAWINGS

.1 As-Builts, Field Record Drawings and Redlines are interchangeable terms meaning Redlines.

.2 Contractor is to provide a printed copy of the drawing set for the intended purpose of creating redline drawings with the words "Redlines" in red written on each page.

.3 Contractor to record changes in red as made and authorized on one set of prints referred to as "Redline Drawings" and at substantial completion of project and prior to final inspection scan and submit drawings to DCC Representative. DCC Representative will review and initial to concur with the content of the final markups.

.4 All Site Instruction Numbers and Change Order Numbers are to be annotated on the Redline Drawing set.

.5 Contractor to maintain information on project site drawings and record accurately, deviations of newly installed or existing plant works from Contract documents during construction.

.6 Contractor will submit for record drawings purposes the original set of redline drawings from construction site used for keeping track of contract design and site condition changes.

.7 The Contractor shall ensure but not limit to the recording of the following information on the original Redline drawings:

- .1 Depths of various elements of foundation in relation to first floor level or finished grade elevation.
- .2 Horizontal and vertical locations of existing and new underground utilities and appurtenances as well as the alignment, bend and curves of buried utilities such as communication, power, water, sewer, storm and natural gas ducts, pipes and lines shall be surveyed and be geographically referenced to the coordinate system of the drawing or accurately dimensioned to surfaces features shown in the drawing.
- .3 Locations of internal utilities and appurtenance concealed in construction, referenced to visible and accessible features of structure.
- .4 Field changes of dimension and detail, such as but not limited to:
  - .1 For Buildings: Door locations, duct sizes, piping valve, and equipment layout, cable tray alignment.
  - .2 For Civil/Utilities: road widths, curve radii, alignment, curb radii, sidewalk extents, conduit/pipe sizes.
- .5 Changes made by Change Order.
- .6 Utilities shall be identified as abandoned, existing or new.

## 1.6 FIELD SURVEYING & DATA FILE

.1 Contractor to notify the DCC Representative with 2 working days’ notice if any buried utility or infrastructure is being exposed to allow DND Surveyor to survey.

.2 DND surveyor is allowed access to site to survey.

.3 Should DND surveyor require special site safety training, the Contractor will notify DCC Representative prior to allow time to be trained.

.4 Should the Contractor have their own Surveyor, and data is collected, it will be submitted with the closeout package.

.5 Field survey data file for service structures, manholes, catch basins, vaults, valves, hydrants etc shall be submitted in excel sheet file format. DCC Representative will get an excel template to be populated from DND. File will contain preset fields to be populated.

.6 Field survey performed for Municipal/Civil/Marine Works forming Part of Project shall:
- .1 Be collected in ASCii format and shape file.
- .2 ASCii file (Test File) shall contain point ID, Northing, Easting, Elevation and Descriptor.
- .3 Shape files (.shp, ESR1 format) shall include point ID, Northing, Easting, Elevation and Descriptor.

**1.7 O&M MANUALS**

.1 Electronic files are to be arranged and indexes into the same numerical order as the contract Specification Section. A maximum of 300 pages per file.

.2 The use of Bookmarks within PDF is an acceptable practice.

.3 Warranties are to remain in the Manual under each section.

.4 Table of Contents for Each Volume: provide Project Title, Building Number, Drawing Number, DND Project Number, DCC KN Number;
- .1 Date of submission; names.
- .2 Addresses, and telephone numbers of Contractor with name of responsible parties.
- .3 List of products and systems, indexed to content of volume.

.5 For each product or system:
- .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.6 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.7 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.8 Text: as required to supplement product data.
- .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.9 Training: refer to Section 01 79 00 - Demonstration and Training.

**1.8 APPROVED SHOP DRAWINGS**

.1 Only copies of approved shop drawings and product data are to be submitted. Rejected and non-approved shop drawings and product data are not to be included.

.2 Approved shop drawings for temporary works required to facilitate construction and that will be removed during or at the completion of construction are not required to be submitted in the closeout package.

## 1.9 WARRANTY

.1 A Cover Sheet and Table of Contents containing all project related warranties with each item's expiry date is to be created.

.2 All project related warranties are to be copied into this folder listed by specification section.

.3 Submit a summary of warranty information to DCC Representative for any warranties.
- .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 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
- .7 Cross-reference to warranty certificates as applicable.
- .8 Duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.

.4 Respond in timely manner to oral or written notification of required construction warranty in the closeout package.

## 1.10 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 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 - General Commissioning Requirements.

**1.11 MATERIALS AND FINISHES**

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- .1 Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional requirements: as specified in individual specifications sections.

**1.12 MAINTENANCE MATERIALS**

.1 Spare Parts:
- .1 Provide spare parts, in quantities specified in individual specification sections to DCC Representative.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed by DCC Representative; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to DCC Representative.
  - .2 Include approved listings in Maintenance Manual.

.2 Extra Stock Materials:
- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections to DCC Representative.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed by DCC Representative; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to DCC Representative.
  - .2 Include approved listings in Maintenance Manual.

.3 Special Tools:
- .1 Provide special tools, in quantities specified in individual specification section to DCC Representative.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed by DCC Representative; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to DCC Representative.
  - .2 Include approved listings in Maintenance Manual.

### 1.13 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 DCC Representative.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

## END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

## 1.2 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel as scheduled with the DCC Representative.

.2 Preparation:
- .1 Verify conditions for demonstration and instructions comply with requirements.
- .2 Verify designated personnel are present.
- .3 Ensure equipment has been inspected and put into operation.
- .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 23 05 93 Testing Adjusting-Balancing and equipment and systems are fully operational.

.3 Demonstration and Instructions:
- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for DCC Representative's approval.

.3 Provide electronic copy of completed operation and maintenance manuals for use in demonstrations and instructions.

## 1.4 QUALITY ASSURANCE

.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
- .1 Instruct personnel as designated by the DCC Representative.
- .2 Provide written report that demonstration and instructions have been completed.

# PART 2 PRODUCTS

## 2.1 NOT USED

.1 Not Used.

## PART 3 3 EXECUTION

### 3.1 3.01 NOT USED

.1 .1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SUMMARY

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

.2 Related Requirements
- .1 Section 01 91 13 General Commissioning Requirements
- .2 Section 01 91 31 Commissioning Plan
- .3 Section 01 91 41 Commissioning Training

## 1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Property, Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

## 1.3 INSTRUCTORS

.1 Contractor and certified factory-trained manufacturers' personnel to provide instruction on the following:
- .1 Start-Up, operation, shut-down of equipment, components and systems.
- .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
- .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.2 Contractor and equipment manufacturer to provide instruction on:
- .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

## 1.4 TRAINING OBJECTIVES

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

## 1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training to consist of demonstration of use and maintenance of equipment and systems.

.3 DCC Representative and DND Project Manager will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

**1.6 SCHEDULING**

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be [3] hours in length.

.3 Training to be completed prior to acceptance of facility.

**1.7 RESPONSIBILITIES**

.1 Contractor will be responsible for:
- .1 Implementation of training activities,
- .2 Coordination among instructors,
- .3 Quality of training, training materials,
- .4 Handouts including all necessary information (ie. flow charts, schematics, function / operations / interconnection information)

**1.8 TRAINING CONTENT**

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Content includes:
- .1 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .2 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
- .3 Maintenance and servicing, including spare parts recommended to be stored as site.
- .4 Trouble-shooting diagnosis.
- .5 Inter-Action among systems during integrated operation.

.3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

## PART 2 PRODUCTS

**2.1 NOT USED**

.1 Not Used.

## PART 3 EXECUTION

**3.1 NOT USED**

.1 Not Used.

## END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 General requirements relating to commissioning of project components and systems, specifying general requirements to Performance Verification of components, equipment, sub-systems, systems, and integrated systems.

.2 Related Requirements
- .1 Section 019131 – Commissioning Plan
- .2 Section 019141 – Commissioning Training

.3 Acronyms:
- .1 BMM - Building Management Manual.
- .2 Cx - Commissioning.
- .3 EMCS - Energy Monitoring and Control Systems.
- .4 O&M - Operation and Maintenance.
- .5 PI - Product Information.
- .6 PV - Performance Verification.
- .7 TAB - Testing, Adjusting and Balancing.

## 1.2 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
- .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
- .2 Ensure appropriate documentation is compiled into the BMM.
- .3 Effectively train O&M staff.

.2 Contractor shall coordinate and directs in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
- .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be operated interactively with each other as intended in accordance with Contract Documents and design criteria.
- .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

## 1.3 COMMISSIONING OVERVIEW

.1 Section 01 91 31 - Commissioning (Cx) Plan.

.2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.

.3 Cx to be a line item of Contractor's cost breakdown.

.4 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.6 DCC Representative will issue Interim Acceptance Certificate when:
- .1 Completed Cx documentation has been received, reviewed for suitability and approved.
- .2 Equipment, components and systems have been commissioned.
- .3 O&M training has been completed.
- .4 The Building is Ready for Use Intended
- .5 The Project Progress meets with the financial criteria outlined in the Construction Act

## 1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by DCC Representative to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

## 1.5 PRE-CX REVIEW

.1 Before Construction:
- .1 Review contract documents, confirm by writing to DCC Representative:
  - .1 Adequacy of provisions for Cx.
  - .2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:
- .1 Co-ordinate provision, location and installation of provisions for Cx with DCC.

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

.4 Inform DCC Representative in writing of discrepancies and deficiencies on finished works.

## 1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to DCC Representative before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

## 1.7 COMMISSIONING DOCUMENTATION

.1 Prepare Installation Verification and Performance Verification forms for all equipment requiring commissioning and as indicated in other sections.

.2 DCC Representative to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to DCC Representative.

## 1.8 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.19 - Construction Progress Schedules

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
- .1 Approval of Cx reports.
- .2 Verification of reported results.
- .3 Repairs, retesting, re-commissioning, re-verification.
- .4 Training.

## 1.9 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings: Section 01 32 16.19 - Construction Progress Schedules and as specified herein.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 At 60% construction completion stage. Section 01 32 16.19 - Construction Progress Schedules Contractor to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
- .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
- .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by the General Contractor who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

## 1.10 STARTING AND TESTING

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

## 1.11 WITNESSING OF STARTING AND TESTING

.1 Provide seven (7) calendar days' notice prior to commencement.

.2 DCC Representative to witness of start-up and testing.

.3 Contractor to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

## 1.12 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:
- .1 Coordinate time and location of testing.
- .2 Provide testing documentation for approval by DCC Representative
- .3 Arrange for DCC Representative to witness tests.
- .4 Obtain written approval of test results and documentation from DCC Representative before delivery to site.

.2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with DCC Representative.
- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.3 Integrity of warranties:
- .1 Use manufacturers trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
- .2 Verify with manufacturer that testing as specified will not void warranties.

.4 Qualifications of manufacturer's personnel:
- .1 Experienced in design, installation and operation of equipment and systems.
- .2 Ability to interpret test results accurately.
- .3 To report results in clear, concise, logical manner.

## 1.13 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:
- .1 Included in delivery and installation:
  - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
  - .2 Visual inspection of quality of installation.
- .2 Start-up: follow accepted start-up procedures.
- .3 Operational testing: document equipment performance.
- .4 System PV: include repetition of tests after correcting deficiencies.
- .5 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies and obtain approval from DCC Representative after distinct phases have been completed and before commencing next phase.

.4 Document requires tests on approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by DCC Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
- .1 Minor equipment/systems: implement corrective measures approved by DCC Representative.
- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by DCC Representative
- .3 If evaluation report concludes that major damage has occurred, DCC Representative shall reject equipment.
  - .1 Rejected equipment to be remove from site and replace with new.
  - .2 Subject new equipment/systems to specified start-up procedures.

## 1.14 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to DCC Representative for approval before commencement of commissioning.

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

## 1.15 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit to DCC Representative for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

## 1.16 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

## 1.17 START OF COMMISSIONING

.1 Notify DCC Representative at least 21 calendar days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

## 1.18 INSTRUMENTS / EQUIPMENT

.1 Submit to DCC Representative for review and approval:
- .1 Complete list of instruments proposed to be used.
- .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:
- .1 2-way radios.
- .2 Ladders.
- .3 Equipment as required to complete work.

## 1.19 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:
- .1 Under actual operating conditions, over entire operating range, in all modes.
- .2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

## 1.20 WITNESSING COMMISSIONING

.1 DCC Representative to witness activities and verify results.

## 1.21 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

## 1.22 COMMISSIONING CONSTRAINTS

.1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

## 1.23 EXTRAPOLATION OF RESULTS

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

## 1.24 EXTENT OF VERIFICATION

.1 Provide manpower and instrumentation to verify up to 40 % of reported results, unless specified otherwise in other sections.

.2 Number and location to be at discretion of DCC Representative

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.5 Perform additional commissioning until results are acceptable to DCC Representative

**1.25 REPEAT VERIFICATIONS**

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

**1.26 DEFICIENCIES, FAULTS, DEFECTS**

.1 Correct deficiencies found during start-up and Cx to satisfaction of DCC Representative

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

**1.27 COMPLETION OF COMMISSIONING**

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by DCC Representative.

**1.28 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

**1.29 TRAINING**

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

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

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

**1.31 OCCUPANCY**

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

**1.32 INSTALLED INSTRUMENTATION**

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications.
.2 Calibration certificates have been deposited with DCC Representative.

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

**1.33 PERFORMANCE VERIFICATION TOLERANCES**

.1 Application tolerances:
.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 5% of specified values.

.2 Instrument accuracy tolerances:
.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:
.1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

**1.34 OWNER'S PERFORMANCE TESTING**

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

## PART 2 PRODUCTS

**2.1 NOT USED**

.1 Not Used.

**2.2 EXECUTION**

.1 NOT USED

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SUMMARY

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

.2 Related Requirements
- .1 Section 01 91 13 – General Commissioning Requirements
- .2 Section 01 91 41 – Commissioning Training

## 1.2 REFERENCES

.1 American Water Works Association (AWWA)

.2 National Fire Protection Association (NFPA)
.1 NFPA-13, latest edition, Installation of Sprinkler Systems Handbook.

.3 Underwriters' Laboratories of Canada (ULC)

.4 ASHRAE Guide to Commissioning

## 1.3 GENERAL

.1 Provide a fully functional facility:
- .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
- .2 Facility user and O&M personnel have been fully trained in aspects of installed systems.
- .3 Optimized life cycle costs.
- .4 Complete documentation relating to installed equipment and systems.

.2 Term "Cx" in this section means "Commissioning".

.3 Use this Cx Plan as master planning document for Cx:
- .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
- .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
- .3 Sets out deliverables relating to O&M, process and administration of Cx.
- .4 Describes process of verification of how built works meet Owner’s requirements.
- .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
- .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
  - .2 Overview of Cx.
  - .3 General description of elements that make up Cx Plan.
  - .4 Process and methodology for successful Cx.

.4 Acronyms:
- .1 Cx - Commissioning.
- .2 BMM - Building Management Manual.
- .3 EMCS - Energy Monitoring and Control Systems.

.4 MSDS - Material Safety Data Sheets.
.5 PI - Product Information.
.6 PV - Performance Verification.
.7 TAB - Testing, Adjusting and Balancing.
.8 WHMIS - Workplace Hazardous Materials Information System.

.5 Commissioning terms used in this Section:
.1 Bumping: short term start-up to prove ability to start and prove correct rotation.
.2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

## 1.4 DEVELOPMENT OF 100% CX PLAN

.1 Contractor is responsible to create the commissioning plan (Cx Plan) and distribute to all trades. Contractor shall carry costs for this portion of the work.

.2 Cx Plan to be 100% complete within sixteen (16) weeks of receipt of Sub SRCL's and take into account:
.1 Approved shop drawings and product data.
.2 Approved changes to contract.
.3 Contractor's project schedule.
.4 Cx schedule.
.5 Contractor's, sub-contractor's, suppliers' requirements.
.6 Project construction team's and Cx team's requirements.

.3 Submit completed Cx Plan to DCC Representative and obtain written approval to proceed as per the plan or modify as directed by DCC Representative.

## 1.5 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:
.1 Changes resulting from Client program modifications.
.2 Approved design and construction changes.

.2 Revise, refine and update every two (2) months during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to DCC Representative for review and obtain written approval.

.4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

## 1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

.1 Contractor to maintain overall responsibility for project commissioning and is sole point of contact between members of commissioning team.

.2 General Contractor (CCA) will select the Cx team consisting of following members:
.1 CCA is responsible for:
.1 Organizing Cx.
.2 Monitoring operations Cx activities.
.3 Witnessing, certifying accuracy of reported results.
.4 Witnessing and certifying TAB and other tests.
.5 Developing BMM.
.6 Ensuring implementation of final Cx Plan.
.7 Performing verification of performance of installed systems and equipment.

.8 Implementation of Training Plan.

.2 Construction Team: discipline commissioning coordinator, contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
- .1 Testing.
- .2 TAB.
- .3 Performance of Cx activities.
- .4 Delivery of training and Cx documentation.
- .5 Assigning one person as point of contact with DCC Representative and Cx Manager for administrative and coordination purposes.

.3 DCC Representative will participate in all commissioning meetings and be actively involved with the team on site.

.4 DCC Representative will be responsible for:
- .1 Reviewing and approving all iterations of the Cx Plan
- .2 Reviewing and approving submitted data
- .3 Reviewing TAB Reports against the design
- .4 Participating at all Owner Training Sessions

**1.7 CX PARTICIPANTS**

.1 Employ the following Cx participants to verify performance of equipment and systems:
- .1 Installation contractor/subcontractor:
  - .1 Equipment and systems except as noted.

.2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
- .1 To include performance verification.

.3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.

.4 Ensure that Cx participant:
- .1 Could complete work within scheduled time frame.
- .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
  - .1 Modify ventilation rates to meet changes in off-gassing.
  - .2 Changes to heating or cooling loads beyond scope of EMCS.
  - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
  - .4 Redistribution of electrical services.
  - .5 Modifications of fire alarm systems.
  - .6 Modifications to voice communications systems.

.5 Provide names of participants to DCC Representative and details of instruments and procedures to be followed for Cx.

**1.8 EXTENT OF CX**

.1 Architectural - Commissioning systems and equipment
- .1 Exterior cladding material maintenance.
- .2 Roofing Warranty and Maintenance
- .3 Doors
  - .1 Wood Door – Maintenance
  - .2 Door Hardware – Operation, and Maintenance
- .4 Windows – Operation and Maintenance

.2 Mechanical - Commission systems and associated equipment:
- .1 Plumbing systems:
  - .1 Hydronic Heating Systems
- .2 HVAC and exhaust systems:
  - .1 HVAC systems.
  - .2 Make-Up Air Systems.
  - .3 General exhaust systems
  - .4 Exhaust systems and related systems
- .3 Fire and life safety systems:
  - .1 Wet pipe sprinkler systems.
  - .2 Fire extinguishers.
- .4 Building Automation System (BAS):
  - .1 Complete Systems as Described in Division 25 and integration with Division 21, 22, 23 and 26.

.3 Electrical - Commission systems and equipment:
- .1 Low voltage below 750 V:
  - .1 Low voltage equipment.
  - .2 Low voltage distribution systems.
  - .3 Voice communications systems.
  - .4 Audio/visual systems
  - .5 Electronic data and communications information systems.
  - .6 Division bells systems.
- .2 Emergency power generation systems:
  - .1 Transfer switchgear and controllers.
  - .2 Uninterruptible power systems.
- .3 Lighting systems:
  - .1 Lighting equipment.
  - .2 Distribution systems.
  - .3 Emergency lighting systems, including battery packs.
  - .4 Fire exit emergency signage.
- .4 Fire alarm systems, equipment:
  - .1 Annunciators.
  - .2 Control panels.
  - .3 Fire alarm battery banks.
- .5 Other systems and equipment:
  - .1 Intrusion and access security and safety systems.
  - .2 Building Automation System.

## 1.9 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to DCC Representative for review and approval same time as project Construction Schedule. Include:
- .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
  - .1 Completion and Submission of Cx Plan
  - .2 Completion Dates for each trade in each section of the building.
  - .3 Timing of the various phases of commissioning, testing, balancing and demonstration process.
  - .4 submission dates for the various documents required prior to verification of commissioning.
  - .5 Pre-TAB review
  - .6 Cx procedures
  - .7 Cx Report format

.8 Discussion of heating/cooling loads for Cx
.9 Submission of list of instrumentation with relevant certificates
.10 Notification of intention to start TAB
.11 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
.12 Notification of intention to start Cx
.13 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
.14 Identification of deferred Cx.
.15 Implementation of training plans.
.16 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Owner

.3 12 months in Cx schedule for verification of performance in all seasons and wear conditions.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

## 1.10 CX REPORTS

.1 Include completed and certified Installation Verification (IV) and Performance Verification (PV) form/ reports in properly formatted Cx Reports.

.2 Before reports are accepted, reported results to be subject to verification by DCC Representative.

.3 Installation Verification Forms:

.1 Installation Verification forms are used to provide field verification and documentation of proper installation of equipment and system prior to formal Startup.

.2 Forms will be developed by the Cx Team referencing the contract documents and manufacturer provided documentation provided during submittal.

.4 Performance Verification Forms:

.1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

.2 PV report forms include those developed by Contractor to record measured data and readings taken during functional testing and Performance Verification procedures.

.3 Performance Verification Forms shall be prepared and used by the Contractor for checks, running dynamic tests and adjustments carried out on equipment and systems.

.4 2 PV forms are used by the Contractor to ensure correct operation, efficiency and independent function and interactive function with other systems as intend by the project requirements.

.5 Prior to PV of integrated system, complete PV forms of related systems and obtain DCC Representative's approval.

.6 Controls Installation Contractor or controls manufacturer shall provide point to point checkout, sensor calibration and actuator test forms, and shall use where required or appropriate.

.7 Forms to include:

.1 System and equipment or component name(s), location and identification number

.2 Reference to system readiness checklist and start-up documentation

.3 Date of testing and list of participating parties

.4 Excerpt of the specification section describing the test requirements

.5 A copy of the specific sequence of operations or other specified parameters

being verified
.6 Points list
.7 Formulas used in any calculations

### 1.11 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate of Completion, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
- .1 Fine tuning of HVAC systems.
- .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.
- .3 Full-scale emergency evacuation exercises.

### 1.12 TESTS TO BE PERFORMED BY OWNER/USER

.1 None is anticipated on this project.

### 1.13 TRAINING PLANS

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

### 1.14 FINAL SETTINGS

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

### 1.15 PAYMENTS FOR CX

.1 Will be progressed as approved by the DCC Representative as work progresses.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

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

## 1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

## 1.3 INSTRUCTORS

.1 DCC Representative will provide:
- .1 Descriptions of systems.
- .2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
- .1 Start-Up, operation, shut-down of equipment, components and systems.
- .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
- .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:
- .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

## 1.4 TRAINING OBJECTIVES

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

## 1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:
- .1 "As-Built" Contract Documents.
- .2 Operating Manual.
- .3 Maintenance Manual.
- .4 Management Manual.
- .5 TAB and PV Reports.

.3 DCC Representative, General Contractor and Owner's representatives will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

.5 Supplement training materials:
- .1 Powerpoint Presentations
- .2 Multimedia presentations.
- .3 Manufacturer's training videos.
- .4 Equipment models.

**1.6 SCHEDULING**

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours.

.3 Training to be completed prior to acceptance of facility.

**1.7 RESPONSIBILITIES**

.1 Be responsible for:
- .1 Implementation of training activities,
- .2 Coordination among instructors,
- .3 Quality of training, training materials,

.2 DCC Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by DCC Representative.

**1.8 TRAINING CONTENT**

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Content includes:
- .1 Review of facility and occupancy profile.
- .2 Functional requirements.
- .3 System philosophy, limitations of systems and emergency procedures.
- .4 Review of system layout, equipment, components and controls.
- .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
- .7 Maintenance and servicing.
- .8 Trouble-shooting diagnosis.
- .9 Inter-Action among systems during integrated operation.
- .10 Review of O&M documentation.

.3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

**1.9 VIDEO-BASED TRAINING**

.1 Manufacturer's videotapes to be used as training tool with DCC Representative's review and written approval 1 month prior to commencement of scheduled training.

.2 On-Site training videos:

.1 Videotape training sessions for use during future training.
.2 To be performed after systems are fully commissioned.
.3 Organize into several short modules to permit incorporation of changes.

.3 Production methods to be high quality.

## PART 2 PRODUCTS

### 2.1 NOT USED

.1 Not Used.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not Used.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Supplementary documentation provided by the *Design Professional* as required by Section 5 of CAN/ULC S1001 for the *Integrated Testing Coordinator* to utilize when preparing the *Integrated Testing Plan (ITP.)*
- .2 Refer also to the latest issue of the construction drawings and specifications for this project.
- .3 Shop drawings for all life-safety and interconnected systems will be available to the *Integrated Testing Coordinator* once received from the associated subtrade and reviewed by the *Design Professional.*

.2 Qualifications of the *ITC/Firm:*
- .1 Shall be as required by Section 4 of the Standard
- .2 The *ITC* must be:
  - .1 A Professional Engineer licensed to practice in the Province of Ontario (P.Eng) or
  - .2 A ULC certified Integrated Testing Coordinator

.3 Scope:
- .1 Provide the required services as the *"Integrated Testing Coordinator"* as defined in The Standard.

## 1.2 INTEGRATED SYSTEMS APPLICABILITY

.1 Section Includes:
- .1 Further to Section 6 of the standard, this part defines which of the following defined systems are applicable to the S-1001 testing plan as integrated systems. The following definitions apply:
  - .1 APPLICABLE – Applicable to the S-1001 testing plan as the system is integrated with another life-safety system on the project.
  - .2 PRESENT – Present in the project but is part of a standalone system and is not integrated with a life-safety system. Verification data will be provided for reference only, by the *design professional.*
  - .3 NOT APPLICABLE – Not present in the project.
- .2 Refer to Section 6 and Annex A of the standard for recommended practices in testing the integration of the below systems

.2 Systems:

| | | |
|---|---|---|
| **.1** | **FIRE ALARM SYSTEM** | **APPLICABLE** |
| .2 | MASS NOTIFICATION SYSTEM | NOT APPLICABLE |
| .3 | ELEVATORS | NOT APPLICABLE |
| .4 | EMERGENCY GENERATORS AND POWER SUPPLY | NOT APPLICABLE |
| .5 | AV SYSTEMS | NOT APPLICABLE |
| .6 | LIGHTING CONTROL SYSTEMS | NOT APPLICABLE |
| .7 | NOTIFICATION SYSTEMS | NOT APPLICABLE |
| .8 | SPRINKLER SYSTEMS | NOT APPLICABLE |
| .9 | STANDPIPE SYSTEMS | NOT APPLICABLE |
| .10 | FIRE PUMPS | NOT APPLICABLE |
| .11 | WATER SUPPLY | NOT APPLICABLE |
| **.12** | WATER SUPPLY CONTROL VALVE | NOT APPLICABLE |
| .13 | FREEZE PROTECTION SYSTEMS | NOT APPLICABLE |

| | | |
|---|---|---|
| .14 | FIXED FIRE SUPPRESION SYSTEMS | NOT APPLICABLE |
| .15 | COOKING SUPPRESSION SYSTEMS | NOT APPLICABLE |
| .16 | HOLD-OPEN DEVICES | NOT APPLICABLE |
| .17 | ELECTROCMAGENTIC LOCKS | NOT APPLICABLE |
| .18 | **SMOKE CONTROL SYSTEMS** | **APPLICABLE** |
| .19 | HAZARDOUS PROTECTION | NOT APPLICABLE |
| .20 | MONITORING | NOT APPLICABLE |
| .21 | SMOKE ALARMS (STANDALONE) | NOT APPLICABLE |
| .22 | PRE-ACTION SYSTEMS | NOT APPLICABLE |
| .23 | ON SITE WATER STORAGE FOR FIRE FIGHTING | NOT APPLICABLE |

## PART 2 SUPPLEMENTAL TO THE DRAWINGS AND SPECIFICATIONS - INTEGRATED SYSTEM SEQUENCES

### 2.1 FIRE ALARM AND ANCILLARY SYSTEMS

The fire alarm system is existing, and a new smoke detector is being installed for HVAC Shut Down.

**HVAC/AHU OPERATION**

1. HVAC shut down to operate as follows based on a general FIRE ALARM condition:

a. If fire alarm is triggered by way of general area smoke detection, heat detectors, sprinkler zone flow switch, manual pull-station, all HVAC equipment to be shut down/turned off with hard wired relay interconnections.

2. AHU shut down operation to operate as follows based on a smoke detected locally by duct detectors at fire separations for HVAC equipment serving more than one fire compartment (AHU-4 and AHU-6).

a. If fire alarm is triggered by way of duct smoke detection, all AHU/MUA equipment to be shut down/turned off with hard wired relay interconnection and ALARM condition indicated at fire alarm panel.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED SECTIONS

.1 01 35 43 – Environmental Protection

.2 02 81 00 Hazardous Building Materials General Requirements

.3 02 82 00.3 Asbestos Abatement – Type 3 (Maximum Precautions)

.4 02 82 14 Mercury Packaging and Disposal

.5 02 82 17.2 Silica Operations -Type 2 (Intermediate Precautions)

.6 02 83 10 Lead – Type 1 Lead and LOPC Minimum Worker Precautions

.7 02 83 11 Lead – Type 2A Lead and LOPC Intermediate Worker Precautions

## 1.2 SUMMARY

.1 This Section includes the following:
- .1 Demolition and removal of selected portions of interior building components and finishes.
- .2 Repair procedures for selective demolition operations.

.2 This section does not include the following:
- .1 Removal of hazardous materials or asbestos abatement.
- .2 Demolition of exterior building components or structural elements.
- .3 Mechanical or electrical equipment, except as required to make minor modifications to allow the work to be completed.

.3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; Contractor is required to develop these details further by submitting a demolition plan prepared by a professional engineer employed by the Contractor.

## 1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)
- .1 ANSI A10.8 2011, Safety Requirements for Scaffolding

.2 ASTM International (ASTM)
- .1 ASTM C 475/C 475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

.3 CSA Group (CSA)
- .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures

.4 Department of Justice Canada (Jus)
- .1 Canadian Environmental Assessment Act (CEAA), 2012
- .2 Canadian Environmental Protection Act (CEPA), 2012
  - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations
  - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission

Regulations
.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34
.4 Motor Vehicle Safety Act (MVSA), 1995
.5 Hazardous Materials Information Review Act, 1985

.5 National Fire Protection Association (NFPA)
.1 NFPA 241 13, Standard for Safeguarding Construction, Alteration, and Demolition Operations

## 1.4 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Detach items from existing construction and deliver them to DCC Representative.

.3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

.5 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
.1 Draft Construction Waste Management Plan (Draft CWM Plan): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 00 – Cleaning & Waste Management and as follows:

.6 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.

.7 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 00 – Cleaning & Waste Management.

.8 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 00 – Cleaning & Waste Management.

.9 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

## 1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate with DCC Representative for the material ownership as follows:
.1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain DCC Representative property, demolished materials shall become Contractor's property and shall be removed from Project site.
.2 Coordinate selective demolition work so that work of this Section adheres to aesthetic criteria established by the Drawings and specified dimensions with all elements in planes as drawn, maintaining their relationships with all other building elements.

.3 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to DCC Representative that may be encountered during selective demolition remain DCC Representative's property:
.1 Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to DCC Representative.
.2 Coordinate with DCC Representative's historical adviser, who will establish special procedures for removal and salvage.

.2 Pre-Demolition Meeting: Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor and DCC Representative in accordance with Section 01 11 00 – General Instructions to:
.1 Confirm extent of salvaged and demolished materials
.2 Review Contractor's demolition plan.
.1 Verify existing site conditions adjacent to demolition work.
.2 Coordination with other construction sub trades

.3 Hold project meetings every bi-weekly.

.4 Ensure key personnel, site supervisor, project manager, subcontractor representatives and WMC attend.

.5 WMC must provide written report on status of waste diversion activity at each meeting.

.6 DCC Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

## 1.6 ACTION AND INFORMATION SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.2 Schedule of Selective Demolition Activities: Coordinate with Section 01 32 16.19 - Construction Progress Schedule - Critical Path Method (CPM) and Section 01 35 43 – Environmental Procedures and indicate the following:
.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
.2 Interruption of utility services.
.3 Coordination for shutoff, capping, and continuation of utility services.
.2 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.
.3 Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## 1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial and federal jurisdictions:
.1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification requirements and regulations of the Authority Having Jurisdiction.

.2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.

.2 Qualifications:

.1 Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project:
  .1 Conform to the provincial Occupational Health and Safety Act and Regulation.
  .2 Conform to Workers' Compensation Board Regulations.
  .3 Conform to City of local municipal bylaws and regulations governing this type of work.

### 1.8 SITE CONDITIONS

.1 DND Personnel will occupy portions of building immediately adjacent to selective demolition area:
  .1 Conduct selective demolition so that DND Personnel's operations will not be disrupted.
  .2 Provide not less than 72 hours notice to DCC Representative of activities that will affect DND Personnel's operations.

.2 Maintain access to existing means of egress, walkways, corridors, exits, and other adjacent occupied or used facilities:
  .1 Do not close or obstruct means of egress, walkways, corridors, exits, or other occupied or used facilities without written acceptance from authorities having jurisdiction.

.3 DCC Representative assumes no responsibility for condition of areas to be selectively demolished:
  .1 Conditions existing at time of Pre Bid Site Review will be maintained by DCC Representative as far as practical.

## PART 2 PRODUCTS

### 2.1 TEMPORARY SUPPORT STRUCTURES

.1 Design temporary support structures required for demolition work and underpinning and other foundation supports necessary for the project using a qualified professional engineer registered or licensed in province of the Work.

### 2.2 DESCRIPTION

.1 This section of the Work includes, but is not necessarily limited to, the following:
  .1 Demolition, removal completely from site, and disposal of all identified components, materials, equipment and debris
  .2 Selective demolition to allow new walls, bulkheads, ceilings and other materials to meet existing construction as indicated
  .3 All material from demolition shall be removed from site immediately with no salvage, selling, sorting or burning permitted on site
  .4 Retain items indicated on drawings for re use in new construction

### 2.3 DEBRIS

.1 Make all arrangements for transport and disposal of all demolished materials from the site.

### 2.4 EQUIPMENT

.1 Provide all equipment required for safe and proper demolition of the building interiors indicated.

### 2.5 REPAIR MATERIALS

.1 Use repair materials identical to existing materials:
  .1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials

that visually match existing adjacent surfaces to the fullest extent possible.
.2 Use a material whose installed performance equals or surpasses that of existing material.
.3 Comply with material and installation requirements specified in individual Specification Sections.

.2 Floor Patching and Levelling Compounds: Cement based, trowelable, self levelling compounds compatible with specified floor finishes; gypsum based products are not acceptable for work of this Section.

.3 Concrete Unit Masonry: Lightweight concrete masonry units, and mortar, cut and trimmed to fit existing opening to be filled. Provide standard hollow core units, square end units and bond beam units as indicated on drawings.

.4 Prefinished Sheet Steel: Prefinished sheet steel, colour to match existing radiant heating cabinets, bent and profiled to match existing radiation cabinets.

.5 Gypsum Board Patching Compounds: Joint compound to ASTM C 475/C 475M, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 21 16 - Gypsum Board Assemblies.

.6 Hoarding and Dust Screens: Refer to Section 01 56 00 - Temporary Barriers and Enclosures for stud framing and gypsum board sheathing materials.

## PART 3 EXECUTION

### 3.1 EXAMINATION

.1 Verify that utilities have been disconnected and capped.

.2 Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

.3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

.4 Notify the DCC Representative where existing mechanical, electrical, or structural elements conflict with intended function or design:
.1 Investigate and measure the nature and extent of conflict and submit a written report to DCC Representative.
.2 DCC Representative will issue additional instructions or revise drawings as required to correct conflict.

.5 Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES

.1 Coordinate existing services indicated to remain and protect them against damage during selective demolition operations.

.2 Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
.1 Arrange to shut off affected utilities with utility companies.
.2 If utility services are required to be removed, relocated, or abandoned, before proceeding with

selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.

.3 Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

.4 Cut off pipe or conduit to a minimum of 25 mm below slab, and remove concrete mound. [Patch concrete using cementitious grout].

.3 Coordinate with Mechanical and Electrical Divisions for shutting off, disconnecting, removing, and sealing or capping utilities.

.4 Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

## 3.3 PREPARATION

.1 Identify and mark all equipment and materials identified to be retained by DCC Representative or to be re used in subsequent construction. Separate and store items to be retained in an area away from area of demolition and protect from accidental disposal.

.2 Post warning signs on electrical lines and equipment that must remain energized to serve other areas during period of demolition.

.3 Confirm that all electrical and telephone service lines entering buildings are not disconnected.

.4 Do not disrupt active or energized utilities crossing the demolition site.

.5 Provide and maintain barricades, warning signs, protection for workmen and the public during the full extent of the Work. Read drawings carefully to ascertain extent of protection required.

.6 Mark all materials required to be re used, store in a safe place until ready for re installation.

.7 Adjust all junction boxes, receptacles, and switch boxes flush with new wall construction where additional layers to existing construction are indicated.

.8 Remove permanent marker lines used or found on exposed surfaces and at surfaces indicated for subsequent finish materials. Mechanically remove permanent marker lines and associated substrates where permanent marker lines occur and patch surface. Sealing or priming over permanent marker lines is not acceptable.

## 3.4 SELECTIVE DEMOLITION

.1 Demolish and dismantle work in a neat and orderly manner and in strict accordance with all regulations.

.2 At end of each day's work, leave Work in safe condition so that no part is in danger of toppling or falling.

.3 Demolish in a manner to minimize dusting and to prevent migration of dust.

.4 Selling or burning of materials on the site is not permitted.

.5 Remove concrete bases by cutting and chipping, take precautions against slab cracking and degradation. Grind edges smooth, fill and make level with self levelling grout.

.6 Fill all openings in concrete block walls with concrete masonry units, coursing to match existing,

prepare ready to receive new finishes to match existing.
.1 Provide bond beams in new openings cut into existing concrete masonry unit walls.
.2 Provide finished end masonry units to patch and repair for new jamb sections in existing concrete masonry unit walls.

.7 Fill all openings in gypsum board walls with gypsum board and steel framing to match existing, skim coat to make wall smooth and even.

.8 Demolish existing hardwood, resilient flooring and adhesive remnants as follows:
.1 Vacuum existing carpet thoroughly, prior to removal, using vacuum equipped with power head/sweeper.
.2 Demolish existing hardwood and resilient floor finishes, remove and dispose of off site.
.3 Remove adhesive to the greatest extent possible using scrapping tools and as follows:
.1 Do not use solvent based cleaners to remove adhesive remnants.
.2 Vacuum floor ready for application of skim coating.
.3 Repair all slab depressions and damage with cementitious patching compound.
.4 Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.
.4 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.
.5 Recycle materials in accordance with Section 01 74 00 – Cleaning & Waste Management.

.9 Demolish existing ceramic tile finishes. Remove setting bed or adhesive to the greatest extent possible using mechanical scrapping tools and as follows:
.1 Saw cut edge of tile for clean and even transition joint between existing tile to remain and new flooring materials.
.2 Lightly shot blast or grind floor to remove remnants of setting materials.
.3 Vacuum floor ready for application of skim coating
.4 Repair all slab depressions and damage with cementitious patching compound. Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.

.10 Remove all wall coverings scheduled for demolition. Patch and repair wall surfaces with skim coat of gypsum board joint compound leaving wall surfaces smooth and even ready for new wall finishes.

.11 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.

.12 Patch and repair all radiation cabinets, mechanical equipment and electrical fixtures damaged or exposed during demolition to match adjacent finished surfaces.

## 3.5 PATCHING AND REPAIRING

.1 Floors and Walls:
.1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.
.2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.
.3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
.4 Patch with durable seams that are as invisible as possible.
.5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.
.6 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.

.7 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

.2 Ceilings: patch, repair, or re hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

## 3.6 PROTECTION

.1 Prevent debris from blocking drainage inlets and systems and ground draining and protect material and electrical systems and services that must remain in operation.

.2 Arrange demolition and shoring work so that interference with the use of adjoining areas by the DCC Representative and users is minimized.

.3 Maintain safe access to and egress from occupied areas adjoining.

.4 Provide and maintain fire prevention equipment and alarms accessible during demolition.

## 3.7 CLEANING

.1 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 00 – Cleaning & Waste Management.

.2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning & Waste Management, and as follows:
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.3 Divert excess materials from landfill to site approved DCC Representative.

.4 Promptly as the Work progresses, and on completion, clean up and remove from the site all rubbish and surplus material. Remove rubbish resulting from demolition work daily.

.5 Maintain access to exits clean and free of obstruction during removal of debris.

.6 Keep surrounding and adjoining roads, lanes, sidewalks, municipal rights of way clean and free of dirt, soil or debris that may be a hazard to vehicles or persons.

.7 Transport material designated for alternate disposal using approved haulers, facilities, receiving organizations listed in CWM Plan and in accordance with applicable regulations.
.1 Written authorization from DCC Representative is required to deviate from haulers, facilities, receiving organizations listed in CWM Plan.

.8 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.
.1 Disposal facilities must be those approved of and listed in CWM Plan.
.2 Written authorization from DCC Representative is required to deviate from disposal facilities listed in CWM Plan.

**END OF SECTION**

# Part 1 General

## 1.1 SUMMARY

.1 This specification outlines the basic requirements for the handling and/or disposal of select hazardous building materials prior to renovation work of Building HR26 located at CFB Kingston, Ontario (the Site).

.2 Hazardous building materials covered by this specification include:

1. Asbestos-containing materials (ACMs)
2. Lead-containing paints
3. Mercury-containing materials
4. Silica-containing materials

.3 The Contractor is to abide by all Federal, Provincial and Municipal regulations and is to complete the work to the satisfaction of the DCC representative.

## 1.2 RELATED REQUIREMENTS

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

.2 Related work specified elsewhere:

.1 Section 01 35 43, Environmental Protection

.2 Section 02 82 00.3, Asbestos Abatement-Type 3 (Maximum Precautions).

.3 Section 02 83 10, Lead and Other Paint Coatings-Type 1 (Minimum Precautions).

.4 Section 02 83 11, Lead and Other Paint Coatings-Type 2A (Intermediate Precautions).

.5 Section 02 82 14, Mercury Packaging and Disposal.

.6 Section 02 82 17.2, Silica Operations -Type 2 (Intermediate Precautions).

## 1.3 REFERENCES

.1 WSP

.1 “Project-Specific Designated Substances and Hazardous Materials Assessment, Support of the Building HR26 HVAC Upgrades at CFB Kingston, Ontario, (Project KN229909_83063) WSP, June 17, 2025”.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205-94, Sealer for Application to Asbestos-Fibre-Releasing Materials.

.3 Canadian Standards Association (CSA International).

.4 Department of Justice Canada.

.1 Canadian Environmental Protection Act (CEPA), 1999.

.2 Transportation of Dangerous Goods Act.

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

.1 Safety Data Sheets (SDS).

.6 Transport Canada (TC)

.1 Transportation of Dangerous Goods Regulations.

.7 Human Resources and Special Development Canada (HRSDC).

.1 Canada Labour Code Part II, - R.S.C., 1985, c. L-2 - Occupational Health and Safety Regulations.

.8 Ontario Occupational Health and Safety Act (OHSA) and all applicable regulations.

.1 Ontario Regulation 278/05 (as amended) – “Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations” (O. Reg. 278/05).

.2 Ontario Regulation 490/09 (as amended) – “Designated Substance”

.3 Ontario Regulation 833/90 (as amended) – “Control of Exposure to Biological or Chemical Agents.”

.4 Ontario Ministry of Labour publication Guideline – Lead On Construction Projects (Issued September 2004, Updated April 2011).

.5 R.R.O. Regulation Mercury R.R.O. 1990, Regulation 844, Amended to O.Reg. 110/04, Designated Substance — Mercury

.6 Ontario Ministry of Labour publication Guideline – Silica Construction Projects (Issued September 2004, Updated April 2011).

.7 Ontario Environmental Protection Act (EPA),

.8 Ontario Regulation 347/90 (as amended) - General - Waste Management.

.9 The DAES Standard on Asbestos- Containing Material in Infrastructure, 2024

.10 National Research Council Canada Institute for Research in Construction (NRC-IRC).

.1 National Fire Code of Canada (2015).

.11 Underwriters' Laboratories of Canada (ULC).

.12 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 17-November-2016, NIOSH Manual of Analytical Methods (NMAM), 5th Edition.

## 1.4 DEFINITIONS

.1 Airlock: System for permitting ingress or egress without permitting air movement between contaminated areas and uncontaminated areas, typically consisting of two (2) curtained doorways spaced minimum of 2 m (6') apart.

.2 Amended Water: Water with a non-ionic wetting agent added to reduce water tension to allow wetting of fibres.

.3 Asbestos-Containing Material (ACM): Materials identified under Site Conditions including fallen materials and settled dust which contain 0.5% or more asbestos by dry weight.

.4 Asbestos or Hazardous Building Materials Contaminated Waste: Materials identified under Site Conditions that have been removed as specified including fallen materials, debris, rubble, and settled dust, and materials and/or equipment deemed to be contaminated under this specification and/or by DCC or their representative.

.5 Asbestos or Hazardous Building Materials Work Area(s): Area(s) where work takes place which will or may disturb asbestos-containing material or other hazardous building materials, including fallen material or settled dust that may contain asbestos.

.6 Authorized Visitor(s): DCC or their representative or person(s) representing regulatory agencies, and person(s) authorized by them.

.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 applicable laws and with the provisions of the regulation that apply to the work.

.3 Has knowledge of all potential or actual danger to health and safety in the work.

.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: A testing method used to determine the integrity of the negative pressure unit using dioctyl phthalate (DOP) HEPA filter leak test.

.10 Fitting: Individual segments of a mechanical service line which may include hangers, tees, elbows, joints, valves, unions, etc.

.11 Friable Material: Material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

.12 Glovebag: Prefabricated polyvinylchloride Glovebag with a minimal thickness of 0.25 mm with integral gloves and valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure, equipped with a reversible double pull throw zipper on top, securing straps and an internal closure strip if intended to be used at multiple locations.

.13 Ground Fault Panel: Portable electrical panel equipped with ground fault circuit interrupters (5 mA protection) of sufficient capacity to power all electrical equipment and lights in asbestos work enclosure. Panel complete with ground fault interrupter lights, test switch to ensure unit is working, and reset switch. The panel is to be installed by licensed technician and meet applicable CSA standards.

.14 Hazardous Building Material: Materials identified under Site Conditions including fallen materials and settled dust.

.15 HEPA Filter: High Efficiency Particulate Aerosol filter at least 99.97 percent efficient in collecting 0.3 micrometer aerosol.

.16 HEPA Vacuum: HEPA filtered vacuum with all necessary fittings, tools and attachments. Air must pass HEPA filter before discharge.

.17 Knife: Knife with fully retractable blade for use inside glove bag.

.18 Negative Pressure: Reduced pressure within specified work area(s) established by extracting air directly from work area and discharging directly to exterior of building. Discharged air first passes through HEPA filter. Extract sufficient air to ensure constant reduced pressure at perimeter of work area with respect to surrounding areas. Air volume extracted should be sufficient to provide four (4) air changes per hour and maintain a reduced pressure of 5 Pascals (0.02 inches water column) within the work area in relation to the surrounding areas.

.1 Negative pressure system shall be equipped with an instrument to continuously monitor and automatically record pressure differences.

.19 Negative Air Unit: Portable air handling system, which extracts air directly from asbestos work area and discharges air outside building. The unit shall be fitted with pre-filter and HEPA final filter. Air shall pass HEPA filter before discharge. Unit shall have pressure differential gauge to monitor filter loading. The unit shall have a warning system for HEPA filter failure. HEPA filters shall have separate hold down clamps to retain filter in place.

.20 Non-Friable Materials: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.21 Occupied Area: Any area of the site building or work site that is outside the work area.

.22 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 areas.

.23 Securing Straps: For glove bag, reusable nylon straps at least 25 mm (1") wide with metal tightening buckle for sealing ends of bags around pipe and/or insulation.

.24 Sprayer: Garden reservoir type portable manual sprayer or airless spray equipment capable of producing mist or fine spray. It must be of appropriate capacity for scope of work.

## 1.5 SUBMITTALS

.1 The Contractor shall ensure that the following has been submitted to DCC or their representative at least seven (7) calendar days prior to commencing work:

.1 Obtain from appropriate agency and submit to the DCC representative necessary permits for transportation and disposal of designated substances or hazardous material waste. Ensure that the waste receiver/dump operator is fully aware of hazardous nature of material being accepted/dumped, and proper methods of disposal. Submit proof satisfactory to the DCC representative that suitable arrangements have been made to receive and properly dispose of asbestos and hazardous building materials waste.

.2 Satisfactory proof that every worker has had instruction and training in the hazards of asbestos and other hazardous building materials (as appropriate), in personal hygiene and work practices, and in the use, cleaning, and disposal of respirators and protective clothing.

.3 Submit to the DCC representative the names of supervisory personnel who will be responsible for the specified work area.

.4 For Type 3 asbestos abatement operations, submit proof in the form of a certificate of completion that supervisory personnel have been certified as supervisors under the Asbestos Abatement Worker and Supervisor Training Program approved by the Ministry of Training, Colleges and Universities (MTCU), as outlined in Section 20 of O. Reg. 278/05. Supervisors are to have performed supervisory function on other projects of similar nature. One supervisor must remain on site of the asbestos work at all times while removal or clean-up is occurring.

.5 For Type 3 asbestos abatement, provide proof that notification of asbestos work has been submitted to the Ontario Ministry of Labour.

.6 Submit proof satisfactory to the DCC representative that employees have respirator fitting and testing. Workers must be fit tested with respirator that is personally issued.

.7 Documentation for materials used in the course of the project including MSDS sheets or other data documenting compliance with specifications for such materials as, but not limited to sealants, encapsulates, wetting agents, and polyethylene sheeting.

.8 Submit an Abatement Plan indicating the locations and layout of proposed isolation enclosures and decontamination facilities to the DCC representative for review. The plan is also to include schedule/phasing of work stages, clearance testing protocols and reporting, materials to be abated/disturbed in compliance with all regulations, and in reference to related Sections. The plan must be reviewed and approved by DCC Representative prior to commencement of abatement activities.

.9 Submit a proposed schedule showing phasing and proposed workforce related to each work area enclosure or repair operation to the DCC representative.

.10 Negative air unit performance data and results of DOP test as required.

.11 Recording manometer calibration data as required.

.12 Provide a written emergency access/egress plan for the work area for acceptance by the DCC representative.

.13 Provide a written visitor entrance procedure, including the provision of necessary PPE (including appropriate fit testing for respirators if required) for the work area for acceptance by the DCC representative.

.14 If requested, submit copies of Contractor's authorized representative's work site health and safety inspection reports to the DCC representative on a weekly basis.

.15 Copies of any reports or directions issued by Federal and Provincial health and safety inspectors.

.16 Copies of incident and accident reports.

.17 Manifests, waybills, bills of ladings etc. as applicable for each type of waste on completion of the work or as requested by the DCC representative.

.18 Submit to the DCC representative a list and photos of existing damage to building materials located in the work area for acceptance.

## 1.6 EXISTING CONDITIONS

.1 Reports and information pertaining to hazardous building materials to be handled, removed, or otherwise disturbed and disposed of during this project are provided in this specification.

.2 This section identifies the known conditions at the site with respect to select hazardous building materials. This information is provided for reference purposes only and each contractor must confirm existing conditions within the work area(s) as a part of this contract.

.3 The presence and/or suspect presence of Asbestos-Containing Materials (ACMs), Lead-Containing Materials (LCMs), and Mercury-Containing Materials (MCMs) have been identified at the site. Identified materials which have specified disposal and/or handling requirements include:

.1 Exterior soffit panels above classroom windows. To be removed under Type 1/Low Risk precautions as per O. Reg. 278/05. Refer to Section 02 82 00.1, Asbestos Abatement-Type 1 (Minimum Precautions). This material is not expected to be disturbed during the upcoming project.

.2 Interior caulking on classroom windows of building old section. To be removed under Type 1/Low Risk precautions as per O. Reg. 278/05. Refer to Section 02 82 00.1, Asbestos Abatement-Type 1 (Minimum Precautions). This material is not expected to be disturbed during the upcoming project.

.3 Suspected pipe straight and pipe elbow insulation as well as debris in the ground floor washroom pipe chase. To be removed under Type 3/ High-risk precautions as per O. Reg. 278/05.

.4 Grey window glazing on interior stairwell windows. To be removed under Type 1/Low Risk precautions as per O. Reg. 278/05. Refer to Section 02 82 00.1, Asbestos Abatement-Type 1 (Minimum Precautions). This material is not expected to be disturbed during the upcoming project.

.5 12” x 12” beige vinyl floor tiles with grey streaks on gymnasium stage entrance. To be removed under Type 1/Low Risk precautions as per O. Reg. 278/05. Refer to Section 02 82 00.1, Asbestos Abatement-Type 1 (Minimum Precautions). This material is not expected to be disturbed during the upcoming project.

.6 Grey transite panels with holes, observed on the exterior south entrance awning. To be removed under Type 1/Low Risk precautions as per O. Reg. 278/05. Refer to Section 02 82 00.1, Asbestos Abatement-Type 1 (Minimum Precautions). This material is not expected to be disturbed during the upcoming project.

.7 Suspected asbestos-containing transite stormwater drainpipes observed in gymnasium rooms 122 and 127. To be removed under Type 1/Low Risk precautions as per O. Reg. 278/05. Refer to Section 02 82 00.1, Asbestos Abatement-Type 1 (Minimum Precautions). This material is not expected to be disturbed during the upcoming project.

.8 Paints with concentrations of lead, arsenic, mercury, chromium and PCBs above the laboratories limit of detection are present throughout the site building. Paints with concentrations of lead that require special handling procedures are present throughout the subject building. If paints are to be disturbed during the renovations it must be done under minimum Type 1 or Type 2A Lead and Other Paint Coatings precautions, Refer to Section 02 83 10 Lead and Other Paint Coatings-Type 1 (Minimum Precautions) and Section 02 83 11 Lead and Other Paint Coatings-Type 2A (Intermediate Precautions).

.9 Drywall, mortar, concrete and other masonry and aggregate products are all assumed to be Silica Containing Materials and are present throughout the site building. If silica is to be disturbed during the renovations it must be done under minimum Type 2 silica precautions, Refer to Section 02 82 17.2, Silica Operations -Type 2 (Intermediate Precautions).

.10 Fluorescent light tubes and bulbs were observed throughout the interior of the building and are presumed to contain mercury vapour, additionally, at least 8 mercury-containing thermostats were observed within the subject building. If mercury containing materials are to be disturbed during the renovations it must be done accordance with current applicable environmental and occupational health regulations and codes, Refer to Section 02 82 14, Mercury Packaging and Disposal.

.4 Examine local conditions affecting work under this contract. No allowance will be made for necessary changes, unless notification of interference has been brought to the attention of DCC or their representative, in writing.

.5 All materials which may contain hazardous building materials indicated in this specification shall be considered hazardous building materials unless proven otherwise by laboratory analysis or other means approved by the DCC representative.

.6 Where a material is encountered by Contractors that is suspected of containing asbestos not identified in this Section or other hazardous substances, the Contractor is to immediately stop work in the area and notify the DCC representative. Do not resume work in the area until further follow-up has been completed and authorization granted by the DCC representative.

1.7 OUTLINE OF WORK

.1 Refer to other Sections of this specification for a specific outline and quantities of work.

.2 Procedures in addressing hazardous building materials known to be present within the building are identified in this section. Hidden or unidentified materials are present and shall be removed in accordance with the procedures stated for similar materials subject to the approval of the DCC representative.

.3 Where unknown or suspect hazardous building materials are encountered that cannot be handled in accordance with the procedures below, all work that will or may disturb such materials shall cease immediately with the area cordoned off. The DCC representative shall provide direction.

.4 Paint coatings containing chromium, lead, mercury, or arsenic exceeding leachable waste regulations were encountered in the Site building and as such, all paint coatings tested must be disposed of as hazardous waste.

.5 No hidden hazardous materials were identified during investigations. The Contractor shall open all hidden spaces within the area of work to confirm no hazardous building materials are present. If hazardous building materials are present that have not been previously identified, they shall be removed in accordance with this specification.

.6 The Contractor shall isolate any exterior work areas by means of fencing, hoarding or other measures approved by the DCC representative to restrict access to the area and minimize potential public safety issues.

.7 All work shall be completed in phases and in building areas that are vacant.

.8 The Contractor shall refer to the referenced hazardous materials report(s) for further information and precautions. In the event a discrepancy between the specifications and the report occurs, these shall be identified to the DCC representative and further direction received.

.9 Do not remove any materials not specifically identified by the DCC representative. Any removal of unauthorized materials shall be at the cost of the Contractor including the cost of repairs or re-insulation subject to the satisfaction of the DCC representative.

.10 Supply all labour, material, and equipment necessary to safely execute and complete all work specified, required, or implied under Section 02 81 00.

.11 Prepare and isolate the specified work area(s) from adjoining occupied and unoccupied areas.

.12 Shut down and/or isolate any air-moving equipment that could contribute to the dispersal of contaminants, including asbestos, from the work area.

.13 Under no circumstances shall existing service or utility lines be disconnected, shut off, or otherwise removed from service without prior consent of the DCC representative.

.14 Construct worker and waste decontamination facilities at the perimeter of the work area as further specified.

.15 As required, allow for access to security and other alarm panels at all times.

.16 Securing the work site is the responsibility of the Contractor. Any damage to the work site or unauthorized access during or after normal working hours resulting from contractor negligence will be the responsibility of the Contractor to make right.

.17 After preparation and approval of the work areas and decontamination facilities, remove and dispose of all required materials.

.18 The Contractor will be responsible for the general upkeep of the site. Workers and trades will use designated washrooms provided by the Contractor only. Designated washrooms must be kept clean at all times. All other facilities will be off limits.

.19 All work will be subject to inspection inside and outside work area by the DCC representative as further specified in the sections listed in 4.1.

.20 All containment structures, such as hoardings, platforms, etc., that are used to segregate the work area are to remain in place until directed by the DCC representative.

.21 When directed by the DCC representative, decommission the work area and decontamination facilities.

.22 Exercise care and caution in operations relative to the site. Any unnecessary destruction or damage to the site will not be permitted.

.23 All hazardous building materials removed shall be transported and disposed as further specified in the sections listed in Part 3.0 of this Section.

## 1.8 SITE EXAMINATION

.1 Prior to commencing actual work, check field conditions, obtain and confirm actual site dimensions, examine surface conditions, site restrictions, etc., as required, to ensure correct execution of work. Notify the DCC representative in writing of all matters which could prejudice proper execution of work.

.2 Determination and confirmation of quantities, location, and nature of asbestos and other regulated work activities including, but not limited to, considerations for transportation, disposal, handling and storage of materials, availability of labor, worker and visitor protection, water, electric power, roads, uncertainties of weather or physical conditions at the site, is the responsibility of the Contractor - quantities listed herein are estimates only.

.3 Commencement of construction or any part thereof constitutes acceptance of existing conditions and means all dimensions, and the scope of work has been considered, verified and is acceptable.

1.9 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at the time that work is performed.

.2 Ensure work proceeds to schedule and meets all requirements of this section.

.3 Perform work so airborne contaminants or wastewater run-off does not contaminate areas outside specified work areas.

.4 Any contamination of surrounding areas, indicated by visual inspection or air monitoring, shall necessitate the enclosure of these areas and complete cleanup of affected areas in same manner as that applicable to work areas, at no cost to The Crown. The DCC representative shall be notified as soon as possible following such an occurrence and informed of the measures being implemented to correct the situation.

.5 Pay cost to DCC of inspection and air monitoring performed as result of failure to perform work satisfactorily.

.6 Protect and maintain work until work has been completed and accepted. Protect work against damage during installation. Repair all damage to existing facilities at no expense to The Crown.

.7 Coordinate work with other sections to avoid conflict and ensure proper installation of all materials.

.8 On completion of work, remove all tools, surplus and waste material and leave work in a clean condition.

.9 Use only skilled and qualified workers for all trades required for this work.

1.10 SCHEDULING

.1 Work is to be carried out during agreed-upon hours with the DCC representative. It is expected that normal working hours will be maintained.

.2 The Contractor is to assume that all work is to be performed when the area is unoccupied as determined by the DCC representative. Removal of hazardous building materials must not delay the performance of other trades.

.3 Prior to any on-site activities, the Contractor shall submit a proposed schedule showing phasing and proposed workforce related to each work area enclosure or repair operation.

.4 Modifications to the project schedule would only be granted on approval of the DCC representative.

1.11 REGULATIONS

.1 Comply with the most stringent requirements of Federal and Provincial Building Codes.

.2 Provide necessary notices, obtain permits and pay all fees, in order that specified work may be carried out. Charges and alterations required by authorized inspectors of any authority having jurisdiction, to be carried out at no additional cost to the Crown.

.3 Ontario Occupational Health and Safety Act (OHSA) and all applicable regulations.

.1 Ontario Regulation 278/05 (as amended) “Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations” (O. Reg. 278/05).

.2 Ontario Regulation 490/09 (as amended) – “Designated Substances” (O. Reg. 490/90).

.3 R.R.O. Regulation Mercury R.R.O. 1990, Regulation 844, Amended to O.Reg. 110/04, Designated Substance — Mercury.

.4 Ontario Regulation 833/90 (as amended) – “Control of Exposure to Biological or Chemical Agents” (O. Reg. 833/90).

.4 Canada Labour Code, Part II, Occupational Health and Safety Regulations (CLC OHSR).

.5 Employment and Social Development Canada Technical Guidelines to Asbestos Management Programs (January 2018)

.6 Ontario Environmental Protection Act (EPA),

.1 Ontario Regulation 347/90 (as amended) – “General - Waste Management” (O. Reg. 347/90).

.2 Ontario Regulation 362/90 (as amended) – “Waste Management – PCBs” (O. Reg. 362/90).

.7 Provincial Guidelines or Safe Work Bulletins associated with the Ontario OHSA.

.8 The DAES Standard on Asbestos-Containing Material in Infrastructure, 2024

.9 The Contractor shall ensure that:

.1 Measures and procedures prescribed under the OHSA and regulations are carried out.

.2 Every employee and every worker under their control complies with applicable Acts and Regulations.

.3 Health and Safety of workers and public are protected.

.4 All handling of material and associated equipment is performed in accordance with the Workplace Hazardous Materials Information System (WHMIS).

.5 Policies and procedures of Defence Construction Canada (DCC), Department of National Defence (DND) or representatives are complied with, including site specific safety, health and environment requirements.

.6 Contact all regulatory agencies as required before commencing work.

.7 Notify sanitary landfill or waste disposal site as per Municipal and Provincial requirements.

.10 Laws of the Province of Ontario shall govern this work. The Contractor shall observe all such laws and shall obtain and/or pay all permits, notices, fees, taxes, duties as may be required. Likewise, it is the responsibility of the contractor to comply with Worker’s Compensation and Workplace Safety and Health Acts.

.11 If no regulations exist, follow guidelines most widely accepted by recognized professional organizations such as occupational hygienists, health professionals or environmental engineers as listed in References.

1.12 SUPERVISION

.1 A minimum of one (1) supervisor is required for every ten (10) workers unless otherwise approved by the DCC representative.

.2 An approved supervisor must remain within the designated work area at all times during the disturbance, removal, or other handling of designated substances.

.3 Site supervision must only be replaced by approved replacement on approval by the DCC representative. The DCC representative reserves the right to request the replacement of the supervisor without explanation.

1.13 PERSONAL TRAINING

.1 Comply with applicable training identified under Submittals.

.2 Before beginning work, provide to the DCC representative 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.

.3 Instruction and training related to respirators in accordance with CSA Standard Z94.4-11 (R2016) - Selection, use, and care of respirators including, but not limited to:

.1 Proper fitting of equipment including qualitative or quantitative fit testing

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.4 Instruction and training must be provided by competent, qualified person.

Part 2 Products

2.1 MATERIALS

.1 Materials and equipment specified, and acceptable manufactures are named in this specification for the purposes of establishing the standard of materials and workmanship to which the Contractor shall adhere. Tender price shall be based on the use of materials and equipment as specified.

.2 Encapsulant: Type 2 surface film forming or Type 1 penetrating type Class A water-based conforming to CAN/CGSB-1.205and approved by the Fire Commissioner of Canada. Encapsulant used to meet requirements for fire resistance, flame spread, or acoustic characteristics as required. Accepted material and approved manufactures include Bakor, Childers and Fosters.

.3 Flexible ducting: Metal reinforced flexible ductwork, 300 mm (12") diameter minimum.

.4 Polyethylene Sheeting: 0.15 mm (6 mil) minimum thickness unless otherwise specified. Sheet size shall be such to minimize joints.

.5 Protective Coveralls: Disposable full body coveralls complete with elasticized hoods made of spun polyolefin material or non-woven material and must be rated for asbestos and lead abatement applications by the manufacturer.

.6 Rip-Proof Polyethylene: 0.15 mm (6 mil) woven fibre reinforced fabric bonded both sides with polyethylene. Sheet size shall be such to minimize joints.

.7 Sealer (Lock down agent): Sealer for purpose of trapping residual fibre debris. Products must have flame spread and smoke development ratings both less than 25. Product shall leave no stain when dry and remains tacky on surfaces for minimum 8 hours. For mechanical equipment, pipes, boilers, etc. use high temperature sealers only.

.8 Tape: Fibreglass-reinforced plastic duct tape suitable for sealing polyethylene to surface encountered under both wet conditions using amended water, and dry conditions.

.9 Waste Containers: contain waste in two separate containers unless otherwise specified.

.1 Inner container: 0.15 mm (6 mil) thick sealable polyethylene bag or where glove bag method is used, 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 (6 mil) thick sealable polyethylene bag.

.3 Containers must be acceptable to disposal site selected and the Ministry of Environment. Other containers may be acceptable as approved by DCC or their representative.

.4 Labelling requirements: affix preprinted cautionary waste warning that is visible when ready for removal to disposal site. Label in both official

languages if required.

.5 Labelling shall be as per the following:

CAUTION CONTAINS [ASBESTOS FIBRES or WASTE NAME] (25 mm high)
Do Not Mishandle (19 mm high).

.10 Wetting Agent (Amended Water): Water with sufficient non-ionic surfactant (50% polyoxyethylene ester and 50% polyoxyethylene ether) or equivalent wetting agent to reduce water surface tension to increase penetration and wetting of fibres.

## Part 3 Waste Management and Disposal

### 3.1 GENERAL REQUIREMENTS AND PROCEDURES

.1 Separate waste materials for recycling as required.

.2 If required, arrange with DCC or their representative to conduct additional leachate sampling and analysis on building materials with paint coatings potentially considered as leachable waste. Further testing of the building component (i.e., coating with gypsum board substrate) may determine that the building component is not leachable waste. Refer to Section 01 35 43, Environmental Protection Specification for leachate requirements.

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Provincial and Municipal regulations.

.5 Check with local landfill operator or waste disposal site to determine type of waste containers are acceptable.

.6 Ensure shipment of containers to landfill or waste disposal site is by a waste hauler licensed by the Province of Ontario to transport the specified waste materials.

.7 Transportation of all waste and materials through occupied areas shall be covered and must never be left unattended. Clean-up waste route and loading area after each load as necessary. Use appropriate worker protection as required.

.8 All waste containing designated substances removed as part of this specification must be removed from the work area at the end of each work shift unless approved by the DCC representative.

.9 Each load requires completion of bill of lading showing type and weight of hazardous waste being transported. Provide proof (copies of all waste manifests or other approved documentation) of proper disposal to the DCC representative on a weekly basis (at a minimum) and on completion of the project.

.10 Cooperate with Provincial or Federal inspectors and immediately carry out instructions for remedial work at landfill or waste disposal sites to maintain the environment, at no additional cost to the DCC representative.

.11 Ensure landfill or waste facility operator is fully aware of substances being disposed of.

.12 Reference for any additional disposal requirements stipulated under 01 35 43provided by DCC for details on the required Hazardous Materials Abatement and Management Plan (HMAMP), Waste Management and Disposal Plan (WMDP) and Spill Prevention Response Plan (SPRP).

.13 Ensure that containers used for disposal are locked and covered at all times.

## Part 4 Inspection and Air Monitoring

### 4.1 GENERAL INSPECTION

.1 The following general inspection specifications shall be followed for all abatement activities, to be arranged by the DCC representative in conjunction with the Contractor.

.2 From commencement of work until completion of clean-up operations, the DCC representative is empowered to inspect for compliance with the requirements of the governing authorities, adherence to specifications and to inspect for cleanliness and completion both inside and outside asbestos and other work areas.

.3 The DCC representative is empowered to shut down all work activities when leakage of asbestos or other hazardous building materials from the work area has occurred or is likely to occur.

.4 The Contractor is to allow inspection by the DCC representative and provide full access to the work area. The Contractor shall make good on any work disturbed by the inspection at no cost to The Crown.

.5 If the designated work area(s) or adjacent areas are found unacceptable in accordance with standards specified or required by authorities having jurisdiction, correct such deficiencies at no cost to The Crown.

.6 The Contractor is to pay cost to provide re-inspection of work found not to be in accordance with these specifications and requirements of authorities having jurisdiction.

.7 The Contractor is to provide a minimum of 48 hours written notice to the DCC representative of any request for scheduling milestone inspections or transportation of waste through an occupied area.

.8 Do not proceed with the next phase of work until written approval of each inspection is received from the DCC representative.

### 4.2 GENERAL AIR MONITORING

.1 If air sampling is conducted general air sampling specifications shall be followed for all projects by DCC and the third-party consultant.

.2 Air sampling may include occupational and area samples including those areas within and immediately adjacent to each work area. Results obtained from all test monitoring shall be posted at the work site and provided to the DCC representative, Project Coordinator, applicable Health & Safety Officer and the Contractor.

.3 All air samples will be collected and analysed in accordance with Provincial and Federal Regulations and Guidelines.

.4 If air monitoring or visual inspection indicates that areas outside the current work area enclosures are contaminated above the designated action level of one half the Provincial Occupational Exposure Limit, clean these areas in the same manner as that applicable to asbestos work areas, at no cost to The Crown.

.5 If air monitoring in work areas shows that removal procedures are not sufficient to maintain airborne levels of specified substances below that are appropriate for the level of personal protective equipment employed by the Contractor, all work is to stop within the work area and removal procedures reassessed.

## Part 5 Execution

### 5.1 PROCEDURES

.1 Conform to sections listed in part 1.2.2 for specific abatement procedures.

END OF SECTION

# Part 1 General

## 1.1 SUMMARY

.1 Comply with requirements of this Section when performing following work as specified in Section 02 81 00 – Hazardous Building Material – General Requirements:

.1 Generally, Type 3 or high-risk asbestos abatement specifications shall apply to activities that pose a high risk of exposure to airborne asbestos and a corresponding higher risk of health effects if handled improperly.

.2 Removal or disturbing, as specified of more than one square metre of friable asbestos-containing material during the alteration or renovation of a building.

.3 Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material using non-HEPA filtered power tools during the alteration or renovation of a building.

## 1.2 RELATED REQUIREMENTS

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

.2 Related work specified elsewhere:

.1 Section 02 81 00 – Hazardous Building Material – General Requirements.

## 1.3 REFERENCES

.1 Refer to Section 02 81 00 – Hazardous Building Material – General Requirements.

## 1.4 DEFINITIONS

.1 Refer to Section 02 81 00 – Hazardous Building Material – General Requirements.

## 1.5 SUBMITTALS

.1 Submittals in accordance with Division 1, as applicable.

.2 Comply with submittals in accordance with Section 02 81 00 – Hazardous Building Material – General Requirements.

## 1.6 QUALITY ASSURANCE

.1 Comply with Section 02 81 00 – Hazardous Building Material – General Requirements.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Comply with Section 02 81 00 – Hazardous Building Material – General Requirements.

1.8 EXISTING CONDITIONS

.1 Refer to Section 02 81 00 – Hazardous Building Material – General Requirements.

.2 Results of bulk samples of asbestos-containing materials to be handled, removed, or otherwise disturbed and disposed of during this work are bound into this specification. The results are for general information only and are not necessarily representative of all asbestos-containing material in the work area.

.3 Notify the DCC representative of previously unidentified suspect asbestos-containing material discovered during work and not apparent from drawings, specifications, or report pertaining to the work. Do not disturb such material until instructed by the DCC representative.

.4 The presence of Asbestos-Containing Materials, and their estimated quantities, that require removal under Type 3/Maximum Risk precautions as per O. Reg. 278/05 that have been identified behind walls in the ground floor washroom pipe chases are listed below.

.1 Suspected pipe straight and pipe elbow insulation as well as debris in the ground floor washroom pipe chase (approximately 12$m^2$). To be removed under Type 3/ High-risk precautions as per O. Reg. 278/05.

1.9 SCHEDULING

.1 Conform to Section 02 81 00 – Hazardous Building Material – General Requirements.

1.10 PERSONNEL TRAINING

.1 Conform to Section 02 81 00 – Hazardous Building Material – General Requirements.

1.11 WORKER AND VISITOR PROTECTION

.1 Instructions: Before entering asbestos work area(s), instruct workers and visitors in use of respirators (including qualitative or quantitative fit testing) in accordance with CSA Standard Z94.4-11 (R2016) - Selection, use, and care of respirators, entry and exit from enclosures and all aspects of work procedures and protective measures including appropriate asbestos awareness and/or abatement training. A competent person, as defined by Ontario Occupational Health and Safety Act (OHSA), shall provide instruction.

.2 Respirators: Provide appropriate respiratory equipment for all persons entering asbestos work area enclosure including authorized visitors. The required respirator must meet the minimum requirements identified in Table 2 Respirators under Ontario Regulation 278/05. The following shall apply to the use of respirators for asbestos work:

.1 During wet removal and clean-up in enclosed asbestos work area workers, supervisors, and authorized visitors shall wear, as a minimum, powered air-purifying full-face respirator (PAPR) with P-100 filter cartridges in accordance with NIOSH Part 84 requirements. Use of other types of respiratory protection can only be used on written approval by DCC or their representative.

.2 Filters shall be replaced daily or tested according to manufacturer's specifications and replaced as necessary. All waste filters shall be disposed as asbestos waste.

.3 Respirators shall be acceptable to the Ontario Ministry of Labour.

.4 Provide instruction to workers and visitors in use of respirators including qualitative or quantitative fit testing.

.5 A worker will not 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.

.6 The employer is to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures is to be provided to and reviewed with each worker who is required to wear a respirator.

.7 No supervisor, worker or authorized visitor shall have facial hair which may affect the seal between the respirator and face.

.8 Maintain respiratory protection equipment in a proper functioning and clean condition. The respirator is to be cleaned, disinfected and inspected after use on each shift, or more often if necessary. The respirator is 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.

.3 Protective Clothing: Provide workers and visitors in full-enclosure asbestos work area with:

.1 New disposable type protective coveralls that do not readily retain or permit penetration of asbestos fibres. Coveralls are to be provided by the employer and worn by every worker who enters the work area. Coveralls are to consist of a head covering and full body covering that fit snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing.

.2 Once coveralls are worn in the asbestos work area, treat and dispose as asbestos contaminated waste.

.3 Workers and visitors shall also wear other protective apparel not discussed in this specification but required by Ontario OHSA.

.4 Footwear shall be of a suitable type that will prevent fibre penetration and able to be wet wiped.

.4 At no time shall the Abatement Contractor use existing furnishings or mechanical equipment (including piping) to support personal.

.5 Before entering full-enclosure asbestos work area(s), remove street clothes in clean change room and don appropriate respirator with new or tested filters, new disposable coveralls and head covers before entering equipment and access areas or asbestos work areas. Store street clothes, uncontaminated footwear, towels etc. in clean change room.

.6 Persons leaving full-enclosure asbestos work area(s) shall:

.1 Remove gross contamination from clothing before leaving asbestos work area using wet wiping and/or HEPA (high efficiency particulate air) vacuuming.

.2 Proceed to equipment and access room and remove all clothing except respirator. Place contaminated work suit in receptacles for disposal with other asbestos contaminated materials. Footwear, clothing, hardhats, protective eyewear, etc., shall be left in equipment and access room to dry for later use.

.3 Still wearing appropriate respirator, proceed naked to showers.

.4 Clean respirator to ensure that visible contamination is removed. After having thoroughly washed hair and body with shampoo and soap, remove respirator. Remove filters and dispose as asbestos waste in container provided for this purpose or test filters according to manufacturer's recommendation. Dispose filters as necessary. Wet clean inside of respirator.

.5 Upon completion of asbestos abatement, dispose footwear as contaminated waste or clean before removing from equipment and access room, or carry in sealed plastic bag to next site.

.6 Following showering, proceed to clean room, dry off and dress in street clothes. Store respirators in such a fashion to allow them to be put on prior to entering asbestos work area at start of next shift without contaminating clean area. If re-entry to asbestos work area is to take place, follow procedures in Para. 1.11.5.

.7 Removal of waste and equipment shall be completed through the waste decontamination enclosure system. No worker shall use this system as means to leave or enter asbestos work area.

.8 Do not eat, drink, smoke or chew gum or tobacco in enclosures.

.9 Workers and visitors shall be protected at all times when a possibility of asbestos disturbance exists.

.10 A copy of the procedures described under Worker and Visitor Protection shall be posted at access points to the asbestos work area. Procedures shall be in both official languages (if required).

.11 Maintain one emergency access kit equipped with a respirator, protective clothing, etc. and post emergency access procedures at the decontamination chamber access point to the asbestos work area for use by DCC or their representative or authorized visitors. The emergency access respirator shall be a PAPR (powered air purifying respirator) Full Face Respirator during hours of active asbestos abatement work and, at a minimum, a half face respirator with minimum P100 filter cartridges after shift-end when active abatement in not being conducted.

.12 Visitor Protection:

.1 Provide protective clothing and approved respirators, including qualitative or quantitative fit testing to Authorized Visitors to enter 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.

## Part 2 Products

### 2.1 MATERIALS

.1 Refer to Section 02 81 00–Hazardous Building Material–General Requirements.

## Part 3 Execution

3.1 CLEAN SITE PREPARATION FOR FULL-ENCLOSURE ASBESTOS WORK AREAS

.1 Request that the DCC representative shut off air handling and ventilation systems supplying or exhausting from asbestos work area enclosure(s). Ensure air-handling systems remain shut off for duration of work.

.2 Pre-clean and remove equipment, tools, furnishings, and stored materials that can be moved without disturbing asbestos-containing materials.

.3 Erect appropriate worker and waste decontamination facilities at locations approved by the DCC representative.

.4 Complete isolation measures between the asbestos work area and occupied areas. Where required, erect hoarding walls and complete other isolation measures between asbestos work area and occupied areas. The hoarding walls shall be constructed as follows:

.1 Build walls of 39 mm x 89 mm (2" x 4") wood framing, 400 mm (16") o.c. with continuous top and sill plates. Cover both side walls with polyethylene sheeting.

.2 If hoarding walls do not extend to the underside of the ceiling construct a ‘roof’ to completing isolate the asbestos work area.

.3 Construct roof as follows: Size of joists shall be determined by span, loads, use and Building Codes. Use as a minimum 39 mm x 138 mm (2" x 4") joists. Cover joists facing the asbestos work area with one layer of polyethylene sheeting, overlapping the perimeter walls at least 600 mm (24"). Wrap the excess sheeting over the polyethylene sheeting covering perimeter walls.

.4 Where required, cover existing wall and floor surfaces with polyethylene sheeting sealed with tape. Provide two separately sealed layers of polyethylene sheeting. Separately seal floor drains or openings. Use sufficient layers (2) and necessary sheathing for walking surface to protect floors which may be damaged. Cover floors first so that polyethylene extends at least 300 mm (12”) up walls then cover walls to overlap floor sheeting.

.5 All wall and horizontal surfaces shall be pre-cleaned using damp cloth or sponge techniques prior to placement of polyethylene sheeting to any wall or floor surfaces. HEPA equipped vacuum cleaners may also be used to perform this task.

.6 Seal off all openings including but not limited to doorways, hatch openings, windows, vents, service holes in walls, and grilles to non-operating ducts with two (2) layers of rip-proof polyethylene sheeting sealed with tape or with polyurethane foam as appropriate.

.7 If necessary, caulk and seal ducts and duct shafts to remain in service as required, to make airtight. Cut and cap supply ducts with rigid sheet metal caps and seal. Perform work at appropriate time under contaminated conditions if necessary.

.8 On approval of the DCC representative, seal joints and holes in HVAC ductwork to remain operational through an asbestos work area, using tape and rip-proof polyethylene to make airtight.

.9 Establish negative pressure in asbestos work area. Negative pressure units shall have total rated capacity with filters in place sufficient to provide a minimum of four air changes every hour. Volume of air shall be sufficient to ensure airflow is maintained from clean areas into asbestos work area.

.10 Vent units to outside of building. Locate vents to discharge air away from building access points or sidewalks. Discharge vents a minimum of 5 m away from building entrances, open windows or air intakes. Do not discharge air into building interior unless approved by the DCC representative. The location of venting must be approved by the DCC representative.

.11 If requested, leak test negative air units prior to commencement of abatement at operating position, using DOP method. Provide reports for unit efficiency test results within 48 hours of testing, including calibration certificates for testing equipment.

.12 Operate negative pressure units continuously from this time until completion of final air monitoring. Replace pre-filters as necessary to maintain airflow. Maintain negative air pressure of 5 Pascals (0.02 inches water column) pressure reduction within asbestos enclosure with respect to surrounding areas.

.13 The system to be inspected and maintained by a competent person prior each use to ensure that there is no air leakage, and if the filter is found to be damaged or defective, it to be replaced before the ventilation system is used.

.14 Pre-clean and cover with polyethylene sheeting all items that are to remain within the enclosure during the abatement work including but not limited to motors, heating units, fire apparatus, door closers, fans, tanks, benches, shelving, storage racks, valves, taps, controllers, lights, and other fixtures and furnishings within enclosure. Clean previously contaminated surfaces with HEPA vacuum before covering with sheeting.

.15 Install plywood enclosures, covered with rip-proof polyethylene, to protect equipment or fixtures in asbestos work area(s) that may be damaged.

.16 Remove, clean and turn over to the DCC representative, all re-usable mechanical equipment, electrical equipment and building components that may interfere with the asbestos removal and associated clean-up. The removal of such materials is at the discretion of the DCC representative.

.17 Ensure existing power supply to asbestos work area is isolated and disconnected where necessary. Do not disrupt power supply to remaining areas of building. Provide ground fault interrupter electrical system(s) in accordance with applicable CSA standard where application of amended water is required for wetting asbestos-containing materials. Ensure safe installation of electrical lines and equipment.

.18 Provide temporary lighting in asbestos work area to levels that will permit work to be done safely, complete with ground-fault protection.

.19 Maintain emergency and fire exits from asbestos work area, or establish alternative exits satisfactory to authorities having jurisdiction.

.20 Provide fire extinguisher at each emergency exit, and in decontamination facilities. Protect extinguishers with polyethylene sheeting in manner that will not hamper emergency use. Existing on-site extinguishers may not be used without prior approval of the DCC representative.

3.2 WORKERS' DECONTAMINATION ENCLOSURE SYSTEM

.1 Construct a workers' decontamination enclosure at entrance to each asbestos work area as approved by the DCC representative. Worker decontamination enclosure system shall be comprised of three interconnecting rooms (chambers) as described below.

.2 Provide a set of curtain doorways between each room, and at both dirty and clean entrances to enclosure systems.

.3 Equipment and Access Room: Build room between shower room and asbestos work area. Install waste receptor, and storage facilities for worker's shoes and any protective clothing to be re-worn in asbestos work areas. Equipment and access room shall be large enough to accommodate specified facilities and other equipment needed, and at least one worker allowing sufficient space to undress comfortably. Minimum size 3 $m^2$ with a minimum height of 1.9 m.

.4 Shower Room: Build room between clean room and equipment and access room of suitable size (minimum height 1.9 m) and install one (1) shower for every five (5) workers. Provide constant separate supplies of hot and cold water capable of maintaining a water temperature of between 40 and 50 $^0$C. Provide valves controllable at shower(s) to regulate water temperature. Provide rigid piping with watertight connections and connect to water sources and drains. Provide soap, clean towels and appropriate containers for disposal of used respirator filters. Direct wastewater to sanitary sewer drains. When requested or where required by Provincial or Municipal law, direct wastewater to sewer via water filtering system consisting of a minimum 2-stage filtering system (25-micron and 5-micron filters) or other approved means of filtering.

.5 Clean Room: Build room between shower room and clean areas outside of enclosures with a minimum height of 1.9 m. At doorway to clean room, provide secure doorway. Provide hangers for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install water heater, if required.

3.3 WASTE AND EQUIPMENT DECONTAMINATION ENCLOSURE SYSTEM

.1 Construct system comprised of three linked rooms: Purpose of this system is to provide means to decontaminate drums, scaffolding, material containers, vacuum and spray equipment; and other tools and equipment for which worker decontamination system is not suitable.

.2 Provide curtain doorways between rooms and at both dirty and clean entrances to the Enclosure System.

.3 Staging Area: Establish a staging area within the asbestos work area for gross removal of dust and debris from waste containers and equipment and temporary storage pending removal to container cleaning room. Minimum size of 3 $m^2$.

.4 Container Cleaning Room: Build container cleaning room between the Staging Area and Holding Room. Room shall be of sufficient size to allow proper washing or otherwise decontaminating equipment, drums and other waste containers and double bagging and labelling of asbestos waste. Treat wash water as asbestos contaminated waste. Minimum size of 1.5 $m^2$ with a minimum height of 1.9 m.

.5 Holding Room: Build Holding Room between Container Cleaning Room and Transfer Room. Room shall be of sufficient size to accommodate largest item of equipment used and two (2) rigid waste containers or five (5) waste bags. Minimum size of 1.5 $m^2$ with a minimum height of 1.9 m.

.6 Transfer Room: Build Transfer Room between Holding Room and uncontaminated area with a secure doorway.

3.4 CONSTRUCTION OF DECONTAMINATION ENCLOSURES

.1 Floor: Prior to erecting wall framing, lay one (1) sheet of rip-proof polyethylene sheeting over floor area to be covered by enclosures. The floor sheeting should extend at least 600 mm (24") beyond the outside perimeter of the planned enclosure on all sides. After the construction of the enclosure walls, wrap the excess floor sheeting up the outside of the enclosure, overlapping the polyethylene sheeting covering perimeter walls. Provide second layer of rip-proof polyethylene to all floors, extending 600 mm up inside of enclosure walls.

.2 Walls: Build load-bearing walls of 39 mm x 89 mm (2" x 4") wood framing, 400 mm (16") o.c. with continuous top and sill plates. Cover both sides of walls with polyethylene sheeting with caulk sealed and taped joints or seams

.3 Roof: Size of joists shall be determined by span, loads, use and Code. Use as a minimum 39 mm x 88 mm (2" x 4") joists. Cover joists with 19 mm (3/4") plywood sheeting and seal and tape joints. Cover with two (2) layers of rip-proof polyethylene, overlapping the perimeter walls at least 600 mm (24"). Wrap the excess sheeting over the polyethylene sheeting covering perimeter walls. At underside of joists install one (1) layer of polyethylene sheeting.

.4 Doorways: Build curtain doorways designed so that when workers or drums and equipment move through doorway, one (1) of two (2) barriers comprising doorway always remains closed.

3.5 MAINTENANCE OF ENCLOSURES

.1 Maintain enclosures and work areas in tidy condition. Thoroughly clean decontamination facilities at the end of each work shift.

.2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

.3 Visually inspect enclosures and work areas at beginning and end of each working period including at least once daily on days when no active abatement occurs (eg., weekends).

.5 The negative air system to be inspected and maintained by a competent person prior each use to ensure that there is no air leakage, and if the filter is found to be damaged or defective, it to be replaced before the ventilation system is used.

.6 Use smoke methods to test the effectiveness of the isolation barriers when directed by the DCC representative.

3.6 EXECUTION

.1 Do Not Commence Asbestos Removal Work Until:

.1 Arrangements have been made for disposal of waste.

.2 Asbestos work areas and decontamination enclosures are effectively segregated.

.3 Negative pressure equipment is operating continuously.

.4 Tools, equipment and waste materials receptors are on hand.

.5 Arrangements have been made with the DCC representative for work area security.

.6 Signs are displayed in areas where access to sealed asbestos work area is possible. Signs shall be in both official languages (if required) and shall read:

CAUTION (25 mm high)
Asbestos Hazard Area (19 mm high)
Unauthorized Entry Prohibited (19 mm high)
Wear Assigned Protective Equipment (19 mm high)
Breathing Asbestos Dust May Cause Serious Bodily Harm (19 mm high).

.2 Provide proof that notification of asbestos work has been submitted to the Ontario Ministry of Labour.

.3 DCC or their representative has been notified of intention to proceed, has reviewed enclosures, equipment, procedures, and other submitted materials, and has granted authorization to proceed.

3.7 CONTAMINATED SITE PREPARATION

.1 Before performing any contaminated work, prepare site as previously described.

.2 Request that building personnel shut off air handling and ventilation systems supplying or exhausting from the asbestos work area enclosure(s). Ensure air-handling systems remain shut off for duration of work.

.3 Seal holes or penetrations to provide airtight enclosure around asbestos work area(s).

.4 Protect electrical, communication, life safety and control systems to remain in place in asbestos work area with polyethylene and tape.

3.8 ASBESTOS-CONTAINING MATERIAL REMOVAL

.1 All individuals involved with any portions of the removal process shall be equipped with appropriate respirators (including qualitative or quantitative fit testing) and protective equipment while working within the enclosure.

.2 Clean and protect from damage all ceiling and wall components that are to remain including but not limited to furring, channels, hangers, wires, and clips.

.3 Repeatedly mist the air throughout the performance of this work and maintain all surfaces within the asbestos work area in a damp state.

.4 Spray asbestos-containing materials with amended water using airless spray equipment. Where impermeable materials exist, slowly remove impermeable layer while wetting underlying layers. Saturate asbestos to prevent release of airborne fibres during removal.

.5 Remove the saturated asbestos-containing material in small sections. Do not allow saturated asbestos to dry out to the extent practicable. As it is being removed, pack the material in waste containers.

.6 Spray asbestos debris on floor with amended water to prevent it from drying out. Remove asbestos debris from the floor and put in waste containers at regular intervals as the work progresses and at the end of every shift.

.7 Seal filled containers, clean external surfaces thoroughly, and remove from working area to staging area.

.8 After completion of removal of asbestos-containing materials, clean surfaces from which asbestos has been removed with stiff bristle brushes, vacuum, and/or wet-sponge (as appropriate) to remove all visible material.

.9 Removal of asbestos waste containers and decontaminated equipment and materials from the asbestos work area shall be removed through the waste decontamination enclosure as follows:

.1 Remove gross contamination from the surface of the item to be removed within the staging area.

.2 Pass the item to a second worker present in the container cleaning room. The item shall be cleaned, wet wiped and double bagged and/or sealed in polyethylene prior to transferring to a third worker present in the holding room. Wash water shall be treated as asbestos-contaminated waste.

.3 The worker present in the holding room shall transfer the clean items to a fourth worker located outside the waste decontamination enclosure. The fourth worker must not enter the waste decontamination enclosure. Those workers present in the enclosure must leave the asbestos work area through the worker decontamination chamber only.

.4 Treat removed materials exposed to asbestos, as asbestos-contaminated waste unless such materials can be properly decontaminated and are specified to be re-used.

.10 After removing all visible asbestos, wet clean entire work area including but not limited to pipes, pipefittings, ducts, and similar items not covered with polyethylene sheeting. Request visual inspection and acceptance.

.11 Following inspection and acceptance, apply heavy coat of slow drying sealer to all surfaces from which asbestos has been removed. Apply thinned coat (sufficient to coat all surfaces) to interior of polyethylene enclosure. Do not disturb the work area for a minimum of 12 hours after the application of sealer. Operate negative air units during this period.

## Part 4 Decommissioning

### 4.1 DISMANTLING OF PROTECTION

.1 All containment structures, such as hoardings, platforms, etc., which are used to segregate the work area, are to remain in place until directed by DCC or their representative.

.2 If air sampling by DCC or their representative shows that levels in asbestos work area do not exceed 0.01 fibres/mL as determined by NIOSH 7400 Analytical Method, A Counting Rules, and when approved in writing by DCC or their representative, proceed with final dismantling of decontamination and work enclosures as follows:

.3 Remove polyethylene sheeting exposed during contaminated work including upper surfaces plus any underlying sheeting contaminated by water leaks, rips, tears, or exposed by failure of upper layer. Wear appropriate respirator and disposable coveralls during removal of sheeting. Carefully roll sheeting away from walls to centre of asbestos work area. As sheeting is rolled away from walls and corners, HEPA vacuum visible debris.

.4 While removing top layer of sheeting from surfaces protected by two (2) layers of sheeting, cut lower sheeting so as to expose horizontal surfaces that may be contaminated with asbestos debris. HEPA vacuum any visible debris.

.5 Place polyethylene sheeting, seals, tape, cleaning material, clothing, and other contaminated waste in asbestos waste receptors for transport. Remove with HEPA vacuum any debris which may have fallen behind sheeting.

.6 Remove hoardings, temporary lighting, equipment and facilities provided for work.

.7 Visible debris discovered on the course of the site dismantlement is to be promptly cleaned using a damp cloth and/or HEPA vacuum.

.8 Site inspections and air monitoring shall be conducted for all Type 3 asbestos work including a final review of the work area by the DCC representative to ensure that no dust or debris remains.

## Part 5 Inspection and Air Monitoring

### 5.1 INSPECTION

.1 From commencement of work until completion of clean-up operations, the DCC representative is empowered to inspect for compliance with the requirements of the governing authorities, adherence to specifications and to inspect for cleanliness and completion both inside and outside asbestos work area(s).

.2 The DCC representative may inspect both inside and outside the work area a minimum of once per 10-hour work shift during active abatement as authorized by the DCC representative.

.3 The DCC representative is empowered to shut-down all work activities when leakage of asbestos from the work area has occurred or is likely to occur.

.4 The Abatement Contractor is to allow inspection by the DCC representative and provide full access to the work area. The Contractor shall make good on any work disturbed by the inspection at no cost to the crown.

.5 If asbestos work area(s) or adjacent areas are found unacceptable in accordance with standards specified or required by authorities having jurisdiction, correct such deficiencies at no cost to the crown.

.6 Pay cost to provide re-inspection of work found not to be in accordance with these specifications and requirements of authorities having jurisdiction.

.7 Provide a minimum of 24 hours written notice to the DCC representative of any request for scheduling milestone inspections or transportation of asbestos water through an occupied area.

.8 The following milestone inspections are to take place during work:

.1 Clean Site Preparation: Inspection of site preparations and set-up prior to contaminated work.

.2 Contaminated Perimeter Preparation: Inspection of contaminated preparations at perimeter of asbestos work area prior to any bulk removal.

.3 Before Bulk Removal (Contaminated Site Preparation): Inspection of asbestos work area following Contaminated Perimeter Preparation but before start of main asbestos removal.

.4 Visual Clearance: Inspection of asbestos work area after removal of asbestos but before the application of sealer.

.5 Final Air Sampling Clearance: Inspection and air sampling after application of sealer but prior to the removal of hoarding and perimeter seals from within the asbestos work area.

.6 DCC representative Joint Visual Clearance. Inspection of asbestos work area by DCC representative and Contractor's site supervisor following Final Air Sampling Clearance and removal of non-critical barriers (i.e. non-perimeter seals such as floor) and seals (i.e. non-perimeter seals such as floor) but before the removal of hoarding and perimeter seals from within the asbestos work area.

.7 Final Dismantling Inspection: Inspection after the removal of hoarding, perimeter seals and decontamination facility from the asbestos work area.

.9 Do not proceed with next phase of work until written approval of each inspection is received from the DCC representative.

## 5.2 AIR MONITORING

.1 In accordance with the COHSR, ambient air sampling will be performed within and immediately adjacent to each active asbestos work area. Results obtained from all test monitoring shall be posted at the work site and provided to the DCC representative, the General Contractor for the Project (if present) and the Abatement Contractor.

.2 The following air samples will be collected at least daily for every Type 3 (high risk) asbestos work enclosure and asbestos abatement project/operation:

.1 Inside the Type 3 asbestos work enclosure Decontamination Clean-Room

.2 Adjacent to the Type 3 asbestos work enclosure

.3 Within the enclosure after the completion of abatement activities (i.e. clearance sample) as follows:

.1 Forced air shall be used within the enclosure throughout the sampling. A minimum of 2,400 litres of air shall pass through each sample.

.2 The Contractor will be responsible for providing on-Site a clean leaf blower and fans which comply with EPA Guideline 560/5-85-024 during all Type 3 clearance sampling. Both pieces of equipment must be approved by the DCC representative at the time of the sampling.

.3 In the presence of DCC or their representative, immediately prior to air clearance monitoring, use a leaf blower to dislodge loose fibre. Direct leaf blower against walls, ceilings, floors, and other surfaces. Perform this for at least five minutes per 93 sq. m. of Asbestos Work Area.

.4 Collection of clearance air samples should be as follows:

.5 2 air samples for enclosures that are $<10m^2$

.6 3 air samples for enclosures that are $>10m^2$ and $<500m^2$

.7 5 air samples for enclosures that are $>500m^2$

.4 Within 24 hours of obtaining air sampling test results as noted above in 5.2.2, the employer shall:

.1 Post a copy of the results in a conspicuous place in the workplace.

.2 Make the results available to the DCC representative for distribution.

.3 Air samples must be collected in accordance with NIOSH 7400 Analytical Method (A Counting Rules).

.4 If air monitoring or visual inspection indicates that areas outside current asbestos work area enclosures are contaminated above the designated action level 0.05 fibre/cc clean these areas in same manner as that applicable to asbestos work areas, at no cost to The Crown.

.5 If clearance air sampling by DCC representative show that levels in asbestos work area do not exceed the clearance concentration of 0.01 fibres/cc, as determined by NIOSH 7400 Analytical Method (A Counting Rules), proceed with dismantling of asbestos work area.

.6 The air clearance concentration within the enclosure upon the completion of abatement shall not exceed 0.01 fibres/cc.

END OF SECTION

# Part 1 General

## 1.1 SUMMARY

.1 The following mercury-containing materials identified as being present within the Building:

.1 Approximately 8 mercury-containing thermostats.

.2 Mercury vapor containing fluorescent light tubes located throughout the building

.2 Perform the following work practices for the handling, packaging, and transfer of Mercury Materials and Waste.

.3 Unless otherwise shown or specified it is the intent that work performed as per this Section will result in the removal and disposal or decontamination of all mercury-containing materials and all materials which have been contaminated by mercury either during or prior to work of this Section.

## 1.2 RELATED REQUIREMENTS

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

.2 Related work specified elsewhere:

.1 Section 02 81 00 - Hazardous Building Material, General Requirements.

## 1.3 REFERENCES

.1 Refer to Section 02 81 00 - Hazardous Building Material - General Requirements.

## 1.4 DEFINITIONS

.1 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with the Occupational Health and Safety Act and Environmental Protection Act, has knowledge of the potential or actual danger to health and safety in the work.

.2 Mercury Waste: Equipment, materials, or items containing mercury or contaminated with mercury.

.3 Polyethylene: Either polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from damage.

.4 Personnel: All contractors' employees, sub-contractor's employees, supervisors.

.5 Work Area: Area of building from which mercury-containing items are being removed.

1.5 REGULATIONS

.1 Perform work in accordance with current applicable environmental and occupational health regulations and codes including but not limited to:

.1 Regulation 347, General Waste, as amended.

.2 R.R.O. Regulation Mercury R.R.O. 1990, Regulation 844, Amended to O.Reg. 110/04, Designated Substance — Mercury

1.6 SUPERVISION

.1 Provide on site, a supervisor, with authority to oversee aspects of the work, including but not limited to, Health and Safety, methods, scheduling, labour and equipment requirements.

.2 A minimum of one supervisor for every 10 workers is required.

.3 Replace supervisory personnel, with approved replacements, within 3 working days of a written request.

1.7 QUALITY ASSURANCE

.1 Ensure the removal and handling of mercury is performed by persons experienced in the methods, procedures and industry practices.

.2 Complete work so that at no time mercury contaminates the building or environment.

1.8 INSTRUCTION AND TRAINING

.1 Instruction and training must be provided to all workers and supervisors. Instruction and training includes the following:

.1 Hazards of Mercury.

.2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during work, including:

.1 Limitations of equipment.

.2 Inspection and maintenance of equipment.

.3 Proper fitting of equipment.

.4 Disinfecting and cleaning of equipment.

.3 Personal hygiene to be observed when performing the work.

.4 The measures and procedures prescribed by this Section.

.5 Instruction and training must be provided by a competent, qualified person.

1.9 PERSONAL PROTECTION

.1 During work involving mercury, personnel are to wear the following additional personal protective equipment:

.1 Non-powered half-face respirators with mercury vapour cartridges with life span indicators in the cartridge.

.2 Protective coveralls.

.3 Protective eyewear/face shield.

.4 Chemical resistant gloves and apron.

.2 Respiratory protection shall be certified by the National Institute of Occupational Safety and Health (NIOSH) or other testing agency acceptable to the Ministry of Labour.

.3 Respirators shall be:

.1 Fitted so that there is an effective seal between the respirator and the worker's face. Ensure that no person required to enter the Work Area has facial hair which affects the seal between respirator and face.

.2 Assigned to a worker for his exclusive use.

.3 Maintained in accordance with manufacturer's specifications.

.4 Cleaned, disinfected and inspected by a competent person after use on each shift, or more often if required.

.5 Repaired or have damaged or deteriorated parts replaced.

.6 Stored in a clean and sanitary location.

.4 Replace filters as necessary.

.5 Personnel must have respirators fit checked by qualitative or quantitative fit-testing. Instruction must be provided by a competent person as defined by the Occupational Health and Safety Act.

.6 Personnel shall wear and use the respirator provided.

.7 Protective clothing shall be replaced or repaired if torn or ripped.

.8 Prior to leaving the Work Area, personnel shall decontaminate their clothing or protective clothing by using a HEPA Vacuum, or by damp wiping.

.9 Dispose of protective clothing not to be reused as mercury waste.

.10 Provide soap, towels and facilities for washing of hands and face, which shall be used by all personnel when leaving the Asbestos Work Area.

.11 Prohibit smoking, eating, drinking, chewing in the Work Area.

.12 Use hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

## Part 2 Products

### 2.1 MATERIALS

.1 Containment Drums: New, not used double bung 45-gallon No. 16 gauge cold rolled steel drums with removable steel lid, chemical resistant gasket, and 12-gauge compression type ring closure with 5/8" bolt and forged lug. Drums shall be newly painted inside and out with bright white rust-resistant enamel.

.2 Drum liners: Clear polyethylene bag, 36" x 60", 6 mils thick. Open one 36" end.

.3 Mercury Sponge: A plated metal-wool pad for the pick-up of mercury spills.

.4 Mercury Vacuum: Vacuum used to collect liquid mercury and granular mercury compounds with an internal HEPA filter and an activated carbon adsorbent filter to purify exhaust air of mercury vapours.

.5 Neutralizing Agent: Mercury neutralizing solution such as 20% sodium sulphide or sodium thiosulphate.

.6 Pipe and Drain Neutralizing Agent: Solution that is designed to prevent the release of mercury vapour from traps, collection systems, pipes, drains and standpipes.

.7 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints. New materials only.

.8 Protective Coveralls: Disposable full body coveralls to prevent splashes to clothing, complete with hoods. Coveralls to fit snugly at ankles, wrists and neck.

.9 Vermiculite: Pre-packed, Industrial grade 3, containing no asbestos.

## Part 3 Execution

### 3.1 MERCURY PACKAGING

.1 Wear personal protection at all times when disturbing lamps, equipment and items that contain mercury.

.2 Do not drop mercury-containing materials.

.3 Do not contaminate building surfaces with mercury.

.4 Protect work area by installing polyethylene drop sheets or sealed polyethylene sheeting below, and at surrounding work area.

.5 Isolate, at panel, and disconnect existing power supply to electrical equipment. Power supply to remaining areas of building must not be disrupted during work of this section.

.1 Lock-out/tag-out power at electrical panels.

.2 Mark/tag any items within or passing through the Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc. as required.

.6 Isolate drains prior to removal of pipes.

.1 Use Pipe and Drain Neutralizing Agent to neutralize mercury in plumbing containing more than 0.003 mg/$m^3$ but less than 0.03 mg/$m^3$.

.1 Remove of pipes, drains, pipe fittings, traps, etc. after neutralization.

.2 Remove pipes, drains, traps etc. where more than 0.03 mg/$m^3$ is present. All components are to be considered contaminated with mercury.

.7 Remove and package entire mercury containing components (i.e. boiler flow valve, thermostat, etc.) for recycling. Do not drain mercury.

.8 Package lamps in cardboard boxes designed for lamps of that size. Do not break lamps.

.9 Place other mercury materials into containment drums. Insert drum liner. When full:

.1 Seal liner bag with duct tape.

.2 Seal drum with lid, gasket and compression ring.

.3 Affix label.

.4 Do not leave liner bags or drums open overnight.

.10 As filled drums accumulate, transfer to temporary storage area.

## 3.2 SPILL CONTAINMENT

.1 For large mercury spills:

.1 Evacuate area. Only personnel using the specified PPE are to be in spill area.

.2 Deactivate air handling systems.

.3 Open windows or provide ventilation to area.

.4 Deactivate heat systems if they are adjacent and may aid in vaporization of mercury.

.5 Contact DCC Representative immediately.

.6 If spill cannot be cleaned up immediately, apply neutralizing agent over mercury spill area.

.7 Collect mercury droplets together will a dustpan, squeegee or mercury vacuum.

.8 Clean-up bulk mercury using aspirator bulb or mercury vacuum. Clean remainder with a mercury sponge. Place mercury in closed container (plastic or glass).

.9 Porous surfaces are to be cleaned with Neutralizing Agent after clean-up of bulk mercury.

.10 If mercury spills into soil, carpet, through cracks, into drains etc. further removal of surface materials at contractor cost will be required. Do not proceed without approval from DCC Representative.

.11 Place all cleaning materials including drop sheets or polyethylene sheeting in containment drums.

## 3.3 TRANSPORTATION AND REPORTING

.1 Transport materials following Transportation of Dangerous Goods Act.

.1 Transport Mercury Materials and Waste to approved site for recycling, including mercury vapour in lamps, and ensure materials are recycled.

.2 The facility used to process and recycle the mercury shall be approved by the Ministry of the Environment, or local jurisdictional authority, and shall have valid Certificates of Approval to carry out the work outlined herein.

.1 The facility must issue a Certificate of Recycling identifying types and quantities of materials generated from the project. The facility must also provide a Certificate of Recycling for the mercury generated from the project. Any mercury contaminated materials not recycled are to be identified by a manifest.

.3 A typed and signed transfer document for each transfer of mercury is to be submitted to Owner's representative, giving following:

.1 Number of drums or boxes.

.2 Contents and approximate quantities.

.3 Approximate net weight of contents.

.4 Dates removal begun and completed (for each lot).

.5 Date transferred.

.4 Submit certificate(s) of recycling and waste manifests from all transfer points. Submit the above for waste regardless of single transport or as blended waste.

3.4 RE-ESTABLISHMENT OF ITEMS

.1 Re-establishment of items will not be required for this demolition project.

END OF SECTION

# Part 1 General

## 1.1 SUMMARY

.1 The following presumed silica-containing materials identified as being present within the Building:

.1 Concrete

.2 Mortar

.3 Cementitious texture coat and other aggregates

.2 Disturbance of silica-containing materials such as plaster and drywall or aggregate materials are considered Type 2 Silica Operations when performing the following Work as part of this project:

.1 The use of a power tool to cut, grind, or break silica-containing materials.

.2 The use of a power tool to remove silica-containing materials.

## 1.2 RELATED REQUIREMENTS

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

.2 Related work specified elsewhere:

.1 Section 02 81 00 - Hazardous Building Material – General Requirements.

## 1.3 REFERENCES

.1 Refer to Section 02 81 00 - Hazardous Building Material - General Requirements.

## 1.4 DEFINITIONS

.1 Approved Supervisor: a person who has charge of a workplace or authority over a worker and has received the appropriate training for that role. A supervisor is ultimately responsible to provide direction to workers on site and must follow the applicable regulations and guidelines that apply to this work including, but not limited to, those as outlined in References (Section 1.3).

.1 Authorized Visitors: Consultants and representatives of regulatory agencies.

.2 Banner Tape: pre-printed cautionary warning banner tape that delineates the Silica Work Area.

.3 Building: HR26, CFB Kingston, Kingston, ON

.4 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 and federal 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.

.5 Contractor: company or individual designated to complete the scope of work outlined in this specification

.6 Consultant: 3rd party consultant contracted by the Owner, competent in the processes to be completed as part of this specification with authority to provide direction on behalf of the Owner.

.7 Dispersed Oil Particulate (DOP) Test: testing method used to evaluate particle penetration and air flow resistance properties of filtration materials - HEPA filter leak test.

.8 HEPA: High Efficiency Particulate Air (HEPA) filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.9 HEPA Filter Efficiency Testing: test to measure the efficiency of all HEPA filtered equipment on the Site prior to use of the equipment. Testing should be conducted using DOP.

.10 HVAC System: all components of the Heating, Ventilation and Air Conditioning system.

.11 Occupied Area: any area of the building outside the Silica Work Areas.

.12 Owner: Defence Construction Canada (DCC).

.13 Silica Work Area: area where work takes place which will, or may, disturb silica-containing material.

.14 Project Area: selected areas within Building HR26, CFB Kingston, Kingston, ON.

## 1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Before beginning work:

.1 Submit to Owner satisfactory proof that every worker has had instruction and training in WHMIS, the hazards of crystalline silica exposure, the recognition of typical operations containing crystalline silica, personal hygiene, respirator requirements, proper work measures, and procedures, and in the use, cleaning, maintenance and disposal of respirators and protective clothing.

.2 Submit to the Owner satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

.1 Instruction and training related to respirators includes, following minimum requirements:

.1 Fitting of equipment;

.2 Inspection and maintenance of equipment;

.3 Disinfecting of equipment; and,

.4 Limitations of equipment.

.2 Instruction and training must be provided by a competent, qualified person.

.3 Submit proof of HEPA filter efficiency testing for all vacuums. HEPA filter efficiency testing must be completed immediately prior to commencing work and every 6 months thereafter. Proof of this testing must be provided to the Owner prior to commencing work.

.4 Submit Worker's Compensation Board status and transcription of insurance.

.5 Submit documentation including test results, fire and flammability data, and Safety Data Sheets (SDS) for all chemicals and/or materials to be used including, but not limited to, the following:

.1 Spray adhesive.

.2 Amended water.

.3 Slow-drying sealer.

.6 Submit a Health & Safety Plan before commencing work to Owner. Comply with all applicable health and safety regulations.

1.6 EXISTING CONDITIONS

.1 Information pertaining to crystalline silica to be handled, removed, or otherwise disturbed and disposed of during this project are provided in the Designated Substances Report.

.2 Any interested parties (i.e., qualified remediation contractors) must verify the approximate quantities and locations of crystalline silica identified in the Designated Substances Report (Project-Specific Designated Substances and Hazardous Materials Assessment, Batoche Community Centre Building HR26 Canadian Forces Base Kingston, Support of the Building HR26 HVAC Upgrades at CFB Kingston, Ontario, DCC Project No. KN229909_KN83063, WSP E&I Canada Limited (WSP), June 17, 2025).

1.7 WORKER AND VISITOR PROTECTION:

.1 Workers and visitors shall use as a minimum; full-face air purifying respirators fitted with P100 particulate filters. Contractors should refer to the MLITSD's Guideline: Silica on Construction Projects, revised in 2011, for respirator requirements under all classifications of work for silica operations.

.1 Respiratory protective devices shall be certified by the National Institute of Occupational Safety and Health (NIOSH) and fit-tested to the worker wearing it.

.2 Ensure that no person required to enter a Silica Work Area has facial hair which affects the seal between respirator and face.

.2 Protective Clothing: If requested by the worker, employer to provide workers with protective clothing that does not readily retain or permit penetration of crystalline silica dust. This clothing can be disposable type or reusable. If reusable clothing is used, it must remain in a designated area on Site and be washed as required based on the level of contamination or as directed by the DCC Representative.

.3 Every worker who enters the work area shall wear protective clothing.

.4 Eating, drinking, chewing, and smoking are not permitted in the Silica Work Areas.

.5 Before leaving the Silica Work Areas, workers shall decontaminate their protective clothing using a HEPA vacuum or by damp wiping. Store clean protective re-usable clothing in clean plastic bag for reuse, or, if protective clothing is not re-usable or not to be reused, dispose of as contaminated waste.

.6 Ensure workers wash hands and face when leaving Silica Work Areas. If washing facilities are not available, a washcloth, water basin and soap shall be made available directly outside the Silica Work Areas.

1.8 VISITOR PROTECTION

.1 Provide protective clothing and approved respirators to Authorized Visitors to the Silica 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 Silica Work Areas.

1.9 NOTIFICATION

.1 Inform all contractors and subcontractors of the presence of crystalline silica identified in the contract documents.

## Part 2 Products

2.1 MATERIALS

.1 All materials brought to work site must be in good condition and free of crystalline silica dust, debris, and fibrous materials. Disposable items must be of new materials only.

2.2 EQUIPMENT

.1 HEPA Vacuum: HEPA-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 with all necessary fittings, tools, and attachments. All air must pass though HEPA filter before discharge.

.2 Portable Eye Wash Station: portable eye wash station, minimum spray time of 15 minutes.

.3 Sprayer: garden-type portable manual sprayer or water hose with spray attachment if suitable.

## Part 3 Execution

### 3.1 PREPARATION

.1 Before beginning work, at each access to Silica Work Areas, warning signs must be posted in sufficient number to warn of the hazard. The signs must display the following information in large, clearly visible letters:

.1 There is a silica dust hazard.

.2 Access to the work area is restricted to authorized persons.

.3 Respirators must be worn in the work area.

.2 Surround the Silica Work Areas with banner tape ensuring that all access points have restricted access. The Silica Work Area must be set up such that other workers (if applicable) are to remain at least 10 meters away from the Silica Work Area. The banner tape is to be set up to prevent unauthorized personnel from entering the Silica Work Area.

.1 Maintenance of Silica Work Areas:

.1 Maintain Silica Work Area in tidy condition.

.2 The Silica Work Area shall be inspected at the beginning of each working period, as a minimum, by a competent worker for defects in the enclosure, barriers, and wash facility.

.3 Defects observed during an inspection shall be repaired immediately and no other work shall be carried out in the Silica Work Area until the repair.

### 3.2 CRYSTALLINE SILICA DISTURBANCE

.1 Any material containing crystalline silica to be removed or disturbed should be thoroughly wetted before work unless wetting creates a hazard or causes damage. Use garden reservoir type low velocity fine mist sprayer or equipment appropriate for work being performed. Perform all work in a manner to reduce dust generation to lowest levels practicable.

.2 Clean up after each operation is required to prevent dust containing silica from spreading.

.3 Compressed air or dry sweeping must be avoided when cleaning a Silica Work Area.

.4 Compressed air must not be used for removing dust from clothing.

.5 Workers exposed to silica must be provided with or have access to washing facilities equipped with clean water, soap, and individual towels.

.6 Silica dust on personal protective clothing and equipment must be removed by damp wiping and/or HEPA vacuuming.

.7 Contaminated personal protective clothing and equipment must be handled with care to prevent disturbing the silica dust and the generation of airborne silica dust.

.8 DCC Representative will perform or arrange for cleanliness inspections and testing, as necessary, and inspect work for adherence to specification sections and guidelines.

.9 Cleanup:

.1 Frequently during the work, and immediately after completion of the work, clean up waste containing crystalline silica in a manner that does not create airborne dust. Wetting the material is likely a feasible method.

## 3.3 WASTE AND MATERIAL HANDLING

.1 Clean up waste routes and loading area after each load.

.2 Cooperate with governmental inspectors and immediately carry out instructions for remedial work, at no additional cost to the owner.

## 3.4 CLEANLINESS TESTING AND AIR MONITORING

.1 Acceptance of the completed work and cleanliness of surfaces in the work areas will be based on visual inspection, as required. The acceptable criteria for airborne crystalline silica dust concentrations within a work area are based on the type of crystalline silica present as outlined in applicable regulations and guidelines. Final visual inspections may be conducted before the dismantling of any barrier system used during silica operations.

.2 The Contractor may perform air monitoring inside and outside the Silica Work Areas upon the request of DCC Representative. If airborne silica concentrations exceed 0.025 $mg/m^3$ outside the work areas, the contractor shall stop all work and modify work practices to reduce worker exposures to acceptable levels.

END OF SECTION

# Part 1 General

## 1.1 SUMMARY

.1 Comply with requirements of this Section when performing following Work:

.1 Disturbance of paint coatings containing lead, mercury, arsenic and/or chromium (lead and other paint coatings; LOPC) by scraping or sanding or removing of materials with a chemical gel or paste and fibrous laminated cloth wrap.

.2 Removal of LOPC using a power tool with an effective dust collection system equipped with a HEPA filter.

.3 Removal of LOPC using non-powered hand tool, other than manual scraping and sanding.

.4 Work operations that generate an airborne lead concentration of less than 0.05 $mg/m^3$.

## 1.2 RELATED SECTIONS

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

## 1.3 REFERENCES

.1 Refer to Section 02 81 00 - Hazardous Building Material - General Requirements.

## 1.4 DEFINITIONS

.1 Action Level Metals and PCBs: employee exposure, without regard to use of respirators, to airborne concentration of lead of 0.05 milligrams per cubic meter of air (0.05 $mg/m^3$) calculated as 8-hour time-weighted average (TWA). Type 1 minimum precautions for lead abatement are based on airborne lead concentrations of >0.05 to 0.50 $mg/m^3$ of air for the work specified. Employee exposure, without regard to use of respirators, to airborne concentration of arsenic, mercury, lead or PCBs of less than one half of the occupational exposure level (OEL) as defined under the Ontario Occupational Health and Safety Act (OHSA).

.2 Lead dust or debris: wipe sampling on vertical surfaces and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot or if visible particles are evident to the DCC Representative.

.3 Lead or LOPC work area: specific area or location where actual work is being performed which actively disturbs known or suspect lead materials or LOPC.

1.5 SUBMITTALS

.1 Submittals in accordance with Division 1, as applicable.

.2 Comply with submittals in accordance with Section 02 81 00 - Hazardous Building Material - General Requirements.

1.6 QUALITY ASSURANCE

.1 Comply with Section 02 81 00 - Hazardous Building Material - General Requirements.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Comply with Section 02 81 00 - Hazardous Building Material - General Requirements.

.2 The removal of building materials with lead or LOPC paint is not required prior to demolition, provided a licensed waste disposal facility can accept the waste,

.3 Check with local landfill operator, waste disposal site or recycler to confirm disposal and handling requirements are acceptable.

.4 Where lead or LOPC must be removed prior to demolition to meet waste disposal requirements, lead and LOPC must be removed prior to demolition. All removed lead or LOPC waste must be handled in accordance with applicable legislation and waste disposal facility requirements.

1.8 EXISTING CONDITIONS

.1 Comply with Section 02 81 00 - Hazardous Building Material - General Requirements regarding lead-containing paint requiring abatement.

.2 Results of bulk samples of paint coatings to be handled, removed, or otherwise disturbed and disposed of during this work are bound into this specification. The results are for general information only and are not necessarily representative of all paint coatings covered in the work area.

.3 Notify the DCC Representative of suspect LOPC discovered during work and not apparent from drawings, specifications, or report pertaining to the work. Do not disturb such material until instructed by the DCC representative.

.4 The presence of Lead-Containing Materials, and their estimated quantities, that require removal under Type 1 Lead and Other Paint Coatings precautions that have been identified at the site are as follows:

.1 Lead-containing, non-leachate grey floor paint in basement mechanical room, approximately 5$m^2$.

.2 Lead-containing, non-leachate white wall paint in basement mechanical room, approximately 5$m^2$.

.3 Lead-containing beige duct paint in 2nd floor mechanical room, approximately 15m$^2$.

.4 Lead-containing yellow corridor and stairwell wall paint, approximately 5m$^2$.

1.9 SCHEDULING

.1 Conform to Section 02 81 00 - Hazardous Building Material - General Requirements.

1.10 PERSONNEL TRAINING

.1 Conform to Section 02 81 00 - Hazardous Building Material - General Requirements.

1.11 WORKER AND VISITOR PROTECTION

.1 Instructions: Before entering lead OR LOPC work area(s), instruct workers and visitors in use of respirators (including fit testing), entry and exit from enclosures and all aspects of work procedures and protective measures including appropriate protective clothing, lead awareness and/or abatement training. A competent person, as defined by Ontario Occupational Health and Safety Act (OHSA), shall provide instruction.

.2 Respirators: Provide appropriate respiratory equipment for all persons entering lead work area including authorized visitors. The following shall apply to the use of respirators:

.1 During active work where there is an airborne expose potential, all workers, supervisors, and authorized visitors shall wear, at minimum, non-powered half-face respirators with minimum N, R or P100 filter cartridges in accordance with NIOSH Part 84 requirements.

.2 Filters shall be replaced daily or tested according to manufacturer's specifications and replaced as necessary. All waste filters shall be disposed as lead or LOPC waste.

.3 Respirators shall be acceptable to the Ontario Ministry of Labour.

.4 Provide instruction to workers and visitors in use of respirators including quantitative or qualitative fit testing.

.5 A worker will not 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.

.6 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.

.7 No supervisor, worker or authorized visitor shall have facial hair which may affect the seal between the respirator and face.

.8 Maintain respiratory protection equipment in proper functioning and clean condition. The respirator is to be cleaned, disinfected and inspected after use on each shift, or more often if necessary. The respirator is 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.

.3 Protective Clothing: Provide workers and visitors conducting lead or LOPC work or present in the work area with:

.1 New disposable type protective coveralls and dermal protection (gloves/footwear coverings) that do not readily retain or permit penetration of lead or LOPC.

.1 Coveralls and dermal protection are to be provided by the employer and worn by every worker who enters the work area.

.2 Coveralls are to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent lead from reaching the garments and skin under the protective clothing.

.3 Use impervious gloves suitable for the cleaning of lead surfaces and the use of any applicable lead cleaning agent.

.2 Once coveralls are worn, treat and dispose as lead contaminated waste.

.3 Workers and visitors shall also wear any other protective apparel not identified in this specification but required by the Ontario Ministry of Labour.

.4 Footwear shall be of a suitable type that will prevent dust penetration and able to be wet wiped.

.4 Set up an isolated worker decontamination area adjacent to the lead or LOPC work area. The facilities must consist of a HEPA filtered vacuum, bucket of warm water, soap, rags, and disposal container for lead or LOPC contaminated protective clothing. Eating, drinking, chewing, and smoking are not permitted in Lead or LOPC Work Area.

.5 Before entering lead work area(s), don appropriate respirator (if required) with new or tested filters, new disposable coveralls, and dermal protection.

.6 Persons leaving lead work area(s) shall:

.1 HEPA (high efficiency particulate air) vacuum or wet wipe clothing and respirator to remove gross contamination.

.2 Remove contaminated coveralls and place in receptacles for disposal with other lead-contaminated materials.

.3 Remove contaminated dermal protection and place in receptacles for disposal with other lead-contaminated materials.

.4 Still wearing appropriate respirator (if using), proceed out of the established lead work area to the decontamination facility.

.5 Clean using soap and warm water wash and remove respirator (if using) then thoroughly wash hands and face. Remove filters and dispose of as lead waste in container provided for this purpose or test filters according to manufacturer's recommendation. Dispose of filters as necessary. Wet clean inside of respirator.

.6 Upon completion of lead work, dispose of footwear coverings as contaminated waste.

.7 Workers and visitors shall be protected at all times when a possibility of lead or LOPC disturbance exists.

.8 A copy of the procedures described under Worker and Visitor Protection shall be posted at access points to the lead or LOPC work area.

.1 Procedures shall be in both official languages if required.

.9 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 lead work area.

.10 Where other abatement or hazardous materials work is occurring the work area, the stricter of the specified Worker and Visitor Protection measures shall apply.

## Part 2 Products

### 2.1 MATERIALS

.1 Polyethylene 0.15 mm thick unless otherwise specified; in sheet size to minimize joints.

.2 Tape: fibreglass-reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.

.3 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 LOPC paint residue.

.4 Lead or LOPC waste containers: Metal, polyethylene or fibre type acceptable to dump operator and Ontario Ministry of Environment with tightly fitting covers and 0.15 mm thickness sealable polyethylene liners.

.1 Label containers with pre-printed cautionary Warning - Contains “WASTE NAME” clearly visible when ready for removal to disposal site. Bilingual warning labels shall be provided if requested.

.2 Materials such as wire or solder which are to be recycled or otherwise disposed of may not require containers. Materials shall be segregated and denoted as lead-containing.

.5 Paint removal gel:

.1 Neutral pH.

.2 Flash point: > 93 C(200 F).

.3 Boiling point: > 315 C(600 F).

.4 Specific gravity: 0.99 g/ml.

.5 VOC: g/l<4.41%.

## Part 3 Execution

### 3.1 SUPERVISION

.1 Lead and LOPC Work Area and areas adjacent and around area to be unoccupied.

.2 Complete isolation measures between the lead and LOPC work area and occupied areas using tape barriers, saw-horses, fencing with polyethylene or other barriers, etc. at the perimeter of the lead work area.

### 3.2 PREPARATION OF LEAD and LOPC WORK AREA(s)

.1 Lead and LOPC Work Area and areas adjacent and around area to be unoccupied.

.2 Complete isolation measures between the lead and LOPC work area and occupied areas using tape barriers, saw-horses, fencing with polyethylene or other barriers, etc. at the perimeter of the lead work area.

.1 A sealed work enclosure is not expected to be required.

.2 Isolation of the work area using polyethylene sheeting may be considered to create a barrier between the work area and occupied spaces to minimize worker exposure.

.3 Pre-clean fixed casework and equipment within work area, using HEPA vacuum and cover and seal with polyethylene sheeting and tape. Clean work area using HEPA vacuum. If not practicable, use wet cleaning method. Do not raise dust.

.3 If required, erect critical barriers around perimeter of Lead or LOPC Contaminated Work Area before disturbance using two layers of 6 mil fibre reinforced polyethylene sheeting. For larger areas, a steel or wooden stud frame can be erected, and fibre reinforced polyethylene sheeting attached to it. Protect floor

surfaces covered from wall to wall with polyethylene sheets. Maintain emergency fire exits or establish alternatives satisfactory to Authority having jurisdiction.

.4 Erect appropriate worker and waste decontamination facilities at locations approved by DCC representative.

.5 Shut off and isolate HVAC system or isolate air intakes and exhausts to prevent dust dispersal into other building areas.

.6 Before beginning work, at each access to contaminated work area, install warning signs in both official languages (if required) in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used:

CAUTION (25 mm high) / Lead Hazard Area (19 mm high) /

Unauthorized Entry Prohibited (19 mm high) /

Wear Assigned Protective Equipment (19 mm high) /

Breathing Dust May Cause Serious Bodily Harm (19 mm high).

.7 Do not start work until:

.1 Arrangements have been made for disposal of waste.

.2 Tools, equipment, and materials waste containers are on site.

.3 Arrangements have been made for building security.

.4 Notifications have been completed, and preparatory steps have been taken.

3.3 EXECUTION

.1 Disturbance of materials with lead or LOPC:

.1 Using a HEPA vacuum, remove all loose LOPC coatings or dust which may pose an increased worker exposure risk, prior to disturbing materials as appropriate.

.2 Use sprayer (low-velocity, fine-mist) to mist (not wet) materials containing lead or other metals to be cut or scraped or removed. Perform work to reduce dust creation to lowest levels practicable.

.2 Removal of LOPC coatings or disturbance of lead using power tools or non-powered hand tools to scrape, sand or otherwise remove the LOPC by abrasive means without an effective HEPA dust collection system is prohibited.

.1 Use of HEPA filtered tools for the removal or disturbance of LCP or lead shall be approved by DCC representative.

.3 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.

.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. Wash containers thoroughly pending removal to outside. Ensure containers are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.

.5 After completion of stripping work, wire brush and wet sponge surface from which lead-based paint has been removed to remove visible material. During this work keep surfaces wet.

.6 After wire brushing and wet sponging to remove visible lead-based paint, and after encapsulating lead-containing material impossible to remove, wet clean entire work area, and equipment used in process. After inspection by Departmental Representative apply continuous coat of slow drying sealer to surfaces of work area. Do not disturb work area for 8 hours no entry, activity, ventilation, or disturbance during this period.

.7 Where possible, minimize disturbance of lead or LOPC materials.

.8 During lead work, should the DCC representative suspect contamination of areas outside the lead or LOPC work area:

.1 Contractor to stop remediation work and immediately decontaminate affected areas and eliminate causes of such contamination.

.2 Prohibit individuals from entering these contaminated areas until a visual inspection determines area is acceptable for work.

.3 DCC or their representative to confirm work conditions and authorize continuation of work.

.9 On completion of LOPC disturbance, where reasonably practicable, clean work area by removing debris and using HEPA vacuum and/or by damp to minimize potential worker exposure.

.10 Leave areas reasonably free from contamination, debris and dust.

.11 After clean-up within barrier dismantle, barrier and dispose if required.

.12 If warranted, Contractor may leave barriers in place to isolate lead or LOPC work areas and minimize worker exposure issues.

## Part 4 Inspection and Sampling

### 4.1 INSPECTION

.1 From commencement of work until completion of clean-up operations, The DCC representative is empowered to inspect for compliance with the requirements of the governing authorities, adherence to specifications and to inspect for cleanliness and completion both inside and outside asbestos work area(s).

.2 The DCC representative may inspect both inside and outside the work area during active disturbance.

.3 The DCC representative is empowered to shut-down all work activities when leakage of lead or LOPC from the work area has occurred or is likely to occur.

.4 The Contractor is to allow inspection by the DCC representative and provide full access to the work area. The Contractor shall make good on any work disturbed by the inspection at no cost to The Crown.

.5 If LOPC work area(s) or adjacent areas are found unacceptable in accordance with standards specified or required by authorities having jurisdiction, correct such deficiencies at no cost to The Crown.

.6 Pay cost to provide re-inspection of work found not to be in accordance with these specifications and requirements of authorities having jurisdiction.

4.2 AIR AND SURFACE SAMPLING

.1 Air and surface sampling may be performed within and immediately adjacent to each active lead work area by the DCC Representative. Results obtained from all test monitoring shall be posted at the work site and provided to DCC, the General Contractor for the Project (if present) and the Contractor.

.1 Air sampling may include occupational and area samples.

.2 The requirement for air and surface sampling will be determined by the DCC representative.

.3 All air samples must be collected and analysed in accordance with Ontario Ministry of Labour requirements.

.4 If air monitoring or visual inspection indicates that areas outside current lead work area enclosures are contaminated above the designated action level, clean these areas in same manner as that applicable to asbestos work areas, at no cost to The Crown.

.5 If air monitoring in work areas shows that removal procedures are not sufficient to maintain airborne levels of specified substances below that appropriate for the level of personal protective equipment employed by the Contractor, all work is to stop within the work area and removal procedures re-assessed.

END OF SECTION

# Part 1 General

## 1.1 SUMMARY

.1 Comply with requirements of this Section when performing following Work:

.1 Disturbance of paint coatings containing lead, mercury, arsenic and/or chromium (lead and other paint coatings; LOPC) by scraping or sanding or removing of materials with affected paint coatings using non-powered hand tools.

.2 Manual demolition of walls or building components with LOPC by striking wall with sledgehammer or similar tool.

.3 Where hand tools cannot be effectively used or where more major disturbance is expected (i.e. use of power saw), disturbance of materials coated with LOPC using a power tool with an effective dust collection system equipped with a HEPA (high efficiency particulate air) filter.

.4 Handling of lead-containing materials such as plumbing with lead solder.

## 1.2 RELATED SECTIONS

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

## 1.3 REFERENCES

.1 Refer to Section 02 81 00 - Hazardous Building Material - General Requirements.

## 1.4 DEFINITIONS

.1 Action Level Metals and PCBs: employee exposure, without regard to use of respirators, to airborne concentration of lead of 0.05 milligrams per cubic meter of air (0.05 $mg/m^3$) calculated as 8-hour time-weighted average (TWA). Type 2A intermediate precautions for lead abatement are based on airborne lead concentrations of >0.05 to 0.50 $mg/m^3$ of air for the work specified. Employee exposure, without regard to use of respirators, to airborne concentration of arsenic, mercury, lead or PCBs of less than one half of the occupational exposure level (OEL) as defined under the Ontario Occupational Health and Safety Act (OHSA).

.2 Lead dust or debris: wipe sampling on vertical surfaces and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot or if visible particles are evident to the DCC representative.

.3 Lead or LOPC work area: specific area or location where actual work is being performed which actively disturbs known or suspect lead materials or LOPC.

1.5 SUBMITTALS

.1 Submittals in accordance with Division 1, as applicable.

.2 Comply with submittals in accordance with Section 02 81 00 - Hazardous Building Material - General Requirements.

1.6 QUALITY ASSURANCE

.1 Comply with Section 02 81 00 - Hazardous Building Material - General Requirements.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Reference for any additional disposal requirements stipulated under 01 35 43

.2 Comply with Section 02 81 00 - Hazardous Building Material - General Requirements.

.3 The removal of building materials with lead or LOPC paint is not required prior to demolition, provided a licensed waste disposal facility can accept the waste,

.4 Check with local landfill operator, waste disposal site or recycler to confirm disposal and handling requirements are acceptable.

.5 Where lead or LOPC must be removed prior to demolition to meet waste disposal requirements, lead and LOPC must be removed prior to demolition. All removed lead or LOPC waste must be handled in accordance with applicable legislation and waste disposal facility requirements.

1.8 EXISTING CONDITIONS

.1 Comply with Section 02 81 00 - Hazardous Building Material - General Requirements regarding lead containing paint requiring abatement.

.2 Results of bulk samples of paint coatings to be handled, removed, or otherwise disturbed and disposed of during this work are bound into this specification. The results are for general information only and are not necessarily representative of all paint coatings covered in the work area.

.3 Notify the DCC Representative of suspect LOPC discovered during work and not apparent from drawings, specifications, or report pertaining to the work. Do not disturb such material until instructed by the DCC representative.

.4 The presence of Lead-Containing Materials, and their estimated quantities, that require removal under Type 2A Lead and Other Paint Coatings precautions that have been identified at the site are as follows:

.1 Lead-containing, non-leachate grey floor paint in mechanical room, approximately 5$m^2$.

.2 Lead-containing, non-leachate white wall paint in mechanical room, approximately 5m$^2$.

.3 Lead-containing beige duct paint in 2$^{nd}$ floor mechanical room, approximately 15m$^2$.

.4 Lead-containing yellow corridor and stairwell wall paint, approximately 5m$^2$.

1.9 SCHEDULING

.1 Conform to Section 02 81 00 - Hazardous Building Material - General Requirements.

1.10 PERSONNEL TRAINING

.1 Conform to Section 02 81 00 - Hazardous Building Material - General Requirements.

1.11 WORKER AND VISITOR PROTECTION

.1 Instructions: Before entering lead OR LOPC work area(s), instruct workers and visitors in use of respirators (including fit testing), entry and exit from enclosures and all aspects of work procedures and protective measures including appropriate protective clothing, lead awareness and/or abatement training. A competent person, as defined by Ontario Occupational Health and Safety Act (OHSA), shall provide instruction.

.2 Respirators: Provide appropriate respiratory equipment for all persons entering lead work area including authorized visitors. The following shall apply to the use of respirators:

.1 During active work where there is an airborne expose potential, all workers, supervisors, and authorized visitors shall wear, at minimum, non-powered half-face respirators with minimum N, R or P100 filter cartridges in accordance with NIOSH Part 84 requirements.

.2 Filters shall be replaced daily or tested according to manufacturer's specifications and replaced as necessary. All waste filters shall be disposed as lead or LOPC waste.

.3 Respirators shall be acceptable to the Ontario Ministry of Labour.

.4 Provide instruction to workers and visitors in use of respirators including quantitative or qualitative fit testing.

.5 A worker will not 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.

.6 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.

.7 No supervisor, worker or authorized visitor shall have facial hair which may affect the seal between the respirator and face.

.8 Maintain respiratory protection equipment in proper functioning and clean condition. The respirator is to be cleaned, disinfected and inspected after use on each shift, or more often if necessary. The respirator is 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.

.3 Protective Clothing: Provide workers and visitors conducting lead or LOPC work or present in the work area with:

.1 New disposable type protective coveralls and dermal protection (gloves) that do not readily retain or permit penetration of lead or LOPC.

.1 Coveralls and dermal protection are to be provided by the employer and worn by every worker who enters the work area.

.2 Coveralls are to consist of a head covering and full body covering that fit snugly at the ankles, wrists and neck, in order to prevent lead from reaching the garments and skin under the protective clothing.

.3 Use impervious gloves suitable for the cleaning of lead surfaces and the use of any applicable lead cleaning agent.

.2 Once coveralls are worn, treat and dispose as lead contaminated waste.

.3 Workers and visitors shall also wear any other protective apparel not identified in this specification but required by the Ontario Ministry of Labour.

.4 Footwear shall be of a suitable type that will prevent dust penetration and able to be wet wiped.

.4 Set up an isolated worker decontamination area adjacent to the lead or LOPC work area. The facilities must consist of a HEPA filtered vacuum, bucket of warm water, soap, rags, and disposal container for lead or LOPC contaminated protective clothing. Eating, drinking, chewing, and smoking are not permitted in Lead or LOPC Work Area.

.5 Before entering lead work area(s), don appropriate respirator with new or tested filters, new disposable coveralls, and dermal protection.

.6 Persons leaving lead work area(s) shall:

.1 HEPA (high efficiency particulate air) vacuum or wet wipe clothing and respirator to remove gross contamination.

.2 Remove contaminated coveralls and place in receptacles for disposal with other lead-contaminated materials.

.3 Remove contaminated dermal protection and place in receptacles for disposal with other lead-contaminated materials.

.4 Still wearing appropriate respirator (if using), proceed out of the established lead work area to the decontamination facility.

.5 Clean using soap and warm water wash and remove respirator (if using) then thoroughly wash hands and face. Remove filters and dispose of as lead waste in container provided for this purpose or test filters according to manufacturer's recommendation. Dispose of filters as necessary. Wet clean inside of respirator.

.6 Upon completion of lead work, dispose of footwear as contaminated waste or clean.

.7 Workers and visitors shall be protected at all times when a possibility of lead or LOPC disturbance exists.

.8 A copy of the procedures described under Worker and Visitor Protection shall be posted at access points to the lead or LOPC work area.

.1 Procedures shall be in both official languages if required.

.9 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 lead work area.

.10 Where other abatement or hazardous materials work is occurring the work area, the stricter of the specified Worker and Visitor Protection measures shall apply.

## Part 2 Products

### 2.1 MATERIALS

.1 Polyethylene 0.15 mm thick unless otherwise specified; in sheet size to minimize joints.

.2 Tape: fibreglass-reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.

.3 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 LOPC paint residue.

.4 Lead or LOPC waste containers: Metal, polyethylene or fibre type acceptable to dump operator and Ontario Ministry of Environment with tightly fitting covers and 0.15 mm thickness sealable polyethylene liners.

.1 Label containers with pre-printed cautionary Warning - Contains "WASTE NAME" clearly visible when ready for removal to disposal site. Bilingual warning labels shall be provided if requested.

.2 Materials such as wire or solder which are to be recycled or otherwise disposed of may not require containers. Materials shall be segregated and denoted as lead-containing.

## Part 3 Execution

### 3.1 SUPERVISION

.1 Lead and LOPC Work Area and areas adjacent and around area to be unoccupied.

.2 Complete isolation measures between the lead and LOPC work area and occupied areas using tape barriers, saw-horses, fencing with polyethylene or other barriers, etc. at the perimeter of the lead work area.

### 3.2 PREPARATION OF LEAD and LOPC WORK AREA(s)

.1 Lead and LOPC Work Area and areas adjacent and around area to be unoccupied.

.2 Complete isolation measures between the lead and LOPC work area and occupied areas using tape barriers, saw-horses, fencing with polyethylene or other barriers, etc. at the perimeter of the lead work area.

.1 A sealed work enclosure is not expected to be required.

.2 Isolation of the work area using polyethylene sheeting may be considered to create a barrier between the work area and occupied spaces to minimize worker exposure.

.3 Pre-clean fixed casework and equipment within work area, using HEPA vacuum and cover and seal with polyethylene sheeting and tape. Clean work area using HEPA vacuum. If not practicable, use wet cleaning method. Do not raise dust.

.3 If required, erect critical barriers around perimeter of Lead or LOPC Contaminated Work Area before disturbance using two layers of 6 mil fibre-reinforced polyethylene sheeting. For larger areas, a steel or wooden stud frame can be erected, and fibre-reinforced polyethylene sheeting attached to it.

.4 Erect appropriate worker and waste decontamination facilities at locations approved by DCC Representative.

.5 Shut off and isolate HVAC system or isolate air intakes and exhausts to prevent dust dispersal into other building areas.

.6 Before beginning work, at each access to contaminated work area, install warning signs in both official languages (if required) in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used:

CAUTION (25 mm high) / Lead Hazard Area (19 mm high) /

Unauthorized Entry Prohibited (19 mm high) /

Wear Assigned Protective Equipment (19 mm high) /

Breathing Dust May Cause Serious Bodily Harm (19 mm high).

3.3 EXECUTION

.1 Disturbance of materials with lead or LOPC:

.1 Using a HEPA vacuum, remove all loose LOPC coatings or dust which may pose an increased worker exposure risk, prior to disturbing materials as appropriate.

.2 Use sprayer (low-velocity, fine-mist) to mist (not wet) materials containing lead or other metals to be cut or scraped or removed. Perform work to reduce dust creation to lowest levels practicable.

.2 Removal of LOPC coatings or disturbance of lead using power tools or non-powered hand tools to scrape, sand or otherwise remove the LOPC by abrasive means without an effective HEPA dust collection system is prohibited.

.1 Use of HEPA filtered tools for the removal or disturbance of LCP or lead shall be approved by the DCC representative.

.3 Where possible, minimize disturbance of lead or LOPC materials.

.4 During lead work, should the DCC representative suspect contamination of areas outside the lead or LOPC work area:

.1 Contractor to stop remediation work and immediately decontaminate affected areas and eliminate causes of such contamination.

.2 Prohibit individuals from entering these contaminated areas until a visual inspection determines area is acceptable for work.

.3 DCC representative to confirm work conditions and authorize continuation of work.

.5 On completion of LOPC disturbance, where reasonably practicable, clean work area by removing debris and using HEPA vacuum and/or by damp to minimize potential worker exposure.

.6 Leave areas reasonably free from contamination, debris and dust.

.7 After clean-up within barrier dismantle, barrier and dispose if required.

.8 If warranted, Contractor may leave barriers in place to isolate lead or LOPC work areas and minimize worker exposure issues.

## Part 4 Inspection and Sampling

### 4.1 INSPECTION

.1 From commencement of work until completion of clean-up operations, The DCC representative is empowered to inspect for compliance with the requirements of the governing authorities, adherence to specifications and to inspect for cleanliness and completion both inside and outside asbestos work area(s).

.2 The DCC representative may inspect both inside and outside the work area during active disturbance.

.3 The DCC representative is empowered to shut-down all work activities when leakage of lead or LOPC from the work area has occurred or is likely to occur.

.4 The Contractor is to allow inspection by the DCC representative and provide full access to the work area. The Contractor shall make good on any work disturbed by the inspection at no cost to The Crown.

.5 If LOPC work area(s) or adjacent areas are found unacceptable in accordance with standards specified or required by authorities having jurisdiction, correct such deficiencies at no cost to The Crown.

.6 Pay cost to provide re-inspection of work found not to be in accordance with these specifications and requirements of authorities having jurisdiction.

### 4.2 AIR AND SURFACE SAMPLING

.1 Air and surface sampling may be performed within and immediately adjacent to each active lead work area by the DCC Representative. Results obtained from all test monitoring shall be posted at the work site and provided to DCC, the General Contractor for the Project (if present) and the Contractor.

.1 Air sampling may include occupational and area samples.

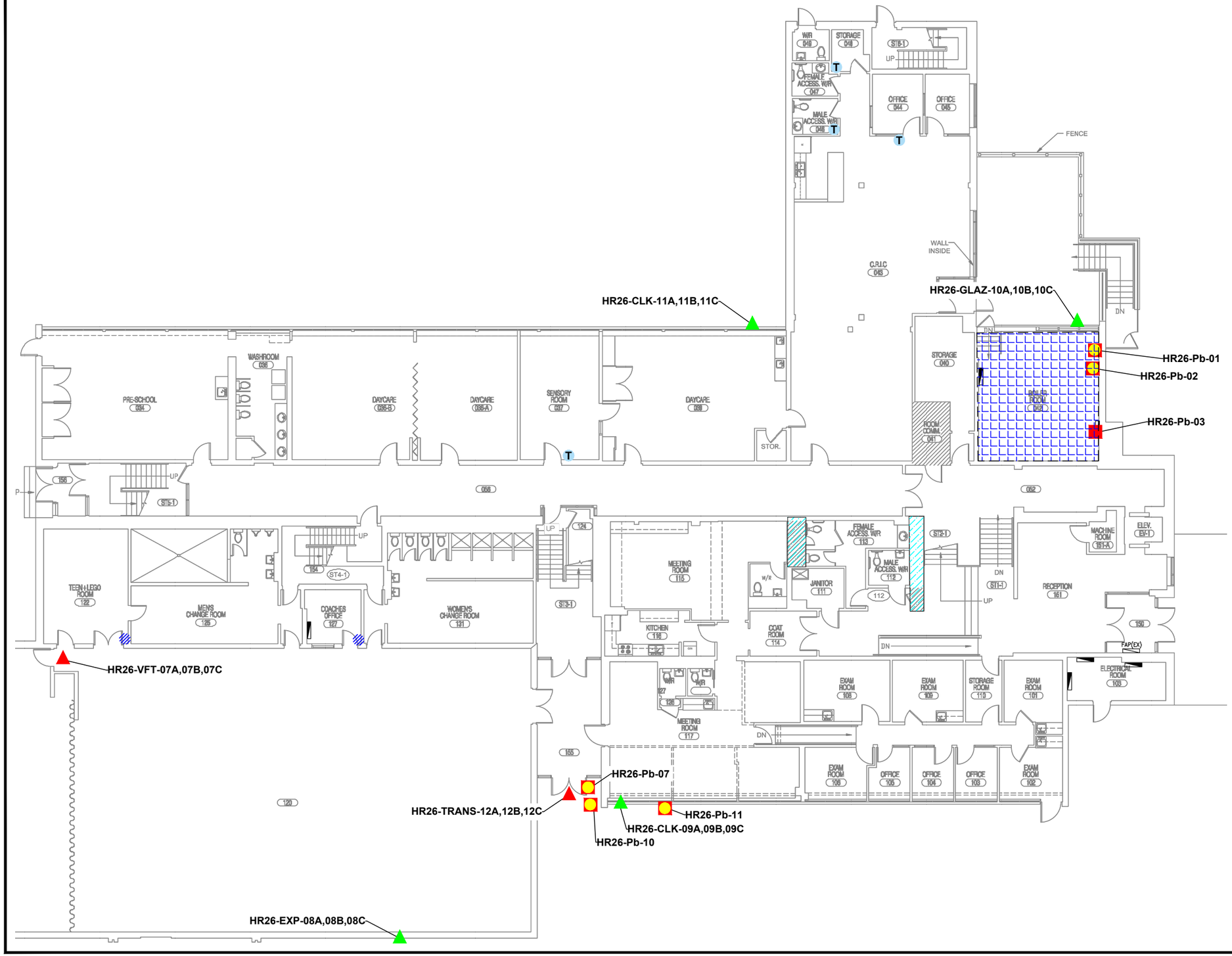
.2 The requirement for air and surface sampling will be determined by the DCC representative.

.3 All air samples must be collected and analysed in accordance with Ontario Ministry of Labour requirements.

.4 If air monitoring or visual inspection indicates that areas outside current lead work area enclosures are contaminated above the designated action level, clean these areas in same manner as that applicable to asbestos work areas, at no cost to The Crown.

.5 If air monitoring in work areas shows that removal procedures are not sufficient to maintain airborne levels of specified substances below that appropriate for the level of personal protective equipment employed by the Contractor, all work is to stop within the work area and removal procedures re-assessed.

END OF SECTION




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LEVEL OF SECURITY | NIVEAU DE SÉCURITÉ

**TO BE REVIEWED | À ÊTRE RÉVISÉ**

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**LEGEND**

- ASBESTOS-CONTAINING SAMPLE LOCATION
- NON-ASBESTOS-CONTAINING SAMPLE LOCATION
- METALS-CONTAINING SAMPLE LOCATION
- NON-METALS-CONTAINING SAMPLE LOCATION
- PCB SAMPLE LOCATION
- T MERCURY CONTAINING THERMOSTAT
- SUSPECTED TRANSITE PIPE
- INACCESSIBLE AREAS
- LEVEL 1/2A LEAD ABATEMENT AREA
- TYPE 3 ASBESTOS ABATEMENT AREA

| NO. | DATE | REVISION | APPR. |
|---|---|---|---|
| 1 | 2026-01-26 | 0 | S.H. |
| 2 | | | |
| 3 | | | |

SCALE | ÉCHELLE: N/A

LOCATION | EMPLACEMENT: **BLDG. HR26, 32 LUNDY'S LANE. KINGSTON, ONTARIO**

PROJECT | PROJET: BUILDING HR26 HVAC UPGRADES AT CFB KINGSTON, ONTARIO

TRADE | MÉTIER: N/A

DATE: 2026-01-26

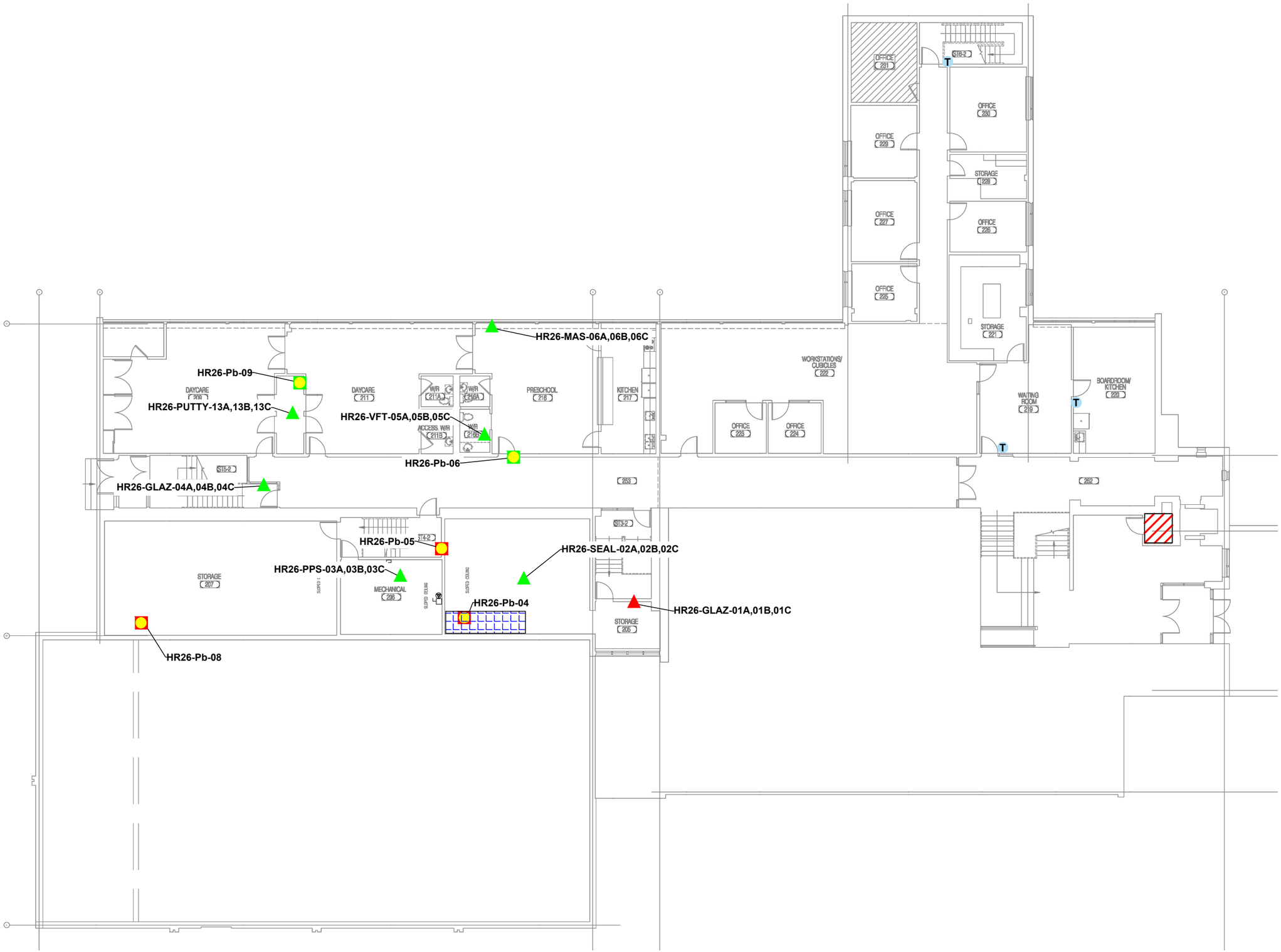
SUBJECT | SUJET: **ASBESTOS, METALS, PCB SAMPLE AND ABATEMENT LOCATIONS**

**GROUND FLOOR AND EXTERIOR**

| PRODUCTION | REVIEWED \| REVU | |
|---|---|---|
| DESIGNED \| ÉTUDIÉ | CUSTOMER \| CLIENT: DCC | DES O \| AGENT CONC |
| DRAWN \| DESSINÉ: R. OCKRANT | | PROJ MGR \| GEST PROJ: S. HEIKKILA |
| CHECKED \| VERIFIÉ: S. HEIKKILA | | DES MGR \| GEST CONC |
| COORDINATION | | FIRE \| INCENDIE |

WBS NO. | NO. OTP | PF NO. | NO. DP

DWG. NO. | NO. DESSIN




Government of Canada | Gouvernement du Canada

LEVEL OF SECURITY | NIVEAU DE SÉCURITÉ

**TO BE REVIEWED | À ÊTRE RÉVISÉ**

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**LEGEND**

- ASBESTOS-CONTAINING SAMPLE LOCATION
- NON-ASBESTOS-CONTAINING SAMPLE LOCATION
- METALS-CONTAINING SAMPLE LOCATION
- NON-METALS-CONTAINING SAMPLE LOCATION
- PCB SAMPLE LOCATION
- T MERCURY CONTAINING THERMOSTAT
- SUSPECTED TRANSITE PIPE
- INACCESSIBLE AREAS
- LEVEL 1/2A LEAD ABATEMENT AREA
- TYPE 3 ASBESTOS ABATEMENT AREA

| NO. | DATE | REVISION | APPR. |
|---|---|---|---|
| 1 | 2026-01-26 | 0 | S.H. |
| 2 | | | |
| 3 | | | |

SCALE | ÉCHELLE: N/A

LOCATION | EMPLACEMENT: **BLDG. HR26, 32 LUNDY'S LANE. KINGSTON, ONTARIO**

PROJECT | PROJET: BUILDING HR26 HVAC UPGRADES AT CFB KINGSTON, ONTARIO

TRADE | MÉTIER: N/A

DATE: 2026-01-26

SUBJECT | SUJET: **ASBESTOS, METALS, PCB SAMPLE AND ABATEMENT LOCATIONS**

**SECOND FLOOR**

PRODUCTION

| DESIGNED \| ÉTUDIÉ | REVIEWED \| REVU: CUSTOMER \| CLIENT: DCC | DES'D \| AGENT CONC. |
|---|---|---|
| DRAWN \| DESSINÉ: R. OCKRANT | | PROJ MGR \| GEST PROJ: S. HEIKKILA |
| CHECKED \| VÉRIFIÉ: S. HEIKKILA | | DES MGR \| GEST CONC |
| COORDINATION | | FIRE \| INCENDIE |

WBS NO.: | NO. OTP | PF NO.: | NO. DP

DWG. NO.: | NO. DESSIN

# PART 1 GENERAL

## 1.1 WORK INCLUDED

.1 Provide all labour, materials, equipment, and services to supply and erect structural steel required as indicated on the drawings.

## 1.2 REFERENCE STANDARDS

.1 All referenced Standards are latest editions referenced by the Building Code in the Place of the Work, or latest editions if not referenced by Code.

.2 National Building Code of Canada

| | | |
|---|---|---|
| .3 | CSA S16 | Design of Steel Structures |
| .4 | CSA S136 | North American Specification for the Design of Cold-Formed Steel Structural Members |
| .5 | CSA W47.1 | Certification of Companies for Fusion Welding of Steel Structures |
| .6 | CSA W59 | Welded Steel Construction (Metal-Arc Welding) |
| .7 | CSA G40.20/G40.21 | General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel |

## 1.3 QUALIFICATIONS

.1 Steel fabricators and erectors must be certified under the requirements of CSA W47.1 as required by CSA S16.

.2 Welding procedures, welders, and welding operations shall be qualified in accordance with the Canadian Welding Bureau Standards.

.3 All connections shall be designed by a CISC-approved Fabricator unless otherwise noted.

## 1.4 EXAMINATION

.1 All dimensions taken from the Drawings are to be confirmed on site prior to fabrication. Contractor is to be responsible for the correctness of such measurements and report to the DCC Representative in writing all discrepancies between measurements at building and those shown on drawings prior to commencing work. Verify location of anchor bolts and embedded steel and ensure that work prepared by other trades is at a proper elevation, on-line, level, and true.

.2 Contractor to locate all mechanical/electrical openings required in structural members for existing systems prior to fabrication.

.3 Contractor responsible for all costs associated with site location of existing conduits and mechanical.

## 1.5 SHOP DRAWINGS

.1 Drawings, which accompany these specifications, are to be used for estimating purposes only, and show in general the type of construction that shall be followed, but must not be considered as fabrication drawings.

.2 Submit detailed erection and shop drawings prepared under the supervision of a Registered Professional Engineer in accordance with the General Requirements. Where pre-engineered or fabricator designed elements are part of the shop drawings, the shop drawings shall be stamped by a Professional Engineer licensed in Ontario.

.3 The shop drawings shall clearly show all shop and erection details, including cuts, copes, connections, holes, threaded fasteners, splices, and welds. All welds, both shop and field, shall be indicated by AWS welding Symbols as specified in CSA W59 Appendix D and E.

.4 Shop drawings shall be submitted in an orderly sequence and sufficiently in advance of the work proceeding so as to not affect the schedule of the Work. The Contractor and the DCC Representative shall jointly determine the schedule for which the shop drawing submissions shall occur.

.5 The DCC Representative’s review of the shop drawings is for general conformance only and does not relieve the Contractor of the responsibility for errors or omissions that may be present in the shop drawings.

.6 Upon request by the DCC Representative, the Contractor shall revise and resubmit the shop drawings.

.7 Provide setting drawings, templates and directions for the installation of bolts, plates and other devices.

.8 Structural drawings are not prepared to be used in sepia form as erection drawings.

.9 Shop drawings shall show complete details necessary for fabrication and erection of the component parts of the structure, including location, type, size and extent of all welds, as well as all mechanical/electrical openings required. Splices not shown on the shop drawings will not be accepted.

.10 Prior to starting erection work, submit a description of the methods, sequence of erection and type of equipment proposed for use in erecting structural steel.

## 1.6 INSPECTION AND TESTING

.1 The DCC Representative will engage and pay for the services of a welding Engineer and a testing agency.

.2 Allow free access to all parts of the work area for the purposes of inspection at all times.

.3 Prior to commencement of work, provide a schedule of shop fabrication.

.4 Submit certified results of testing in accordance with CSA G40.20 properly correlated to the elements being fabricated.

.5 High tensile bolts will be tested in accordance with Section 23 of CSA S16.

.6 For the purpose of bidding, assume all welds will be examined by a non-destructive testing method.

.7 The Contractor shall advise the testing agency of the scheduling of all shop and field work pertaining to this Project. The Contractor shall permit the testing agency full access to the fabrication shop and the site for the purpose of carrying out their work and he shall provide assistance required to aid in the performance of the inspection and testing.

.8 The DCC Representative may reject at any time during the progress of the work a piece of material for any member found defective or not in accordance with the detailed drawings. This material may be rejected notwithstanding any previous acceptance and components so rejected shall be replaced at no expense to the Owner. In case of dispute, the decision of the DCC Representative shall be final.

### 1.7 STORAGE AND HANDLING

.1 The Contractor shall be responsible for the protection of all steel work during fabrication, shipping, storage, and construction. All small bends and damage shall be reported to the DCC Representative for instruction. Steel work that is bent, broken, or otherwise damaged shall be replaced by the Contractor prior to erection, to the satisfaction of the DCC Representative, at no cost to the Owner.

.2 The Contractor shall be responsible for proper scheduling of delivery and erection for the structural steel, all in accordance with the construction schedule.

.3 Structural steel members shall be stored at the site above ground on platforms, skids, or other devices.

.4 Steel shall be protected from corrosion.

.5 Other material shall be stored in a weather tight and dry place until ready for use in the Work.

.6 Package materials shall be stored in their original unbroken packages or container.

### 1.8 COORDINATION WITH OTHER TRADES

.1 Supply all necessary instructions and drawings to other trades for setting bearing plates, and other members that are built in with the work of other trades. Supply the necessary material in accordance to the construction schedule.

## PART 2 PRODUCTS

### 2.1 MATERIALS

.1 Rolled shapes, rolled plate, and welded wide flange sections to CSA G40.21 300W.

.2 Hollow structural sections shall be to CSA G40.21 350W Class C.

.3 High strength bolts shall be to ASTM F3125/F3125M.

.4 Welding material shall be in accordance with CSA W59.

.5 Touch-up primers for exterior exposure not to receive a shop or field paint finish shall be zinc chromate Type 1, conforming to CGSB 1-GP-40D.

.6 Primers used in a multi-coat system where a final shop or field paint finish is to be applied shall be selected and pre-approved based on surface preparation, exposure conditions, and compatibility with subsequent coatings.

### 2.2 DESIGN

.1 All connections and beam web openings shall be designed by the fabricator to the reference standards unless otherwise noted.

## PART 3 EXECUTION

### 3.1 FABRICATION

.1 Verify all dimensions and take necessary field measurements before fabrication.

.2 All fabrication shall be to CSA S16.

.3 All welding shall be to CSA W59.

.4 All fabricated units shall be straight and true and without sharp kinks or bends.

.5 All plates and shapes shall be inspected visually for laminations. Repair plates or shapes that contain laminations in a manner approved by the DCC Representative.

.6 Provide punched holes for the convenience of other trades in attaching wood blocking or other materials. Coordinate with drawings of other disciplines for location and details.

.7 Obtain DCC Representative’s approval for holes required through structural steel that are not shown on the drawings.

### 3.2 CLEANING AND PRIMING

.1 All steel shall be thoroughly cleaned of loose mill scale, loose rust, oil, or dirt.

.2 All steel shall be primed (exterior exposure) except for steel to be encased in concrete, steel to be fireproofed, steel that will receive shear studs, and faying surfaces of friction connections.

.3 Structural steel to be primed for exterior exposure or to receive a shop or field paint finish shall be cleaned in accordance with SSPC-SP6 “Commercial Blast Cleaning”.

.4 All primers shall be applied strictly in accordance with the manufacturer’s instructions. Apply one coat of primer thoroughly and evenly and work well into the joints and other open spaces.

.5 After erection and after connections are completed, provide a field touch-up coat of primer to all surfaces that had no shop coat, or have been chipped or scraped.

## 3.3 SHOP PAINTING

.1 Steel shall be painted with shop primer meeting the requirements of CSA S16 unless noted otherwise.

## 3.4 CONNECTIONS

.1 Use connections of type and detail shown on the Drawings. Modifications to the specified connection types and details will not be permitted without prior approval from the DCC Representative.

.2 Connections designed by the fabricator shall be in accordance with CSA S16.1 and stamped and sealed by a Professional Engineer registered in the Province of Ontario.

.3 All connections shall be designed to carry the loads specified on the Drawings. If loads are not given, the connection shall have the capacity not less than the members being connected.

.4 Column to beam and girder connections shall allow for a horizontal stability force in all directions equal to 2% of the design column axial load in addition to all other loads.

.5 Structural steel members spliced for ease of fabrication or transportation shall have splices designed to develop the full strength and stiffness of the member. Splices shall be subject to non-destructive testing as directed by the DCC Representative. The cost for such testing shall be borne by the Contractor.

.6 Use standard connection types where possible.

.7 Provide stiffeners in beam webs at all locations of beam continuity. Unless noted otherwise web stiffeners shall be 12 mm minimum.

## 3.5 SEPARATORS AND MISCELLANEOUS SUPPORTS

.1 Provide separators for all double members in accordance with CSA S16.

.2 Provide plates and / or angles for support of masonry where required.

## 3.6 ERECTION

.1 Install all temporary bracing that is required to stabilize the work against wind, earthquake, and construction loads. Keep structure true and plumb until completion of the building.

.2 As erection progresses, the work shall be securely bolted up to take care of all dead loads, wind, and erection stresses. Any failure to make proper and adequate provisions for stresses during erection shall be solely the responsibility of the Contractor.

.3 The structural steel erector shall be responsible for the design of all hooks, erection connections, and handling gear.

.4 Whenever piles of materials, erection equipment, or other loads are carried during erection, proper provision shall be made to take care of stresses resulting from it.

.5 All structural steel shall be assembled and erected in accordance with the approved erection drawings and specified reference standards.

.6 Plumb, level, and align individual members of steel work as specified in CSA S16.

.7 Structural steel frames shall be accurately assembled to the lines and elevations indicated within the specified tolerances.

.8 The various members forming parts of complete frame of structure after being assembled shall be aligned and adjusted accurately before being fastened.

.9 Bearing surfaces and surfaces that will be in permanent contact shall be cleaned before the members are assembled.

.10 Temporary bolts, clips, angles, etc. used to facilitate the erection shall be removed unless noted otherwise on the drawing.

**3.7 TEMPORARY FLOORING**

.1 Provide all temporary flooring, planking, and scaffolding necessary in connection with erection of structural steel, or support of erection machinery in accordance with governing regulations or by-laws.

**3.8 COMPLETION**

.1 The Registered Professional Engineer responsible for the shop drawings, or their representative shall visit to review in place connections and components designed by that Registered Professional Engineer as required to substantiate compliance with their sealed shop drawings. They shall then submit a letter of compliance with a seal to the DCC Representative.

.2 On completion of the work of this section, all protection erected in conjunction with the structural steel work shall be removed, all damage to this work and adjoining work shall be made good, and all surplus materials, debris, tools, and equipment shall be removed from the site.

**3.9 WELDING**

.1 All welding shall be done by the shielded metal-arc method in accordance with the requirements CSA W59. The welding operators shall have passed, within the preceding six months, the qualifications test as set forth in CSA W47.1.

.2 Submit welding procedures prepared and sealed by a Professional Engineer registered in Ontario and familiar with this discipline to the DCC Representative for their examination and comments.

.3 Surface to be welded shall be free from loose scale, rust, paint, or other foreign matter. Where weld material is deposited in two or more layers, each layer shall be cleaned before the next layer is deposited. Take care to minimize stresses due to heat expansion, contraction, and distortion by using proper sequence in welding and by approved methods.

.4 Welding consumables for all processes shall be fully approved by the Canadian Welding Bureau and certified by the manufactures as complying with the requirement of this specification. Such certificates shall be not more than two years old.

.5 Electrode strengths to be equal to E480XX (E70xx) or better.

## 3.10 FIELD QUALITY CONTROL

.1 Structural steel work (material and workmanship) shall be subject to review and tested by a testing agency retained by the DCC Representative.

.2 Construction review by the testing agency, DCC Representative does not relieve the Contractor of their responsibility to furnish materials and workmanship in accordance with the Drawings and Specifications.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SYSTEMS DESCRIPTION

.1 This Section specifies fire stop systems and/or fire stop materials intended to fill gaps between fire separations, between fire separations and other construction assemblies, or used in or around items which fully or partially penetrate a fire separation, to restrict the spread of fire and smoke thus maintaining the integrity of a fire separation.

.2 This Section includes requirements for:
- .1 Through-penetration fire stops:
  - .1 For openings created to allow a penetrating item such as piping, conduits, raceways, ducts, cable trays, cables, tubing or structural components to pass completely through a fire separation or fire-resistance rated assembly.
- .2 Membrane penetration fire stops:
  - .1 For openings where penetrating items such as piping, conduits, raceways, ducts, cable trays, cables, tubing, recessed components (e.g.: panels, electric boxes, devices) or structural components pass through only one membrane of a fire separation or fire-resistance rated assembly.
- .3 Blank opening fire stops:
  - .1 For openings created in a fire separation where the penetrating item has not yet been installed or has been removed.
- .4 Construction joint fire stops:
  - .1 For locations where adjacent fire separations or components of fire separations meet. These locations include: ceiling/wall and roof/wall joints, wall/wall joints at corners or in the same plane, wall/floor joints, floor/floor joints and ceiling/ceiling joints.
  - .2 Includes fire stops for seismic joints, vertical control joints, expansion joints, and joints which occur at the tops and bottoms of fire separation walls.
  - .3 Includes fire stops for head of wall to non-rated roof or floor assemblies.
- .5 Building perimeter fire stops:
  - .1 For the space between a fire-resistance rated floor assembly and the curtain wall (e.g.: safing slot gaps).

.3 This Section includes fire stopping work for entire Project including selection, installation and inspection of all required fire stops.

## 1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)
- .1 ASTM E 595-15, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment.
- .2 ASTM E 2032-09(2013), Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E?119.
- .3 ASTM E 2174-14b, Standard Practice for On-Site Inspection of Installed Firestops.
- .4 ASTM E 2307-15be1, Standard Test Method for Determining Fire Resistance of Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus.
- .5 ASTM E 2393-10a(2015), Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .6 ASTM E 2837-13(2017), Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.

.2 Firestop Contractors International Association (FCIA)
.1 FCIA Firestop Manual of Practice, 6th Edition 2015.

.3 Factory Mutual Approvals (FM)
.1 FM 4991, Approval Standard for Firestop Contractors.

.4 International Accreditation Service (IAS)
.1 IAS AC291, Accreditation Criteria for Special Inspection Agencies.

.5 International Firestop Council (IFC)
.1 IFC Guidelines for Evaluating Engineering Judgments.
.2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.
.3 IFC Inspection Guidelines for Penetration Firestop Systems and Fire Resistive Joint Systems in Fire Resistance Rated Construction, [5th Edition].

.6 National Research Council Canada (NRC)
.1 National Building Code of Canada 2015 (NBC).

.7 Underwriter's Laboratories of Canada (ULC)
.1 CAN/ULC-S115-11(R2016), Standard Method of Fire Tests of Firestop Systems.
.2 ULC Qualified Firestop Contractor Program.

## 1.3 DEFINITIONS

.1 Fire Blocking: materials, components or system installed in a concealed space in the building to restrict the spread of fire and smoke in that concealed space or from that concealed space to an adjacent space.

.2 Fire Stop: a material, component or system, and its means of support, used to protect gaps between fire separations, between fire separations and other construction assemblies, or used in openings where penetrating items wholly or partially penetrate fire separations, to restrict the spread of fire and smoke thus maintaining the fire-resistance continuity of a fire separation.

.3 Fire Stop System: the combination of specific materials and/or devices required with the penetrating item(s), the assembly and the opening to assemble the fire stop.

.4 Intumescent: materials that expand with heat to prevent fire spread through fire separations.

.5 Listed Fire Stop System: a specific field erected construction consisting of the assembly, fire stop materials, any penetrating items and their means of support which have met the requirements for an F, FT, FH, FTH and/or L rating when tested in a fire-resistance rated assembly in accordance with CAN/ULC-S115 - Standard Method of Fire Tests of Firestop Systems.

.6 F-Rating: the amount of time a fire stop system can remain in place without the passage of flame through the opening or the occurrence of flaming on the unexposed face of the fire stop.

.7 FT-Rating: a fire stop system with an F-Rating for the required time period which can also resists the transmission of heat through the fire stop during the same period and limit the rise in temperature on the unexposed face and/or penetrating item of the fire stop.

.8 FH-Rating: a fire stop system with an F-Rating for the required time period which can also resists the force of a hose stream without developing openings for a prescribed period.

.9 FTH-Rating: a fire stop system with an FT-Rating for the required time period which also passed the

hose stream test for a prescribed period.

.10 L-Rating: largest test sample leakage rate, determined in accordance with the optional air leakage test of CAN/ULC-S115.

.11 Multi-penetration: two or more service penetrations through an opening in the fire separation.

.12 Non-rated Fire Separation: fire separation acting as a barrier to the spread of smoke until a response is initiated such as the activation of a fire suppression system.

.13 Single-penetration: single service penetration through an opening in the fire separation.

.14 System Design Listing: document providing proof of testing with technical details, specifications and requirements that leads to the application of a specific listed fire stop system.

## 1.4 PRE-INSTALLATION MEETINGS

.1 Convene pre-installation meeting two weeks prior to beginning work of this Section, with Contractor's representative and DCC Representative to:
- .1 Verify Project requirements.
- .2 Review sustainable requirements.
- .3 Review installation and substrate conditions.
- .4 Coordinate with other building trades.
- .5 Review system design listings, manufacturer's installation instructions and warranty requirements.
- .6 Review quantity and location of mock-ups.

.2 Convene pre-installation meetings with other trades to review:
- .1 Installation procedures and precautions.
- .2 Location, scheduling and sequencing of other work around fire stops that can affect the outcome of the installation.
- .3 Requirements for annular opening sizes.
- .4 Requirements and preparations for wall/floor single and multi-penetrations.
- .5 Requirements for construction and perimeter joints.
- .6 Mock-up requirements.

.3 Submit copies of applicable listed fire stop system details to each trade for opening preparation. Include installation details required for the listed system.

.4 Meeting minutes: Contractor to take minutes of pre-installation meetings and distribute to DCC Representative and each affected trades.

## 1.5 SEQUENCING

.1 Proceed with installation only when submittals have been reviewed by DCC Representative.

.2 Fire stops located in floor assemblies: install before interior partition erections.

.3 Metal deck bonding: unless noted otherwise on system design listing and manufacturer's installation instructions, fire stopping to precede spray applied fireproofing to ensure required bonding.

.4 Pipe and duct insulation: certified fire stop system component.
- .1 Ensure pipe and duct insulation installation precedes fire stopping.

## 1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet. Submit complete product data for each individual component and include:
  - .1 Product name and product number.
  - .2 Product characteristics and performance criteria.
  - .3 Physical size, finish and limitations.
  - .4 Technical data on out-gassing, off-gassing and age testing.
  - .5 Curing time.
  - .6 Chemical compatibility to other construction materials.
  - .7 Shelf life.
  - .8 Life expectancy.
  - .9 Temperature range for installation.
  - .10 Humidity range for installation.
  - .11 Sound attenuation STC-Rating.
- .2 Manufacture Product Certification:
  - .1 Submit certification by the manufacturer that products supplied comply with local regulations controlling use of Volatile Organic Compounds (VOC's) and are non-toxic to building occupants.
  - .2 Submit test reports showing compliance to ASTM E 595.
- .3 For each individual component, Submit copies of WHMIS Safety Data Sheets (SDS).
- .4 Submit a comprehensive list of all products and components included in submittal.

.3 Shop Drawings:
- .1 Submit shop drawings showing system design listings for Project including proposed materials, reinforcement, anchorage, fastenings and method of installation.
- .2 Construction details to accurately reflect actual job conditions for each product and assembly.
- .3 Submit details for materials and prefabricated devices.
- .4 Submit electronic copy of shop drawings and include:
  - .1 Title page, labelled "Fire and Smoke Stop System Listings". Include project name, date and the names of the installation company and the manufacturer of proposed products.
  - .2 Table of Contents.
  - .3 List of each proposed listed fire stop system and corresponding service penetration type or joint type in a matrix spreadsheet schedule, indicating floor and wall system, including rating for each.
  - .4 Location of penetrations:
    - .1 Drawings showing the location of each penetration with a unique penetration identification number and associated listing number.
    - .2 Schedules listing each penetration with a unique identification number, their associated listing number, organized by floor, wall and ceiling area and indicating each room number.
  - .5 System Design Listings:
    - .1 Submit CAN/ULC-S115 design listings for each listed fire stop system and each application identified.
    - .2 When more than one product is specified for the listed fire stop system or more than one packing/damming material is indicated, identify the item that will be used on this Project.
  - .6 Certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling

criteria, installation sequence and cleaning procedures.

.5 Engineering Judgments:
- .1 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stop configuration, review systems from other manufacturers to obtain a listed fire stop system.
- .2 Submit an Engineering Judgment (EJ) from the system manufacturer if there are no listed systems available from other manufacturers.
- .3 Prepare and submit an EJ in accordance with best practices established in the following documents:
  - .1 IFC Guidelines for Evaluating Engineering Judgments.
  - .2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.
- .4 For each EJ submitted, include:
  - .1 Project name, number and location.
  - .2 A description of the proposed system with detailed drawing.
  - .3 Installation instructions.
  - .4 Complete descriptions of critical elements for the fire stop configuration.
  - .5 Copies of all referenced system design listings on which the EJ is based on.
  - .6 EJ issuer name and contact information.
  - .7 Date of issue of EJ with authorization signature of issuer.
  - .8 Manufacturer letter stating their opinion, with supporting justification, that the EJ will perform as a fire stop system were it to be subjected to the appropriate standard fire test method for the required fire rating duration.

.6 Once the EJ has been reviewed, submit the EJ to the authority having jurisdiction for final approval.

.7 EJ shall be issued only by fire stop manufacturer's qualified technical personnel or in concert with the manufacturer by a knowledgeable registered Professional Engineer, a Fire Protection Engineer or an independent testing agency that provides testing and listing services for fire stop systems similar to the EJ being contemplated.

.8 EJ shall be based upon interpolations of previously tested fire stop systems that are either sufficiently similar in nature or clearly bracket the conditions upon which the Engineering Judgment is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g.: ASTM E 2032) may also be used as further support data.

.9 EJ shall be based upon knowledge of the elements of the construction to be protected and understanding of the probable behaviour of that construction and the recommended fire stop system protecting it were they to be subjected to the adequate standard fire test method for the required fire rating duration.

.10 EJ shall be limited to the specific conditions and configurations upon which EJ was rendered and should be based upon reasonable performance expectations for the recommended fire stop system under those conditions.

.11 EJ shall be accepted only for a single specific job and location and should not be transferred to any other job or location without thorough and appropriate review of all aspects of the next job or location's circumstances.

.12 Manufacturer's Field Reports: submit manufacturer's written reports within [3] days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

## 1.7 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual. Include:
- .1 WHMIS Safety Data Sheets (SDS).
- .2 Product data and manufacturer's installation and maintenance instructions for each product/system used on this project.
- .3 Approved system design listings and Engineering Judgments.
- .4 Matrix schedule listing all system design listings and Engineering Judgments with a description of their penetration or joint type.
- .5 Certifications:
  - .1 Proof of training for each worker that performed installation on the Project.
  - .2 Proof of company as a FCIA - Member in Good Standing.
  - .3 Certification of company as a ULC Qualified or FM 4991 Approved Firestop Contractor, including the Designated Responsible Individual (DRI) certificate.
  - .4 Accreditation of third-party inspection firm.
- .6 Manufacturer's field reports.
- .7 Warranty information on fire stop installations.
- .8 Life expectancy of each product installed as part of Project. For each system, list the installation date of products and the expected expiration date (month/year).

## 1.8 QUALITY ASSURANCE

.1 Provide systems selection and analysis, installation and inspection of fire stop systems in accordance with the recommended practices detailed in the following guides:
- .1 FCIA Firestop Manual of Practice (MOP).

.2 Qualifications:
- .1 Contractor specializing in selection and installation of fire stops.
- .2 Company recognized as a Member in Good Standing with the Firestop Contractors International Association (FCIA). Submit written proof of current membership.
- .3 Training: workers, including site supervisor, to have completed:
  - .1 Manufacturer training on the products/systems installed as part of this Section.
  - .2 Training under the FCIA Firestop Containment Worker Education Program.
- .4 Certified Firestop Contractor: company certified with one of the following programs:
  - .1 ULC Qualified Firestop Contractor Program. Submit signed copy of ULC Qualified Firestop Contractor Program certificate.
  - .2 FM 4991 Approved Firestop Contractor. Submit signed copy of FM 4991 Approval certificate.
- .5 Third-Party Inspection Firm: IAS AC291 Accredited inspection agency with inspectors who have passed the ULC Firestop Exam or FM Firestop Exam.

.3 Manufacturer Site Visits: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
- .1 After delivery and storage of products, and when preparatory work is complete, but before installation begins.
- .2 During the mock-up review.
- .3 Three times during progress of Work at 30%, 60% and 90% completion stages. Confirm completion percentages DCC Representative.
- .4 Upon completion of Work, after cleaning is carried out.

### 1.9 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings, manufacturing date, shelf life expiry date.

.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, expired or damaged materials with new.
- .3 Coordinate delivery of materials with scheduled installation dates to allow minimum storage time on site.
- .4 Comply with recommended procedures, precautions and measures described in WHMIS Safety Data Sheets (SDS).

.3 Waste Management and Disposal:
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning & Waste Management.

### 1.10 FIELD CONDITIONS

.1 Ambient Conditions:
- .1 Install fire stops when ambient and substrate temperatures are within the limits prescribed by the manufacturer and when the substrate is dry and without risk of condensation.
- .2 Maintain manufacturer's recommended ambient and substrate temperatures for 48 hours before and 72 hours after installation.

.2 Ventilate fire stops in accordance with manufacturers' instructions by natural means or where this is inadequate using forced air circulation.

### 1.11 WARRANTY

.1 For the Work of this Section 07 84 00 - Fire Stopping, the 12 month warranty period is extended to 24 months.

.2 Manufacturers shall warrant work of this section against defects and deficiencies in the product material for a period of 24 months. Promptly correct any defects or deficiencies, which become apparent within warranty period at no expense.

.3 Contractor shall warrant workmanship on materials and installation for a period of 24 months. Promptly correct any defects or deficiencies which become apparent within warranty period at no expense.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

.1 Provide products from a single manufacturer, to the greatest extent possible, to perform all fire stopping work. Materials of different manufacturers will not be permitted without written authorization

from DCC Representative.

.2 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stopping application, provide a listed system from an alternative manufacturer to avoid providing an Engineering Judgment.

## 2.2 DESIGN/PERFORMANCE CRITERIA

.1 Fire stop and smoke stop systems and systems providing a barrier to smoke spread consisting of a material or combination of materials installed to maintain the integrity of the fire resistance rating of a fire separation in accordance with the requirements of NBC-2015.

.2 Non-rated fire separations: provide L-Rated smoke protection fire stop system for application on both sides of separation.

.3 Acoustic insulation properties, as shown on drawings.

.4 Dynamic joints: where required, fire and smoke stop systems to be designed to accommodate a defined amount of movement to account for expansion or contraction in construction joints and mechanical piping, for movement in structural elements and to accommodate for movement and sound and vibration control in mechanical installations.

.5 Insulated pipes and ducts: listed fire stop system designed and tested with actual insulation materials penetrating the fire separation, as indicated on the system design listing.

.6 Use in wet areas: water based products are unacceptable in wet areas or areas that may be subject to occasional water exposure or flooding during and after construction.

.7 Architectural considerations: when exposed to view, fire stop system to consider architectural finish, potential traffic, and exposure to moisture and heat.

.8 Environment considerations: materials selected to consider the environment in which they will be used during and after curing as well as the intended use of space. Fire stop manufacturer to confirm compatibility of the proposed materials/products for the following cases:
- .1 Spaces requiring resistance to infection and biological spread through assemblies.
- .2 Spaces containing sensitive electronic equipment.
- .3 Preventing contamination of laboratory and manufacturing environments.

## 2.3 MATERIALS

.1 Fire stop and smoke stop systems: in accordance with CAN-ULC-S115.
- .1 Asbestos-free materials and systems capable of maintaining effective barrier against the passage of flame, smoke and water and the transmission of heat in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended, as indicated on System Design Listing.
- .2 Fire stop system rating: to match fire resistance rating of fire separation as indicated on drawings.
- .3 Service penetration assemblies and fire stop components: certified by test laboratory to CAN/ULC-S115.

.2 Fire and smoke stop systems at openings intended for re-entry such as cables: provide elastomeric seal or non-shrink foam cement mortar.

.3 Fire and smoke stop systems at openings around penetrations for pipes, ductwork and other

mechanical items requiring sound and vibration control: provide elastomeric protection.

.4 Fire and smoke stops behind and around mechanical and electrical boxes within wall, floor and ceiling assemblies: provide elastomeric seal.

.5 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.6 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.7 Packing/damming materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.8 Fire stop insulation: pre-formed, semi rigid, non-combustible mineral wool, [pre-cut in 1220 mm lengths to required depth and width].

.9 Junction box / outlet sealing putty: intumescent putty, pre-formed in pads.

.10 Sealants: good adhesion without use of primer, high visibility safety colours.
- .1 Flame spread rating: maximum 25.
- .2 Smoke development classification: maximum 50.
- .3 For vertical joints: non-sagging.
- .4 For horizontal joints: single component, self-levelling.

## 2.4 FIRE STOP IDENTIFICATION

.1 Identification labels and markings to be indelible for the expected service life of the installation.

.2 Fire Stopped Penetrations:
- .1 Provide identification labels at each penetration.
- .2 Identification labels: adhesive plastic stickers with metal fastening device with the following information:
  - .1 Penetration number.
  - .2 Floor number.
  - .3 Room number.
  - .4 Product name and number.
  - .5 System Design number.
  - .6 Fire Rating Required: in hours.
  - .7 Fire Stop Contractor's Name and phone number.
  - .8 Installer's Name.
  - .9 Date of Installation.
  - .10 Re-penetrated by: Company, Installer and Date.
- .3 Label shall state that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.

.3 Fire Separation (Barrier) Markings:
- .1 Provide identification for all vertical fire separations.
- .2 Identification markings: stencil painted with lettering at least 75mm in height with a minimum 10mm stroke in contrasting colour.
- .3 Marking to incorporate the assembly's fire-resistance rating and the following suggested wording, "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS", or other accepted wording.

.4 Include horizontal red painted line, 75 mm in width, between identification markings.

.5 For occupied areas with exposed ceilings: use stencil painted red dots without horizontal painted lines

### 2.5 FIRE STOP COLOUR

.1 Fire Stopping installation locations:
- .1 Exposed: White
- .2 Hidden: Red

## 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 EXAMINATION

.1 Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and approved system design listings for each condition.

.2 Verify each opening/annular space to ensure it does not exceed the maximum and minimum dimensions indicated on the approved system design listing.

.3 Verify that all joints, service penetrating elements and supporting devices/hangers have been properly installed as indicated on approved system design listings. All temporary lines and markings have been removed to meet the approved system design listings.

.4 Verify that the proposed fire stop system is composed of components that are compatible with each other, the substrates forming the openings, and the items, if any, penetrating the fire stop under conditions of application and service, as demonstrated by the fire stop manufacturer based on testing and field experience.

.5 Pipe and duct insulation: confirm that the proposed fire stop system has been tested with the actual insulation penetrating the fire separation on site, as indicated in the approved system design listing. Maintain insulation around pipes and ducts penetrating the fire separation.

.6 Ensure no additional items have been installed through opening that does not appear on the approved system design listing.

.7 Ensure areas that are to be fire stopped are accessible for proper application and conditions are suitable for installation of the fire stop system. Areas to remain accessible for inspection.

.8 Report in writing to DCC Representative any defective surfaces or conditions affecting the fire stop system installation, immediately and prior to commencing any installations.

.9 Proceed only once defected surfaces or conditions have been corrected.

.10 Beginning of installation means acceptance of site conditions.

### 3.3 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thickness and installation of

materials.
.1 Ensure that substrates and surfaces are clean, dry and frost free.
.2 Ensure substrates and surfaces are free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.

.2 Prepare surfaces in contact with fire stop and smoke stop materials 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.

.5 Protect adjacent work areas and finish surfaces from damage during product installation.

.6 Ensure multi-penetration openings have been framed and boarded out, all around the annular opening as indicated in the system design listing prior to prepping the opening.

**3.4 INSTALLATION**

.1 Install fire stop and smoke stop materials and components in accordance with manufacturer's certified tested system listing.

.2 Coordinate with other sub-trades to ensure that all pipes, conduits, cables, and other items, which penetrate fire separations, have been permanently installed before installation of fire stop systems.

.3 Schedule work to ensure that fire separations and all other construction that conceals penetrations are not erected before installation of fire and smoke stop systems

.4 Protect holes or gaps made by through penetrations, poke through termination devices, and un-penetrated openings or joints to ensure that both 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 per manufacturer's instructions.

.6 Tool or trowel exposed surfaces to neat finish.

.7 Remove excess compound promptly as work progresses and upon completion.

.8 Protect gaps around recessed components (e.g.: panels, electrical boxes, outlets) with sealing putty in accordance with manufacturer's instructions.

.9 Do not use damaged or expired material.

.10 Joint Fire Stops:
.1 For sealant applications, install joint fillers to support fire stop materials during application. Position joint fillers to ensure fire stop material cross-sectional shape and thickness relative to the joint width allows for optimum sealant movement, while developing the required fire-resistance rating.
.2 Install fire stops using techniques recommended by the manufacturer:
.1 Fully wetting joint substrates to optimize adhesion.
.2 Completely filling recesses provided for each joint configuration.
.3 Providing uniform, cross-sectional shapes and thickness relative to joint width that

optimize movement capability.

.4 Tooling non-sag fire stop materials immediately after their application and prior to the time skinning begins. Form smooth, uniform beads of configuration indicated or required to:
  .1 Provide required fire-resistance rating.
  .2 Eliminate air pockets
  .3 Ensure contact and adhesion with sides of joint.

.3 Joint Systems and Perimeter Fire Containment Systems:
  .1 For systems with dynamic joints, ensure movement capabilities of the installation meet or exceed the movement expectations of the system design listing and manufacturer's installation instructions.

## 3.5 IDENTIFICATION

.1 General:
  .1 Clean substrate prior to applying identification.
  .2 Final location of identification to be determined on site.
  .3 Identification is not required on both sides of the fire separation.
  .4 Refer to drawings for locations of fire separations and rating required.

.2 Fire Stopped Penetrations:
  .1 Install identification label adjacent to each wall/floor service penetrations fire stopped Provide one identification label per single opening or per grouping cluster.
  .2 Securely apply identification to substrate by providing adequate adhesive.
  .3 Secure tags with metal fasteners or hang with metal chain or wire.
  .4 Identification shall be completely filled out and installed prior to requesting substantial performance.

.3 Fire Separations (Barriers):
  .1 Provide identification at least 4500 mm of the end of each wall and at intervals not exceeding 9000 mm along wall/floor joint fire stops.
  .2 Markings to be installed within ceiling spaces, 600 mm below horizontal fire separation or roof structure unless otherwise indicated.
  .3 For occupied areas with exposed ceilings: review location of identification with DCC Representative before proceeding.

## 3.6 REPAIRS AND MODIFICATIONS

.1 Identify damaged or re-entered seals requiring repair or modification.

.2 Remove loose or damaged materials. If penetrating items are to be added, remove sufficient material to insert new elements and to avoid damaging the balance of the seal.

.3 Ensure that surfaces to be sealed are clean and dry.

.4 Use only materials that are suitable for repair of original seal, as approved by manufacturer. Do not mix products from different manufacturers.

.5 Repair all damage resulting from fire stop destructive testing.

## 3.7 FIELD QUALITY CONTROL

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

.2 Manufacturer's Field Services:
- .1 Mock-ups: manufacturer to provide written confirmation that the fire stop system installed meets or exceeds the system design listing requirements for each mock-up application.
- .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .3 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.
- .4 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

## 3.8 INSPECTIONS

.1 Third-Party Inspection Firm: provide the services of a third-party inspection firm to conduct random inspections and direct exploratory review (i.e.: destructive testing) during the course of construction and prior to closing off any concealed areas. Inspections and destructive testing shall be performed in compliance with ASTM E 2174 and ASTM E 2393.

.2 DCC Representative will conduct random inspections and direct exploratory review (i.e.: destructive testing) during the course of construction and prior to closing off any concealed areas. Inspections and destructive testing will be performed in compliance with ASTM E 2174 and ASTM E 2393.
- .1 Include for a minimum of 2% for each area of 900 square meters for exploratory reviews for each approved system design listing and each trade involved. Perform cut tests at perimeter joints every 15 meters. Perform cut test at bottom and top of wall joints and wall to wall joints and building expansion joints every 15 meters.
- .2 Perform exploratory review as directed by Third-Party Inspection Firm. Cut out fire stop and remove to ensure fire stop system installation meets or exceeds the system design listing as identified.

.3 Upon completion of construction and before requesting substantial performance review, fire stop contractor and manufacturer's representative shall inspect all fire stopping work and prepare a deficiency list. Submit deficiency list to DCC Representative for review. Repair any deficiencies and re-inspect work to ensure that all deficiencies have been completed.

.4 Submit formal request for substantial performance review of work once all work is completed, quality control has been performed and all fire stop installations have been inspected and identified with the approved fire stop identification labels.

.5 Third-Party Inspection Firm will conduct the substantial performance review in the presence of the fire stop contractor and the manufacturer's representative.

.6 Perform all cutting and removal of systems for visual review by Third-Party Inspection Firm. After review and acceptance are completed, replace fire stop system with new materials.

## 3.9 FIRE STOPPING LOCATIONS

.1 Provide fire stop and L-Rated smoke-resistant fire stop systems at:
- .1 Penetrations through fire-resistance and smoke-resistance rated masonry, concrete, and gypsum board partitions and walls.
- .2 Penetrations through fire-resistance rated floor slabs/systems, ceilings and roof.
- .3 Edge of floor slabs at curtain wall and precast concrete panels.
- .4 Edge of fire-resistant floor or roof assemblies and exterior wall assemblies.
- .5 Joints at top and bottom of fire-resistance rated masonry and gypsum board partitions. Joints to allow for independent movement.

.6 Joints at top and bottom of fire-resistance rated walls where they meet non-rated fire separation assemblies.
.7 Intersection of fire-resistance rated masonry, concrete and gypsum board partitions.
.8 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
.9 Expansion joints in fire-resistance rated floors, walls, ceilings and roof assemblies.
.10 Perimeter gaps at curtain wall or other exterior wall assembly and horizontal fire-separation.
.11 Openings and sleeves installed for future use through fire separations.
.12 Around mechanical and electrical assemblies/devices penetrating fire separations.
.13 Mechanical and electrical recessed boxes in walls and partitions.
.14 Rigid ducts: fire stopping to consist of bead of fire stop material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

.2 Provide fire stop and L-Rated smoke-resistant fire stop systems at locations shown on drawings and as indicated on drawing schedules and details.

## 3.10 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning & Waste Management.

.2 Remove equipment, excess materials and debris and clean adjacent surfaces immediately after application. Use methods and cleaning materials approved by manufacturer.

.3 Protect fire stops during and after curing period from contact with contaminating substances. Repair all damage.

.4 Remove temporary dams after initial set of fire stop and smoke stop materials.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED DOCUMENTS

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

## 1.2 SUMMARY OF WORK

.1 Work Included: The work of this Section includes the provision of all labour, materials, equipment and services required to execute sealant work, as indicated on the drawings, as specified herein and as required by job conditions and normally considered to be work covered by this Section.

.2 The term "sealant" shall be interpreted as synonymous with the term "caulking" where used on the drawings and/or in the specifications.

## 1.3 REFERENCE STANDARDS

.1 ASTM International
- .1 ASTM C 919-18, Standard Practice for Use of Sealants in Acoustical Applications.

.2 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.

.3 General Services Administration (GSA) - Federal Specifications (FS)
- .1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

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

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

## 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Manufacturer's product to describe:
  - .1 Caulking compound.

.2 Primers.
.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Submit 2 copies of WHMIS SDS in accordance with Section 01 70 12 - Safety Requirements and 01 35 43 - Environmental Protection.

.3 Samples:
.1 Submit 2 samples of each type of material and colour.
.2 Cured samples of exposed sealants for each colour where required to match adjacent material.

.4 Manufacturer's Instructions:
.1 Submit instructions to include installation instructions for each product used.

## 1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

## 1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 Common Product 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 joint sealants from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 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 Section 01 74 00 – Cleaning and Waste Management.

## 1.7 SITE CONDITIONS

.1 Ambient Conditions:
.1 Proceed with installation of joint sealants only when:
.1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
.2 Joint substrates are dry.
.3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Joint-Width Conditions:

.1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:
.1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

### 1.8 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to Health Canada.

.2 Ventilate area of work as directed by DCC Representative] by use of approved portable supply and exhaust fans.

## PART 2 PRODUCTS

### 2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

.3 Where sealants are qualified with primers use only these primers.

### 2.2 SEALANT MATERIAL DESIGNATIONS

.1 Polysulfide Two Part.
.1 Self-Levelling to CAN/CGSB-19.24, Type 1, Class B, colour as selected by DCC Representative.

.2 Polysulfide One Part.
.1 Self-Levelling to CAN/CGSB-19.13. Colour as selected by DCC Representative.

.3 Silicones One Part.
.1 To CAN/CGSB-19.13.

.4 Acoustical Sealant.
.1 Utilize Fire To ASTM C 919, colour as selected by DCC Representative.

.5 Preformed Compressible and Non-Compressible back-up materials.
.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
.1 Extruded closed cell foam backer rod.
.2 Size: oversize 30 to 50 %.
.2 Neoprene or Butyl Rubber.
.1 Round solid rod, Shore A hardness 70.
.3 High Density Foam.
.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³

density, or neoprene foam backer, size as recommended by manufacturer.

.4 Bond Breaker Tape.

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

## 2.3 JOINT CLEANER

.1 Joint cleaner: xylol, methylethyleketon, IPA, or non corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

## 2.4 SEALANTS SCHEDULE

.1 Sealant Types:

| Application | Type | Description | Movement Capability | Standards | Comments |
|---|---|---|---|---|---|
| Around interior door frames and windows, against drywall and where acoustical sealant exposed to sight is called for. | A | Paintable, siliconized, acrylic latex sealant | | ASTM C834 | |
| Exterior joint work interior and exterior masonry control joints and where extreme movement is anticipated | B | Ultra-low-modulus, one-part, neutral-cure silicone sealant for extreme movement joints | + 100%<br>- 50% | ASTM C920, Type S,<br><br>Grade NS, Class 100/50<br><br>Use T, NT, M, G, A, O | No primer reqd. on concrete. Non-staining, good unprimed adhesion to most substrates (Fluoropolymer coatings, polyethylene faced mod.bit. membrane etc.) |
| Exterior joint work where not otherwise specified or indicated. | C | One-part, neutral-cure silicone sealant | ± 50% | ASTM C920, Type S<br><br>Grade NS, Class 50<br><br>Use NT, M, G, A | Manufacturer to recommend Type C or D for specific application<br><br>Note that Type C has a limited colour range |
| | D | One-part, neutral-cure, medium modulus, architectural grade, silicone sealant | ± 50% | ASTM C920, Type S<br><br>Grade NS, Class 50<br><br>Use NT, G, A, O | |

| | | | | | |
|---|---|---|---|---|---|
| Sealant for caulking countertops at wall, ceramic tile, plumbing fixtures, and in wet areas where not otherwise specified | E | One-part, acetoxy-cure, mildew- resistant, silicone sealant for non-porous substrates | + 25% | | |
| Acoustical Sealant in concealed locations | F | Flexible synthetic rubber acoustical sealant | | | |

## PART 3 EXECUTION

### 3.1 EXAMINATION

.1 Examine areas and conditions under which work is to be performed and notify the DCC Representative in writing of conditions detrimental to the proper and timely completion of the work.

.2 For exterior sealants, arrange for a technical representative of the manufacturer to conduct adhesion tests for each joint condition and to make recommendations with respect to sealant type, primers (if required) and joint preparation. Do not deviate from the manufacturer's recommendations without prior written approval.

.3 Do not proceed with the work until unsatisfactory conditions have been corrected to the satisfaction of the installer.

.4 Commencement of the work of this Section will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

### 3.2 SURFACE PREPARATION

.1 Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.

.2 Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.

.3 Remove oil, grease and other coatings from non ferrous metals with joint cleaner.

.4 Prepare concrete, masonry, glazed and vitreous surfaces to sealant manufacturer's instructions.

.5 Examine joint sizes and correct to achieve depth ratio 1/2 of joint width with minimum width and depth of 6 mm. Maximum width 75 mm.

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

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

.8 Apply bond breaker tape where required to manufacturer's instructions.

.9 Use primers where recommended by the sealant manufacturer. Prime sides of joints to sealant

manufacturer's instructions immediately prior to caulking.

**3.3 WORKMANSHIP**

.1 Caulk all joints between dissimilar materials.

.2 Before application of any sealant, confirm that sealant material is compatible with the materials and finishes of the surfaces to which the material is applied or is in contact with.

.3 Apply sealants in strict accordance with the manufacturer's printed directions for the specific applications of the particular materials used, using a gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.

.4 Concrete or masonry joints shall be a minimum of 6 mm wide x 6 mm deep. Depth shall be equal to width in joints up to 12 mm wide. For joints 12 mm to 25 mm wide, depth shall be 12 mm.

.5 For joints in metal, glass and other non porous surface, sealant depth shall be a minimum of 1/2 the applied sealant width, and shall in no case exceed the applied sealant width.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.

.7 Cure sealants in accordance with manufacturer's instructions. Do not cover up sealant until curing is complete and proper seal has been achieved.

**3.4 SEALANT APPLICATION**

.1 Apply caulking around the perimeter of every wall and partition, both sides of openings in interior partitions; interior side of openings in exterior walls.

.2 Apply sealant to all exposed control joints in masonry, concrete, and gypsum board walls, ceilings, and bulkheads, joints between adjacent building components.

.3 Provide interior caulking in walls, floor finishes around all metal frames, door frames, access panels, built-in specialties; around pipes, ducts, grilles, outlet boxes, conduits, etc. penetrating floors, walls and ceiling.

.4 Apply siliconized acrylic latex caulking around wood trim and wipe smooth prior to painting.

.5 Caulk solidly around inside of all window/wall and door/wall joints, horizontal and vertical window and door surrounds, and all other trim, to provide a weathertight seal and prevent condensation.

.6 Caulk the connection between the tops of the concrete block walls and the underside of the steel deck, wherever exposed to sight.

.7 Caulk around plumbing fixtures, base and rim of sinks with mildew resistant sealant.

.8 Supply and install paintable sealant around all piping to sinks and lavatories where piping passes through walls.

**3.5 PREFORMED FOAM SEALANT INSTALLATION**

.1 Install preformed foam sealant in joints where indicated, in accordance with the manufacturer's printed instructions.

.2 Verify dimensions on site and take particular care to select the correct size preformed sealant for the joint.

.3 Install sealant to a clean line, flush with adjacent surfaces, and filling the joint, without interruption, for its entire length.

## 3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 Cleaning & Waste Management.
- .1 Leave Work area clean at end of each day.
- .2 Clean adjacent surfaces immediately.
- .3 Remove excess and droppings, using recommended cleaners as work progresses.
- .4 Remove masking tape after initial set of sealant.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 Cleaning & Waste Management.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

## 3.7 PROTECTION

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

.2 Repair damage to adjacent materials caused by joint sealants installation.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 REFERENCE STANDARDS

.1 Green Seal Environmental Standards (GS)
  .1 GS-11-2008, 2nd Edition, Paints and Coatings.

.2 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  .1 SCAQMD Rule 1113-A2007, Architectural Coatings.

## 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for access door components 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 catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

.4 Samples:
  .1 Submit for review and acceptance of each unit.
  .2 Samples will be returned for inclusion into work.
  .3 Submit 1 of each type of hand entry access door.
  .4 Submit one 300 x 300 mm corner sample of each type of body entry door.

.5 Sustainable Design Submittals:
  .1 Construction Waste Management:
    .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
    .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
  .2 Recycled Content:
    .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
  .3 Regional Materials: submit evidence that project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
  .4 Low-Emitting Materials:
    .1 Submit listing of paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction 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 cleaning and maintenance of finishes for incorporation into manual.

### 1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 access doors from nicks, scratches, and blemishes.
- .3 Apply temporary protective coating to finished surfaces. Remove coating after installation.
  - .1 Use coatings in accordance with manufacturer's written instructions that are easily removable.
  - .2 Leave protective coating in place until final cleaning of building.
- .4 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 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 Section 01 74 00 – Cleaning and Waste Management.

### 1.5 SITE CONDITIONS

.1 Site Measurements: Before fabrication, verify actual dimensions of openings by measuring on site, and indicate actual measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 PRODUCTS

### 2.1 ACCESS DOORS

.1 Sizes: as follows unless indicated:.
- .1 For body entry: 600 x 600 mm minimum.
- .2 For hand entry: 300 x 300 mm minimum.

.2 Construction: rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.

.3 Materials:
- .1 Tiled or marbled surfaces: stainless steel with brushed satin.
- .2 Other areas: prime coated steel.
  - .1 Primer: VOC limit 50 g/L maximum to GS-11

### 2.2 EXCLUSIONS

.1 Lay-in tile ceilings: use unobtrusive identification locators.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

.1 Installation: locate access doors within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.
- .1 Install gypsum board surfaces: in accordance with Section 09 21 16 – Gypsum Board Assemblies.

### 3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### 3.4 PROTECTION

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

.2 Repair damage to adjacent materials caused by access door installation.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 REFERENCE STANDARDS

.1 Aluminum Association (AA)
- .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM C 475-02(2015), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2 ASTM C 514-04(2014), Standard Specification for Nails for the Application of Gypsum Board.
- .3 ASTM C 557-03(2009)e1, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- .4 ASTM C 840-16, Standard Specification for Application and Finishing of Gypsum Board.
- .5 ASTM C 954-15, 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.
- .6 ASTM C 1002-14, 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.
- .7 ASTM C 1047-14a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .8 ASTM C 1177/C 1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .9 ASTM C 1178/C 1178M-13, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .10 ASTM C 1280-13a, Standard Specification for Application of Gypsum Sheathing.
- .11 ASTM C1396/C1396M-14a, Standard Specification for Gypsum board.

.3 Association of the Wall and Ceilings Industries International (AWCI)
- .1 AWCI Levels of Gypsum Board Finish-GA-214-2015.

.4 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.

.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.

.7 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

## 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Indicate components such as fastener type, dimensions, spacing and locations at gypsum board edges, ends and in field of board as well as installation methods. Components and work to confirm to ASTM C 840 standard specification for application and finishing of gypsum board.
- .2 Indicate type of joint compound, and number of joint compound layers.
- .3 Indicate number and location of electrical boxes for wall and ceiling.

.4 Samples:
- .1 Submit for review and acceptance of each component specified or necessary for complete installation. Include technical descriptive data.
- .2 Submit 300 x 300 mm size samples of vinyl faced gypsum board and 300 mm long samples of corner and casing beads.

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

## 1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product 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 and applicable standard designation.

.3 Exercise care in unloading gypsum board materials shipment to prevent damage.

.4 Storage and Handling Requirements in accordance with ASTM C 840-16:
- .1 Store gypsum board assemblies materials level flat 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 gypsum board from direct exposure to rain, snow, sunlight, or other excessive weather conditions.
- .4 Protect ready mix joint compounds from freezing, exposure to extreme heat and direct sunlight.
- .5 Protect from weather, elements and damage from construction operations.
- .6 Handle gypsum boards to prevent damage to edges, ends or surfaces.
- .7 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- .8 Replace defective or damaged materials with new.

### 1.4 AMBIENT CONDITIONS

.1 Maintain temperature 10 °C minimum, 21 °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, clean, 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 Standard board: to ASTM C1396/C1396M-14 regular, 12.7 mm thick and Type X, 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

.2 Glass mat water-resistant gypsum backing board: to ASTM C 1178/C 1178M-13, 15.9 mm thick, 1200 mm wide x maximum practical length.

.3 Acoustically Enhanced Gypsum Board: ASTM C1766. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.Steel drill screws: to ASTM C 1002-14.
- .1 Core: As indicated on Drawings.
- .2 Long Edges: Tapered.
- .3 Mold Resistance: ASTM D3273, score of 10 (no mold growth) as rated in accordance with ASTM D3274.
- .4 Surface Abrasion: ASTM C1629/C1629M, complies with or exceeds Level 1 requirements.
- .5 Indentation: ASTM C1629/C1629M, complies with or exceeds Level 1 requirements.
- .6 Soft-Body Impact: ASTM C1629/C1629M, complies with or exceeds Level 2 requirements.

.4 Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
- .1 Core: As indicated on Drawings.
- .2 Long Edges: Tapered.
- .3 Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

.5 Casing beads, corner beads, control joints and edge trim: to ASTM C 1047, metal, 0.5 mm base thickness, perforated flanges, one piece length per location.

.6 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.7 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 C 475, asbestos-free.

### 2.2 FINISHES

.1 Texture finish: asbestos-free texture coating and primer-sealer, recommended by gypsum board manufacturer.

### 2.3 TRIMS

.1 Paper-Faced Metal Corner trim for Inside and Outside Corners J-trims, L-Trims and where gypsum board terminates against exposed wood, Reveal Trim.

## 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 Visually inspect substrate in presence of Professional.
   .2 Inform Professional 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 Professional.

### 3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C 840-16 except where specified otherwise.

.2 Do application of gypsum sheathing to ASTM C 1280-13a.

.3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C 840-16 except where specified otherwise.

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

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

.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

.7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

.8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.10 Install wall furring for gypsum board wall finishes to ASTM C 840-16, except where specified otherwise.

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

.12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

.13 Erect drywall resilient furring transversely across joists between layers of gypsum board, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.

.14 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 layers of gypsum board to wood or metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.
- .1 Single-Layer Application:
  - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C 840-16.
  - .2 Apply gypsum board on walls vertically or horizontally, providing sheet lengths that will minimize number of board edges or end joints.
- .2 Double-Layer Application:
  - .1 Install gypsum board for base layer and exposed gypsum board for face layer.
  - .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
  - .3 Apply base layers at right angles to supports unless otherwise indicated.
  - .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

.3 Apply layers of gypsum board to concrete or concrete block surfaces, where indicated, using laminating adhesive.
- .1 Comply with gypsum board manufacturer's recommendations.
- .2 Brace or fasten gypsum board until fastening adhesive has set.
- .3 Mechanically fasten gypsum board at top and bottom of each sheet.

.4 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

.5 Arrange vinyl-faced gypsum board symmetrical about openings and wall areas, with butt joints.

.6 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.7 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.

.8 Install gypsum board with face side out.

.9 Do not install damaged or damp boards.

.10 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 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

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

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

.8 Install control joints straight and true.

.9 Ensure that screws or nails are properly applied in process of attaching gypsum board to framing without damaging of gypsum board edges and ends.

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

.11 Install expansion joint straight and true.

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

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

.14 Splice corners and intersections together and secure to each member with 3 screws.

.15 Install access doors to electrical and mechanical fixtures specified in respective sections.
- .1 Rigidly secure frames to furring or framing systems.

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

.17 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 4: 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.

.18 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.

.19 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, invisible after surface finish is completed.

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

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

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

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

## 3.5 ACOUSTIC SEPARATIONS

.1 Minimize gaps between gypsum board and adjacent constructions and partition perimeters. Gaps greater than 6 mm wide are unacceptable.

.2 Gaps between 6 mm and 13 mm to be packed with back-up rod and caulked with acoustical sealant specified in Section 07 92 00 "Joint Sealants". Gaps below 6 mm do not require back-up rod.

.3 Tape all inner layers of drywall. Inner layers do not need require sanding.

.4 Apply acoustical sealant to the first layer of gypsum board and arrange for review by the DCC Representative before application of the second layer of gypsum board. Seal entire perimeter.

.5 Cut drywall neatly and tight around all penetrations at STC rated walls. Provide fitted drywall flanges around all mechanical penetrations. Complete drywall flange by caulking full perimeter to penetrations and adjacent gypsum board. Caulking to be reviewed by the DCC Representative before concealing.

.6 Stagger electrical outlets or mechanical installations on opposing sides of STC rated walls so they are in different stud cavities. Ensure sound attenuation insulation runs behind all penetrations. All electrical outlets to have vapour hoods and cover plate gaskets.

.7 Cut acoustic batt insulation around services. Do not compress batt.

.8 Break (separate) gypsum board at tee, crosses and corner junctions. Do you pass gypsum board through wall junctions.

## 3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

.3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

## 3.7 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 REQUIREMENTS

.1 Section 09 21 16 - Gypsum Board Assemblies

.2 Division 23 - Heating, Ventilating and Air Conditioning (HVAC)

.3 Division 26 – Electrical.

## 1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):
- .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- .2 ASTM E580/E580M-16, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
- .3 ASTM C635/C635M-13a, Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .4 ASTM C636/C636M-13, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- .5 ASTM E1264-14, Standard Classification for Acoustical Ceiling Products.
- .6 ASTM E1414-16, Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
- .7 ASTM E1477-98a(2017), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.

.2 California Department of Public Health (CDPH):
- .1 CDPH/EHLB, Standard Method Version 1.1 - 2010.

.3 Federal Trade Commission (FTC).

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

.5 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

## 1.3 COORDINATION

.1 Do not begin erection of the ceiling suspension system until the work above the ceiling has been inspected by the DCC Representative.

## 1.4 PRE-INSTALLATION MEETING

.1 Convene a pre-installation meeting prior to beginning on-site installation, with the Contractor, the DCC Representative and other affected trades:
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Coordinate with the work of other sections.
- .4 Review the manufacturer's installation instructions and warranty requirements.
- .5 Review accepted shop drawings for installation requirements.

## 1.5 SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension, acoustic panels, and system accessories. Include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit manufacturer’s installation instructions.
- .3 Submit for each type of ceiling unit and suspension system required.
- .4 Include manufacturer's material safety data sheets for the safe handling of the specified materials and products, in accordance with Workplace Hazardous Materials Information Service (WHMIS) requirements.

.3 Shop Drawings:
- .1 Submit reflected ceiling plans for special grid patterns as indicated.
- .2 Indicate the layout, insert and hanger spacing and fastening details, the splicing method for main and cross runners, change in level details, access panel dimensions and locations, and acoustical unit support at ceiling fixtures, lateral bracing and accessories.
- .3 The ceiling suspension system, including all related connections and fastenings, shall be designed by a structural engineer licensed to practise in the Province of Ontario. Each shop drawing submitted shall bear the stamp and signature of the aforesaid structural engineer.
  - .1 Indicate components and installation methods to conform to specified seismic design and construction requirements of Contract Documents and in general accordance with ASTM E580/E580M.
  - .2 Include supporting details, treatment of cross runners, main runners, and wall closures at terminal ends, suspension wire, lateral force bracing, light fixtures and services within the ceiling, seismic isolation joints and partition bracing].

.4 Samples:
- .1 Submit for review and acceptance of each component specified or necessary for a complete installation. Include technical descriptive data.
- .2 Submit duplicate samples of each component proposed for use in the ceiling suspension system.
- .3 Submit duplicate 150 mm x 100 mm samples of each type of acoustical unit.

.5 Manufacturer's Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Include certification of sustainable requirements.

.6 Maintenance Data: Submit maintenance data for the acoustical suspension system and for the acoustical panels for incorporation into the operation and maintenance manual specified in Section

01 78 00 Closeout Submittals.

.7 Post-installation certification: After installation, provide written certification, signed by the Structural Engineer responsible for the shop drawings, that all items have been installed in accordance with the shop drawings.

.8 Maintenance Materials
- .1 Provide for maintenance use, acoustical units amounting to 2% of the gross ceiling area for each pattern and type of acoustical panel, suspension system and trim components, required for the project.
  - .1 Provide a minimum of 1 complete factory-sealed package of each.
  - .2 Ensure extra materials are from same production run as installed materials.
  - .3 Deliver extra materials for each type of acoustical unit in original unopened packages clearly identified, including colour and texture and store where directed.
  - .4 Do not use maintenance materials for the correction of deficiencies or remedial work during the warranty period.

## 1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with the manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials flat, indoors in a clean, dry, well-ventilated area and in accordance with the manufacturer's recommendations.
- .2 Store and protect acoustical ceiling panels and suspension grid components from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Store extra materials required for maintenance, where directed by the DCC Representative.

## 1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Handle and dispose of waste materials generated by the work of this Section, including packaging materials, in accordance with Section 01 74 00 – Cleaning and Waste Management.

## 1.8 ENVIRONMENTAL REQUIREMENTS

.1 Permit wet work to dry before beginning to install.

.2 Maintain uniform minimum temperature of 15°C and humidity of 20 to 40% before and during installation.

.3 Store materials in the work area 48 hours prior to installation.

# PART 2 PRODUCTS

## 2.1 DESIGN CRITERIA

.1 Design Requirements:
- .1 Intermediate duty system to ASTM C635.
- .2 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

.2 Seismic design requirements:
- .1 Design acoustical ceiling installation to resist effects of earthquake motions under seismic design conditions specified in the Contract Documents. Provide components as necessary to implement the design.

## 2.2 ACOUSTICAL CEILING SUSPENSION

.1 Intermediate duty system to ASTM C 635/ASTM C635M, exposed tee system, as follows:
- .1 Material: Double web electrogalvanized sheet steel.
- .2 Face dimension: 24 mm.
- .3 Surface finish: Baked polyester paint, colours: White.
- .4 Grid dimensions: To suit panel size.

.2 Basic materials for suspension system: commercial quality cold rolled steel zinc coated.

.3 Suspension system: non fire rated, made up as follows:
- .1 2 directional exposed tee bar grid.
- .2 2 directional concealed tee spline.
- .3 Concealed tee access spline.
- .4 Concealed tongue and groove runner.
- .5 Concealed H runner, tee spline and flat steel spline.
- .6 Concealed zee runner and flat steel spline.

.4 Exposed tee bar grid components: shop painted satin sheen white. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.

.5 Hanger wire: galvanized soft annealed steel wire:
- .1 3.6 mm diameter for access tile ceilings.
- .2 To ULC design requirements for fire rated assemblies.
- .3 2.6 mm diameter for other ceilings.

.6 Hanger inserts: purpose made.

.7 Accessories: splices, clips, wire ties, retainers and wall moulding flush, to complement suspension system components, as recommended by system manufacturer.

## 2.3 ACOUSTICAL CEILING PANELS

.1 **ACT**: Acoustical Ceiling Tiles: characteristics as follows:
- .1 Type: Acoustic Lay-In Panels, Type IV, Form 2, Pattern E.
- .2 Size: 609 mm x 1220 mm x 19 mm.
- .3 Colour: white

.4 Edge detail: Square
.5 Fire performance: to CAN ULC S102 Class A, flame spread 25 or less, smoke developed index of 50 or less.
.6 NRC 0.80
.7 Light reflectance: 0.88

### 2.4 ACCESSORIES

.1 Hold down clips: purpose made clips to secure the panel to the suspension system.

## PART 3 EXECUTION

### 3.1 EXAMINATION

.1 Verify conditions of substrates are acceptable for acoustical ceiling panel and suspension system installation in accordance with the manufacturer's written instructions.
.1 Visually inspect the substrate in the presence of the DCC Representative.
.2 Inform the DCC Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with the installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the DCC Representative.

.2 Commencement of the installation will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

### 3.2 INTERFACE WITH OTHER WORK

.1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

### 3.3 SUSPENSION SYSTEM INSTALLATION

.1 Comply with manufacturer's written installation instructions and recommendations, including product technical bulletins, product carton installation instructions, and data sheets.

.2 Install the suspension system in accordance with accepted shop drawings, Certification Organizations tested design requirements and ASTM C636 except where specified otherwise.

.3 Lay out the centre line of ceiling both ways, to provide balanced borders at the room perimeter with border units not less than 50% of the standard unit width, according to the reflected ceiling plan.

.4 The finished ceiling system to be square with adjoining walls and level within 1:1000.

.5 Secure hangers to overhead structure using attachment methods as indicated on the reviewed and accepted shop drawings and acceptable to the DCC Representative.

.6 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.

.7 Ensure the suspension system is coordinated with the location of related components. Provide carrying channels as necessary to bridge at unavoidable interference between the suspension system and other work above the ceiling.

.8 Install wall moulding to provide the correct ceiling height.

.9 The completed suspension system to support superimposed loads, such as lighting fixtures, diffusers, grilles, and speakers.

.10 Support at light fixtures, diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around the perimeter of the fixture.

.11 Attach cross members to main runners to provide a rigid assembly.

.12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

.13 Expansion joints:
- .1 Erect two main runners parallel, 25 mm apart, on the building expansion joint line. Lay in a strip of acoustic board, painted black, 25% narrower than the space between 2 T-bars.
- .2 Supply and install "Z" shaped metal trim pieces at each side of the expansion joint. Design to accommodate ± 25 mm movement and maintain visual closure. Finish metal components to match adjacent exposed metal trim. Provide backing plates behind butt joints.

## 3.4 ACOUSTICAL CEILING PANEL INSTALLATION

.1 Install lay-in acoustical panels in ceiling suspension system in accordance with manufacturer's instructions and as indicated.

## 3.5 SITE QUALITY CONTROL

.1 Arrange for periodic site visits by the structural engineer responsible for the shop drawings to review installed work for conformity to the design.

.2 Arrange for periodic site visits by the manufacturer's representative to review installed work for conformity to manufacturer's installation instructions and recommendations.

.3 Submit written site reports by the designer to the DCC Representative within 3 business days of visit.

## 3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .1 Leave the work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 –Cleaning and Waste Management.

## 3.7 PROTECTION

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

.2 Repair damage to adjacent materials caused by acoustical suspension installation.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SUMMARY

.1 This section covers the general requirements for Mechanical systems. Read all divisions of the building specifications.

.2 The mechanical work shall consist of the supply and installation of complete and operable systems and shall include all necessary labour, plant, materials and incidentals for the work involved.

.3 The mechanical work shall include all of Division, 21 and 23 as noted on the drawings and specifications.

.4 Refer to the electrical and controls drawings and specifications and note exact scope of work required by mechanical trades.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 61 00 - Common Product Requirements

.3 Section 01 78 00 - Closeout Submittals

.4 Section 01 45 00 - Quality Control

.5 Section 08 31 00 – Access Doors – Mechanical & Electrical

.6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

## 1.3 REFERENCES

.1 General:
  .1 All references, codes, regulation, by-laws, etc. as noted in the Specification for Divisions 21 and 23 shall be the latest edition / revision, except where specific editions are specified.

## 1.4 SUBMITTALS

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

.2 Shop drawings; submit drawings to the DCC Representative for all equipment as outlined in the specifications and on the Mechanical drawings.

.3 Shop drawings to show (as a minimum) (refer to equipment specification sections for details):
  .1 Make & Model Number.
  .2 Capacity.
  .3 Dimensions.
  .4 Installation arrangement.
  .5 Plan View and sections.
  .6 Weights.
  .7 Operating characteristics.
  .8 Operating Performance.
  .9 Performance curves showing the operating point of the equipment.

.10 Piping hook-ups.
.11 Construction details.
.12 Energy Efficiency Ratings.
.13 Sound Data.
.14 Mounting arrangements.
.15 Operating and maintenance clearances.
.16 Installation instructions.
.17 Electrical data and characteristics.
.18 Motor duty.
.19 Motor brand and model no.
.20 Wiring Diagrams.
.21 All miscellaneous equipment and accessories to complete the system.
.22 Schematic Flow Diagrams.
.23 Approvals.

.4 Shop drawings and product data accompanied by:
.1 Detailed drawings of bases, supports, and anchor bolts.
.2 Acoustical sound power data, where applicable.
.3 Points of operation on performance curves.
.4 Manufacturer to certify current model production.
.5 Certification of compliance to applicable codes.

.5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures use "Shop Drawing Submittal Stamping Sheet". Identify section and paragraph number.

.6 The mechanical contractor shall ensure that equipment has been checked for conformance with all the requirements of the drawings and specifications and that the equipment has been coordinated with other equipment to which it is attached or connected, and that all dimensions have been verified to ensure the proper installation of equipment within the available space without interference with the work of other trades. All information on the shop drawings such as wiring diagrams, accessories and details must be specifically prepared for this project. Shop drawing containing information irrelevant to this project will be rejected for resubmission. Make sure that electrical, controls and structural co-ordination is complete before submitting drawings for approval

.7 Closeout Submittals:
.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
.2 Operation and maintenance manual approved by, and final copies deposited with, DCC Representative before final inspection.
.3 Operation data to include:
.1 Control schematics for systems including environmental controls.
.2 Description of systems and their controls.
.3 Operation instruction for systems and component.
.4 Description of actions to be taken in event of equipment failure.
.5 Valves schedule and flow diagram.
.6 Colour coding chart.
.4 Maintenance data to include:
.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
.2 Data to include schedules of tasks, frequency, tools required and task time.
.5 Performance data to include:
.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
.2 Equipment performance verification test results.
.3 Special performance data as specified.
.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing,

Adjusting and Balancing for HVAC.

.6 Approvals:
- .1 Submit 2 copies of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
- .2 Make changes as required and re-submit as directed by DCC Representative.

.7 Additional data:
- .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:
- .1 The DCC Representative will provide 1 set of reproducible mechanical drawings. Mark changes as work progresses and as changes occur.
- .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
- .3 Use different colour waterproof ink for each service.
- .4 Make available for reference purposes and inspection.

.9 As-built drawings:
- .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
- .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
- .3 Submit to the DCC Representative for approval and make corrections as directed.
- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

## 1.5 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

## 1.6 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
- .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

## 1.7 DELIVERY, STORAGE, AND HANDLING

.1 Material Delivery Schedule: coordinate delivery of material to suit proposed construction schedule.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials in accordance with Section 01 74 00 – Cleaning and Waste Management.

.3 Building Loads
- .1 Before loading any part of the structure, make sure that the construction is sufficiently complete and that concrete has attained sufficient strength to support such loads.

## 1.8 SYSTEM STARTUP

.1 Instruct DCC 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 technician 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 will aspects of its care and operation.

### 1.9 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

.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 the 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 Names and addresses of nearest suppliers for all items included in maintenance manuals.

.4 Print operating instructions and frame under glass or in approved laminated plastic.

.5 Post instructions where directed.

.6 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.7 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## PART 2 PRODUCTS

### 2.1 MATERIALS

.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements

.2 This section covers the materials and methods of workmanship of items that are common to more than one section of division 21 and 23.

.3 Verify installation and co-ordination responsibilities related to equipment and controls, as indicated.

.4 Access doors in ducts: Refer to 08 31 00
- .1 Manufactured from 2mm core thickness galvanized steel, c/w galvanized concealed hinges, positive locking screwdriver or cam lock, include neoprene sponge air seal all around.
- .2 Standard of acceptance: Acudor, Miami Carey, Air-O-Metal, Krugar, Maxam, Nailor.

.5 Other access doors: Refer to 08 31 00
- .1 Flush mounted 610mmx610mm for body entry and 305mmx305mm or hand entry unless otherwise noted. Doors shall open 180$^{o}$, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Steel shall be prime coated. Doors in fire rated assemblies shall be fire rated.

.2 Standard of acceptance: Le Hage, Zurn, Acudor, Maxam.

## PART 3 EXECUTION

### 3.1 EQUIPMENT REQUIREMENTS AND INSTALLATION

.1 Comply with division 1 for coordination of the work with other trades.

.2 Carry out complete installation in such a manner that will permit equipment maintenance and disassembly by use of unions or flanges, will minimize disturbance to connecting piping and duct systems and will be free of interference with building structure or other equipment.

.3 Extend inaccessible lubricating connections and sight glasses to accessible locations outside of housings or other restricted access spaces.

.4 Install base mounted equipment on concrete housekeeping pads with chamfered edges. Make pads a minimum of 100mm high and 50mm larger than the equipment base dimensions all around.

.5 Provide drain lines from equipment into local floor drains.

.6 Line-up equipment, floor plates and ceiling plates with building walls wherever possible.

.7 Assist the Electrical Trade to ensure proper connection, correct thermal overload selection, correct stop-start controls and interlocking.

.8 Rigidly comply with manufacturer's instructions and recommendations for the installation of equipment. Where required, arrange and pay for the manufacturers' field engineer to supervise the installation of the equipment.

### 3.2 HANGERS & SUPPORTS

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and requirements of ULC C203.

.2 Set inserts in position in advance of concrete work.

.3 Support all equipment and piping from structural members. Where structural supports do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members. Obtain approval before using expansion shields. Use minimum two shields for each hanger. **Do not suspend from metal deck.** Anchoring of piping and equipment shall be to manufacturers recommendations. Provide special supports for equipment where required, fabricated from welded steel structural members. Provide shop drawings and obtain their approval when requested.

.4 Provide split adjustable steel ring hangers on piping NPS 50mm dia. and under and clevis type for NPS greater than 50mm dia. Use roller type hangers as required.

Provide rigid hangers, swing hangers or pipe rollers complete with bracing for hot & chilled water/glycol supply and return, domestic hot & cold water and hot water recirculation pipes in accordance with the following:

| Hanger Type | Rigid | Swing | Pipe Roller |
|---|---|---|---|
| Pipe expansion to hanger rod length | <1/24 | 1/24-1/6 | >1/6 |
| Minimum rod length | 305mm | 305mm | 305mm |

.5 Provide pipe roller stand on supplementary structural members where hangers cannot be used.

.6 Provide spring hangers where required to offset expansion on horizontal runs which follow long vertical risers.

.7 Use the smallest pipe size to determine spacing between pipe rack supports.

.8 Use rod diameters and support spacing as shown in the following table except where specified otherwise:

Rod Diameter and Support Spacing Table

| Pipe Size (Nominal) | Maximum Support Spacing | | |
|---|---|---|---|
| | Rod Diameter | Steel Pipe | Copper Pipe |
| 15mm | 8mm | - | 1525mm |
| 20mm – 25mm | 9.5mm | 1830mm | 1830mm |
| 32mm | 9.5mm | 1830mm | 1830mm |
| 40mm | 9.5mm | 2750mm | 2440mm |
| 50mm | 9.5mm | 3050mm | 2750mm |
| 65mm – 80mm | 9.5mm | 3660mm | 3050mm |

.9 Support plumbing piping in accordance with the more stringent requirements of authorities having jurisdiction, plumbing code, or as specified above.

.10 Place support within 300mm of each horizontal elbow and within 600mm of each side of valve or tee.

.11 Mild steel wall hooks may be used to support non-expanding piping. Allow 25mm minimum clearance for insulated pipe.

.12 Provide riser clamps for all risers unless detailed otherwise.

.13 Uninsulated copper piping, use copper hangers or 6mm lead crimped to hanger between copper and ferrous hanger.

.14 Provide insulation protection shields:
- .1 Insulated cold piping (Fluid Operating Temperature Range <4 deg. C to 15 deg. C):
  - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping Fluid Operating Temperature Range 20 deg. C to 175 deg. C):
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

.15 Offset hanger pipe and structural attachments in such a manner that rod is vertical when piping is hot and equalize loads on all hangers where possible.

**3.3 SLEEVES**

.1 Provide pipe sleeves at all points where pipes pass through masonry or concrete. Sleeves shall be at least 20 gauge core thickness galvanized sheet steel with lock seam joints.

.2 Provide cast iron pipe sleeve with integral annular fin or steel pipe sleeves with annular fin continuously welded at midpoint where the sleeve passes through foundation walls or extends above finished floor.

.3 Size sleeves to provide 6mm clearance all around, between sleeve and pipes or between sleeve and insulation. As a minimum where piping passes below footings, provide a clearance of at least 50mm between sleeve and pipe. Backfill around pipe sleeve up to underside of footing with concrete of the same strength as the footing. Do not embed pipe in concrete.

.4 Terminate sleeves flush with vertical surface of concrete and masonry or 100mm above floors.

.5 For pipes passing through roofs, provide cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight durable joint.

.6 Fill voids around pipes as follows:
- .1 Caulk between sleeve and pipe in foundation walls and below grade floors.
- .2 Where sleeves pass through walls or floors, caulk space between insulation and sleeve or between pipe and sleeve with waterproof fire retardant non-hardening mastic.

.7 Ensure no contact between copper tube or pipe and ferrous sleeve.

.8 On any exterior wall penetrations, provide a Modular Mechanical Pipe Penetration Seal. Modular mechanical seal consisting of interlocking elastomeric links with steel pressure plates and stainless steel bolts, designed to create a watertight seal in the annular space between the pipe and wall sleeve or core-drilled opening. The seal shall be rated for a minimum hydrostatic pressure of 20 psig (46 ft head of water) with EPDM rubber elements suitable for continuous service temperatures of -40°F to 250°F. The seal assembly shall be fully adjustable, removable, and reusable without damage to the pipe, sleeve, or seal components, and shall be sized to suit the specific pipe OD and sleeve ID at each penetration.

.9 Fill future-use sleeves with easily removable filler.

.10 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

.11 Temporarily plug all pipe openings during construction.

## 3.4 FIRESTOPPING

.1 All firestopping and smoke sealing (except for fire dampers) required for mechanical service penetrations of rated walls, floors and partitions shall be the responsibility of Division 7.

.2 Fire Compartments are indicated on Architectural Drawings

## 3.5 ESCUTCHEONS AND PLATES

.1 Provide escutcheons on exposed pipes passing through finished walls, partitions, floors and ceilings and secure to pipe or finished surface but do not secure to insulation. Inside diameter shall fit around the finished pipe or insulation. Outside diameter shall cover the opening or sleeve.

## 3.6 ACCESS DOORS

.1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating, or fire devices for installation by the appropriate trade.

## 3.7 DIELECTRIC COUPLINGS

.1 Provide wherever pipes of dissimilar metals are joined.

.2 Provide insulating unions for pipe sizes 50mm and under; flanges for pipe sizes over 50mm.

.3 Provide felt or rubber gaskets to prevent contact of dissimilar metals.

**3.8 PAINTING REPAIRS AND RESTORATION**

.1 Painting of equipment and material installed under Division 21 and 23 is not part of the mechanical work except as noted.

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

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

.4 Clean all uncoated metal surfaces such as piping, fittings, valves, and equipment and leave ready for painting.

.5 Prime uncoated metal surfaces in areas exposed to view that will be inaccessible to painter after installation.

.6 Assist painter to determine proper colour coding.

**3.9 ANCHORAGE OF EQUIPMENT**

.1 Anchor all machinery and equipment. Install lift rings for all major items of equipment, if required.

.2 Construct equipment supports of structural steel or steel pipe, securely braced. Use only welded construction. Bolt mounting plates to structure.

.3 Anchoring by explosive charge inserts is not acceptable unless approved by the DCC Representative

**3.10 CANNING OR SLEEVING OF OPENINGS & HANGER INSERTS**

.1 Provide all cans or forms required for openings in poured-in-place concrete to suit pipes or ducts etc. Locate each in place, well in advance of concrete pouring.

.2 Where cutting of the building framing or envelope is required to suit the work of this division, mark out the exact dimensions and position of such work and obtain the approval of the DCC Representative before carrying out cutting.

.3 Supply all sleeves and hanger inserts required for the work of this division.

**3.11 PIPING EXPANSION LOOPS**

.1 Provide expansion loops or joints where required.

.2 Securely anchor pipes to the building structure where necessary to provide proper expansion. Install pipe guides on each side of each expansion loop or joint.

.3 Refer to section 23 05 16 Expansion Fitting and Loops for HVAC equipment.

**3.12 SETTING AND ALIGNMENT**

.1 Employ a journeyman millwright to align all V belt drives and shaft coupling drives prior to start up.

.2 Submit a certificate from the millwright certifying that the above work has been carried out.

## 3.13 EQUIPMENT LUBRICATION

.1 Lubricate all equipment which has provision for lubrication, with the exception of factory sealed bearings which shall be checked for alignment and smooth operation.

.2 Use the lubricant recommended by the manufacturer for the service for which the equipment is specified.

.3 Maintain and adequately lubricate equipment furnished and operated before completion of the Contract until the completed work is handed over to, and accepted by, the DCC Representative. Provide a cardboard tag, wired in place on the equipment showing the date of motor start-up, the last date of lubrication, and the lubricant used.

## 3.14 CLEANING

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

## 3.15 FIELD QUALITY CONTROL

.1 Testing Piping Systems:
- .1 Conduct tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Conduct tests and pay for all associated work including making good and re-testing when required.
- .3 Notify DCC Representative 48 hours in advance of date when tests will be conducted.
- .4 Make sure all work has been tested and approved prior to insulating or concealing.
- .5 Carry out tests in the presence of the DCC Representative and the Authority having jurisdiction.
- .6 Forward written test results to the DCC Representative.
- .7 Schedule of Tests:

| Service | Test Pressure | Testing Fluid | Duration |
|---|---|---|---|
| Water Systems | 200 psi | Water | 2 hours |
| Natural Gas | 75 psi | Air | 24 hours |
| Drainage Systems | 5 psi | Water | 6 hours |

- .8 Carry out tests on the natural gas system in accordance with applicable codes and regulations.
- .9 Carry out tests on the water supply and drainage systems in accordance with governing bodies.
- .10 Leave all work uncovered until completion of testing. However, should the construction schedule require that work be covered, carry out tests on portions of system prior to system covering. Give a minimum of 48 hours notice to DCC Representative prior to testing.

.2 Testing HVAC Systems:
- .1 Refer to Section 23 05 93 Testing, Adjusting and Balancing for HVAC Systems.

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

.4 Field Testing:
.1 If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Owner. In the event that equipment does not meet specifications, the Contractor shall be responsible for the costs of the above laboratory tests, and all subsequent testing and correction required.

## 3.16 SYSTEMS COMMISSIONING

.1 Refer to Section 01 91 13 General Commissioning (CX) requirements.

.2 Refer to Section 01 91 31 Commissioning (CX) Plan.

.3 Refer to Section 01 91 41 Commissioning: Training.

.4 In addition to the commissioning requirement of the sections above provide:
.1 Commission all Mechanical systems (Plumbing, HVAC and Controls) or components to achieve:
.1 Systems which are in full, demonstrated, and documented working order, and
.2 The familiarization and instruction of Owner's operating staff to ensure they are capable of operating systems properly and maintaining ongoing systems performance.
.2 Give the following points particular emphasis:
.1 Provide clear, concise, yet comprehensive control sequence descriptions for all systems and components. These are important as they will form the basis for the systems performance test checklists.
.2 Provide system performance testing of all systems and components. Cover all modes of operation (e.g. summer/winter; occupied / unoccupied) and all specified control sequences, both for normal operations and abnormal conditions.
.3 If outside temperature, lack of full occupancy, or other factors prevent full performance testing of some functions, then testing, verifying, and documenting the performance of these functions may be carried out at an appropriate time during the 12 months after Substantial Performance.

.5 Mechanical Contractor to assign a Mechanical Commissioning Coordinator to:
.1 Assign direct overall charge of commissioning to the mechanical commissioning coordinator. Use a Commissioning Coordinator who is fully qualified through practical experience, has a comprehensive knowledge of the interactive nature of building systems and their controls, understands the complete system, and who is available to carry the project through total completion. This person, a Principal or an employee of the Mechanical Contractor or hired from an outside source, shall be responsible for Commissioning, Demonstration to the Owner, and Certifications of Substantial and Total Performance. This person shall not be the Mechanical Contractor's superintendent.

.6 Schedule, Commissioning Plan
.1 Contribute to the construction team’s efforts to prepare and submit a schedule within two months after award of contract (integrated with general construction schedule) for the commissioning phase of the work. Show:
.1 completion dates for each trade in each major section of the building.
.2 timing of the various phases of the commissioning, testing, balancing, and demonstration process.
.3 submission dates for the various documents required prior to verification of commissioning.
.2 The Mechanical Contractor shall contribute to the preparation of the commissioning Plan. It is a description of how the commissioning process will be organized, scheduled, and documented. Indicate:

.1 The composition of the Mechanical Contractor's group representation to the Commissioning Team.
.2 A list of activities and proposed checklists required to commission the system and its subsystems.
.3 A schedule for each activity linked to the master project schedule to make possible the coordination necessary between trades and trade divisions.

.3 The Mechanical Commissioning Coordinator shall review design intent and intended commissioning procedures with the commissioning team and submit a detailed plan identifying the orderly progression of the prestart commissioning check and subsequent commissioning performance check of each sub-system, leading to the ultimate commissioning of entire systems. This review shall be completed 6 months prior to substantial performance.

.7 Field Testing

.1 If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Owner. If equipment does not meet specifications, the Contractor shall be responsible for the costs of the above laboratory tests, and all subsequent testing and correction required.

.8 System Completion

.1 Have the Mechanical Commissioning Coordinator provide written certification that each system is ready for start-up and that the following work is fully completed and checked.
.1 All systems physically installed.
.2 Permanent electrical connections
.3 Controls
.4 Vibration Isolation adjusted
.5 Filter systems
.6 Fan drives
.7 Duct Leakage Testing
.8 Duct cleaning
.9 Rotational checks
.10 Equipment lubrication
.11 Equipment Prestart Checks
.12 Chemical Cleaning
.13 Chemical Treatment
.14 All safety controls operational and tested
.15 Qualified personnel operating systems
.16 Manufacturers equipment start-up and commissioning reports by equipment supplier.
.17 All deficiencies recorded, reviewed by the commissioning team, and subsequently corrected.

.9 System Activation

.1 System Activation is the stage at which the System Completion has been completed and the services (i.e. electrical power, hot water, chilled water, natural gas) have been connected and started. Perform an activation inspection so that the system is operational and ready for testing and balancing.

.10 Testing, Balancing, and Adjusting

.1 Include the following:
.1 activation of all subsystems
.2 testing and adjustment of all subsystems
.3 major or composite system activation
.4 major or subsystem testing and adjustment

.2 As in the case of the System Completion Phase, record all deficiencies, review by the Commissioning team and, subsequently, correct. Repeat the process at the point of the

deficiency before proceeding forward.

.3 This phase is concluded when the installation is in full working order and acceptable for use. Include the following:
- .1 position all balance dampers in ductwork
- .2 position all balance valves in piping systems
- .3 make provisions for testing air pressures and flow rates
- .4 set up air diffusers, registers, and grilles
- .5 set up all automatic control valves/dampers and automatic temperature control devices
- .6 set up fans and pumps
- .7 plug all air pressure and flow measuring holes
- .8 adjust vibration isolators as necessary
- .9 correct problems revealed by Balancing Agency. Change fan speed and pitch as necessary
- .10 a detailed check by a person having direct overall charge of commissioning This check must include all items and functions to be later demonstrated to the Owner's representatives.
- .11 systems operation in the fire mode in the presence of the authorities having jurisdiction. Obtain a written statement/certificate of approval.

.11 System Performance Verification

.1 Do not commence Verification of Commissioning by the commissioning team until System Activation and Testing, Balancing, and Adjusting has been completed. Submit test procedure completion certificates at the time of requesting the commencement of the verification procedure. Demonstrate to the commissioning team the following:
- .1 Operation of all mechanical equipment
- .2 Location of and opening and closing of all access panels
- .3 Operation of all automatic control dampers and automatic temperature control devices
- .4 Proper response of all variable air volume terminals, reheat coils, valves, etc…
- .5 Fire damper operation
- .6 Noise levels
- .7 Exhaust systems

.2 At the completion of the system performance verification submit the following to the commissioning team:
- .1 A letter certifying that all work specified under this contract is complete, clean, and operational in accordance with the specification and drawings
- .2 A copy of verification certificates and signed checklists provided by the specialist trades for transmission to the Owner
- .3 Record drawings
- .4 A letter from the testing and balancing agency certifying that all necessary data for inclusion in operating and maintenance manuals has been received

.12 Commissioning and Documentation

.1 Provide and coordinate commissioning documentation as described in Division 1.

## 3.17 DEMONSTRATION

.1 Refer to Section 01 79 00 – Demonstration and Acceptance.

.2 DCC Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

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

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

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

**3.18 PROTECTION**

.1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Cover all equipment with polyethylene plastic sheets during plaster or concrete work and clean and return to "as new" condition prior to Substantial Performance of the Work. Provide for repainting of marked or damaged surfaces as required. Refer to Equipment Specific Installation and Operation Manuals for proper receiving, storage, installation and protection of equipment during construction.

.2 Mask or grease and cover machined surfaces. Securely cover equipment openings and open ends of piping, conduit, and ductwork as work progresses.

.3 Any equipment that has operating parts, bearings, or machined surfaces that show signs of rusting, pitting, or physical damage will be rejected.

**3.19 CLEAN-UP**

.1 At all times keep the premises free from accumulations of waste material caused by employees or work, and at the completion of the work, remove surplus materials and leave area "broom clean" or equivalent, unless otherwise specified.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Co-operate and co-ordinate with the requirements of other units of work specified in other sections.

.2 This section covers the insulation of the following:
- .1 Domestic hot, cold, and hot water recirculation piping
- .2 Refrigerant Piping
- .3 Hydronic heating piping
- .4 Storm drainage lines inside building (All Storm Drainage Lines shall be insulated as specified in this section for all piping Cast Iron, Copper and Plastic PVC Drainage piping. The insulation of PVC Piping shall be for sound attenuation.)
- .5 Horizontal and concealed vertical rainwater leaders inside the building (All Storm Drainage Lines shall be insulated as specified in this section for all piping Cast Iron, Copper and Plastic PVC Drainage piping. The insulation of PVC Piping shall be for sound attenuation.)

## 1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM B 209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
- .2 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C 533, Calcium Silicate Block and Pipe Thermal Insulation.
- .6 ASTM C 547, Mineral Fiber Pipe Insulation.
- .7 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .8 ASTM C 921, 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.
- .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)
- .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
- .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

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

.6 Manufacturer's Trade Associations
.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC)
.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings
.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

## 1.3 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.

## 1.4 SUBMITTALS

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

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.3 Shop Drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit product data for the following:
.1 Aluminum/Canvas Coverings
.2 Piping Insulation Types, noting application for each product
.3 Finishing cement
.4 Lagging adhesive
.5 Lavatory Drain Insulation
.6 Pipe Coverings
.7 Piping Insulation Inserts
.8 PVC/ABS Jackets

.4 Samples:
.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Instructions: submit manufacturer's installation instructions.

### 1.5 QUALITY ASSURANCE

.1 Installer: specialist in performing work of this Section.

### 1.6 DELIVERY, STORAGE AND HANDLING

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

.2 Storage and Protection:
- .1 Protect from weather, construction traffic.
- .2 Protect against damage.
- .3 Store at temperatures and conditions required by manufacturer.

## PART 2 PRODUCTS

### 2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.
- .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 C 335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
- .1 Mineral fibre: to CAN/ULC-S702.
- .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.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702.

.5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
- .1 Mineral fibre: to CAN/ULC-S702.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: flexible unicellular tubular elastomer.
- .1 Insulation: with vapour retarder jacket.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702.
- .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
- .1 Insulation: to ASTM C 533.
- .2 Maximum "k" factor: to CAN/ULC-S702.
- .3 Design to permit periodic removal and re-installation.

**2.3 INSULATION SECUREMENT**

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

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 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 C 449/C 449M.

**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 OUTDOOR VAPOUR RETARDER FINISH**

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

**2.8 JACKETS**

.1 Polyvinyl Chloride (PVC):
- .1 Use PVC jackets only where surface temperature is between -20 degrees C and 65 degrees C only.
- .2 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.
- .3 Colours: White
- .4 Minimum service temperatures: -20 degrees C.
- .5 Maximum service temperature: 65 degrees C.
- .6 Moisture vapour transmission: 0.02 perm.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special requirements:
  - .1 Outdoor: UV rated material at least 0.5mm thick.

.2 Aluminum:
- .1 To ASTM B 209.
- .2 Thickness: 0.50 mm sheet.

.3 Finish: smooth, stucco embossed or corrugated.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.3 Stainless steel:
.1 Type: 304.
.2 Thickness: 0.25 mm.
.3 Finish: smooth.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

### 2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Section 07 92 10 - Joint Sealing.

### 2.10 LAVATORY DRAIN INSULATION

.1 Use PVC seamless lavatory insulation kits, manufactured of anti-microbial closed cell molded vinyl material.

## 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 manufacturer’s 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.

.6 Provide insulation protection shields:

.1 Insulated cold piping (Fluid Operating Temperature Range <4 deg. C to 15 deg. C):
.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
.2 Insulated hot piping Fluid Operating Temperature Range 20 deg. C to 175 deg. C):
.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

.7 Fittings
.1 Insulate fittings with sections of the pipe covering mitred to fit tightly, or strips of flexible insulation, then apply reinforcing membrane embedded in barrier coating. Alternatively insulate fittings with tightly placed flexible insulation and apply PVC fitting covers.

.8 Valves
.1 Insulate valve bodies, bonnets and strainers with insulating cement; or with fitted pipe coverings; or with mitred blocks all to thickness of adjacent pipe covering, then apply reinforcing membrane embedded in barrier coating. Alternatively, insulate with tightly placed flexible insulation covered with reinforcing membrane, stapled in place and covered with a barrier coating. Leave drains, blow-off plugs and caps uncovered.

.9 Flanges
.1 Insulate cold flanges with oversized pipe covering or mitred blocks to the thickness of the adjacent pipe covering, then apply reinforcing membrane embedded in barrier coating.

.10 Insulation Termination Points
.1 Terminate insulation 3” from fittings to provide working clearance and bevel insulation at 45° angle.

## 3.4 REMOVABLE, PREFABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements and 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: aluminum, PVC or high temperature fabric.

## 3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer’s 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 In piping 1 in. or less, insulation is not required for strainers, control valves and balancing valves.

.3 TIAC Code: A-1.
.1 Securements: bands, Tape at 300 mm on center.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code 1501-H.

.4 TIAC Code: A-3.
- .1 Securements: bands, Tape at 300 mm on center.
- .2 Seals: VR lap seal adhesive, VR lagging adhesive.
- .3 Installation: TIAC Code: 1501-C.

.5 TIAC Code: A-6.
- .1 Insulation securements: Tape.
- .2 Seals: lap seal adhesive, lagging adhesive.

.6 TIAC Code: C-2 with vapour retarder jacket.
- .1 Securements: bands, Tape at 300 mm on center.
- .2 Seals: lap seal adhesive, lagging adhesive.
- .3 Installation: TIAC Code: 1501-C.

.7 Thickness of insulation as listed in following table.
- .1 Thicknesses listed below are based upon adherence to ASHRAE 90.1-2013.
- .2 Run-outs to individual units and equipment not exceeding 4000 mm long.
- .3 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

| Service | Operating Temperature (°F) | TIAC Code | Pipe Diameter | Insulation Thickness |
|---|---|---|---|---|
| Domestic Cold Water, and Above Ground Storm Water & Vertical Rainwater leaders (Anti-Sweat) | | A-3 or C-2 | 1 1/4” and under | 13 mm (½”) |
| | | | 1 ½” and over | 25 mm (1”) |
| Domestic Hot Water and Hot Water Recirculation | <140°F | A-3 | 1 1/4” and under | 25 mm (1”) |
| | | | 1 ½” and over | 38 mm (1 ½”) |
| Refrigeration Lines | <40°F to 60°F | A-6 | <1” | 13 mm (½”) |
| | | | 1” and over | 25 mm (1”) |
| Hot Water Heating Piping (Supply & Return) | 150°F to 180 °F | A-3 | 1 1/4” and under | 38 mm (1 ½”) |
| | | | 1 ½” and over | 50 mm (2”) |

.8 Finishes:
- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: PVC jacket.
- .3 Concealed, indoors: insulation on concealed piping will be left as factory finished with no further finish required.
- .4 Outdoors: water-proof aluminum jacket.
- .5 Finish attachments: Seals: closed.
- .6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

## 3.7 FIELD QUALITY CONTROL

.1 Use only licensed journeymen for the work.

.2 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.

.3 Carry out insulation work only after the following conditions have been met:
- .1 Required tests have been completed;
- .2 Surfaces to be covered are clean and dry;
- .3 Ferrous surfaces have been painted.

.4 Use only clean and dry insulation for the work.

.5 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shape to blend with fitting insulation and adjacent covering; with full length section and tight to insulated object.

.6 Supports:
- .1 Do not penetrate vapour seals with pipe hangers and supports.
- .2 Vertical pipe over 80mm: use insulation supports welded or bolted to pipe directly above lowest pipe fitting, thereafter locate on 4600mm centres and at each valve or pair of line flanges.
- .3 Space insulation and support for movement of piping as required.

.7 Penetrations:
- .1 For covered or uncovered pipes, pack mineral fibre insulation solidly around pipes where they pass through sleeves, for depth of penetration. Those with vapour barrier jacket shall have continuous covering. Make sure that pipe sleeves accommodate full thickness of insulation and allow pipe expansion. Provide mastic topping to seal annular space.

.8 Butt Joints:
- .1 Adhere and seal laps of vapour barrier cover or use 100 mm wide vapour barrier strip using vapour seal adhesive.
- .2 Stagger both longitudinal and horizontal joints on duct insulation in multi-layered construction.
- .3 At each end of unions and flanges on low pressure systems, at pipe hangers, and at other points where required, terminate insulation with insulation cement trowelled on bevel.

.9 Allow for radial expansion of pipe and permit pipe to move longitudinally inside insulation and to expand and contract without opening up joints between sections.

.10 Gouge out insulation for proper fit where there is interference between weld bead and insulation. Bevel insulation away from studs and nuts to permit their removal without damage to insulation. Closely and neatly trim insulation around extending parts of pipe saddles, supports, hangers, and clamp guides and seal with insulating cement.

.11 For all locations where pipe hangers are on the outside of the insulation, provide insulation saddles or blocks of high-density insulation to prevent crushing or compression of insulation due to weight of pipe. See Item 3.3.

## 3.8 CLEANING

.1 Proceed in accordance with Section 01 74 10 – Cleaning & Waste Management.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, garbage, tools and equipment.

END OF SECTION

# PART 1 GENERAL SUMMARY

.1 The intent is for all ductwork and HVAC related equipment to remain clean during construction. The contractor shall provide the following activities specified during all construction activities.

.1 HVAC Protection:

.1 Seal off all supply, return and exhaust air system openings to prevent the accumulation of dust and debris in the systems at all times unless work is being completed on the immediate area of the system using plastic seals to the approval of the DCC Representative. This is to include overnight and longer work stoppages. All diffusers, grilles, registers, laminar flow diffusers etc. are also to be sealed in plastic.

.2 Keep all construction areas clean and neat as specified elsewhere in this specification.

.3 Where ductwork and equipment become contaminated due to inadequate protection these ducts will be cleaned as specified in Section 23 01 31 – Air Duct Cleaning Systems.

**.2** Providing the DCC Representative is satisfied that the activities as specified above have been performed through construction, the Section 23 01 31 – Air Duct Cleaning Systems shall be waived. The DCC Representative reserves the right to enforce the Section 23 01 31 – Air Duct Cleaning Systems at their discretion.

**.3** Refer to Section 23 05 01 – Use of HVAC Systems During Construction.

## 1.2 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 74 00 – Cleaning and Waste Management.

.4 Section 23 05 01 – Use of HVAC Systems During Construction.

.5 Section 23 31 13 – Metal Ducts – Low Pressure to 500 Pa

## 1.3 REFERENCES

.1 Definitions:

.1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:

.1 Rigid supply and return ductwork;

.2 Flexible ductwork;

.3 Mixing plenum boxes;

.4 Return air plenums including ceiling plenums;

.5 Cooling and heating coils and compartments;

.6 Condensate drain pans, eliminator blades and humidifiers;

.7 Fans, fan blades and fan housing;

.8 Filter housing and frames;

.9 Acoustically insulated duct linings;

.10 Diffusers, registers and terminal units;

.11 Dampers and controls;

.2 Reference Standards:

.1 National Air Duct Cleaners Association (NADCA)

.2 ACR Standard: Assessment, Cleaning and Restoration of HVAC Systems.

.3 North American Insulation Manufacturers Association (NAIMA)

.1 NAIMA, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.

.4 United States Environmental Protection Agency (US EPA)

.1 US EPA, 40 CFR Parts 152 and 156.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit cleaning plan developed during site evaluation.

.1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.

.3 Product Data:

.1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.

### 1.5 CLOSEOUT SUBMITTALS

.1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.

.2 Post Cleaning Inspection Report: submit 2 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:

.1 Name and address of facility;
.2 Name and address of HVAC cleaning contractor;
.3 Description of HVAC systems with drawings identifying systems cleaned;
.4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
.5 Comments complete with photographs of each sampling location and other observed system features;
.6 Identify systems tested, observations, actions taken and recommendations for future maintenance.

## PART 2 PRODUCTS

### 2.1 ACCESS DOORS AND PANELS

.1 Equipment Access Doors and Panels: construct from same materials as equipment paneling complete with sealing gasket and positive locking device.

.1 Size access doors and panels in equipment to allow for inspection and cleaning.

.2 Ductwork Access Doors: construct access doors from 1.27 minimum galvanized sheet steel with gasketed seal.

.1 Ensure access door is 25mm greater in every dimension than access opening.
.2 Access door size 200 mm x 200 mm minimum.
.3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.

.3 Access Doors and Panels Acoustic Lining:

.1 Install acoustic lining to match existing.
.2 Self-adhesive glass fiber tape capable of adhering to both acoustic lining and metal access door or panel materials.
.3 Water-based duct sealer for repairing cut acoustic lining.

### 2.2 ANTIMICROBIAL AGENT

.1 Use antimicrobial agents registered with US EPA-40 CFR.

### 2.3 SYSTEM FILTERS

.1 Supply and install new filters for each HVAC System cleaned.

### 2.4 AIR DUCT CLEANING EQUIPMENT

.1 Manually propelled full contact brushes:
- .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
  - .1 Ensure brushes are sized to fit various duct sizes in HVAC system.
- .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.

.2 Brushes: manually propelled with integrally-mounted motor and nylon or polypropylene or other non-metallic material bristles.
- .1 Ensure motor has capacity to continue to push brush after bristles are distorted.
- .2 Replace worn and ineffective brushes when required.

### 2.5 HEPA FILTER EVACUATION FAN

.1 Evacuation Fan: includes fan, HEPA filter, flexible hose and motor capable of maintaining debris and particulates airborne in airstream until they reach evacuation fan and maintaining system under negative pressure.
- .1 Ensure HEPA filters are clean and maintain evacuation fan and HEPA filter to run efficiently.

### 2.6 HEPA VACUUM UNIT

.1 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.
- .1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.

## PART 3 EXECUTION

### 3.1 PREPARATION

.1 Close down HVAC system.

.2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
- .1 Control devices;
- .2 Fire and smoke control dampers;
- .3 Balancing dampers: indicate and record positions for resetting;
- .4 Air volume control boxes: indicate and record positions for resetting;
- .5 Fire alarm devices;
- .6 Monitoring devices and controls;

.3 Cut openings in equipment panels and ductwork for access to system interior.
- .1 Square or rectangular opening sizes: 200 mm minimum each side.
- .2 Circular opening sizes: 200mm minimum diameter.

.4 Installation of Access Doors and Panels: install access doors and panels for equipment where required to facilitate system inspection and cleaning.
- .1 Install access doors and panels for inspection and cleaning of equipment as follows:
  - .1 Filters;
  - .2 Dampers;
  - .3 Sensors;

.5 Installation of Access Doors in Ductwork: install access doors in ductwork where required to facilitate system inspection and cleaning.
- .1 Access door installation is not permitted in flexible ductwork.
  - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.

.6 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.
- .1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.

.7 Remove and reinstall ceiling tiles to gain access to HVAC system as required.
- .1 Replace ceiling tiles damaged or soiled by air duct cleaning procedures.

## 3.2 EXAMINATION / PRE-CLEANING INSPECTION

.1 Verification of Conditions:
- .1 Make visual inspection of interior of HVAC system using remote controlled robotic camera.
- .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.

.2 Evaluation and Assessment:
- .1 Identify location and type of internal components.
- .2 Identify extent of potential problems.

## 3.3 DUCT CLEANING

.1 Do duct cleaning in accordance with NADCA ACR Standard.

.2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zones which has already been cleaned.
- .1 Isolate zone of duct using closed-cell polyurethane foam or air inflated zone bag before cleaning.

.3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.

.4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.

.5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.

.6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75mg of particulate per 0.01 square metres.

.7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.
- .1 Pass brushes through sections as often as necessary to achieve required cleanliness.

.2 Change brush sizes as required to ensure positive contact with duct and component interiors.
.3 Clean corners and pockets where dirt and debris can accumulate.

.8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.

.9 Clean diffusers, registers, louvers, fan coils and cassette and other terminal units.

## 3.4 ACOUSTICALLY LINED DUCTWORK CLEANING

.1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices.
.1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.
.2 Monitor cleaning process progress by onboard camera.

## 3.5 COMPONENTS AND EQUIPMENT CLEANING

.1 Brush and vacuum rooftop unit surfaces to achieve required cleanliness.

.2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by DCC Representative for cleaning.
.1 Pressure wash with water and cleaning solution until required cleanliness is achieved.
.2 Clean equipment and components in place only if there is no hazard to adjacent materials.

.3 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows:
.1 Fan blades;
.2 Dampers;
.3 Turning vanes;
.4 Controls;
.5 Sensor bulbs;
.6 Fire alarms;
.7 Smoke detectors;

## 3.6 FIELD QUALITY CONTROL/FINAL INSPECTIONS

.1 Post Cleaning Inspection: Carry out a visual final inspection and provide photo documentation after final cleaning has been completed.
.1 Identify on HVAC system record drawings access points used for inspection and cleaning.
.2 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

## 3.7 SYSTEM STARTUP

.1 Install new system filters after cleaning operations are completed.

.2 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.

.3 Restart each HVAC system.

## 3.8 CLEANING

.1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Use of mechanical systems during construction.

.2 Related Sections:
- .1 Section 21 05 01 – Common Work Results Mechanical
- .2 Section 23 01 31 – Air Duct Cleaning for HVAC Systems
- .3 Section 23 05 93 – HVAC Testing, Adjusting and Balancing

## 1.2 USE OF SYSTEMS

.1 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is not permitted.

# PART 2 PRODUCTS

## 2.1 NOT USED

.1 Not Used.

# PART 3 EXECUTION

## 3.1 NOT USED

.1 Not Used.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Co-operate and co-ordinate with the requirements of other units of work specified in other sections.

.2 Provide complete piping system including:
- .1 Refrigerant piping
- .2 Plumbing systems (domestic, sanitary, storm)
- .3 Hydronic heating piping
- .4 Natural gas piping system

## 1.2 RELATED REQUIREMENTS

.1 Section 21 07 19 – Thermal Insulation for Piping

.2 Section 23 11 23 – Facility Natural Gas Piping

.3 Section 23 21 13.01 – Hydronic Systems Copper

.4 Section 23 21 13.02 – Hydronic Systems Steel

.5 Section 23 23 00 – Refrigerant Piping

## 1.3 REFERENCES

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

.2 National Fire Code of Canada (NFCC 2005)

.3 National Building Code

.4 CSA B149.1 – Natural Gas Code

## 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

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

## 1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product 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.

## PART 2 PRODUCTS

### 2.1 MATERIAL

.1 Refer to appropriate specifications section for the service.

.2 Paint: zinc-rich to CAN/CGSB-1.181.
- .1 Primers, Paints: in accordance with manufacturer's recommendations for surface conditions.

.3 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.4 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping. (All firestopping and smoke sealing required for mechanical service penetrations of rated walls, floors and partitions shall be the responsibility of Division 7).

## 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 PIPING PREPARATION

.1 Cut all piping square. Remove all burrs and slivers by filing.

.2 Thoroughly clean copper pipe and fittings over entire contact surface before applying flux. Use non-corrosive flux only.

.3 Threads in pipe and fittings shall be standard taper pipe thread. Make joints full length, full depth, clean cut, smooth, strong and free of imperfect threads.

.4 Ream and countersink all threaded pipe ends to remove burrs. Wipe finished joints clean.

.5 Clean all rust scale, paint, oil, or foreign matter from pipe surfaces prior to welding.

### 3.3 PIPING CONNECTIONS

.1 Provide threaded joints for steel pipe 2” and smaller and welded joints for pipe 2 ½” and larger.

.2 Use main sized saddle type weldolet branch connections. In steel pipe, branch lines may be directly connected to the main if the main is at least two times the branch size, for up to 6” mains, or if the main is at least 3 times the branch size for 8” and larger mains. Do not project branch lines inside main.

.3 Cut openings in mains for Weldolets neatly and sized to suit fitting. Clean slag from inside of opening.

.4 Assemble steel to cast iron flanged joints using flat faced steel flanges and full faced gaskets only.

.5 Fit all flanged joints uniformly on contact faces of gaskets. Extend all bolts completely through their nuts. Use a mixture of graphite and oil or an anti-seize compound on all bolts.

.6 Fit threaded joints using good quality pipe joint cement or PTFE tape on male threads only. All joint compounds to be compatible with type of service pipe will carry.

.7 Provide non-conducting type connections wherever jointing dissimilar metals. Brass adaptors and valves are acceptable.

.8 Provide MJ couplings consisting of neoprene sleeve and stainless steel shield and clamps, for plain end cast iron pipe.

.9 Use fittings with joints suitable for the type of pipe employed. Provide fittings of equal quality and thickness as the pipe to which they are attached.

**3.4 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.

**3.5 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 AND as indicated without interrupting operation of other system, equipment, components.

**3.6 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.

**3.7 AIR VENTS**

.1 Install air vents where indicated on Drawings and on all high points of closed water systems. Fit with manual isolation cocks.

.2 Provide safe drain fittings and copper drain tubing to nearest drain point, for air vents installed in areas where leakage could cause damage.

.3 Install drain piping to approved location and terminate where discharge is visible.

**3.8 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.

**3.9 PIPEWORK INSTALLATION**

.1 Screwed fittings jointed with PTFE 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 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.

.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 Install pipe straight, true and parallel, clean and free of rust and scale. Cap exposed ends during construction to prevent entrance of foreign material.

.14 Provide clearance for proper installation of insulation and for access to valves, air vents, drains, unions, etc.

.15 Provide approved plugs or caps on all lines left for future connection.

.16 Run branch lines to fixtures, tanks, pumps, and other items of mechanical equipment to sizes shown on the drawings, regardless of whether tappings smaller than pipe size shown are provided.

.17 Cut piping to measurements taken at the site and work into place without spring.

.18 Make all connections to equipment and branch mains with unions or flanges. Provide flexible connections, vibration and expansion connectors at equipment as indicated.

.19 Do not use bushings. Make reductions in water pipe sizes with eccentric reducing fittings installed so that top of mains form a straight line, free from air pockets.

.20 Install piping to allow expansion and contraction without unduly stressing pipe or connected equipment. Provide for expansion compensation where pipe runs past building expansion joints. Locate and size expansion joints or loops to permit an expansion 50 percent greater than that required. Provide expansion loops where possible but where impracticable owing to space

considerations provide an approved type of proprietary expansion compensator complete with pipe anchors and guides.

.21 Repair all pipe coatings and linings after welding to the original condition 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 gate, 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 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.22 Check Valves:
- .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

## 3.10 UNIONS, COUPLINGS, STRAINERS, ARRESTORS

.1 Install unions and couplings where indicated on Drawings and at all equipment, to allow disassembly.

.2 Install strainers on supply lines upstream of all automatic control devices, pressure regulating valves, circulator pumps.

.3 Install water hammer arresters on hot and cold supply lines at quick closing valves and each fixture or group of fixtures to prevent water hammer. Install between fixtures being served and supply main. Install additional units on risers. Size arresters in accordance with manufacturer's standards and Plumbing and Drainage Institute WH201.

.4 Air chambers may be installed in lieu of water hammer arresters provided no more than 3 fixtures are serviced by each air chamber.

.5 Protect entire water distribution system against contamination due to backflow from non-potable sources. Refer to AWWA manual for cross connection control. Provide an approved backflow preventer for each connection to fixture or equipment for which approved air gap or vacuum breaker is not shown or specified elsewhere (e.g. in connection with fixture or equipment itself). Provide isolating valves and valved bypass, for each backflow preventer.

.6 Install flexible connectors immediately adjacent to equipment subject to vibration and where indicated on the Drawings. Secure other end to prevent shaking or excessive movement.

## 3.11 VALVES

.1 Install all valves indicated on Drawings or necessary for proper control and isolation of piping and equipment. All valves are to suit the particular service required.

.2 All valves of similar type to be of one manufacturer.

.3 Check all valves for specified criteria and proper operation before installation.

.4 Orientate handwheels or operators as indicated on Drawings. When not indicated, orientate to most convenient location for operation.

.5 Provide access to concealed valves.

.6 Provide valves and piping that are compatible to avoid galvanic corrosion.

.7 Use gate valves for shut-off valves unless indicated otherwise.

.8 Lead Free Ball valves shall be used for shut-off valves on potable water systems.

.9 Use globe valves for throttling service or where specifically indicated for shut-off service. Use globe valves for meter by-pass.

.10 Use gate and globe valves with rising stems except where lack of space exists because of obstructions, in which case use non-rising stems.

.11 Provide drain valves at main shut-off valves, and at low points of piping and equipment.

.12 Provide isolating valves for each piece of equipment, including heating elements.

**3.12 PIPE ROUTING AND GRADES**

.1 Route piping in an orderly manner, maintaining proper grades. Install to conserve headroom and interfere as little as possible with use of the space. Run exposed pipe parallel to walls. Group pipes wherever practical. Install concealed piping close to building structure to keep furring to a minimum.

.2 Conceal piping in ceiling spaces and partitions where possible, except in mechanical room. Where pipes cannot be concealed, obtain details of pipe run from the DCC Representative.

.3 Slope water piping 0.25% and arrange for drainage at low points; provide proper air relief.

.4 Equip low points of all closed systems with ¾” drain valves and hose nipples. Provide high capacity float operated automatic air vents at all high points.

.5 Install storm and sanitary drains to invert elevations and slopes indicated on the drawings. Where invert elevations and slopes are not shown install piping to the minimum requirements of the Plumbing Code, generally 2% minimum slope for sizes 3” and smaller, and for all branch lines, and 1% minimum slope for building drains 4” and larger.

.6 Install drain lines from drain points in concealed locations or inaccessible areas to nearest floor drain.

**3.13 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.

**3.14 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.

**3.15 PREPARATION FOR FIRE STOPPING**

.1 All firestopping and smoke sealing required for mechanical service penetrations of rated walls, floors and partitions shall be the responsibility of Division 7. Firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

**3.16 FLUSHING OUT OF PIPING SYSTEMS**

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

**3.17 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

.1 Conduct tests and pay for all associated work including making good and re-testing when required.

.2 Notify DCC Representative 48 hours in advance of date when tests will be conducted.

.3 Make sure all work has been tested and approved prior to insulating or concealing.

.4 Carry out tests in the presence of the DCC Representative and the Authority having jurisdiction.

.5 Forward written test results to the DCC Representative.

.6 Schedule of Tests:

| Service Test | Testing Pressure | Fluid | Duration |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Water Systems | 200 psi | Water | 2 hours |
| Natural Gas | 75 psi | Air | 24 hours |
| Drainage Systems | 5 psi | Water | 6 hours |

.1 Carry out tests on the natural gas system in accordance with applicable codes and regulations.

.2 Carry out tests on the water supply and drainage systems in accordance governing bodies.

.3 Leave all work uncovered until completion of testing. However, should the construction schedule require that work be covered, carry out tests on portions of system prior to system completion. Give a minimum of 48 hours notice to DCC Representative of such prior testing.

.7 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

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

.9 Pay costs for repairs or replacement, retesting, and making good.

.10 Insulate or conceal work only after approval and certification of tests.

**3.18 CLEANING**

.1 Clean in accordance with Section 01 74 00 - Cleaning and Waste Management.

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

.2 At all times keep the premises free from accumulations of waste material or rubbish caused by employees or work, and at the completion of the work, remove all rubbish and all tools, equipment and surplus materials from and about the work and leave the work "broom clean" or its equivalent, unless more exactly specified.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
.1 Electrical motors, drives and guards for mechanical equipment and systems.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedure section 01 78 00 - Closeout Submittals
.2 Section 21 05 01 – Common Work Results for Mechanical.

## 1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

.3 NEMA MG1-1993, Revision1, Part 31, Section IV

## 1.4 SUBMITTALS

.1 Shop Drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Indicate the following:
.1 Product description, model number, dimensions, unit weights, electrical information and motor efficiency

## 1.5 QUALITY ASSURANCE

.1 Manufacturer’s Certification: The motor manufacturer shall certify the following:
.1 The products and systems furnished are in strict compliance with the specifications.
.2 Comply with the energy requirements of the latest edition of ASHRAE 90.1.
.3 The specified factory tests have been performed.
.4 The equipment furnished contains inter-changeable parts with specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

.2 Contractor Certification: The Contractor shall certify the following:
.1 The products and systems installed are in strict compliance with the specifications and all applicable local or state codes.
.2 The specified field tests have been satisfactorily performed.
.3 The equipment furnished contains inter-changeable parts with specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

## PART 2 PRODUCTS

### 2.1 GENERAL

.1 Provide all motors for equipment specified unless noted otherwise

.2 All motors of 1HP or larger shall be premium efficiency

.3 In general, provide motors with open drip proof (ODP) enclosures except provide totally enclosed fan cooled (TEFC) enclosures for motors located in plenums, in dusty environments or where exposed to outdoor temperatures.

.4 Provide explosion proof motors as required by code.

### 2.2 MOTORS

.1 Motors under 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.2 Motors over 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, three phase, 208/600 V, unless otherwise specified or indicated.

.3 All motors shall be minimum EEMAC Design B, squirrel cage induction, speed as indicated, drip proof, ball bearing continuously rated with Class ‘B’ temperature rise in ambient temperature not exceeding 100F, Class F insulation, service factor 1.15, unless noted otherwise or conflicting with electrical area classification.

.1 Where motors are fed from Variable Frequency Drives (VFD), they are to comply with NEMA MG-1-1993, Revision1, Part 31, Section IV “Performance Standards Applying to All Machines”, Part 31 – “Definite Purpose Inverter-Fed Motors”.

.4 For motors exposed to outdoor temperatures, lubricate with lubricants suitable for operation at the specified minimum outdoor temperature.

### 2.3 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals

### 2.4 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;
- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm dia holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension. -

.5 Guard for flexible coupling:
- .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

.6 Unprotected fan inlets or outlets:
- .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
- .2 Net free area of guard: not less than 80% of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

### 2.5 SHAFT COUPLINGS

.1 Provide shaft couplings of the pin or jaw neoprene insert type, gear type or flexing steel insert type.

.2 Make sure that the coupling can be easily removed without disassembly of the equipment.

.3 Die-cast couplings are not acceptable.

## 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 74 10 – Cleaning & Waste Management

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

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SECTION INCLUDES

.1 Materials and installation for flexible connections, expansion joints, anchors and guides for building services piping.

.2 Install piping to allow expansion and contraction without unduly stressing pipe or connected equipment. Provide for expansion compensation where pipe runs past building expansion joints and where required based on pipe sizing and anchor points. Contractor to provide proposed locations on plans for review by engineer. Locate and size expansion joints or loops to permit an expansion 50 percent greater than that required. Provide expansion loops where possible but where impracticable owing to space considerations provide an approved type of expansion compensator complete with pipe anchors and guides.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 21 05 01 - Common Work Results for Mechanical

.4 Section 23 05 05 – Installation of Mechanical Piping systems

.5 Section 23 08 01 - Performance Verification Mechanical Piping Systems.

## 1.3 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A 105/A 105M, Standard Specification for Carbon Steel Forgings, for Piping Applications.

## 1.4 SUBMITTALS

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

.2 Submit product data and indicate for item as applicable:

.1 Manufacturer, model number, line contents, pressure and temperature rating.
.2 Proposed location on Plan drawings for each system.
.3 Movement handled, axial, lateral, angular and the amounts of each.
.4 Nominal size and dimensions including details of construction and assembly.

.3 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

.4 Data to include:

.1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

## PART 2 PRODUCTS

### 2.1 SLIP TYPE EXPANSION JOINTS

.1 Application: for axial pipe movement, as indicated.

.2 Repacking: under full line pressure.

.3 Body and packing housings: Class 150, 1MPa carbon steel pipe to ASTM A 53/A 53M, Grade B. Wall thickness to match pipe with raised face slip-on or weld neck flanges to match pipe.

.4 Slip or traverse sleeves: carbon steel pipe to ASTM A 53/A 53M, Grade B.

.5 Anchor base: construction steel, welded to body.

.6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.

.7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.

.8 Packing rings: 6 minimum, PTFE or graphite impregnated non-asbestos.

.9 Thermal plastic packing: PTFE or graphite impregnated non-asbestos slug supplied loose.

.10 Lubricating fittings: pet cocks with grease nipple.

.11 Plunger body and plunger:
- .1 Plunger body: heavy wall carbon steel welded to body.
- .2 Plunger: carbon steel with hex head for use with socket wrench.

.12 Lubricant: to manufacturer's recommendations.

.13 Lubricant gun: complete with hose assembly.

### 2.2 BELLOWS TYPE EXPANSION JOINTS

.1 For axial, lateral or angular movements, as indicated.

.2 Maximum operating pressure: to suit service.

.3 Maximum operating temperature: to suit service.

.4 Type B: externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1 ½ times maximum working pressure. Furnish test certificates.

.5 Bellows:
- .1 Multiple bellows, hydraulically formed, single ply, for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.

.6 Reinforcing or control rings:
- .1 2 piece nickel iron.

.7 Ends:
- .1 flanges to match pipe.

.8 Liner:

.1 Austenitic stainless steel in direction of flow.

.9 Shroud:
.1 Carbon steel, painted.

### 2.3 FLEXIBLE CONNECTION

.1 2” diameter and smaller:
.1 flexible metallic connector constructed of corrugated stainless steel or bronze hose with heavy mesh braided cover minimum 12” long with union connections.

.2 Over 2” to 4” diameter:
.1 flexible metallic connector constructed of corrugated stainless steel or bronze hose with heavy mesh braided cover minimum 15” long with flanged connections.

.3 Over 4” diameter:
.1 Wire reinforced rubber vibration joints complete with retaining rings, stretcher plates, bolts, washers and companion flanges.

.4 Use flexible connectors suitable for the conditions of temperature and pressure encountered.

### 2.4 ANCHORS AND GUIDES

.1 Anchors:
.1 Provide as required.

.2 Alignment guides:
.1 Provide as required.
.2 To accommodate specified thickness of insulation.
.3 Vapour barriers, jackets to remain uninterrupted.

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 Install expansion joints with cold setting, required to allow expansion and contraction without unduly stressing pipe or connected equipment. Make record of cold settings.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install pipe anchors and guides as indicated. Anchors to withstand 150 % of axial thrust.

### 3.2 CLEANING AND START-UP

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

### 3.3 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 - Cleaning and Waste Management

.3 Section 21 05 01 - Common Work Results for Mechanical

.4 Section 23 05 05 - Installation of Pipework

.5 Section 23 05 53.01 - Mechanical Identification.

## 1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
- .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

## 1.4 SUBMITTALS

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

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items:
- .1 Thermometers.
- .2 Pressure gauges.

# PART 2 PRODUCTS

## 2.1 GENERAL

.1 Design point to be at midpoint of scale or range.

## 2.2 DIRECT READING THERMOMETERS

.1 Industrial style, mercury in glass, red reading, black numerals, aluminum case, glass window, adjustable angle, 225mm long, variable angle type with separable well.

.2 Celsius scale selected so normal operating point is approximately mid-scale; 1% accuracy.

.3 Standard of Acceptance: Weksler AA5, Trerice, Weis.

### 2.3 REMOTE READING THERMOMETERS

.1 100 mm diameter liquid filled activated dial type: to CAN/CGSB-14.5 ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass case for wall mounting.

### 2.4 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

.3 Separable socket suitable for stem type thermometer with gasket and cap.

### 2.5 PRESSURE GAUGES

.1 Dial size 110mm, aluminium case, chrome ring, bronze movement, phosphor bronze bourdon tube.

.2 Metric scale (Pa/kPa) selected so that normal operating point is approximately mid-scale; 1% accuracy

.3 Accessories - lever handle cock

.4 Standard of Acceptance: Weksler BA1, Trerice, Weis

.5 Provide:
- .1 Snubber for pulsating operation.
- .2 Diaphragm assembly for corrosive service.
- .3 Gasketted pressure relief back with solid front.
- .4 Bronze stop cock.

## 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 in indicated and on inlet and outlet of:
- .1 Heat Exchangers.
- .2 DHW Heaters.

.3 Install wells for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

### 3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.
.2 Upstream and downstream of PRV's.
.3 Upstream and downstream of control valves.
.4 Inlet and Outlet of Heat Exchangers.
.5 As indicated on drawing schematics and controls schematics.

.2 Install gauge cocks for balancing purposes, elsewhere.

.3 Use extensions where pressure gauges are installed through insulation.

**3.4 NAMEPLATES**

.1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 23 05 23.03 – Valves – Cast – Steel

.2 Section 02 81 00 – Hazardous Materials

## 1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch)

.2 ASME B16.18-2018, Cast Copper Alloy Solder-Joint Pressure Fittings

.2 ASTM International (ASTM):

.1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes

.2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings

.3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed)

.4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

.1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions

.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves

.3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS SDS-Safety Data Sheets in accordance with Section 02 81 00 – Hazardous Materials.

.3 Shop Drawings:

.1 Submit data for valves specified in this Section.

## 1.4 CLOSEOUT SUBMITTALS

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

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:

.1 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1.

.2 Discs: one for every 10 valves, each size. Minimum 1.

.3 Stem packing: one for every 10 valves, each size. Minimum 1.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

.2 Tools:

.1 Furnish special tools for maintenance of systems and equipment.

.2 Include following:

.1 Lubricant gun for expansion joints.

.2 Valve wrench or key for each type and size of operating nut.

### 1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

## PART 2 PRODUCTS

### 2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 Products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: screwed ends to ASME B1.20.1

.2 Copper tube systems: solder ends to ASME B16.18

.3 Lockshield Keys:

.1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

.4 Gate Valves:

.1 Requirements common to gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic

.5 Packing: non-asbestos.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: Handwheel.

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: handwheel.

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem

.3 Operator: handwheel.

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: handwheel.

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, union bonnet.

.2 Operator: handwheel.

.5 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505

.3 Operator: lockshield.

.3 NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505

.3 Operator: lockshield.

.4 NPS 2 and under, plug disc, Class 150, screwed ends:

.1 Body and bonnet: union bonnet.

.2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem

.3 Operator: handwheel.

.5 Angle valve, NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.

.3 Operator: lockshield.

.6 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 NPS 2 and under, swing type, bronze disc:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.4 NPS 2 and under, swing type, composition disc, Class 200:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.

.5 NPS 2 and under, horizontal lift type, composition disc, Class 150:

.1 Body: with integral seat, union bonnet ring with hex shoulders, cap.

.2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:

.1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

.7 Silent Check Valves:

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B62 with integral seat

.2 Pressure rating: Class 125.

.3 Connections: screwed ends to ASME B1.20.1 and with hex. shoulders

.4 Disc and seat: renewable rotating disc.

.5 Stainless steel spring, heavy duty.

.6 Seat: regrindable.

.8 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62

.2 Pressure rating: 2760-kPa CWP, 860 kPa steam.

.3 Connections: solder ends to ANSI.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.9 Butterfly Valves:

.1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.

.1 Body: cast bronze, with copper-tube dimensioned grooved ends.

.2 Disc: elastomer coated ductile iron with integrally cast stem.

.3 Operator: lever or handwheel.

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

### 3.2 CLEANING

.1 Clean in accordance with Section 01 74 00 – Cleaning.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 23 05 23.01 – Valves-Bronze

## 1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B16, Fittings and Valves Package

.1 ASME B16.5-2017, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard

.2 ANSI/ASME B16.10-2009, Face-to-Face and End-to-End Dimensions Valves

.3 ANSI/ASME B16.25-2007, Buttwelding Ends

.4 ANSI/ASME B16.34-2009, Valves Flanged, Threaded and Welding End. Includes Supplement (2010)

.2 American Petroleum Institute (API):

.1 API STD 598-2009, Valve Inspection and Testing

.3 ASTM International (ASTM):

.1 ASTM A49-12, Standard Specification for Heat-Treated Carbon Steel Joint Bars, Micro Alloyed Joint Bars, and Forged Carbon Steel Comprise Joint Bars

.2 ASTM A182/A182M-11a, Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service

.3 ASTM A193/A193M-12, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications

.4 ASTM A194/A194M-2011, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both

.5 ASTM A216/A216M-08, Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service

.6 ASTM B85/B85M-10, Standard Specification for Aluminum-Alloy Die Castings

.4 Efficiency Valuation Organization (EVO):

.1 International Performance Measurement and Verification Protocol (IPMVP)

.1 *IPMVP 2007 Version*

.5 Green Seal Environmental Standards (GS):
  .1 GS-11-11, Standard for Paints and Coatings
  .2 GS-36-11, Standard for Commercial Adhesives
.6 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
  .1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions
  .2 MSS SP-61-2009, Pressure Testing of Valves

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for each valve and include product characteristics, performance criteria, physical size, finish and limitations.
.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### 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 valves for incorporation into manual.

### 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

### 1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

## PART 2 PRODUCTS

### 2.1 MATERIAL

.1 Valves:
  .1 To be of single manufacturer.
  .2 Test valves individually.
.2 Requirements common to valves, unless specified otherwise:
  .1 Pressure-temperature ratings: to ANSI B16.34
  .2 Inspections and tests: to API 598
  .3 Pressure testing: to MSS SP-61
  .4 Flanged valves:
    .1 *Face-to-face dimensions: to ANSI B16.10*
    .2 *Flange dimensions: to ANSI B16.5 with 1.6 mm raised face*
  .5 Butt-weld valves:
    .1 *End-to-end dimensions: to ANSI B16.10*
    .2 *End dimensions: to ANSI B16.25 bored for standard pipe schedule.*

.6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49

.7 Markings: to MSS SP-25

.8 Identification:

.1 *Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.*

.2 *Body markings: manufacturer, size, primary service rating, material symbol.*

.9 CRN registration number required for all products.

## 2.2 GATE VALVES

.1 NPS 2 1/2-12, rising stem, OS&Y, solid wedge disc, flanged ends, Class 300:

.1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB, with full length disc guides designed to ensure correct re-assembly

.2 Body/bonnet joint: male-female face with corrugated metallic gasket.

.3 Bonnet studs: to ASTM A193/A193M Type B7

.4 Bonnet nuts: to ASTM A194/A194M Type 2H

.5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.

.6 Gland packing: containing corrosion inhibitor to prevent stem pitting.

.7 Yoke sleeve: Ni-Resist, minimum melting point above 954°C.

.8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.

.9 Disc: with disc stem ring to connect to stem, guided throughout its travel.

.1 *NPS 2 1/2-6: solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.*

.2 *NPS 8 and larger: carbon steel faced with corrosion and heat resistant 13 chromium steel with minimum hardness of 350 HB.*

.10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.

.11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut, T-head disc-stem connection.

.12 Operator: see elsewhere in this Section.

## 2.3 GLOBE VALVES

.1 NPS 2 1/2-12, rising stem, OS&Y, flanged ends, Class 300:

.1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB

.2 Body/bonnet joint: male-female face with corrugated metallic gasket.

.3 Bonnet studs: to ASTM A193/A193M Type B7

.4 Bonnet nuts: to ASTM A194/A194M Type 2H

.5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.

.6 Gland packing: containing corrosion inhibitor to prevent stem pitting.

.7 Yoke bushing: Ni-Resist, minimum melting point above 954°C.

.8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.

.9 Disc: ball type with 35 degrees taper seat.

.10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.

.11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.12 Operator: see elsewhere in this Section.

## 2.4 VALVE OPERATORS

.1 Handwheel: on all valves.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.

.3 Motors:

.1 Application: full open and full close applications.

.2 Position and precision control.

.4 Hydraulic operators:

.1 Application: conveyor and feeder drives.

.2 Mixer and agitator drives.

.5 Pneumatic operators:

.1 Application: media with high dirt content, media with high viscosity, high ambient temperatures, large flow quantities, damp environments and where there is a risk of explosion.

### 2.5 BYPASSES FOR GATE AND GLOBE VALVES

.1 Locations: on valves as indicated.

.2 Position of bypass valve on main valves: upstream side.

.3 Size of bypass valve:

.1 Main valve up to NPS 8: NPS 3/4.

.2 Main valve NPS 10 and over: NPS 1.

.4 Type of bypass valves:

.1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 – Valves-Bronze.

.2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 – Valves-Bronze.

### 2.6 CHECK VALVES

.1 NPS 2 1/2 and over, flanged ends, Class 300: swing check.

.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 Hinge: ASTM A182/A182M.

.8 Hinge pin: ASTM A182/A182M.

.9 Hinge pin plugs: ASTM A182/A182M.

### 2.7 SILENT CHECK VALVES

.1 Construction:

.1 Body: cast steel to ASTM A216 Grade WCB with integral seat.

.2 Pressure rating: Class 250.

.3 Connections: flanged ends.

.4 Double bronze disc with SS seat and stem. Renewable disc, seat, stem and spring. Spring rating must match system design for silent operation and installation.

.5 Stainless steel spring, heavy duty.

.6 Seat: regrindable.

## 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 DCC Representative.

.2 Inform DCC 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 DCC Representative.

## 3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

## 3.3 COMMISSIONING

.1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

## 3.4 CLEANING

.1 Clean in accordance with Section 01 74 00 – Cleaning.

## 3.5 PROTECTION

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

.2 Repair damage to adjacent materials caused by cast steel valve installation.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

## 1.2 RELATED SECTIONS

.1 Section 21 05 01 - Common Work Results for Mechanical

.2 Section 23 05 05 - Installation of Pipework.

## 1.3 REFERENCES

.1 Conform to relevant ANSI, ASME, ASTM, Factory Mutual (FM), and ULC requirements.

## 1.4 SYSTEM DESCRIPTION

.1 Design Requirements:
- .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 Design 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.

## 1.5 SUBMITTALS

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

.2 Submit shop drawings and product data for following items:
- .1 Bases, hangers and supports.
- .2 Connections to equipment and structure.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
- .2 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .3 Deliver, store and handle materials in accordance with manufacturer's written instructions.

# PART 2 PRODUCTS

## 2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1, ULC C203 and MSS SP 58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

.3 Set inserts in position in advance of concrete work.

.4 Support all equipment and piping from structural members. Where structural supports do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members. Obtain approval before using expansion shields. Use minimum two shields for each hanger. **Do not suspend from metal deck.** Anchoring of piping and equipment shall be to manufacturers recommendations. Provide special supports for equipment where required, fabricated from welded steel structural members. Provide shop drawings and obtain their approval when requested.

.5 Use the smallest pipe size to determine spacing between pipe rack supports.

.6 Support plumbing piping in accordance with the more stringent requirements of authorities having jurisdiction, plumbing code, or as specified above.

.7 Place support within 300mm of each horizontal elbow and within 600mm of each side of valve or tee.

.8 On uninsulated copper piping, use copper hangers or 6mm lead crimped to hanger between copper and ferrous hanger.

.9 Offset hanger pipe and structural attachments in such a manner that rod is vertical when piping is hot and equalize loads on all hangers where possible.

## 2.2 PIPE HANGERS

.1 Finishes:
- .1 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:
- .1 Cold piping 50mm maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut.
- .2 Cold piping 65mm or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washer.

.3 Upper attachment structural: suspension from upper flange of I-Beam:
- .1 Cold piping 50mm maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
- .2 Cold piping 65mm or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.

.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 69.

.5 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.

.6 Adjustable clevis: material to MSS SP 69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.7 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.

.8 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
- .1 Finishes for steel pipework: black or galvanized.
- .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.

.9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

**2.3 RISER CLAMPS**

.1 Steel or cast-iron pipe: galvanized or black carbon steel to MSS SP 58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

**2.4 INSULATION PROTECTION SHIELDS**

.1 Insulated cold piping (Fluid Operating Temperature Range <4 deg. C to 15 deg. C):
- .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping Fluid Operating Temperature Range 20 deg. C to 175 deg. C)
- .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

**2.5 CONSTANT SUPPORT SPRING HANGERS**

.1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

**2.6 VARIABLE SUPPORT SPRING HANGERS**

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops.

.4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

### 2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 10 00 - Structural Steel.

### 2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.

.2 Clamps on riser piping:
- .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
- .2 Bolt-tightening torques to industry standards.
- .3 Steel pipes: install below coupling or shear lugs welded to pipe.
- .4 Cast iron pipes: install below joint.

.3 Clevis plates:
- .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.5 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.

.6 Use variable support spring hangers where:
- .1 transfer of load to adjacent piping or to connected equipment is not critical.
- .2 variation in supporting effect does not exceed 25 % of total load.

### 3.3 HANGER SPACING

.1 Support plumbing piping in accordance with the more stringent requirements of authorities having jurisdiction, plumbing code, or as specified above.

.2 Copper piping: up to 15mm: every 1.5 m.

.3 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.4 Within 300 mm of each elbow.

| Maximum Pipe Size: | Maximum Spacing Steel | Maximum Spacing Copper |
|---|---|---|
| up to 32mm | 2.1 m | 1.8 m |
| 40mm | 2.7 m | 2.4 m |
| 50mm | 3.0 m | 2.7 m |
| 65mm | 3.6 m | 3.0 m |
| 80mm | 3.6 m | 3.0 m |
| 95mm | 3.9 m | 3.3 m |
| 100mm | 4.2 m | 3.6 m |
| 150mm | 5.1 m | |
| 200mm | 5.7 m | |

**3.4 HANGER INSTALLATION**

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

**3.5 HORIZONTAL MOVEMENT**

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

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

**3.6 FINAL ADJUSTMENT**

.1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.

.2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.

.3 C-clamps:
- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:
- .1 Hammer jaw firmly against underside of beam.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Vibration isolation materials and components, seismic control measures and their installation.

## 1.2 REFERENCES

.1 National Fire Protection Association (NFPA)
- .1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 National Building Code of Canada (NBC) - 2024

## 1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures
- .1 Shop drawings: submit drawings stamped and signed by professional engineer licensed in the Province of Ontario.
- .2 Provide shop drawings for each system complete with performance and product data.
- .3 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Quality assurance submittals: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

## 1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.2 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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

# PART 2 PRODUCTS

## 2.1 GENERAL

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

## 2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9mm minimum thick neoprene bonded to 1.71mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9mm minimum thick rubber bonded to 1.71mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

**2.3 ELASTOMERIC MOUNTS**

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

**2.4 SPRINGS**

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Colour code springs.

**2.5 SPRING MOUNT**

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

**2.6 HANGERS**

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

### 2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy-duty duck and neoprene isolation material.

### 2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

### 2.9 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 50 mm minimum.

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

- .1 Up to 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.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

## 3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
- .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
- .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
  - .1 After delivery and storage of Products.
  - .2 After preparatory work is complete but before installation commences.
  - .3 Upon completion of installation.
- .3 Submit manufacturer's reports to DCC Representative within 7 days of manufacturer representative's review.
- .4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

## 3.4 CLEANING

.1 Proceed in accordance with Section 01 74 00 – Cleaning & Waste Management.

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

END OF SECTION

# PART 1 GENERAL

## 1.1 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 Conform to relevant CAN/CGSB requirements.

## 1.3 SUBMITTALS

.1 Product Data:

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

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

.4 Samples:
- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

## 1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

# PART 2 PRODUCTS

## 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Equipment Identification
- .1 Manufacturer's Nameplates:
  - .1 Provide on each piece of equipment a metal nameplate, mechanically fastened with raised or recessed letters.
  - .2 Include registration plates (e.g. pressure vessel, UL and ASME approval), as required by respective agency and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase, and power of motors, all factory supplied.
  - .3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

## 2.2 SYSTEM NAMEPLATES

.1 System Nameplates:
- .1 Provide laminated plastic plates with black face and white centre of minimum size 80mm x 40mm x 1.6mm nominal thickness, engraved with 6mm high lettering. Use 25mm high lettering for major equipment.
- .2 Fasten nameplates securely in conspicuous place. Where nameplates must be mounted on a hot surface, provide standoffs.

.3 Identify equipment type and number (e.g. ERV-1) and service or areas or zone of building served (e.g. Room S100).

.4 Submit list of system nameplates to DCC Representative for review prior to engraving.

.5 Colours:

.1 Hazardous: red letters, white background.

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

.6 Sizes: Conform to following table:

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

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

.2 Locations:

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

.2 Equipment in Mechanical Rooms: use size # 9.

**2.3 PIPING SYSTEMS GOVERNED BY CODES**

.1 Identification:

.1 Natural Gas: to CSA B149.1.

.2 Sprinkler Systems: to NFPA 13.

**2.4 IDENTIFICATION OF PIPING SYSTEMS**

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Do colour coding for piping identification to ANSI Standard A13.1, and local standards.

.3 Identify piping with colour coded bands only, unless painting of piping with primary colour is noted below.

.4 Identify medium in piping with markers showing name and service including temperature and pressure and directional flow arrows where relevant.

.5 Apply primary colour bands in exposed areas only, on finished piping surfaces, including secondary colour bands to indicated type and degree of hazard.

.6 Manufactured Pipe Markers and Colour Bands:

.1 Provide plastic coated cloth material with protective overcoating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of 150°C and intermittent temperature of 205°C. Apply to prepared surfaces.

.2 Apply 50mm wide tape single wrap around pipe or pipe covering with ends overlapping one

pipe diameter but not less than 1" for colour bands.

.3 Use block capital letters 50mm high for pipes of 80mm nominal and larger O.D. (including insulation) and not less than 20mm high for smaller diameters. Use black lettering on yellow and orange primary colour background and white lettering for all other background colours.

.4 Use direction arrows 150mm long by 50mm wide for piping of 80mm nominal or larger O.D. including insulation and 100mm long by 20mm wide for smaller diameters. Use double headed arrows where direction of flow is reversible.

.5 Use waterproof and heat resistant plastic marker tags for pipes and heat resistant plastic marker tags for pipes and tubing of 20mm nominal and smaller O.D.

.6 In general, use black pipe marker direction arrows. Use white on red background for fire protection pipe markers.

.7 Location of identification:

.1 Locate markers and classifying colour bands on piping systems so they can be seen from floor or platform.

.2 Identify piping runs at least once in each room.

.3 Do not exceed 9m between identifications in open areas

.4 Identify both sides where piping passes through walls, partitions and floors.

.5 Where piping is concealed in a pipe chase or other confined space, identify at point of entry and leaving, and at each access opening.

.6 Identify piping at major manual and automatic valves immediately upstream of valves. Where this is not possible, place identification as close to the valve as possible.

.7 Identify branch, equipment or building served after such valve.

.8 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.9 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.10 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.11 Submit legends with colour classifications to DCC Representative for review before ordering material where colours differ from following table:

.1 Pipe and Valve Identification

| Background colour: | Legend, arrows: |
|---|---|
| Yellow | BLACK |
| Green | WHITE |
| Red | WHITE |

.2 Background colour marking and legends for piping systems:

| Pipe Marker Legend | Valve Tag Legend | Primary Colour | Secondary Colour |
|---|---|---|---|
| Dom. Cold Water | Dom. Cold Water | Green | None |
| Dom. Hot Water Supply | Dom. Hot Water Supply | Green | None |
| Dom. Hot Water Recirc. | Dom. Hot Water Recirc. | Green | None |
| Sprinklers | Sprinkler | Red | White |
| Fire Protection | F.P.W. | Red | White |
| San. Sewer | San. Sewer | Green | None |
| Vent | Vent | Yellow | Black |
| Storm Sewer | St. Sewer | Green | None |
| Glycol Hot Water Supply | GHWS | Yellow | Black |
| Glycol Hot Water Return | GHWR | Yellow | Black |
| Refrigeration Suction | Ref. Suction | Yellow | None |
| Refrigeration Liquid | Ref. Liquid | Yellow | None |

## 2.5 IDENTIFICATION DUCTWORK SYSTEMS

.1 Ductwork Identification
- .1 Use 50mm high black stenciled letters with directional flow arrow
- .2 Identification to be as per the HVAC drawings as follows:
  - .1 Fresh Air
  - .2 Exhaust Air
  - .3 Supply Air
  - .4 Return Air
- .3 Do not exceed 9m maximum distance between markings.
- .4 Identify ducts each side of dividing walls or partitions and beside each access door.
- .5 Stencil over final finish only.

## 2.6 VALVES, CONTROLLERS

.1 Valves and Controllers Identification
- .1 Provide brass tags with 15mm stamped code lettering and numbers filled with black paint. Secure with non-ferrous chains or "S" hooks. Use for all valves and operating controllers.
- .2 Provide DCC Representative with six identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item, and normal operating position of valves.
- .3 Mount, where directed, one copy of flow diagram and schedule mounted in glazed frame. Provide one copy in each maintenance instruction manual.
- .4 Consecutively number valves in systems.
- .5 Coordinate between the various mechanical sections to prevent overlapping of numbering systems.

## 2.7 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.

**2.8 LANGUAGE**

.1 Identification in English.

## PART 3 EXECUTION

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 TIMING**

.1 Provide identification only after insulation and/or painting has been completed.

**3.3 INSTALLATION**

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

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

**3.4 NAMEPLATES**

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

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

.3 Protection:
.1 Do not paint, insulate or cover.

**3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 30 ft intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

## 3.6 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning and Waste Management

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, garbage, tools and equipment.

END OF SECTION

## PART 1 GENERAL 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.

.3 TAB shall be completed for all Rooftop units, air-handling units, exhaust fans and all associated control valves, circuit balancing valves etc. to make a complete and operational mechanical system.

### 1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 The TAB agency shall be a certified member of one of the following to perform TAB service for HVAC and water balancing of systems and of equipment:
- .1 Canadian Associated Air Balance Council (CAABC)
- .2 Associated Air Balance Council (AABC)
- .3 Testing, Adjusting and Balancing Bureau (TABB)
- .4 National Environmental Balancing Bureau (NEBB)
- .5 The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the Contractor shall immediately notify the DCC Representative and submit another qualified TAB firm for approval. Any agency that has been the subject of disciplinary action by either the CAABC, AABC, TABB or NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.

.2 TAB Specialist: The TAB specialist shall be either a member of CAABC, AABC or TABB or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein.

.3 Provide documentation confirming qualifications, successful experience.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
- .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
- .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (CAABC, AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

**1.3 PURPOSE OF TAB**

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

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

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

**1.4 EXCEPTIONS**

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

**1.5 CO-ORDINATION**

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

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

**1.6 PRE-TAB REVIEW**

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

.2 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 DCC Representative for verification of TAB reports.

**1.9 START OF TAB**

.1 Notify DCC Representative 7 calendar days prior to start of TAB.

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

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

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

## 1.10 APPLICATION TOLERANCES

.1 Measure and adjust all HVAC (Outside Air, Exhaust air, Supply air, Return Air, etc.) systems to conform within 5% of specified requirements and arrange and pay for all changes to drive sheaves and belts to meet these requirements. Adjust individual outlets for desired air pattern. Carry out tests under maximum conditions, where practicable.

.2 Carry out complete adjustment of water flow rates associated with each part of the HVAC systems. This includes such systems as glycol hot water, chilled water, heat recovery system, cooling towers, domestic water recirculation. Record final flow rates in each case plus operating pressures and temperatures at full load conditions.

## 1.11 ACCURACY TOLERANCES

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

## 1.12 INSTRUMENTS

.1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.2 Calibrate within 3 months of TAB.

## 1.13 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 DCC 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 Properly record all final results, together with all pertinent data, such as temperatures, pressures, motor loads, alignment, belt condition, etc., for each piece of equipment. Deliver 4 copies to the DCC Representative. On approval, 2 copies will be returned for inclusion in the Maintenance Manuals.

.2 Follow SMACNA or AABC Standards.

.3 Include the following for all systems:
- .1 Installation data:
  - .1 Manufacturer and model size, discharge arrangement and class, motor type, HP, voltage, phase, cycles, full load amps, location, and local identification data.
- .2 Design data:
  - .1 Total cfm, static pressure, motor HP, rpm, amps, outside air cfm, fan rpm, and fan bhp.
- .3 Fan data:
  - .1 cfm, static pressure, fan rpm, motor operating amps, motor bhp.
- .4 Complete air system schematic with design and actual cfm at each outlet or inlet. Show room numbers and floors.
- .5 Following acceptance of the report, permanently mark settings of all splitters, dampers and other adjustment devices so that adjustment can be restored if disturbed at any time.
- .6 Pump data:
  - .1 Pump manufacturer’s data, motor kw, rated speed and head characteristics, actual performance characteristics including motor amperage and hydraulic head. Include observations with respect to any control difficulties and specific operating characteristics if different from those specified.
- .7 Balancing Data (Water Systems)
  - .1 Provide flow rate measurements for ALL circuit balancing valves, control valves, pressure bypass valves, pressure sensor settings and flow rates for each piece of mechanical equipment. TAB report MUST provide design flow rates for each fixture and also provide actual balancing valve setting and corresponding flow rates for every fixture. Data must be compiled in a table for easy comparison of design and actual results.
- .8 Any areas deemed unacceptable and/or do not meet design flow rates shall be adjusted by TAB contractor at no additional cost. Schedule walkthrough with DCC Representative once balancing is completed. Any additional deficiencies or discrepancies found during walkthrough must be corrected by TAB contractor at no additional cost.

**1.16 VERIFICATION**

.1 Reported results subject to verification by DCC Representative.

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

.3 Pay costs to repeat TAB as required to satisfaction DCC Representative.

**1.17 SETTINGS**

.1 After TAB is completed to satisfaction of DCC 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 AIR SYSTEMS

.1 Do TAB of systems, equipment, components, controls specified Division 23.

.2 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.3 Locations of equipment measurements: to include as appropriate:
- .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
- .2 At controllers, controlled device.

.4 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

### 1.19 HYDRONIC SYSTEMS

.1 Do TAB of systems, equipment, components, controls etc. for all hot water systems.

.2 Measurements shall include, at a minimum, the following information:
- .1 Heat Exchangers, Cooling Towers, Chillers, Ice Rink System
  - Manufacturer and type
  - Model and/or Serial number
  - Design water flow rate
  - Rated water pressure drop
  - Design water temperature in and out
  - Rated heating capacity
  - Measured discharge water pressure
  - Measured inlet water pressure
  - Calculated water pressure drop
  - Measured water temperature in and out
  - Control Valve Reading (pressure drop, control setting, flow rate)
  - Circuit Balancing Valves (Pressure drop, design flow rate, actual flow rate, balancing valve setting)
  - Date and time measurements taken

### 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 FIRE DAMPERS

.1 Test all fire dampers as follows:
- .1 Make the test by releasing the fusible link and witnessing closure of the damper. Reset upon completion. Leave all fire dampers in the open position. Make a set of white prints to show that each damper has been checked for closure, accessibility, and installation. Submit the prints to the DCC Representative.
- .2 Do the balancing process strictly in accordance with the full intent and requirement of the

ASHRAE Handbook - Testing, adjusting and balancing chapter.

## PART 3 EXECUTION

### 3.1 NOT USED

.1 Not used.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 The intent is for all Ducts to be constructed, installed and sealed in accordance with Section 23 31 13 – Metal Ducts – Low Pressure to 500Pa. Providing the DCC Representative is satisfied with the quality of the ductwork installation and sealing procedures, Section 23 05 94 – Pressure Testing Air Systems may be reduced. The DCC Representative reserves the right to fully enforce the Section 23 05 94 – Pressure Testing of Air Systems at their discretion.

.2 Section Includes:

.1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return, outside or exhaust ductwork system directly or indirectly connected to air handling equipment.

## 1.2 RELATED SECTIONS

.1 Section 23 31 13 – Metal Ducts – Low Pressure to 500 Pa

## 1.3 REFERENCES

.1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.1 SMACNA HVAC Air Duct Leakage Test Manual.

.2 American Society of Heating, Refrigerating and Air-Conditioning DCC Representatives, Inc. (ASHRAE).

.1 ASHRAE Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

## 1.4 SUBMITTALS

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

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:

.1 Submit proposed report form and test report format to DCC Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from DCC Representative.

.2 Prepare report of results and submit to DCC Representative within 24 hours of completion of tests. Include:

.1 Schematic of entire system.

.2 Schematic of section under test showing test site.

.3 Required and achieved static pressures.

.4 Orifice differential pressure at test sites.

.5 Permissible and actual leakage flow rate (L/s) for test sites.

.6 Witnessed certification of results.

.3 Include test reports in final TAB report.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's field reports specified.

### 1.5 QUALITY ASSURANCE

.1 Pre-Installation Meetings:
- .1 Convene pre-installation meeting one week prior to beginning work of this Section.
  - .1 Verify project requirements.
  - .2 Review installation conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review installation instructions and warranty requirements.

## PART 2 PRODUCTS

### 2.1 TEST INSTRUMENTS

.1 Test apparatus to include:
- .1 Fan capable of producing required static pressure.
- .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
- .3 Calibration curves for orifice plates used.

.2 Test apparatus: accurate to within +/- 2 % of flow rate and pressure.

.3 Submit details of test instruments to be used to DCC Representative at least three months before anticipated start date.

## 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 TEST PROCEDURES

.1 Test all exterior ductwork and representative sections of other pressure ducts totaling 25% of the total system. Sections shall be chosen by the DCC Representative.

.2 Test sections minimum of 5m long with inclusive of takeoffs, fittings, branch connections, and/or elbows.

.3 Maximum lengths of ducts to be tested consistent with capacity of test equipment.

.4 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.5 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual and ASHRAE 90.1 Standard requirements.

.6 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

### 3.3 SITE TOLERANCES

.1 System leakage tolerances for tested sections shall be calculated based on design duct pressure rating for Class A seals as defined in ASHRAE 90.1 and listed in cfm/100ft2 duct surface area.

.2 Testing shall be performed at design duct pressure.

.3 Leakage tests for all exterior ducts and ductwork designed to operate at static pressure in excess of 750 Pa shall not exceed calculated leakage rate.

.4 Leakage tests on following ducts shall not exceed calculated tolerances for Class A seal. This requirement, at the DCC Representatives discretion, based on visual inspection of sealing procedures and workmanship, may be waived or reduced to the following:
- .1 Small duct systems up to 250 Pa: leakage 2%.
- .2 Large low pressure duct systems up to 500 Pa: leakage 2%.
- .3 High pressure duct systems, up to 2,500 Pa: leakage 2%

.5 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

**3.4 TESTING**

.1 Test ducts before installation of insulation or other forms of concealment.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

**3.5 CLEANING**

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

## 1.1 SUMMARY

.1 Operate and co-ordinate with the requirements of other units of work specified in other sections.

.2 This section covers the insulation of the following:
- .1 Ducts & Plenums Exposed to Outside Air Temperatures
- .2 Supply Air Ductwork
- .3 Return/Exhaust Air Ductwork
- .4 Acoustic Duct Liner (Supplied and Installed by Division 23)

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 - Cleaning and Waste Management

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.4 Section 23 31 13 – Metal Ducts – Low Pressure to 500 PA.

## 1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)
- .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
- .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C 547, Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C 553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C 612, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
- .9 ASTM C 921, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.3 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701, Thermal Insulation Polyotrene, Boards and Pipe Covering.

## 1.4 DEFINITIONS

.1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and

non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as defined herein.
.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
.1 CRD: Code Round Ductwork,
.2 CRF: Code Rectangular Finish.

**1.5 SHOP DRAWINGS**

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

.2 Submit product data for the following:
.1 Jacket materials, noting application for each type
.2 Ductwork Insulation Types, noting application for each product
.3 Finishing cement
.4 Lagging adhesive
.5 Duct Coverings

.3 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

**1.6 SAMPLES**

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

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

**1.7 MANUFACTURERS' INSTRUCTIONS**

.1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.

.2 Installation instructions to include procedures used, and installation standards achieved.

**1.8 QUALIFICATIONS**

.1 Installer: specialist in performing work of this section and experience in this size and type of project.

**1.9 DELIVERY, STORAGE AND HANDLING**

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

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended 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 & FINSH

.1 Mineral fibre: as specified 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 C 335.

.3 Ductwork mounted external to the building envelope:
- .1 50mm rigid glass mineral wool board faced on one side with foil-crim-kraft (FSK) vapour barrier and with lightweight black glass mat on the airstream side. Min R value of 8.
- .2 Provide external all weather jacketing system – Aluminum Finish

.4 Acoustic Duct Liner (Supplied and Installed by ductwork contractor):
- .1 Internal Surfaces (acoustic): 15mm flexible duct liner, fibre glass bonded with thermosetting resin and faced with a black coated mat on the airstream side.

.5 Ducts & Plenums Exposed to Outside Air Temperatures
- .1 Ductwork within the Building Envelope exposed to raw exterior air (ie. Outside Air intake/exhaust Ducts, mixing box & Plenums until connection with equipment): a) **Concealed**: For concealed locations, use fiberglass flexible blanket insulation complete with white polypropylene scrim-kraft (PSK) vapour barrier. Min R value of 8 (50mm @ 1.5 PCF) b) **Exposed**: 50mm rigid glass fibre board faced on one side with a white all service jacket (ASJ) vapour barrier. Min R value of 8.
- .2 c) Refer to the equipment specific application table in section 2.3 for the insulation requirements.

.6 Air Ductwork Insulation:
- .1 Refer to the equipment specific application table in section 2.3 for the insulation requirements.
- .2 **Concealed** Ductwork:
  - .1 Thermal insulation: Rigid or flexible mineral fibre insulation in accordance with ASTM C553 or ASTM C612, as applicable.
  - .2 Acceptable products: Flexible blanket insulation complete with factory-applied white polypropylene scrim-kraft (PSK) vapour barrier.
  - .3 Performance requirements:
    - .1 Minimum RSI 0.62 (R-3.5) at 24°C mean temperature.
    - .2 Minimum density: 12 kg/m³ (0.75 pcf).
    - .3 Flame spread ≤ 25, smoke developed ≤ 50 to CAN/ULC-S102.
  - .4 Installation: In accordance with TIAC National Standards.

- .3 **Exposed** Ductwork: use rigid glass fibre board faced on one side with a white all service jacket (ASJ) vapour barrier. Min R value of 3.5 (25mm @ 3.0 PCF).
  - .1 Thermal insulation: Rigid mineral fibre board insulation in accordance with ASTM C612.
  - .2 Acceptable products: Rigid glass fibre or mineral wool board insulation complete with factory-applied white All Service Jacket (ASJ) vapour barrier, suitable for exposed applications.
  - .3 Performance requirements:
    - .1 Minimum RSI 0.62 (R-3.5) at 24°C mean temperature.

.2 Minimum density: 48 kg/m³ (3.0 pcf).
.3 Flame spread ≤ 25, smoke developed ≤ 50 to CAN/ULC-S102.
.4 Suitable for exposed applications with durable, cleanable finish.

.4 Installation: In accordance with TIAC National Standards.

.7 Air Ductwork Insulation protective jacketing:
.1 Refer to the equipment specific application table in section 2.3 for the jacket requirements.
.2 Type A: prefabricated, sheet-type self-adhesive protective membrane system - White
.3 Type B: Molded Polyvinyl Chloride (PVC) - White
.1 One-piece molded type to CAN/CGSB-51.53 with pre-formed shapes as required.
.2 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.

## 2.3 INSULATION APPLICATION TABLE

.1 Insulation and Jacket Application Table:

| System | Location | Insulation | | | Jacket Type | Thickness (mm) | Remarks |
|---|---|---|---|---|---|---|---|
| | | SA | RA | EA | | | |
| AHU-1 | Interior | yes | no | n/a | n/a | 38 | |
| AHU-2 | Interior | yes | no | n/a | n/a | 38 | Insulation not required on duct in reception. |
| AHU-3 | Interior | yes | no | n/a | n/a | 38 | |
| AHU-4 | Interior | yes | no | n/a | n/a | 38 | |
| AHU-5 | Interior | yes | no | n/a | n/a | 38 | |
| AHU-6 | Interior | yes | no | n/a | n/a | 38 | |
| AHU-7 | Interior | yes* | no | n/a | n/a | 38 | *Insulation only required within mechanical room. |
| EF-1-5 | Interior | n/a | n/a | yes* | n/a | 38 | *Insulate first 10 ft. of duct from fan. |

## 2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 ULC Listed Canvas Jacket:
.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.5 Outdoor Vapour Retarder Mastic:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

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

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

.9 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.10 Fasteners: 2 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

## PART 3 EXECUTION

### 3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

### 3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.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 - Hangers and Supports for HVAC Piping and Equipment.
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm on centre in horizontal and vertical directions, minimum two rows each side.

.7 Supply, Return and Exhaust Air Duct Insulation:
.1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300mm on centre, each way.
.2 Application: Cut insulation with integral vapour barrier to required size and apply to exterior of duct or plenum with vapour barrier on the warm side with horizontal surfaces overlapping vertical surfaces. Butt edges together tightly. Secure insulation by impaling on mechanical fasteners. Where mechanical fasteners penetrate vapour barrier, and at all corners and joints, apply vapour barrier tape or vapour barrier strips adhered with vapour barrier adhesive. Where raised seams are encountered, secure to the seams an overlapping strip of flexible insulating material with integral vapour barrier to provide a continuous vapour barrier.

.8 Acoustic Duct Liner (Internal)
.1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at

approximately 300mm on centre each way.

.2 Application: Cut insulation material to required size and apply to interior of duct or plenum with horizontal surfaces overlapping vertical surfaces and with edges tightly butted together. Secure insulation by impaling on mechanical fasteners. Where mechanical fasteners penetrate factory finish and at all joints, apply a seal coating. On high velocity duct systems apply reinforcing membrane over the entire insulation surface. Seal off leading edge of insulation to duct surface with reinforced seal coating. Apply acoustic lining to interior of all supply air ducts as indicated on Drawings.

END OF SECTION

# PART 1 GENERAL

## 1.1 REFERENCES

.1 None

## 1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

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

## 1.3 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:
- .1 Conduct full scale tests at maximum design flow rates, temperatures, and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
- .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
  - .1 Pump operation.
  - .2 Boiler operation.
  - .3 Control pressure failure.
  - .4 Maximum heating demand.
  - .5 Boiler failure.
  - .6 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

## 1.4 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:
- .1 TAB has been completed
- .2 Verification of operating, limit, safety controls.
- .3 Verification of primary and secondary pump flow rates.
- .4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:
- .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
  - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
  - .2 Reducing space temperature by turning of heating system for sufficient period of

time before starting testing.

.2 Test procedures:
- .1 Open fully force flow heaters and radiator control valves.
- .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
- .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

### 1.5 HYDRONIC SYSTEMS

.1 In addition to procedures specified above, perform following:
- .1 Add chemicals once per week as required.
- .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.

### 1.6 GASEOUS FUEL SYSTEMS

.1 Operation tests:
- .1 Measure gas pressure at gas meter outlet and at burner manifold.
- .2 Verify details of temperature and pressure compensation at meter.
- .3 Verify settings, operation, venting of high- and low-pressure cut-outs, alarms.
- .4 Check terminals of vents for gas pressure regulators.

### 1.7 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:
- .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
- .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
- .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.
- .4 Ensure that domestic hot water recirculation system is operational.

### 1.8 WET AND DRY PIPE SPRINKLER SYSTEM

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.

.2 Verification of controls, detection devices, alarm devices is specified Division 26.

.3 Verify operation of interlocks between HVAC systems and fire alarm systems.

### 1.9 SANITARY AND STORM DRAINAGE SYSTEMS

.1 Ensure that traps are fully and permanently primed.

.2 Ensure that fixtures are properly anchored, connected to system.

.3 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

## PART 2 PRODUCTS

**2.1 NOT USED**

.1 Not Used.

## PART 3 EXECUTION

**3.1 NOT USED**

.1 Not Used.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

## 1.2 REFERENCES

.1 01 35 43 – Environmental Protection

# PART 2 PRODUCTS

## 2.1 CLEANING SOLUTIONS

.1 Accomplish alkaline cleaning by circulating a compound of Tri-sodium polyphosphate, Meta-silicate, Sodium Nitrate, and a wetting agent. Use concentration to the manufacturer's recommendations.

# 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.

.4 Provide chemical cleaning for each of the following systems. Provide full clean water flush to Owner’s satisfaction.
- .1 100% water heating system.
- .2 Propylene Glycol Piping.

.5 Provide necessary materials, plant, labour, electricity, heat, water, and all required connections to systems to complete the chemical cleaning.

.6 Notify consultant 48 hours prior to chemical cleaning so that work may be verified and inspected.

.7 Clean each system of all construction debris, oils, grease, varnish, and millscale.

.8 Flush each system until the issuing water is free of sediment.

.9 Accomplish alkaline cleaning by circulating a compound of Tri-sodium polyphosphate, Meta-silicate, Sodium Nitrate, and a wetting agent. Use concentration to the manufacturer's recommendations.

.10 It is preferred that the solution circulate for 8 hours at a temperature between 180ºF and 200ºF. If the solution is used at 70ºF, circulate the solution for 24 hours.

.11 Drain and rinse the complete system with clear water until the discharge water shows the same pH and total dissolved solids as that of the raw water entering the system.

.12 If required for removal of iron oxide deposits, acid cleaning shall be accomplished by a compound of inhibited sulfuric acid and synthetic detergent solution through the system.

.13 Ensure that any chemicals harmful to plastic do not contact plastic piping.

.14 Acceptable Firms: Pace Chemicals, Dearborn Chemical, Guardian Chemicals

.15 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.

.16 Report on Completion of Cleaning:
- .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.17 Hydronic Systems:
- .1 Fill system with water, ensure air is vented from system.
- .2 Use water meter to record volume of water in system to +/- 0.5%.
- .3 Add chemicals under direct supervision of chemical treatment supplier.
- .4 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.
- .5 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
- .6 Add chemical solution to system.

## 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 water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .7 Repeat with water 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.
- .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 74 00 - Cleaning and Waste Management

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

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation for piping, valves and fittings for gas fired equipment.

## 1.2 RELATED REQUIREMENTS

.1 Section 22 05 01 – Common Work Results for Mechanical

.2 Section 23 05 05 – Installation of Pipework

.3 Section 23 05 23 – Valves

.4 Section 23 05 93 – Performance Verification of Mechanical Piping

.5 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

## 1.3 REFERENCES

.1 Conform to latest version of CSA B149.1 for supply and installation of natural gas systems.

## 1.4 SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
- .2 Indicate on manufacturers catalogue literature following:
  - .1 valves.
  - .2 pipe

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

## 1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Black steel pipe shall be shipped to the jobsite in such a manner to protect the pipe. The pipe and fittings shall not be roughly handled during shipment. Pipe and fittings shall be unloaded with reasonable care.

.3 Protect the stored product from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.

.4 Protect fittings and piping specialties from moisture and dirt.

## PART 2 PRODUCTS

### 2.1 QUALITY CONTROL

.1 Fittings shall be listed & approved for their intended application.

.2 All fittings used in Fuel Gas Applications shall be listed by a third-party agency as being acceptable for fuel gas piping systems.

### 2.2 PIPE

.1 Steel pipe: to ASTM A 53/A 53M, Schedule 40, seamless as follows:
- .1 NPS 1/2 to 2, screwed.
- .2 NPS 1/2 to 2, plain end (press-connect carbon steel pipe fitting system)
- .3 NPS2 1/2 and over, plain end.

### 2.3 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

.4 Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have unpressed connection leak-detection feature to assure leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
- .1 Acceptable Manufacturer’s for press fittings: ProPress, PressG, Mega Press

### 2.4 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 Welding: butt-welding fittings.
- .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A 47M.
- .5 Bolts and nuts: to ASME B18.2.1.
- .6 Nipples: schedule 40, to ASTM A 53/A 53M.

.2 Cold Press Mechanical Joint Fitting:
- .1 Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have unpressed connection leak-detection feature to assure leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
- .2 Acceptable Manufacturer’s for press fittings: ProPress, PressG, MegaPress

### 2.5 VALVES

.1 See Section 23 05 23 – Valves.

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

.2 The installing contractor shall examine the pipe and fittings for defects, sand holes or cracks. There shall be no defects of the pipe or fittings. Any damaged pipe or fittings shall be rejected.

.3 The installing contractor shall insure that internal components of the cold press mechanical joint press fitting are properly in place and free from damage. This is to include sealing elements, grip ring & separator rings.

.4 Black steel pipe shall be cut with an approved pipe cutting tool. The pipe shall be cut square to permit proper joining with the fittings.

.5 Remove scale, slag, dirt and debris from inside and outside of pipe and fittings before assembly. The protective coating shall be removed from the outside of the pipe end and shall be wiped clean and dry. The burrs on the pipe shall be reamed with a de-burring or reaming tool.

### 3.2 PIPING

.1 Install in accordance with Section 23 05 05 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149

.2 Install drip points:
- .1 At low points in piping system.
- .2 At connections to equipment.

.3 Press Fittings: Cold Press Mechanical Joint Fittings shall be installed in accordance with the manufacturer's installation instructions. The protective corrosion coating shall be removed from the outside of the pipe end. The pipe shall be fully inserted into the fitting and the pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the pipe to assure the pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.
- .1 Acceptable Manufacturer's for press fittings: ProPress, PressG, Mega Press

### 3.3 VALVES

.1 Install valves with stems upright or horizontal.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

### 3.4 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
- .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 See Section 23 05 05 – Installation of Pipework.

## 3.5 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

.2 Pre-Start-Up Inspections:
- .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
- .2 Check gas trains, entire installation is approved by authority having jurisdiction.

## 3.6 CLEANING

.1 Cleaning: in accordance with Section 23 08 02- Cleaning and Start-Up of Mechanical Piping Systems, CAN/CSA B149.1, supplemented as specified.

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

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 23 05 00 – Common Work Results for HVAC

.2 Section 23 05 17 – Pipe Welding

.3 Section 23 05 23.01 – Valves-Bronze

.4 Section 23 05 23.02 – Valves-Cast Iron

## 1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/American Welding Society (AWS):

.1 ANSI/AWS A5.8/A5.8M-11, AMD1 Specification Filler Metals for Brazing and Braze Welding

.2 American Society of Mechanical Engineers (ASME):

.1 ANSI/ASME B16.4-06, Gray-Iron Threaded Fittings Classes 125 and 250

.2 ANSI/ASME B16.15-11, Cast Copper Alloy Threaded Fittings Classes 125 and 250

.3 ANSI B16.18-12, Cast Copper Alloy, Solder Joint Pressure Fittings

.4 ANSI/ASME B16.22-12, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings

.3 ASTM International (ASTM):

.1 ASTM B32-08, Standard Specification for Solder Metal

.2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings

.3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings

.4 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube Metric

.5 ASTM E202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols

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

.1 Safety Data Sheets (SDS)

.5 Manufacturers Standardization Society (MSS):

.1 MSS SP67-2011, Butterfly Valves

.2 MSS SP70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends

.3 MSS SP71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends

.4 MSS SP80-2008, Bronze Gate, Globe, Angle and Check Valves

.5 MSS SP85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 43 – Environmental Procedures.

.3 Indicate on manufacturers catalogue literature the following: valves.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### 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 hydronic systems for incorporation into manual.

.3 Submit 2 copies of operation and maintenance manual.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Furnish following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

### 1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial regulations.

### 1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 00 – Cleaning & Waste Management.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 10 – Cleaning & Waste Management.

## PART 2 PRODUCTS

### 2.1 TUBING

.1 Type A or B C hard drawn copper tubing: to ASTM B88M

## 2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22

.3 Cast iron threaded fittings: to ANSI/ASME B16.4

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18

## 2.3 FLANGES

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

## 2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32

.2 Silver solder BCUP: to ANSI/AWS A5.8

.3 Brazing: as indicated.

## 2.5 VALVES

.1 Connections:

.1 NPS 2 and smaller: ends for soldering.

.2 NPS 2 1/2 and larger: flanged grooved ends.

.2 Gate Valves: application: isolating equipment, control valves, pipelines:

.1 NPS 2 and under:

.1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Section 23 05 23.01 – Valves-Bronze.

.2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01 – Valves-Bronze.

.3 Butterfly valves: application: isolating each cell or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):

.4 Globe valves: application: throttling, flow control, emergency bypass:

.1 NPS 2 and under:

.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 – Valves-Bronze.

.2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 – Valves-Bronze.

.5 Balancing, for TAB:

.1 Sizes: calibrated balancing valves, as specified.

.2 NPS 2 and under:

.1 Mechanical rooms: globe, with plug disc as specified Section 23 05 23.01 – Valves-Bronze.

.2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 – Valves-Bronze.

.6 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 – Valves-Bronze.

.7 Bypass valves on gate globe valves NPS 8 and larger: NPS 3/4, globe, with PTFE disc as specified

Section 23 05 23.01 – Valves-Bronze.

.8 Swing check valves:

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 – Valves-Bronze.

.9 Silent check valves:

.1 NPS 2 and under:

.1 As specified Section 23 05 23.01 – Valves-Bronze.

.10 Ball valves:

.1 NPS 2 and under: as specified Section 23 05 23.01 – Valves-Bronze.

## 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 hydronic systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of DCC Representative.

.2 Inform DCC 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 DCC Representative.

### 3.2 MANUFACTURER'S INSTRUCTIONS

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

### 3.3 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 where ever 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 Assemble piping using fittings manufactured to ANSI standards

### 3.4 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install butterfly valves on chilled water and condenser water lines only.

.3 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.4 Install globe valves for balancing and in by-pass around control valves as indicated.

.5 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as

indicated.

.6 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

.7 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.

.8 Install ball valves for glycol service.

## 3.5 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

## 3.6 SITE QUALITY CONTROL

.1 Testing:

.1 Test system in accordance with Section 23 05 00 – Common Work Results for HVAC.

.2 For glycol systems, retest with ethylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

.2 Balancing:

.1 Balance water systems to within plus or minus 5% of design output.

.3 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 DCC Representative.

.4 Refer to Section 01 91 13 for commissioning requirements.

## 3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 10 – Cleaning & Waste Management.

**END OF SECTION**

.1 GENERAL

**1.2 SUMMARY**

.1 Section Includes.
.1 Materials and installation for steel piping, valves and fittings for hydronic systems:
.1 Glycol Piping

**1.3 RELATED REQUIREMENTS**

.1 Section 22 05 01 – Common Work Results for Mechanical

.2 Section 23 05 05 – Installation of Pipework

.3 Section 23 05 23 – Valves

.4 Section 23 08 01 – Performance Verification of Mechanical Piping

.5 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

**1.4 REFERENCES**

.1 Conform to relevant CSA and ASTM standards for installation of hydronic piping systems.

**1.5 SUBMITTALS**

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

**1.6 DELIVERY, STORAGE AND HANDLING**

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Black steel pipe shall be shipped to the jobsite in such a manner to protect the pipe. The pipe and fittings shall not be roughly handled during shipment. Pipe and fittings shall be unloaded with reasonable care.

.3 Protect the stored product from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.

.4 Protect fittings and piping specialties from moisture and dirt.

## PART 2 PRODUCTS

**2.1 PIPE**

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
.1 Schedule 40 black steel, standard weight.

**2.2 PIPE JOINTS**

.1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 NPS2-1/2 and over: welding fittings and flanges to CAN/CSA W48.

.3 Roll grooved: standard coupling to CSA B242.

.4 Flanges: plain or raised face, slip-on or weld neck to AWWA C111.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to AWWA C111.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.9 Roll grooved coupling gaskets: type EPDM suitable for hydronic service including glycol.

.10 Grooved Mechanical Piping Systems:
- .1 Provide roll-grooved piping system for hydronic steel piping NPS 2-1/2 and larger.
- .2 Form pipe ends by roll grooving in accordance with AWWA C606.
- .3 Grooved couplings shall consist of two-piece ductile iron or malleable iron housings with elastomeric gasket and mechanical fasteners.
- .4 Gaskets shall be EPDM suitable for hydronic systems including glycol service.
- .5 Couplings shall be rated for minimum working pressure of 1200 kPa or greater as required by system design.
- .6 Provide rigid or flexible couplings as required to accommodate thermal expansion, contraction, vibration isolation, and equipment connections.
- .7 Grooved fittings shall be factory fabricated and fully compatible with the coupling system.
- .8 All grooved piping system components shall be from a single manufacturer.
- .9 Installation shall be in accordance with manufacturer's written instructions.

## 2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:
- .1 Cast iron: to ASME B16.1, Class 125.
- .2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.
- .1 Use factory fabricated butt weld fittings for welded steel pipes. Do not use shop of site fabricated fittings.

.4 Unions: malleable iron, to ASTM A 47/A 47M and ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A 47/A 47M. to be compatible with grooved mechanical piping system specified herein.

.6 Use long radius elbows for steel water piping.

## 2.4 VALVES

.1 See Section 23 05 23 – Valves.

.2 Connections:
- .1 NPS2 and smaller: screwed ends.
- .2 NPS2.1/2 and larger: Flanged or grooved ends.

.3 Gate valves:

.1 Application: Isolating equipment, control valves, pipelines:

.4 Butterfly valves:
.1 Application: Isolating cells or section of multiple component equipment.

.5 Globe valves:
.1 Application: Throttling, flow control, emergency bypass.

## PART 3 EXECUTION

### 3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

### 3.2 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

### 3.3 CLEANING, FLUSHING AND START-UP

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

### 3.4 TESTING

.1 Test system in accordance with Section 23 05 05 – Installation of Pipework.

### 3.5 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

### 3.6 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes.
- .1 Materials and installation of piping, valves and fittings required for pressure joint piping systems for hydronic systems.
  - .1 Hot water heating.

## 1.2 RELATED REQUIREMENTS

.1 Section 21 05 01 – Common Work Results for Mechanical

.2 Section 23 05 05 – Installation of Pipework

.3 Section 23 05 23 – Valves

.4 Section 23 08 01 – Performance Verification of Mechanical Piping

.5 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

## 1.3 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .2 ASTM A 135, Standard Specification for Electric-Resistance-Welded Steel Pipe.
- .3 ASTM A 795, Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- .4 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
- .5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E 202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
- .1 MSS-SP-71, Cast Iron Swing Check Valves Flanged and Threaded Ends.
- .2 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

## 1.4 SUBMITTALS

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

.2 Submit data for following:
- .1 Valves.
- .2 Couplings, Components.

## 1.5 QUALITY ASSURANCE

.1 Fittings shall be listed & approved for their intended application.

## 1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Black steel pipe shall be shipped to the jobsite in such a manner to protect the pipe. The pipe and fittings shall not be roughly handled during shipment. Pipe and fittings shall be unloaded with reasonable care.

.3 Protect the stored product from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.

.4 Protect fittings and piping specialties from moisture and dirt.

## PART 2 PRODUCTS

### 2.1 PIPING

.1 Steel pipe: Black steel pipe shall conform to ASTM A53, A106, A135 or A795. Pipe schedule (pipe wall thickness) shall conform to the standard referenced dimensions for schedule 40.

### 2.2 FITTINGS

.1 Cold drawn steel complete with grade "C" Butylene.

.2 Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4.

.3 Sealing elements for press fittings shall be EPDM or HNBR suitable for hydronic service including glycol mixtures.

.4 Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer.

.5 Press ends shall have unpressed connection leak-detection feature to assure leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

.6 Provide fittings, valves, and accessories from a single manufacturer meeting the requirements above and regularly engaged in the production of press-joint piping systems.

.7 Acceptable Manufacturer’s for press fittings: ProPress, PressG, Mega Press

### 2.3 VALVES

.1 See Section 23 05 23 – Valves.

## PART 3 EXECUTION

### 3.1 PIPING

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.

.2 Install press joint piping system in accordance with manufacturer's latest recommendations.

.3 Visibly mark both ends of pipe with proper insertion depths prior to assembly and installation.

.4 Press Fittings: Cold Press Mechanical Joint Fittings shall be installed in accordance with the manufacturer's installation instructions. The protective corrosion coating shall be removed from the outside of the pipe end. The pipe shall be fully inserted into the fitting and the pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the pipe to assure the pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

## 3.2 VALVES

.1 Install valves as indicated in Section 23 05 23 - Valve.

.2 Install calibrated balancing valves for balancing purposes as indicated.

## 3.3 PRESSURE TESTS

.1 Test system in accordance with Section 23 05 05 – Installation of Pipework.

.2 Test pressure: test with water to greater of 1 1/2 times maximum system operating pressure or 860 kPa.

.3 Provide additional low level air pressure test (50 PSI), for 48 hrs. This test shall be scheduled to include all piping and end connections to equipment. Notify consultant 7 days prior to testing.

## 3.4 CLEANING AND START UP

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

## 3.5 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

## 3.6 TESTING AND BALANCING

.1 Balance water systems to within plus or minus 5% of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures and to Section 21 05 01 - Common Work Results for Mechanical.

END OF SECTION

# PART 1 GENERAL SUMMARY

.1 Section Includes:
- .1 The supply and installation of Hydronic Specialties Equipment.

## 1.2 RELATED REQUIREMENTS

.1 Section 22 05 01 – Common Work Results for Mechanical

.2 Section 23 05 05 – Installation of Pipework

.3 Section 23 05 23 – Valves

.4 Section 23 05 93 – Performance Verification of Mechanical Piping

.5 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

## 1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME, Boiler and Pressure Vessel Code.

.2 American Society for Testing and Materials, (ASTM).
- .1 ASTM A 47/A 47M, Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A 278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
- .3 ASTM A 516/A 516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
- .4 ASTM A 536, Specification for Ductile Iron Castings.
- .5 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International).
- .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

## 1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - SubmittalsProcedures.
- .2 Indicate on product data:
  - .1 expansion tanks
  - .2 air vents
  - .3 Air separators
  - .4 Chemical pot feeders

.2 Closeout Submittals:
- .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

## 1.5 DELIVERY STORAGE AND DISPOSAL

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Accept on site in shipping containers with labeling in place. Inspect for damage.

.3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.4 Protect piping components from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system

## PART 2 PRODUCTS

### 2.1 FULL BLADDER TYPE EXPANSION TANK

.1 Acceptable Manufacturers:
- .1 The following manufacturers are approved in principle subject to meeting the specifications. The mechanical contractor shall be responsible for all co-ordination issues and costs to other trades based on variances induced by using alternate products that do not meet this specification. Some acceptable manufacturers are listed below:
  - .1 Armtrol
  - .2 Armstrong
  - .3 Aurora
  - .4 Wessels

.2 Construction: Welded steel, designed, tested and stamped in accordance with ASME (BPV code sec VIII, div 1); supplied with National Board Form U-1, rated for working pressure of 150 psi, with flexible heavy duty butyl rubber bladder. Bladder shall be able to accept the full volume of the expansion tank and shall be removable and replaceable.

.3 Accessories: Pressure gage (field installed in adjacent piping by others) and air-charging fitting; precharge as per schematic and equipment schedule.

.4 Automatic Cold Water Fill Assembly (field installed by others): Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

.5 Size: as per equipment schedule.

### 2.2 CHEMICAL FEEDER

.1 Acceptable Manufacturer:
- .1 Basis of design product: Neptune, Axiom, Taco, Bell & Gossett

.2 See equipment schedule.

### 2.3 GLYCOL FEEDEER

.1 Acceptable Manufacturer:
- .1 Basis of design product: HG Spec, Axiom, Taco, Bell & Gossett

.2 Size: As per equipment schedule.

.3 The Single GMP unit (GMP) has a mechanical system composed with a pump, a magnetic starter and a low which stops the pump in the event of a low level. Low liquid level sensors are in the tank. The user will be warned by a visible and audible (which can be disabled) alarm. The GMP unit is mounted on a sturdy steel frame, complete with legs to keep it off the floor. The package includes a pump (120V/1ph/60Hz), one built-in safety valve, one pressure tank, one priming valve, one pressure regulator valve (PRV), a shut-off valve, a pressure gauge and a 50 or 100 gallons polyethylene tank with level indicator.

.4 The Duplex GMP unit (GMPD) has two mechanical systems composed each of one magnetic starter and a low level alarm switch, which stops the pump in the event of a low level. Low liquid level sensors are in the tank. The user will be warned by a visible and audible (which can be disabled) alarm. The GMPD unit is mounted on a sturdy steel frame, complete with legs to keep it off the floor. The package includes two pumps (120V/1ph/60Hz), two built-in safety valves, two pressure tanks, two priming valves, two pressure regulator valves (PRV), a shut-off valve, two pressure gauges, and a 50 or 100 gallons polyethylene tank with level indicator.

### 2.4 AIR SEPARATOR

.1 Acceptable Manufacturer:
- .1 Basis of design product: Bell & Gossett, Spirotherm, Taco, Armstrong, Caleffi

.2 Size: As per equipment schedule.

.3 Components:
- .1 The Air & Sediment Separator shall be designed, constructed, and stamped in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors.
- .2 The Air & Sediment Separator shall be rated for 150 psi maximum working pressure.
- .3 The Air & Sediment Separator shall have a maximum temperature rating of 350°F (171°C).
- .4 The Air & Sediment Separator body shall be made of carbon steel.
- .5 The Air & Sediment Separator body shall be three times the nominal inlet/outlet pipe diameter.
- .6 The Air & Sediment Separator shall include an air collection tube to filter and direct collected air to the top of the unit so it can be removed. The air collection tube shall have 3/16” perforations and 51% open area. The air collection tube shall be made of 304 stainless steel.
- .7 The Air & Sediment Separator shall include a dome style collection cap on the bottom of the unit to allow removed sediment to collect outside of the flow of the system fluid.
- .8 The Air & Sediment Separator shall include an internal deflector screen on the inside of the tank body to direct sediment down to the collection cap. The deflector screen shall be made of carbon steel.
- .9 The Air & Sediment Separator shall include threaded blow down connection to allow for sediment to be regularly cleaned out of the unit.
- .10 The Air & Sediment Separator shall include a threaded air removal connection on top of the unit so an air vent or expansion/compression tank can be connected, allowing collected air to be removed from the unit.
- .11 The Air & Sediment Separator shall be available with either flanged end connections or grooved end connections.
- .12 Flange end connections should be designed according to ANSI Standards.

.4 Accessories:
- .1 Blowdown Valve.
- .2 Air Vent

## 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 the DCC Representatives' directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

## 3.2 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

## 3.3 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

## 3.4 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems, supplemented as specified herein.

END OF SECTION

# PART 1 GENERAL

## 1.1 SECTION INCLUDES

.1 Materials, equipment selection, installation and start up for hydronic system pumps.

.2 This Section governs the materials and installation of closed hydronic systems associated with building heating.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 21 05 01 – Common Work Results for Mechanical

.3 Section 23 05 05 – Installation of Pipework

.4 Section 23 05 23 – Valves

.5 Section 23 05 93 – Performance Verification of Mechanical Piping

.6 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

## 1.3 REFERENCES

.1 Conform to relevant ASHRAE and CSA standards for pumping systems and equipment.

## 1.4 SUBMITTALS

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

.2 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

.4 Submit product data of pump curves for review showing point of operation.

.5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

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

## 1.5 QUALITY ASSURANCE

.1 Manufacturer’s Certification: The pump manufacturer shall certify the following:
- .1 The products and systems furnished are in strict compliance with the specifications.
- .2 Comply with the energy requirements of the latest edition of ASHRAE 90.1.
- .3 The specified factory tests have been performed.
- .4 The equipment furnished contains inter-changeable parts with specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

.2 Contractor Certification: The Contractor shall certify the following:
- .1 The products and systems installed are in strict compliance with the specifications and all applicable local or state codes.
- .2 The specified field tests have been satisfactorily performed.
- .3 The equipment furnished contains inter-changeable parts with specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

**1.6 DELIVERY, STORAGE, AND HANDLING**

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

## PART 2 PRODUCTS

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 Do Work in accordance with CAN/CSA-B214.

.2 Vertical Closed Coupled Pumps
- .1 All pump suctions to be fitted with a multifunction inlet suction diffuser fitting. The suction guide body and cover plate shall be ductile iron and be rated for 250 psi for all jobs. The guide flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The suction guide shall include the following components; full length S.S. straightening vanes, permanent S.S. strainer, disposable 16 mesh bronze start up strainer, blow down ports, and metering ports. For those pumps where an inlet guide fitting is not installed, there should be five pipe diameters of straight undisturbed flow going into the pump suction.
- .2 All pumps shall be fitted with one 4 ½" dial pressure gauge piped to the inlet and outlet pump flanges. The gauge is to be isolated from each flange via ¼" ball valve. This gauge is to be used to take the differential across the pump unless otherwise indicated.
- .3 Contractor shall install pump in accordance with the manufacturer's instructions. Contractor shall level each pump.
- .4 Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors.
- .5 Pumps shall NOT be run dry to check rotation.
- .6 Change start-up strainers to permanent strainer upon acceptance of the job. Provide a blowdown valve on each strainer and terminate with hose thread or extend blowdown line to nearest floor drain.

.3 Base Mounted Pumps
- .1 All pumps shall be fitted with a discharge multi-purpose balancing valve or other means of providing system balance, isolation, and check feature for reverse flow. The valve shall be straight or angle pattern and shall be field convertible between the two. The valve shall be ductile iron and rated for 250 psi working pressure for all jobs. The valve flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The valve shall include the following components; non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Valve shall be serviceable under full system pressure. The valve shall be a multi-purpose bypass valve.
- .2 All pump suctions to be fitted with a multifunction inlet suction diffuser. The suction diffuser body and cover plate shall be ductile iron and be rated for 250 psi for all jobs. The guide

flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The suction guide shall include the following components; full length S.S. straightening vanes, permanent S.S. strainer, disposable 16 mesh bronze start up strainer, blow down ports, and metering ports. For those pumps where an inlet guide fitting is not installed, there should be five pipe diameters of straight undisturbed flow going into the pump suction.

.3 All pumps shall be fitted with one 4 ½" dial pressure gauge piped to the inlet and outlet pump flanges. The gauge is to be isolated from each flange via ¼" ball valve. This gauge is to be used to take the differential across the pump unless otherwise indicated.

.4 Contractor shall install pump in accordance with the manufacturer's instructions. All base mounted pumps to be aligned upon receipt at jobsite, during installation, and after system fill. Contractor shall level and grout each pump according to the manufacturer recommendations to insure proper alignment prior to operation.

.5 Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors.

.6 Pumps shall NOT be run dry to check rotation.

.7 Change start-up strainers to permanent strainer upon acceptance of the job. Provide a blowdown valve on each strainer and terminate with hose thread or extend blowdown line to nearest floor drain.

## 3.2 START-UP

.1 General: In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

## 3.3 PERFORMANCE VERIFICATION (PV)

.1 General

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Assumptions: these procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.3 Net Positive Suction Head (NPSH):

.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in the Standard.

END OF SECTION

# PART 1 GENERAL SUMMARY

.1 Section Includes:
.1 Materials and installation for copper tubing and fittings for refrigerant piping of split systems and remote condensing units.

## 1.2 RELATED REQUIREMENTS

.1 Section 21 05 01 – Common Work Results for Mechanical

.2 Section 23 05 05 – Installation of Pipework

.3 Section 23 08 01 – Performance Verification of Mechanical Piping

.4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

## 1.3 REFERENCES

.1 Conform to relevant CSA and Environment Canada regulations.

## 1.4 SUBMITTALS

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

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

## 1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Pipe shall be shipped to the jobsite in such a manner to protect the pipe. The pipe and fittings shall not be roughly handled during shipment. Pipe and fittings shall be unloaded with reasonable care.

.3 Protect the stored product from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.

.4 Protect fittings and piping specialties from moisture and dirt.

# PART 2 PRODUCTS

## 2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
.1 Hard copper: to ASTM B 280, type ACR.
.2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

## 2.2 FITTINGS

.1 Brazed:

.1 Fittings: wrought copper to ASME B16.22.
.2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.2 Flanged:
.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
.2 Gaskets: suitable for service.
.3 Bolts, nuts and washers: to ASTM A 307, heavy series.

.3 Flared:
.1 Bronze or brass, for refrigeration, to ASME B16.26.

### 2.3 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

### 2.4 VALVES

.1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

### 3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

### 3.4 PIPING INSTALLATION

.1 Install as per manufacturer’s recommendations.

### 3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 00 - Cleaning and Waste Management

.3 Section 07 84 00 - Firestopping.

.4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.5 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.6 Section 23 33 00 – Air Duct Accessories

## 1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A 480/A 480M-[03c], Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .2 ASTM A 635/A 635M-[02], Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
- .3 ASTM A 653/A 653M-[03], Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

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

.4 National Fire Protection Association (NFPA).
- .1 NFPA 90A-[02], Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .2 NFPA 90B-[02], Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 NFPA 96-[01], Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.5 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.

## 1.4 SUBMITTALS

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

### 1.5 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.

.2 Contractor Certification: The Contractor shall certify the following:
- .1 The products and systems were installed in strict compliance with the specifications, manufacturer's recommendations and all applicable local or state codes.
- .2 The specified field tests have been satisfactorily performed.
- .3 The ductwork was protected from dust and debris throughout construction and cleaned in accordance with Section 23 01 31.

### 1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

## PART 2 PRODUCTS

### 2.1 SEAL CLASSIFICATION

.1 All Ductwork and plenums with a pressure class rating shall be constructed to seal class A in conformance with ASHRAE 90.1.
- .1 The specific article referenced in ASHRAE 90.1 is 6.4.4.2. Duct Sealing. This is applicable to most ductwork on this project (all ducts connected to a fan system). The pressure class of all duct systems can be read from the external static listed in the associate equipment schedule, and if not provided can be assumed at 1"w.c. An example of a non-pressure class duct would be a transfer duct or cross talk – these can be sealed to Class C. Also refer to section 23 05 94 for the intent for pressure testing of the ducted air system.

.2 All other ductwork shall be constructed to a seal class C
- .1 An example of a non-pressure class duct would be a transfer duct or cross talk – these can be sealed to Class C. Also refer to section 23 05 94 for the intent for pressure testing of the ducted air system

.3 Seal classification:
- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class C: transverse joints and connections made air tight with gaskets, sealant, tape], or combination thereof. Longitudinal seams unsealed.

### 2.2 SEALANT

.1 Sealant: Low VOC oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

### 2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

.2 Pressure sensitive tape shall not be used as the primary sealant, unless it has been certified to comply with UL-181A or UL-181B as per ASHRAE.

## 2.4 DUCT LEAKAGE

.1 All ductwork designed to operate at static pressures in excess of 750 PA and all exterior ductwork shall be tested as required by ASHRAE 90.1.

.2 Duct Leakage Testing shall be performed in accordance with SMACNA HVAC Air Duct Leakage Test Manual.

## 2.5 FITTINGS

.1 Fabrication: to SMACNA and ASHRAE.

.2 Radiused elbows.
- .1 Rectangular: standard radius, short radius with single thickness turning vanes, Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:
- .1 To 400 mm: with minimum 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: 30 degrees maximum included angle.

.6 Offsets:
- .1 Full or short radiused elbows as indicated.

.7 Obstruction deflectors: maintain full cross-sectional area.
- .1 Maximum included angles: as for transitions.

## 2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.

.2 Fire stopping material and installation must not distort duct.

## 2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A 653/A 653M, G90/Z275 zinc coating.

.2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.

.3 Joints: to ASHRAE and SMACNA. Proprietary manufactured duct joints to be considered if meet class A seal.

### 2.8 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
.1 Maximum size duct supported by strap hanger: 500.

.3 Hanger configuration: to ASHRAE and SMACNA.
.1 Hangers: galvanized steel angle hangers with supporting rods, locking nuts and washers to ASHRAE and SMACNA as per the following table:

| Duct Size (mm) | Angle Size (mm) | Rod Size (mm) | Spacing (m) |
|---|---|---|---|
| up to 750 | 25 x 25 x 3 | 6 | 3 |
| 751 to 1050 | 40 x 40 x 3 | 6 | 3 |
| 1051 to 1500 | 40 x 40 x 3 | 10 | 3 |
| 1501 to 2100 | 50 x 50 x 3 | 10 | 2.5 |
| 2101 to 2400 | 50 x 50 x 5 | 10 | 2.5 |
| 2401 and over | 50 x 50 x 6 | 10 | 2.5 |

.4 Upper hanger attachments:
.1 For concrete: manufactured concrete inserts.
.2 For steel joist: manufactured joist clamp, steel plate washer.
.3 For steel beams: manufactured beam clamps.

## PART 3 EXECUTION

### 3.1 GENERAL

.1 Do work in accordance with ASHRAE and SMACNA standards.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Insulate strap hangers 100 mm beyond insulated duct
.2 Ensure diffuser is fully seated

.3 Support risers in accordance with 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.

.6 Manufacture duct in lengths and diameter to accommodate installation of ½” internal acoustic duct lining where indicated on drawings.

.7 Ground across flexible connector with No. 2/0 braided copper strap.

.8 Provide offsets as required to prevent interferences.

.9 Install Air Duct Accessories defined in Section 23 33 00.

.10 Install 1” test plugs, with chain and cap, where required to accommodate testing and balancing instruments.

**3.2 HANGERS**

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

**3.3 SEALING AND TAPING**

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

**3.4 LEAKAGE TESTS**

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems

.2 Perform visual inspections throughout construction to ensure proper sealing.

.3 Self-perform trail leakage tests as required to ensure sealing techniques are adequately achieving desired seal classification.

.4 Provide ductwork free of audible leaks in quiet ambient.

.5 Complete tests before performance insulation or concealment Work.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 07 84 00 - Firestopping.

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.4 Section 23 31 13 – Metal Ducts – Low Pressure to 500 Pa__

## 1.3 REFERENCES

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

## 1.4 SUBMITTALS

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

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

## 1.5 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.

.2 Contractor Certification: The Contractor shall certify the following:
- .1 The products and systems were installed in strict compliance with the specifications, manufacturer’s recommendations and all applicable local or state codes.
- .2 The specified field tests have been satisfactorily performed.
- .3 The equipment was protected from dust and debris throughout construction and cleaned in accordance with Section 23 01 31.

### 1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

## 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 0.66mm 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/m².

.3 Standard of Acceptance:
- .1 Duro-dyne, Vent Fabrics, Kinetics Noise Control

### 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 sponge air seal all around.

.4 Hardware:
- .1 Up to 300 x 300mm: two sash locks complete with safety chain.
- .2 301 to 450mm: 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.

.5 Standard of Acceptance:
- .1 Miami Carey, Air-O-Metal, Kruger, Maxam, Nailor Hart

### 2.4 TURNING VANES

.1 Factory or shop fabricated single thickness and double thickness with or without trailing edge to recommendations of SMACNA and as indicated.

### 2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

**2.6 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 GENERAL**

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

.2 Pre-Installation Meetings:
- .1 Convene pre-installation meeting prior to beginning work of on-site installations in accordance
  - .1 Verify project requirements.
  - .2 Review installation conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

**3.2 INSTALLATION**

.1 Flexible Connections:
- .1 Install in following locations:
  - .1 Inlets and outlets to fans.
  - .2 Inlets and outlets of Rooftop Units and AHUs.
  - .3 As noted.
- .2 Minimum distance between metal parts when system in operation: 50 mm for systems < 470 L/s CFM, 100mm for systems with >470 L/s
- .3 Install in accordance with recommendations of SMACNA.
- .4 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:
  - .1 600 x 600 mm for person size entry.
  - .2 300 x 300 mm for hand servicing entry and viewing.
  - .3 As indicated.
- .2 Locations:
  - .1 Fire and smoke dampers.
  - .2 Control dampers.
  - .3 Devices requiring maintenance.
  - .4 Required by code.
  - .5 Reheat coils.
  - .6 Elsewhere as indicated.

.3 Instrument Test Ports:
- .1 General:
  - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.
.4 Locations:
.1 For traverse readings:
.1 Ducted inlets to roof and wall exhausters.
.2 Inlets and outlets of other fan systems.
.3 Main and sub-main ducts.
.4 And as indicated.
.2 For temperature readings:
.1 At outside air intakes.
.2 In mixed air applications in locations as approved by DCC Representative.
.3 At inlet and outlet of coils.
.4 Downstream of junctions of two converging air streams of different temperatures.
.5 And as indicated.

.4 Turning vanes:
.1 Install in accordance with recommendations of SMACNA.
.2 Install turning vanes on all supply, return and exhaust air ductwork with widths greater than 610mm.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
- .2 Operating dampers for mechanical forced air ventilation and air conditioning systems.
- .3 Fire and smoke dampers, and fire stop flaps.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 07 84 00 - Firestopping.

.3 Section 23 31 13 – Metal Ducts – Low Pressure to 500 Pa

## 1.3 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
- .1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

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

.3 Underwriters Laboratories of Canada (ULC)
- .1 CAN4-S112-[M1990], Fire Test of Fire Damper Assemblies.
- .2 ULC-S505-[1974], Fusible Links for Fire Protection Service.

## 1.4 SUBMITTALS

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

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

## 1.5 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.

.2 Contractor Certification: The Contractor shall certify the following:
- .1 The products and systems were installed in strict compliance with the specifications, manufacturer’s recommendations and all applicable local or state codes.

.2 The specified field tests have been satisfactorily performed.
.3 The equipment was protected from dust and debris throughout construction and cleaned in accordance with Section 23 01 31.

### 1.6 DELIVERY, STORAGE, AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

## PART 2 PRODUCTS

### 2.1 GENERAL

.1 Manufacture to SMACNA standards.

.2 Acceptable Manufacturer:
.1 Alumavent.
.2 Ventex.
.3 Tamco.
.4 Nailor.

### 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 meet SMACNA requirements.

.3 Locking quadrant with shaft extension to accommodate insulation thickness where indicated.

.4 Inside and outside nylon or bronze end bearings.

.5 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 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 Operator: Refer to Division 25

.8 Maximum leakage: 1 % at 500Pa static pressure.

### 2.4 MULTI-LEAF INSULATED DAMPERS

.1 Opposed blade type.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed 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 Operator: Refer to Division 25

.6 Performance:
.1 Leakage: in closed position less than 90 L/s/sq m of rated air flow at 250 Pa differential across damper in accordance with ASHRAE 90.1

.7 Insulated aluminum dampers:
.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

**2.5 BACK DRAFT DAMPERS**

.1 Automatic gravity operated, aluminum or steel construction with nylon bearings, spring assisted or counterweighted.

**2.6 RELIEF DAMPERS**

.1 Automatic multi-leaf aluminum dampers with vinyl seals, with ball bearing centre pivoted and counter-weights set to open at 10 Pa static pressure.

**2.7 FIRE DAMPERS**

.1 Fire dampers: arrangement Type A, B, C, listed and bear label of ULC, and meet requirements of provincial fire authority, Fire Commissioner of Canada (FCC), ANSI/NFPA 90A, and all authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

### 2.8 SMOKE DAMPERS

.1 Smoke Dampers: to be ULC or UL listed and labelled.

.2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link as indicated. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.

.3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.

.4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.

.5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74 degrees C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

### 2.9 FIRE STOP FLAPS

.1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN4-S112.2.

.2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C or 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 recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.3 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.4 Ensure damper operators are observable and accessible.

.5 Corrections and adjustments conducted by Engineer.

.6 Seal multiple damper modules with silicon sealant.

## 3.3 INSTALLATION OF FIRE DAMPERS

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Coordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

## 3.4 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation of flexible ductwork, joints and accessories.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 07 84 00 - Firestopping.

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.4 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.5 Section 23 33 00 – Air Duct Accessories

## 1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
- .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, [95] (Addendum No.1, November 1997).
- .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition [1995].

## 1.4 SUBMITTALS

.1 Shop Drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Application of flexible ducts,
  - .2 Thermal properties.
  - .3 Friction loss.
  - .4 Acoustical loss.
  - .5 Leakage.
  - .6 Fire rating

## 1.5 QUALITY ASSURANCE

.1 Certification of Ratings:
- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

## 1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

## PART 2 PRODUCTS

### 2.1 GENERAL

.1 Factory fabricated to CAN/ULC-S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

.4 Length of flexible duct shall not exceed 2,440 mm.

.5 Standard of Acceptance
- .1 Thermaflex
- .2 Wiremold Co
- .3 Flexmaster

### 2.2 METALLIC - UNINSULATED

.1 Allowable for Supply, Return and Exhaust air diffuser/grille connections not required to have acoustic connection.

.2 Spiral wound flexible aluminum or stainless steel.

.3 Performance:
- .1 Factory tested to 2.5 kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3.

### 2.3 METALLIC - INSULATED

.1 Allowable for Outside Air diffuser/grille connections.

.2 Spiral wound flexible aluminum with factory applied, 50 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl, reinforced mylar/neoprene laminate, or aluminum jacket.

.3 Performance:
- .1 Factory tested to 2.5 kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3.

### 2.4 NON-METALLIC - UNINSULATED

.1 Allowable for Supply, Return and Exhaust air diffuser/grille connections not required to have acoustic connection.

.2 Non-collapsible, coated mineral base fabric, aluminum foil mylar type, mechanically bonded to, and helically supported by, external steel wire, as indicated.

.3 Performance:
- .1 Factory tested to 2.5 kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3

### 2.5 NON-METALLIC - INSULATED

.1 Allowable for Outside air diffuser/grille connections.

.2 Non-collapsible, coated mineral base fabric, aluminum foil/mylar type mechanically bonded to, and helically supported by, external [steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl reinforced mylar/neoprene laminate jacket.

.3 Performance:
.1 Factory tested to 2.5 kPa without leakage.
.2 Maximum relative pressure drop coefficient: 3

### 2.6 NON-METALLIC - ACOUSTIC INSULATED

.1 Shall be used for diffuser/grille connections in the following locations:
.1 N/A

.2 Non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible mineral fibre acoustic insulation and encased in aluminum foil/mylar laminate Type M vapour barrier.

.3 Performance:
.1 Factory tested to 2.5kPa without leakage.
.2 Maximum relative pressure drop coefficient: 3.
.3 Acoustical performance: Minimum attenuation (dB/m) to following table:

| | Frequency (Hz) | | | | |
|---|---|---|---|---|---|
| Duct Diam: | 125 | 250 | 500 | 1000 | 2000 |
| [100] | [0.6] | [3] | [12] | [27] | [0] |
| [150] | [1.2] | [3] | [12] | [22] | [27] |
| [200] | [2.0] | [5] | [12] | [19] | [20] |
| [300] | [2.4] | [5] | [12] | [16] | [15] |

## PART 3 EXECUTION

### 3.1 DUCT INSTALLATION

.1 Install in accordance with: CAN/ULC-S110, UL-181 and SMACNA Requirements.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 23 05 13 – Common Motor Requirements for HVAC Equipment

.2 Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

.3 Section 23 33 00 – Air Duct Accessories

## 1.2 REFERENCE STANDARDS

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):

.1 ANSI/AMCA Standard 99-16, Standards Handbook

.2 ANSI/ASHRAE 51-16 (ANSI/AMCA 210-16), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

.3 ANSI/AMCA Standard 300-14, Reverberant Room Method for Sound Testing of Fans

.4 ANSI/AMCA Standard 301-14, Methods for Calculating Fan Sound Ratings from Laboratory Test Data

.2 The Master Painters Institute (MPI):

.1 Architectural Painting Specification Manua, current edition

.1 MPI #18, Primer, Zinc Rich, Organic

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Shop Drawings:

.1 Provide:

.1 Fan performance curves showing point of operation, bhp, kW and efficiency.

.2 Sound rating data at point of operation.

.2 Indicate:

.1 Motors, sheaves, bearings, shaft details, etc.

.2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Spare Parts:

.1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

.1 Supply:

.1 Matched sets of belts.

.2 Supply 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.

### 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

.2 Storage and Handling Requirements:

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

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

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 – Waste Management and Disposal.

## PART 2 PRODUCTS

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.1 Capacity: flow rate, total static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.2 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

.3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.

.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Provide unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

.5 HVAC Fans: ENERGY STAR certified.

## 2.1 FANS GENERAL

.1 Motors:

.1 In accordance with Section 23 05 13 – Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers.

.3 Sizes as indicated specified.

.4 Two speed with two windings and speeds of approximately 900 r/min low and 1750 r/min high as indicated.

.5 Two speed with split winding, constant or variable torque and speeds of 1750 r/min.

.6 Motor Speed: variable1750r/min

.2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and/or outlet safety screens as indicated and as specified in Section 23 05 13 – Common Motor Requirements for HVAC Equipment, inlet and outlet dampers and vanes and as indicated.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Finish on fume hood exhaust fans: powder-coat enamel.

.6 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.7 Vibration isolation: to Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

.8 Flexible connections: to Section 23 33 00 – Air Duct Accessories.

## 2.2 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded steel construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Forward curved blades, as indicated.

.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80 000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, cast iron, steel, aluminum, for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide latched airtight access doors with handles.

.4 Variable volume control devices:

.1 Mounted by fan manufacturer.

.2 Adjustable inlet vanes: operated from a centre mechanism linked to each damper vane. Support each vane at ends in bronze bearings. On DWDI fans interconnect vanes to operate in unison. Provide locking devices for manual operation.

## 2.3 CABINET FANS-GENERAL PURPOSE

.1 Fan characteristics and construction: as centrifugal fans.

.2 Casing floor mounted, Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, variable speed V-belt drive and guard inside or outside casing.

.3 Fabricate casing of zinc coated or phosphate treated steel of 1.6 mm thickness thickness as indicated reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to MPI #18. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 50 mm thick rigid acoustic insulation, pinned and cemented, 48 kg/$m^3$ density, complete with perforated metal liner complete with metal nosings on exposed edges.

## 2.4 UTILITY SETS

.1 Characteristics and construction: for centrifugal fans.

.2 Preassemble single width centrifugal fan with removable weatherproof protective hood with vents, and automatic spring loaded back draft dampers and 12 mm mesh bird screens.

.3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

## 2.5 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

.1 Casings: welded steel with welded motor support, hinged access plates, streamlined inlet cone and discharge bell sections and integral silencer casing.

.2 Blade material: aluminum. Hub material: steel.

.3 Supports:

.1 Floor mounted units: reinforced legs.

.2 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.

.4 Bearings: ball or roller with extension tubes to outside of casing.

.5 Direct drive:

.1 Adjustable blade wheels: totally-enclosed, air over motors.

.2 Diameter of wheel hub: at least equal to that of motor frame.

.3 Adjustable blades for varying range of volume and pressure. Provide permanent pitch angle indication vernier scale on hub. Provide adjustment set at factory before shipment for automatic adjustment while in motion. Provide adjustment stops to avoid overloading motor.

.6 Belt drive:

.1 Drive fixed blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.

.2 Adjust blades for varying range of volume and pressure. Hubs to facilitate indexing of blade angle. Provide automatic adjustment stops to avoid overloading motor.

### 2.6 IN-LINE CENTRIFUGAL FANS

.1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct drive.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

### 2.7 PROPELLER FANS

.1 Fabricate multibladed propellers of sheet steel or aluminum of airfoil shape within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, direct or belt driven, complete with motor as indicated.

.2 Provide blade guards, bird screen and automatic back draft dampers on discharge, with gasketted edges.

## PART 3 EXECUTION

### 3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for HVAC fans installation in accordance with manufacturer's instructions.

.1 Visually inspect substrate in presence of DCC Representative.

.2 Inform DCC Representativeof unacceptable conditions immediately upon discovery.

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

### 3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 – Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

### 3.3 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

## 3.4 SITE QUALITY CONTROL

.1 Refer to Section 01 91 13 – General Commissioning Requirements for commissioning requirements.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures

.2 Section 01 45 00 - Quality Control

.3 Section 01 74 19 - Construction Waste Management and Disposal

.4 Section 01 78 00 - Closeout Submittals

.5 Section 23 33 00 - Air Duct Accessories.

.6 Section 25 05 01 – BAS General Requirements

.7 Section 25 05 01a – BAS Sequence of Operations

## 1.2 REFERENCE STANDARDS

.1 AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.

.2 AHRI 880 - Performance Rating of Air Terminals.

.3 AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

.4 ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.5 ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

.6 ASHRAE 130 - Methods of Testing for Rating Ducted Air Terminal Units.

.7 ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

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

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

.10 ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.

.11 CSA C22.2 No. 236 – Heating and Cooling Equipment.

.12 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

.13 NFPA 70 - National Electrical Code.

.14 NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

.15 UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

.16 UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.

.17 UL 1995 – Standards for Heating and Cooling Equipment.

## 1.3 ACTION ITEAMS AND INFORMATIONAL SUBMITTALS

.1 Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this section and require attendance by all affected installers.

.2 Sequencing: Ensure that utility connections are achieved in an orderly and efficient manner.

.3 Submittals to be in accordance with Section 01 33 00 – Submittal Procedures.
- .1 Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate air flow, static pressure, NC designation, electrical characteristics, and connection requirements.
- .2 Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
  - .1 Manufacturer shall include schedules listing discharge and radiated sound power level for each of the second through seventh octave bands (125 – 4000 Hertz) at specified differential static pressures.

.4 Manufacturer shall include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures from 248 to 995 Pa.

.5 Certificates shall be issued to certify that the air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements or coils are tested and rated in accordance with AHRI 410.

.6 Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, recommendations, and service clearances required.

.7 Product Listing Organization Qualifications: The manufacturer shall be listed with an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

.2 Project Record Documents shall record actual locations of units and controls components and locations of access doors.

.3 Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

.4 Maintenance Materials shall be furnished for the Owner's use in maintenance of the project.

## 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

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

.3 Storage and Handling Requirements:
.1 Store materials indoors and in accordance with manufacturers' recommendations in clean, dry, well-ventilated area.
.2 Store and protect air terminal units from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

### 1.6 WARRANTY

.1 See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

.2 Provide 18-month manufacturer warranty from Substantial Completion for air terminal units, integral sound attenuators, integral heating coils, and integral controls.

## PART 2 PRODUCTS

### 2.1 SINGLE-DUCT TERMINAL UNITS

.1 Performance Requirements:
.1 The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume. Sound ratings of air distribution assemblies: Not to exceed 20 NC at 125 Pa inlet static pressure, with a downstream static pressure of 25 Pa.
.2 Use attenuation values found in AHRI 885 Appendix E.

.2 General:
.1 The terminal units shall be factory-assembled, AHRI 880 rated and bearing the AHRI seal for an air volume control terminal with damper assembly and flow sensor.

### 2.2 SINGLE-DUCT TERMINAL UNITS, STANDARD

.1 Description:
.1 Furnish and install single duct terminal units in the sizes and configurations as indicated on the plans.

.2 Unit Casing:
.1 The unit casing shall be constructed of a minimum 22 gauge, 0.8128 mm galvanized steel.
.1 The casing shall be mechanically fastened.
.2 Casing leakage shall be tested in accordance with ASHRAE 130.
.3 Casing leakage for the basic assembly shall not exceed 1.0 percent of the maximum rated airflow at 250 Pa.
.4 Casing leakage for the basic assembly shall not exceed 2.0 percent of the maximum rated airflow at 750 Pa.

.3 Unit Discharge:
.1 Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

.4 Liners:
.1 Standard:
.1 Fiberglass Liner - FG. Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
.2 The insulation shall be secured with adhesive.
.3 Insulation edges exposed to the airstream shall be coated with NFPA 90A

approved sealant.

.4 Insulation thickness shall be:

.1 13mm thick, R-value of 2.1.

.5 Primary Air Damper Assembly:

.1 The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.

.2 The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.

.3 The damper shaft shall be mounted on the right of the damper when looking in the direction of airflow.

.4 The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.

.5 Air leakage past the closed damper shall not exceed 2 percent of the unit maximum rated airflow at 375 Pa inlet static pressure, tested in accordance with ASHRAE 130.

.6 The damper, seal, and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.

.6 Airflow Sensor:

.1 The airflow sensor shall be a differential pressure airflow device measuring total and static pressures and mounted to the inlet valve.

.2 Plastic parts shall be fire-resistant, complying with UL 94.

.3 The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Material containing polybrominated compounds shall not be acceptable.

.4 Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.

.5 The airflow sensor shall be furnished with twelve total pressure sensing ports and four static pressure sensing ports and shall include a center averaging chamber that amplifies the sensed airflow signal.

.6 After balancing, the airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

.7 The airflow sensor shall maintain accuracy plus or minus five percent throughout terminal operating range even without 3 equivalent straight duct diameters per ASHRAE 130

.7 Inlet Valve - Standard:

.1 The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.

.2 The inlet valve shall include a 3.175mm raised single bead weld for added strength.

.3 The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.

.4 The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.

.8 Options:

.1 Bottom Access Door:

.1 The unit shall be supplied with a 101.6mm x 171.45mm bottom access door, secured to the casing with Quarter turn sash latches.

.2 Control Transformers:

.1 The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

.3 Certified Low Leakage Construction (CLL):

.1 The terminals shall be provided with factory certified low leakage construction up to 1.5 KPa internal pressure.
.2 Inlet dampers shall exhibit leakage rates of less than 1% of maximum nominal catalog airflow
.3 Single duct casings shall exhibit external leakage rates of less than 1.5% of maximum nominal catalog airflow
.4 Terminals with low leakage construction shall include the following design features:
.1 The access door shall be supplied with compression style gasketing and quarter turn latches.
.2 The unit casing shall be flanged and gasketed at all external casing seams.
.3 All production units shall be individually factory tested to ensure compliance with project specific leakage requirements.
.4 Leakage test results shall be documented on a label affixed to each certified low leakage unit.

.9 Electrical Requirements:
.1 Single duct terminal units shall be provided with single-point power connection.
.2 The terminal unit equipment wiring shall comply with the requirements of NFPA 70.

.10 Controls:
.1 See drawing 414 and specification 25 05 01 for controls requirements.

.11 Controls Sequence:
.1 See Section 25 05 01a - BAS Sequence of Operations for controls sequence requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of DCC Representative.
.2 Inform DCC 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 DCC Representative.

### 3.2 INSTALLATION

.1 Install the terminal units in accordance with the manufacturer's instructions.

.2 Install the inlets of the air terminal units with the air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.

.3 See drawings for the size(s) and duct location(s) of the air terminal units.

.4 Provide ceiling access doors or locate units above easily removable ceiling components.

.5 Support the terminal units individually from the structure.

.6 Embed anchors in concrete in accordance with ASTM E488/E488M.

.7 Do not support the terminal units from the ductwork.

## 3.3 ADJUSTING

.1 Ensure the damper operator attached to the assembly allows full modulation of flow range from 100 percent of design flow to zero.

## 3.4 FIELD QUALITY CONTROL

.1 See Section 01 45 00 - Quality Control, for additional quality requirements.

## 3.5 PERFORMANCE VERIFICATION

.1 Refer to Section 01 91 13 – General Commissioning Requirements for commissioning requirements.

## 3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures

.2 Section 01 45 00 - Quality Control

.3 Section 01 74 19 - Construction Waste Management and Disposal

.4 Section 01 78 00 - Closeout Submittals

.5 Section 23 33 00 - Air Duct Accessories.

## 1.2 REFERENCE STANDARDS

.1 ASHRAE 70 – Method of Testing the Performance of Air Outlets and Air Inlets

.2 ASTM 610 – Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces

.3 ASTM 714 – Test Method for Evaluating Degree of Blistering of Paints

.4 ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes

.5 ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

.6 ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub

.7 NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems

.8 UL/ULC – Underwriters Laboratories Fire Resistance Directory/Underwriters Laboratories of Canada Equipment and Materials Directory

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation.

.3 Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication.

.4 Project Record Documents: Record actual locations of units and control components.

.5 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions (if applicable), and maintenance and repair data.

.6 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

.7 Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

.8 See Section 01 61 00 - Product Requirements for additional provisions.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

.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.

### 1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

### 1.6 WARRANTY

.1 See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

.2 Provide 12-month manufacturer warranty from date of shipment of diffusers.

### 1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

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

.3 Storage and Handling Requirements:
- .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Section 01 74 19 – Waste Management and Disposal.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:
- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### 2.2 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated on the drawing schedules.

.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.

.4 Colour: standard as directed by DCC Representative.

## 2.3 MANUFACTURED UNITS

.1 Grilles, registers, and diffusers of same generic type, products of one manufacturer.

## 2.4 SQUARE PLAQUE DIFFUSERS

.1 Construction:
- .1 Diffusers shall be steel construction, and shall consist of a seamless, one-piece, precision formed backpan that incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct.
- .2 An inner plaque assembly shall be incorporated and shall drop no more than 6.35mm below the ceiling plane to assure proper air distribution performance.
- .3 The inner plaque assembly shall be completely removable from the room side to allow for full access to any dampers or other ductwork components located near the diffuser neck.
- .4 The diffuser shall integrate with all duct sizes shown on the plans without affecting the face size and appearance of the unit.
- .5 The face panel shall have smooth edges and rounded corners to blend with the back cone.
- .6 The diffuser ceiling module size shall be the following:
  - .1 24 x 24 inches (600 x 600 millimeters)
  - .2 12 x 12 inches (300 x 300 millimeters)

.2 Paint Specification:
- .1 Paint finish shall be:
  - .1 Baked-on powder coat finish.
  - .2 The paint film thickness shall be a minimum of 2 mils.
  - .3 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.
  - .4 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.
  - .5 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.
  - .6 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.
  - .7 Colour shall be white unless noted otherwise.

.3 Mounting Frame:
- .1 The diffuser mounting frame shall be suitable for lay-in or surface mount applications with the following frame style:
  - .1 Surface mount, or
  - .2 15/16 inch wide flat T-bar

## 2.5 STEEL LOUVERED SUPPLY GRILLE

.1 Construction:
- .1 The grille blades and border shall be steel construction.
- .2 Grilles shall be double deflection louver type, and shall have):
- .3 One set of fully adjustable blades, with 3/4 inch on center blade spacing

.2 The grilles front blade orientation shall be as indicated on the outlet schedule.
.1 Front blades parallel to the long dimension.

.3 Paint Specification:
.1 Paint finish shall be:
.1 Baked-on powder coat finish.
.2 The paint film thickness shall be a minimum of 2 mils.
.3 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.
.4 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.
.5 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.
.6 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.
.7 Colour shall be white unless noted otherwise.

.4 Opposed Blade Damper:
.1 The register shall be supplied with a coated steel opposed blade damper. The damper shall be operable from the register face.

.5 Border Style:
.1 The grille shall be suitable for surface mounting complete with a border in the following style:
.2 25mm narrow frame.

.6 Mounting Frames:
.1 The grille shall be supplied with:
.1 9.525mm flat border mounting frame.

.7 Fastening:
.1 The grille shall be supplied with the following fastening method:
.1 Countersunk screw holes complete with screws.

## 2.6 EGG CRATE GRILLES

.1 Construction:
.1 Grilles shall be aluminum construction, consisting of an extruded aluminum border and:
.1 An aluminum 13mm x 13mm x 13mm grid egg crate core.
.2 The minimum grille size shall be 152.4mm by 101.6mm. The maximum one-piece grille size without a mullion shall be 1219.2mm x 609.6mm. The maximum size grille size with a mullion is 2438.4mm x 1219.2mm.

.2 Paint Specification:
.1 Paint finish shall be:
.1 Baked-on powder coat finish.
.2 The paint film thickness shall be a minimum of 2 mils.
.3 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.
.4 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.
.5 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.
.6 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.
.7 Colour shall be white unless noted otherwise.

.3 Where egg crate return grilles are being provided in t-bar ceiling spaces and returning air into the plenum, the grilles shall be lay-in style with narrow border.

.4 Where egg crate return grilles are being provided in a gypsum ceiling, a galvanized plenum box shall be provided for duct connection into the diffuser. Surface mounting shall be provided in gypsum ceilings.

## 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 diffuser, register and grille installation in accordance with manufacturer's instructions.
- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC 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 DCC Representative.

### 3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install with flat head screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

.4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

### 3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures

.2 Section 01 61 00 – Common Product Requirements

.3 Section 01 74 00 – Cleaning & Waste Management

## 1.2 REFERENCE STANDARDS

.1 Air Movement and Control Association (AMCA):
- .1 ANSI/AMCA Standard 500-L-12, Laboratory Methods of Testing Louvers for Rating

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
- .1 ASHRAE Handbook 2011 – HVAC Applications

.3 ASTM International (ASTM):
- .1 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .2 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- .3 ASTM E2886/E2886M-20, Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement

.4 Fenestration and Glazing Industry Alliance (FGIA, formerly AAMA):
- .1 AAMA 2605-22, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)

.5 National Fire Protection Association (NFPA):
- .1 NFPA 96-2014, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

.6 National Research Council Canada (NRC):
- .1 National Building Code of Canada (NBC), 2020

.7 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- .1 ANSI/SMACNA 006-2020, HVAC Duct Construction Standards – Metal and Flexible

## 1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:
- .1 Coordinate with Division 09 for painting and color selection.
- .2 Coordinate with Division 26 for electrical connections for motor operated adjustable louvres.

## 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's instructions, product literature, and data sheets for louvres, intakes and vents. Indicate product characteristics, performance criteria, physical size,

finishes, and limitations.

.2 Show anchorage details, elevations, sections, and specific details for each louvre. Include a list of all louvres and their locations in the Project using the identification numbers on the Drawings.

.3 Indicate the following:

.1 Pressure drop
.2 Face area
.3 Free area
.4 Air Flow
.5 Velocity

.3 Certificates: When requested submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Test Reports: Submit certified data from independent laboratory substantiating:

.1 Acoustic and aerodynamic performance to ASTM E90.
.2 Louvres tested to ANSI/AMCA Standard 500-L for pressure drop, airflow leakage, water penetration, wind-driven rain, wind-driven sand.

### 1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

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

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect louvres, intakes and vents from potential sources of damage.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### 2.2 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Colour: as indicated at time of shop drawings and within this specification.

.3 Number, locations: as indicated in Drawings

### 2.3 GOOSENECK HOODS

.1 Thickness of Metal: To ASHRAE Handbook – HVAC Applications, TC4.3 and SMACNA

.2 Fabrication: To ASHRAE and ANSI/SMACNA 006, chapter 5.

.3 Joints: To ASHRAE and SMACNA.

.4 Supports: As indicated.

.5 Screens: Integral bird screens made of a minimum 2mm diameter: stainless steel wire.
- .1 Exhaust Screens: 3.0-mm mesh aperture.
- .2 Intake Screens: 3.0-mm mesh aperture.

.6 Vertical backdraft dampers

### 2.4 HEAVY DUTY WALL CAPS

.1 Construction:
- .1 Made off 24 GA Satin Coated Steel. Painted Brown. Final color selection at time of shop drawings.
- .2 Built-in bird screen or fly screen and Damper. Easily removable for cleaning
- .3 Impact resistant.
- .4 Prevents Mold & Mildew and eliminates water penetration.
- .5 Made in Canada

.2 Testing:
- .1 AMCA 511 Standard for testing weather penetration effectiveness.
- .2 Test Standard: Cyclic / Static Test ASTM E547-00 (Tested at 800 Pa)

.3 Features:
- .1 Fly screen
- .2 Aluminum backdraft damper with spring close.

.4 Size:
- .1 Inlet size: 250mmØ
- .2 Inlet length: 152.4mm
- .3 Exposed width: 317.5mm
- .4 Exposed depth: 195.26mm
- .5 Height: 317.5mm

## PART 3 EXECUTION

### 3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's instructions.
- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC 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 DCC Representative.

### 3.2 INSTALLATION

.1 Perform in accordance with manufacturer’s and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with sealant to ensure weather tightness.

.4 Install screens where indicated. Where screen joints are unavoidable, overlap edges and ends by a minimum of 25 mm.

## 3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning & Waste Management.

.3 Waste Management: separate waste materials in accordance with Section 01 74 00 – Cleaning & Waste Management.

**END OF SECTION**

# PART 1 GENERAL SUMMARY

.1 Section Includes:

.1 This section includes the design, controls and installation requirements for air-cooled condensers / condensing units.

## 1.2 RELATED REQUIREMENTS

.1 Section 21 05 01 – Common Work Results for Mechanical

.2 Section 23 05 05 – Installation of Pipework

.3 Section 23 05 48 - Vibration and Seismic Controls – HVAC Piping and Equipment

.4 Section 23 08 01 – Performance Verification of Mechanical Piping

.5 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

## 1.3 REFERENCES

.1 Conform to relevant CSA and Environment Canada regulations.

## 1.4 QUALITY ASSURANCE

.1 Unit shall be certified in accordance with UL Standard 60335-2-40 and CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

.2 Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

.3 Energy Efficiency Ratio (EER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

.4 Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL label.

.5 The nameplate, safety labels, and warnings shall be in English and French.

## 1.5 SUBMITTALS

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

.2 Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided.

.3 Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, clearances, and connection details. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

## 1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Unit shall be shipped with doors bolted shut to prevent damage during transport and thereafter while in storage awaiting installation.

.3 Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

.4 Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

### 1.7 WARRANTY

.1 Manufacturer shall provide a warranty for a period of 12 months from the date of substantial completion. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance and refrigerant.

## PART 2 PRODUCTS

### 2.1 CONDENSING UNITS

.1 General Description
- .1 Air-Source heat pump condensing unit shall include compressors, air-cooled condenser coils, condenser fans, suction and liquid connection valves, accumulator, receiver, reversing valve, filter driers with check valves, and thermal expansion valves.
- .2 Unit shall be factory assembled and tested including leak testing of the coil and run testing of the completed unit. Run test report shall be supplied with the unit in the control compartment.
- .3 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
- .4 Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
- .5 Installation, Operation and Maintenance manual shall be supplied within the unit.
- .6 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's access door.
- .7 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's access door.
- .8 Unit shall be provided with factory-engineered seismic anchorage attachment points capable of resisting the seismic forces determined by the project structural/seismic engineer per the National Building Code of Canada and the project structural drawings. Manufacturer shall provide unit weight, center of gravity, and recommended anchorage locations to enable the project seismic engineer to complete the seismic restraint design. Where required, manufacturer shall provide OSHPD pre-approved seismic anchorage details. Coordinate with Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment."

.2 Construction
- .1 Unit shall be completely factory assembled, piped, and wired and shipped in one section.
- .2 All cabinet walls, access doors, and roof shall be fabricated of G90 galvanized steel panels.
- .3 Unit shall be specifically designed for outdoor application.
- .4 Access to compressors and control components shall be through hinged access doors with quarter turn, lockable handles.
- .5 Access to condenser coils and fans is through removable access panels.
- .6 Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
- .7 Unit shall include lifting lugs.

.8 Unit shall include forklift slots.

.3 Electrical
- .1 Unit shall be provided with standard power block for connecting power to the unit.
- .2 Control circuit transformer and wiring shall provide 24 VAC control voltage from the line voltage provided to the unit.
- .3 Unit shall have a 5kAIC SCCR.
- .4 Air-source heat pump shall include an optimized start defrost cycle to prevent frost accumulation on the outdoor coil during heat pump heating operation and to minimized defrost cycle energy usage. If the temperature of the outdoor heat exchanger and/or the suction line is less than a predetermined value, a deferred defrost cycle is initiated wherein the defrost cycle starts after a variable, continuously optimizing, time interval has elapsed. The defrost cycle is terminated when the relative temperatures of the outdoor heat exchanger and/or the suction line indicate that sufficient frost is melted from the heat exchanger to insure adequate time between successive defrost cycles for optimizing the efficiency and reliability of the system, or after a predetermined time interval has elapsed, whichever condition occurs first. During defrost cycle all compressors shall energize, reversing valves shall energize, and auxiliary heat shall energize.
- .5 Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
- .6 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage, or on phase reversal.

.4 Refrigeration System
- .1 Each compressor shall be furnished with a crankcase heater.
- .2 Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to the compressors.
- .3 Compressors shall be isolated from the base pan with the compressor manufacturer’s recommended rubber vibration isolators and mounted on an elevated compressor deck, to reduce any transmission of noise from the compressors into the building area.
- .4 Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided and installed. Field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line, insulated hot gas reheat line, and insulated suction line.
- .5 Unit shall include a factory holding charge of R-454B refrigerant and oil. Adjusting the charge of the system will be required during installation.
- .6 Lead refrigeration circuit shall be provided with modulating hot gas reheat valve, electronic controller, liquid line receiver, supply air temperature sensor and a dehumidification control signal terminal that enables the dehumidification mode of operation, and includes supply air temperature control to prevent supply air temperature swings and overcooling of the space. The matching indoor air handler must include a hot gas reheat coil and a check valve on the hot gas reheat line.
- .7 Unit shall be configured as an air-source heat pump. Each refrigeration circuit shall be equipped with a bi-flow liquid line filter drier, reversing valve, suction line accumulator, liquid line receiver, and a bypass loop with check valve around a thermal expansion valve. Reversing valve shall de-energize during the heat pump heating mode of operation. The matching indoor air handler must include a bypass loop with check valve around the thermal expansion valve.
- .8 The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling. The controls shall also include an adjustable, 20 second delay timer for each additional capacity stage to prevent multiple capacity stages from starting simultaneously and adjustable compressor lock out.
- .9 Each refrigeration circuit shall be equipped with a liquid line sight glass.

.10 Units shall be provided with a suction pressure transducer on each refrigeration circuit.

.5 Fans

.1 Variable frequency drive controlled variable speed condenser fans shall be provided for head pressure control and allow operation down to 35°F. Fan motor shall be weather protected, single phase, direct drive, and open, air over (OPAO) with thermal overload protection.

.6 Coils

.1 Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

.2 Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.

.3 Coils shall be hydrogen leak tested.

.7 Controls

.1 Unit shall be provided with a factory-supplied and factory-installed controller capable of integrating with the building BAS.

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

### 3.3 INSTALLATION, OPERATION, AND MAINTENANCE

.1 Installation, Operation and Maintenance manual shall be supplied with the unit.

.2 Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

.3 Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF SECTION

# PART 1 GENERAL

## 1.1 OVERVIEW

.1 This section includes the design, controls and installation requirements for air-cooled condensers / condensing units.

## 1.2 RELATED REQUIREMENTS

.1 Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

.2 Section 23 33 00 – Air Duct Accessories

## 1.3 REFERENCES

.1 ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.
- .1 33: Methods of Testing Forced Circulation Air Cooling and Air Heating Coils.
- .2 62.2: Ventilation and Acceptable Indoor Air Quality

.2 AMCA: Air Movement and Control Association.
- .1 99: Standards Handbook
- .2 210: Laboratory Methods of Testing Fans for Ratings.
- .3 300: Reverberant Room Method for Sound Testing of Fans
- .4 500: Test Methods for Louvers, Dampers and Shutters

.3 AHRI: Air Conditioning and Refrigeration Institute.
- .1 410: Forced Circulation Air Cooling and Air Heating Coils.

.4 ASTM: American Society for Testing and Materials.
- .1 A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 NFPA: National Fire Protection Association.
- .1 70 National Electrical Code.
- .2 90A Installation of Air Conditioning and Ventilation Systems.

.6 NEMA: National Electrical Manufacturers Association
- .1 MG1: Motors and Generators

.7 AFBMA: Anti-Friction Bearing Manufacturers Association.
- .1 9: Load Ratings and Fatigue Life for Ball Bearings.

.8 Underwriters Laboratories (UL).
- .1 UL900 Test Performance of Air Filter Units.

## 1.4 SUBMITTALS

.1 Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, and electrical characteristics and connection requirements. Submit fan performance curves with specified operating point clearly plotted, and with TSP, power, RPM and sound power indicated.

.2 REFRIGERANT SAFETY COMPLIANCE: Provide complete refrigerant safety calculations for each packaged rooftop unit based on the actual submitted equipment, refrigerant type, refrigerant charge, installation configuration, occupancy classification, and room/zone data. Calculations shall demonstrate compliance with the latest adopted editions of ASHRAE Standard 15, ASHRAE Standard 34, CSA B52, and UL/CSA 60335-2-40, as applicable. Submit calculations, assumptions, refrigerant charge data, minimum room area requirements, effective dispersal volume calculations, releasable charge calculations, and identification of the governing space(s) served by each refrigerant circuit. Where refrigerant detection systems, isolation devices, ventilation systems, or other mitigation measures are required to achieve compliance, provide complete documentation of the compliance methodology and all associated equipment, controls sequences, alarms, and operational requirements.

.3 Submittal Drawings: Submit general arrangement drawings showing unit dimensions, weight loadings, required clearances and field connection details

### 1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing air handling equipment with minimum of ten years documented experience.

.2 Each unit shall bear an ETL or UL label under UL Standard 1995 indicating the complete unit is listed as an assembly. ETL or UL listing of individual components is not acceptable.

### 1.6 DELIVERY, STORAGE, AND HANDLING

.1 Accept products on site with factory-fabricated shipping skids and lifting lugs. Inspect for damage.

.2 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. Do not drag, drop or distort casings.

### 1.7 WARRANTY

.1 Unit manufacturer to warrant it's product to be free of defects in materials and workmanship under normal use when installed and operated in accordance with factory recommendations for a period of 12 months from Substantial Completion.

### 1.8 ENVIRONMENTAL REQUIREMENTS

.1 Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

## PART 2 PRODUCTS

### 2.1 CASING

.1 General.

.1 Unit casing shall be constructed of 2" (50.8mm) injected polyurethane foam exterior panels attached to an extruded aluminum frame. Casing panels designed to limit deflections to 1/200th of span at design working pressures.

.2 Unit casing shall be unitized and shipped in one piece, or the largest size permissible for shipment, with minimum screws so the unit can be completely disassembled in the field to facilitate ingress to mechanical room prior to installation.

.3 All side, end and roof panels shall provide a flush, smooth, architecturally pleasing exterior appearance.

.4 Seal panels with silicone caulking in dry areas, polyurethane caulk in wet areas, and closed cell neoprene gasket at any point the panels are attached to the unit frame.

.2 Frame members shall be extruded aluminum and shall have integral 25.4mm PVC thermal break extrusions to limit heat transfer to the exterior surface. Interior of frame shall be insulated with injected polyurethane foam insulation. Frame members that are not insulated are unacceptable. Frame members shall have a mill finish.

.3 Double wall top, side and end panels. Interlocking unit panels shall be comprised of injected polyurethane foam sandwiched between a 20 gauge mil galvanized exterior skin, and a 24 gauge mil galvanized interior skin. Exterior and interior skin of the unit panels shall be designed that the two do not come in contact with each other to provide a thermal break. Panels shall be attached to the gasketed unit frame with screws.

.4 Double wall floor. Limit deflection to 1/200 at design working pressure, and to 1/360 including loads from maintenance personnel, installed equipment and working pressure.

.5 Base. Construct of 10 gauge formed galvanized steel.

.6 Unit shall be provided with factory-engineered seismic anchorage attachment points capable of resisting the seismic forces determined by the project structural/seismic engineer per the National Building Code of Canada and the project structural drawings. Manufacturer shall provide unit weight, center of gravity, and recommended anchorage locations to enable the project seismic engineer to complete the seismic restraint design. Where required, manufacturer shall provide OSHPD pre-approved seismic anchorage details. Coordinate with Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

## 2.2 INSULATION

.1 Insulation in all frame members and panels of roof, walls, and floors shall be injected polyurethane foam.

## 2.3 ACCESS DOORS

.1 Provide a minimum of one double wall, hinged and latched access door for each fan, filter and access section and at other locations as shown on the drawings.

Insulation: Injected polyurethane foam, at 35.24 kilograms per cubic meter.

Frame: Extruded aluminum with integral high-density polyurethane thermal break.

Gasket: Dual gasketed around door perimeter, utilizing a primary air seal bulb gasket inner seal and a neoprene flat gasket outer rain seal to prevent rain from freezing in the door jamb.

Hinges: Zinc plated steel hinges with adjustability in three planes to ensure door sealing, and proper compression on gasket. (X, Y, Z adjustable).

Handles: Durable glass reinforced nylon, UV Stable.

.2 Door height to be maximum height allowable based on unit height, or 1828.8mm, whichever is less.

## 2.4 DRAIN PANS

.1 Provide sealed double wall drain pans. Inner pan to be minimum 16 gauge 304 stainless steel, 50.8mm minimum depth. Drain pan shall extend the entire width of the coil, including headers and return bends. Drain pan shall extend downstream of the coil leaving face in accordance to ASHRAE standard 62-2. Cross break and pitch drain pan toward drain connection to allow for positive drainage. Provide with minimum 40mm diameter stainless steel male pipe thread drain line connection. Insulate between inner and outer pan walls with a minimum of *2.2 pcf closed-cell spray foam*.

.2 Provide intermediate drain pans of the same materials for stacked cooling coils.

## 2.5 FACTORY TESTING

.1 Standard Factory Testing

.1 Fans shall be run tested to verify correct RPM, rotation and current draw per design.

.2 Electrical connections shall be tested to ensure proper operation.

.3 High potential (Hi-pot) Testing shall be conducted per UL1995.

## 2.6 PLENUM FANS WITH AC INDUCTION MOTORS

.1 Fans shall be direct-drive, single width, single inlet, plenum as shown on the equipment schedule.

.2 Fan blades shall be extruded air-foil shape, with continuous welds around edges.

.3 Unit fan selection and ratings shall be based on tests made in accordance with AMCA Standard 210 and licensed to bear the AMCA Certified Ratings Seal for Air Performance.

.4 Fan sound power level ratings shall be based on tests made in accordance with AMCA Standards 300 and 301 and licensed to bear the AMCA Certified Ratings Seal for Sound. Sound power ratings shall be in decibels (reference 10-12 watts) in eight octave bands.

.5 Fans operating on a variable speed drive shall be selected for a design speed within 45Hz to 75Hz.

.6 Fans shall be capable of operating safely at every point of rating on or below the minimum performance class limit. Fan shall have stable operation over the entire operating range from shut off to free delivery.

.7 Fan wheels shall be aluminum.

.8 Inlet Cones shall be spun steel inlet cones, manufacturer's standard thickness for wheel size, matched to wheel intake rim.

.9 Mount fan, motor, and drive assembly on a structural steel base, isolated from the unit base frame with rubber-in-sheer isolation.

.10 Fan shall be fitted with inlet and discharge safety screens or other OSHA-approved protective device, to protect all personnel from dangers of rotating equipment.

.11 AC INDUCTION FAN MOTOR

.1 Motors to be TEFC premium efficiency, with horsepower and voltage as shown on the equipment schedule. Motors shall be large enough so the driven load will not require motor to operate in service factor (above 1.0).

.2 Motors shall be suitable for use on variable frequency drives.

.3 Motors shall be equipped with shaft grounding mechanism or ceramic bearings.

.4 Mount the fan motor on an adjustable base.

## 2.7 PLENUM FANS WITH ELECTRONICALLY COMMUTATED MOTORS (ECM)

.1 Fans shall be direct-drive, single width, single inlet, plenum as shown on the equipment schedule.

.2 Impeller made of aluminum, with backwards-curved, continuously welded, blades; flow-optimized inlet ring made of galvanized sheet steel with pressure test nipple.

.3 Unit fan selection and ratings shall be based on tests made in accordance with AMCA Standard 210 and licensed to bear the AMCA Certified Ratings Seal for Air Performance.

.4 Fan sound power level ratings shall be based on tests made in accordance with AMCA Standards 300 and 301 and licensed to bear the AMCA Certified Ratings Seal for Sound. Sound power ratings shall be in decibels (reference 10-12 watts) in eight octave bands.

.5 Fan assembly shall be statically and dynamically balanced on two planes to balancing grade G 6.3 in accordance with ISO 1940-1.

.6 Fans shall be capable of operating safely at every point of rating on or below the minimum performance class limit. Fan shall have stable operation over the entire operating range from shut off to free delivery.

.7 Fan motor and drive assembly shall be mounted on a fabricated steel tubing frame (spider bracket) to provide permanent positive alignment with inlet cone.

.8 Fan shall be fitted with inlet and discharge safety screens or other OSHA-approved protective device, to protect all personnel from dangers of rotating equipment.

## 2.8 HEATING AND COOLING COILS

.1 General.

.1 Coil capacities, pressure drops, and selection procedures shall be in accordance with ARI 410 or ASHRAE 33. Coils which fall outside the scope of ARI 410 standard rating conditions shall be noted as such.

.2 Coils shall be designed to withstand 1724 KPa psi maximum operating pressure.

.3 Pressure test coils submerged in water with a minimum 2172 KPa air pressure.

.4 Coil headers shall be fabricated from seamless copper tube, with threaded red brass inlet and outlet male pipe connections extending beyond unit exterior wall. Any extension piping required for staggered coils is to be piped in the field by others to avoid damage during handling and installation.

.5 Return bends shall be brazed and shall have wall thickness equivalent to the tube. Hairpin turn construction is not acceptable.

.6 Provide manual vent and drain connections for each coil that are of similar material as the coil header.

.7 Stacked coils shall be provided with intermediate drain pans and equipped with copper tubing for drainage into main drain pan.

.2 Coil Casings.

.1 Heating coil casings to be 16 gauge galvanized steel.

.2 Cooling direct expansion coil casings to be 16 gauge 304 stainless steel steel.

.3 Tube sheet holes to be formed with belled extrusions to prevent chafing of the tubes.

.4 Provide intermediate coil tubing supports at intervals for coils in excess of 1219.2mm fin length.

.3 Hydronic Coils

.1 Tubes shall be 15.875mm OD x 0.508mm wall seamless copper tube, staggered, mechanically expanded into fin collars.

.2 Fins shall be 0.1905mm aluminum.

.4 Direct Expansion Coils

.1 Connections shall be sweat copper and includes a refrigerant distributor. Thermal expansion valve shall be provided loose, to be piped in the field by others to avoid damage during handling and installation.

.2 Hot gas reheat coil to be factory provided and installed for field piping by others.

.3 Tubes shall be 15.875mm OD x 0.508mm wall seamless copper tube, staggered, mechanically expanded into fin collars.

.4 Fins shall be 0.1905mm aluminum.

## 2.9 DAMPERS

.1 Dampers shall be installed by the air handler manufacturer.

.2 Control Dampers:

.1 Frame: 16 ga. galvanized steel hat channel with die-formed corner gussets

*.2* Blades: 14 ga galvanized, 152.4mm wide, formed into an airfoil cross section blades on 139.7mm centers, maximum 1219.2mm length, with 13mm diameter plated steel operating rods. O*pposed blade operation*

.3 Bearings: 13mm" dia. self-lubricating bronze.

.4 Linkage: Concealed side type totally enclosed within the frame and out of the air stream. Plated steel.

.5 Drive shaft: 152.4mm long x 13mm dia. rigid shaft. A factory-installed jackshaft is required on all multiple-section damper assemblies.

*.6* Damper actuators shall be furnished and installed in the field by the control contractor.

.7 Dampers shall be low leakage (Class 1A), with cambered stainless steel compression type jamb seals and extruded blade seals.

## 2.10 FILTERS

.1 Filter housings shall be manufactured by the air handling unit manufacturer. Equip side loaded filter sections with a hinged and latched side-access door. Provide gasketed galvanized steel filter blanks to prevent air bypass around filters.

.2 Prefilter to be 50.8mm thick, pleated media type, MERV8 efficiency, with beverage board frame.

.3 Final filter to be 152.4mm thick rigid type, MERV13 efficiency, with 24-gauge galvanized steel sides and header.

## 2.11 ELECTRICAL AND MOTOR CONTROLS

*.1* Electrical components not specifically outlined in previous sections or listed below shall be furnished and installed by others.

.2 Variable Frequency Drive

.1 Variable Frequency drive shall comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for variable frequency drives specified

.2 Variable Frequency Drive shall be as manufactured by ABB, or Yaskawa or Danfoss as approved equals.

.3 Electrical power to be wired by the air handling unit manufacturer:

.1 Single point power connection for motor

## PART 3 EXECUTION

### 3.1 INSPECTION

.1 Examine areas and conditions under which air handling units are to be installed. Refer for manufacturer's IOM manual. Do not proceed with work until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

.1 Install units in strict accordance with equipment manufacturer's installation instructions and recommendations.

.2 Install air handling units where indicated. Ensure that units comply with requirements and serve intended purposes. Coordinate with other work, including ductwork, floor construction, roof decking and piping, as necessary. Provide access space around air handling units for service.

### 3.3 STARTUP AND CLOSEOUT

.1 Upon completion of air handling unit installation, startup and operate equipment to demonstrate capability and compliance with requirements. Field adjust as necessary, then restart to demonstrate compliance.

### 3.4 SITE QUALITY CONTROL

.1 Refer to Section 01 91 13 – General Commissioning Requirements for commissioning requirements.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 SUMMARY

.1 Provide materials and installation for self-contained gas heat, electric cooling, packaged rooftop HVAC units factory designed and manufactured to the specific requirements of this project.

.2 This section is applicable for the Packaged Outdoor HVAC Equipment (Tag: AHU). Refer to drawings for location, unit specific performance information, layouts and configurations

.3 This section includes the design, controls and installation requirements for packaged rooftop units / heat pumps / outdoor air handling units..

## 1.2 RELATED SECTIONS

.1 Related Sections:
- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 91 13 - General Commissioning (CX)
- .4 Section 21 05 01 – Common Work Results for Mechanical
- .5 Section 23 01 31 - Air Duct Cleaning for HVAC Systems
- .6 Section 23 05 01 – Use of HVAC Systems During Construction.
- .7 Section 23 05 48 - Vibration and Seismic Controls – HVAC Piping and Equipment
- .8 Section 23 11 23 – Facility Liquid Petroleum Piping.
- .9 Section 23 11 23 – Facility Natural Gas Piping
- .10 Section 23 23 00 – Refrigerant Piping
- .11 Section 25 05 01 – BAS General Requirements

## 1.3 REFERENCES

.1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)
- .1 ANSI/AHRI 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- .2 ANSI/AHRI 270, Sound Rating of Outdoor Unitary Equipment.

.2 ANSI/UL 1995 B, Standard for Heating and Cooling Equipment.

.3 Canadian Standards Association (CSA International)
- .1 CSA B52, Mechanical Refrigeration Code.
- .2 CSA C22.1 HB, Canadian Electrical Code Handbook.

.4 National Fire Protection Association
- .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.5 Underwriters Laboratories (UL)
- .1 UL 1995, Standard for Heating and Cooling Equipment.

.6 ASHRAE 90.1 Energy Code.

.7 ASTM D-1929-11, Standard Test Method for Determining Ignition Temperature of Plastics

.8 ASTM C 1071, Standard Specification for Fibrous Glass Duct Lining Insulation

.9 AHRI 1350, Mechanical Performance Rating of Central Station Air-handling Unit Casings

.10 ASTM B 117, Standard Practice for Operating Salt Spray (Fog) Apparatus

**1.4 SUBMITTALS**

.1 Shop Drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 General arrangement, drawing of each unit including product description, model number, dimensions, unit weights, openings, wall, door and base construction details, coil rack(s) and drain pan details, field connection details, damper details, and trapping requirements for cooling coil condensate.
  - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
  - .3 Clearances for operation, maintenance, servicing.
  - .4 Fan make, model and performance information including: fan curves with specified operating point clearly indicated, weights, capacities, motor electrical characteristics, finishes, materials, motor and fan efficiencies, fan isolation details.
  - .5 Sound power levels for each octave band for at fan inlet, fan outlet and each unit opening.
  - .6 Submit product data of filter media, filter performance data, filter assembly, and filter frames.
  - .7 Coil make, model, construction details, refrigerant used, performance details at operating conditions, and connection requirements with details of field required installation and devices.
  - .8 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed disconnects and field-installed wiring.
  - .9 Details of controls devices clearly indicating factory or field installed with necessary details and wiring diagrams
  - .10 The following criteria shall be clearly indicated in the shop drawings and are to be as specified: Air flow rates, external static pressures, unit configurations and dimensions. The following are to be equaled or bettered: heating and cooling coil performance, Coil face velocities, filter face velocities. Any other parameters shall be within 10% of specified values.
  - .11 REFRIGERANT SAFETY COMPLIANCE: Provide complete refrigerant safety calculations for each packaged rooftop unit based on the actual submitted equipment, refrigerant type, refrigerant charge, installation configuration, occupancy classification, and room/zone data. Calculations shall demonstrate compliance with the latest adopted editions of ASHRAE Standard 15, ASHRAE Standard 34, CSA B52, and UL/CSA 60335-2-40, as applicable. Submit calculations, assumptions, refrigerant charge data, minimum room area requirements, effective dispersal volume calculations, releasable charge calculations, and identification of the governing space(s) served by each refrigerant circuit. Where refrigerant detection systems, isolation devices, ventilation systems, or other mitigation measures are required to achieve compliance, provide complete documentation of the compliance methodology and all associated equipment, controls sequences, alarms, and operational requirements.
- .3 Omission of any of the above information will cause shop drawings to be immediately returned without review.
- .4 Bidders proposing equipment other than the basis of design shall include a clearly defined outline of all proposed deviations to the scheduled parameters, along with any required coordination and/or revisions to other trades to ensure compliance with the design intent.

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

## 1.5 QUALITY ASSURANCE

.1 Packaged air-cooled condenser and air-source heat pump units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.

.2 Unit shall be certified in accordance with UL Standard 60335-2-40 and CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

.3 Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

.4 Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.

.5 Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

.6 Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL/ETL Canada label. The nameplate, safety labels and warnings will be in English and French.

.7 Contractor Certification: The Contractor shall certify the following:
.1 The products and systems were installed in strict compliance with the specifications, manufacturer’s recommendations and all applicable local codes.
.2 The specified field tests have been satisfactorily performed.
.3 Units received on site were as specified
.4 Units received were free from damage
.5 From the time of receipt of the units on site to turn over to the owner, the units were maintained in a weather tight fashion and inspected regularly. Fan wheels were rotated monthly and any job site moisture was removed immediately.

## 1.6 DELIVERY, STORAGE AND HANDLING

.1 Unit shall be shipped with doors bolted shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.

.2 Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

.3 Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

## 1.7 WARRANTY

.1 Manufacturer shall provide a warranty for a period of 12 months from the date of Substantial Completion. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer’s written instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

.2 Provide an extended 3-year parts warranty for the direct digital controls system within the HVAC units.

.3 Manufacturer shall provide a minimum 5-year non-prorated parts warranty on the compressors.

.4 Manufacturer shall provide a minimum 15-year non-prorated warranty on the stainless steel heat exchanger (25 years preferred where offered as standard).

.5 Submit warranty information in accordance with Section 01 78 00 – Closeout Submittals.

### 1.8 MAINTENANCE

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.3 Extra Materials:

- .1 Provide a full set of filters to be installed at time of equipment start up.
- .2 The contractor shall also provide complete replacement set of filters turned over to the Owner to be used for their first required filter change

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

.1 Acceptable Manufacturers:

- .1 Aaon (Basis of Design) – RN Series / RQ Series
- .2 York – Sun Core / Sun Choice
- .3 Daikin - Rebel
- .4 Carrier – 48GERM / 48GETT Series

.2 This approval is based on product similarity and quality, however, confirmation that the product specific design is compatible with the design as presented (unit construction, layout, openings, clearance requirements, performance capacities) is the responsibility of the mechanical contractor.

.3 The mechanical contractor shall be fully responsible for all co-ordination issues and costs to other trades based on variances induced by using approved equals.

.4 Substitute equipment from approved manufacturers shall meet the following minimum performance criteria to be considered approved-equal:

- .1 R-454B refrigerant.
- .2 Variable capacity or multi-stage scroll compressor with minimum 4 stages of capacity control (variable preferred).
- .3 Direct-drive supply fan with VFD, OR equivalent belt-drive blower with VFD providing equivalent fan efficiency (FEI ≥ 1.0).
- .4 Cabinet construction with thermal R-value ≥ R-6 minimum.
- .5 Foam insulation tested per ASTM D-1929-11 with minimum flash ignition temperature of 600°F, OR encapsulated fiberglass per ASTM C 1071.
- .6 Stainless steel, aluminum, or polyester SMC composite drain pan with positive slope to drain.
- .7 Hinged access doors with lockable handles at filters, fans, coils, compressors, and controls compartments.
- .8 Stainless steel heat exchanger with minimum 15-year non-prorated warranty.
- .9 MERV-13 final filters (factory or field-installed kit acceptable).
- .10 BACnet IP or BACnet MS/TP communication with full point list available to BAS.

## 2.2 ROOFTOP UNITS

.1 General Description

.1 Packaged rooftop unit shall include:

.1 Evaporator coils
.2 Filters
.3 Supply fans
.4 Dampers
.5 Variable capacity compressors
.6 Air-cooled condenser coils and condenser fans
.7 Reheat coil
.8 Gas heaters
.9 Exhaust fans
.10 Unit controls

.2 Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.

.3 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.4 Unit components shall be labeled, including refrigeration system components and electrical and controls components.

.5 Estimated sound power levels (dB) shall be shown on the unit ratings sheet.

.6 Installation, Operation, and Maintenance manual shall be supplied within the unit.

.7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.2 Construction

.1 All cabinet walls, access doors, and roof shall be fabricated of double-wall, impact-resistant, rigid polyurethane foam panels, OR of single-wall powder-painted galvanized steel construction with internal foam or fiberglass insulation meeting the thermal and leakage performance requirements specified herein.

.2 Unit insulation shall have a minimum thermal resistance R-value of R-6 (R-16 preferred where offered as standard). Insulation shall be injected polyurethane foam tested in accordance with ASTM D-1929-11 for a minimum flash ignition temperature of 600°F, OR encapsulated fiberglass meeting ASTM C 1071 for erosion resistance.

.3 Unit construction shall be double-wall with G90 galvanized steel on both sides and a thermal break, OR single-wall powder-painted galvanized steel construction. Double-wall construction is preferred where offered as standard. Where single-wall construction is provided, manufacturer shall demonstrate compliance with the leakage and thermal requirements through factory test data and provide additional perimeter sealing as required to prevent moisture accumulation and exterior condensation.

.4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at design external static pressure per AHRI Standard 1350, OR at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Manufacturer shall submit factory test data confirming compliance.

.5 Panel deflection shall not exceed L/240 ratio at 125% of design static pressure. Continuous sealing shall be included between panels and access doors. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

.6 Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors or large hinged access panels with quarter-turn lockable handles. Full-length stainless steel piano hinges preferred; manufacturer standard heavy-duty corrosion-protected hinges acceptable.

.7 Exterior paint finish shall be capable of withstanding a minimum of 1,000 hours, with no visible

corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117 test procedure. Premium finishes (2,500 hours) preferred where offered as standard.

.8 Units with cooling coils shall include double-sloped drain pans constructed of 304 stainless steel, aluminum, or polyester SMC composite material with positive slope to drain connection.

.9 Unit shall be provided with bottom discharge and bottom return air openings. Openings shall have upturned flanges of at least 1/2 inch in height around the opening.

.10 Unit shall include lifting lugs on the top of the unit.

.11 Unit shall include factory installed, painted galvanized steel condenser coil guards on the face of the condenser coil.

.12 Units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps

.13 Unit shall be provided with factory-engineered seismic anchorage attachment points capable of resisting the seismic forces determined by the project structural/seismic engineer per the National Building Code of Canada and the project structural drawings. Manufacturer shall provide unit weight, center of gravity, and recommended anchorage locations to enable the project seismic engineer to complete the seismic restraint design. Where required, manufacturer shall provide OSHPD pre-approved seismic anchorage details. Coordinate with Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

## 2.3 ELECTRICAL

.1 Where noted in the schedules the unit shall be provided with factory installed and factory wired, non-fused disconnect switch.

.2 Non-fused disconnect ampacity shall be sized for the unit MCA with minimum 25% spare capacity. All AHU-1 through AHU-6 to be provided with factory-installed non-fused disconnect; power blocks not acceptable. Where MCA is below the smallest standard factory disconnect ampacity, the smallest available factory non-fused disconnect shall be provided.

.3 Unit shall have a 5 kAIC SCCR.

.4 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

## 2.4 SUPPLY FANS

.1 Unit shall include direct-drive, unhoused, backward-curved, plenum supply fans, OR equivalent belt-drive backward-curved or forward-curved blowers with VFD providing equivalent fan efficiency meeting ASHRAE 90.1 (FEI ≥ 1.0 preferred).

.2 Blowers and motors shall be dynamically balance and mounted on rubber isolators.

.3 Belt-drive blowers, where provided, shall include adjustable sheaves and accessible belt service through hinged access doors.

.4 Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

.5 Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

.6 Motor shall include shaft grounding

**2.5 EXHAUST FANS**

.1 Exhaust dampers shall be sized for 100% relief.

.2 Fans and motors shall be dynamically balanced.

.3 Unit shall include barometric relief dampers.

.4 Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

.5 Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable handles.

.6 Unit shall include belt driven, unhoused, backward curved, plenum exhaust fans.

.7 Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency. (Except AHU-5 - ECM Exhaust Motor)

.8 Motor shall include shaft grounding

**2.6 COOLING COILS**

.1 Evaporator Coils
- .1 Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
- .2 Coils shall have interlaced circuitry and shall be 6 row high capacity.
- .3 Coils shall be hydrogen or helium leak tested.
- .4 Coils shall be furnished with factory installed expansion valves.

**2.7 REFRIGERATION SYSTEM**

.1 Unit shall be factory charged with R-454B refrigerant.

.2 Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.

.3 Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.

.4 Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

.5 Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.

.6 Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, service fittings on both the high pressure and low pressure sides and a factory installed liquid line filter driers.

.7 Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity, and a two-stage compressor on the lag refrigeration circuit that shall modulate between two capacity settings, 67% and 100%.

.8 For alternate manufacturers, equivalent compressor staging of minimum 4 stages total cooling capacity control (variable capacity preferred) is acceptable.

.9 Lag refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

.10 Reheat coil shall be multi-pass and fabricated from aluminum microchannel tubes, OR copper-tube/aluminum-fin with corrosion-resistant coating, OR equivalent factory-installed modulating dehumidification system capable of supply air temperature control during dehumidification mode. Each refrigeration circuit shall be equipped with a liquid line sight glass.

.11 The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling. The controls shall also include an adjustable, 20 second delay timer for each additional capacity stage to prevent multiple capacity stages from starting simultaneously and an adjustable compressor lock out.

## 2.8 CONDENSERS

.1 Air-Cooled Condenser
- .1 Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
- .2 Heat pump outdoor coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
- .3 Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
- .4 Coils shall be hydrogen or helium leak tested.
- .5 Condenser fans shall be high efficiency electrically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.

## 2.9 GAS HEATING

.1 Stainless steel heat exchanger furnace shall carry a minimum 15-year non-prorated warranty (25 years preferred where offered as standard), from the Substantial Completion date.

.2 Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.

.3 Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.

.4 High Turndown Modulating Natural Gas Furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heater shall be capable of capacity turndown ratio as shown on the unit rating sheet. Heat trace shall be include on the condensate drain line.

## 2.10 FILTERS

.1 Unit shall include 4-inch thick, pleated panel filters with an ASHRAE MERV rating of 13, upstream of the cooling coil. Unit shall also include 2-inch thick, pleated panel pre-filters with an ASHRAE MERV rating of 8, upstream of the 4-inch MERV 13 filters. Where MERV-13 final filters are supplied as a factory-approved field-installed kit by the manufacturer, contractor shall ensure the filter kit is included in the bid and installed at startup.

.2 Unit shall include a clogged filter switch for the unit filters.

## 2.11 OUTSIDE AIR/ECONOMIZER

.1 Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Unit shall include outside air opening bird screen and outside air hood. Unit, except for horizontal series, shall also include barometric relief dampers.

.1 Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator.

## 2.12 CONTROLS

.1 Factory Installed and Factory Provided Controller

.1 Unit to be complete with a terminal strip or unit controller with BACnet IP, BACnet MS/TP, OR equivalent BAS-compatible communication protocol, capable of controlling all features and options of the unit and communicating all required points to the Building Automation System. Refer to Drawing 414 for required points list.

.2 Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.

.3 Variable Air Volume Controller

.1 BAS shall utilize a variable capacity compressor system and a variable speed supply fan system to modulate cooling and airflow as required to meet space temperature cooling loads and to save operating energy. Supply fan speed shall modulate based on supply air duct static pressure. Cooling capacity shall modulate based on supply air temperature.

.2 With modulating hot gas reheat, BAS shall modulate cooling and hot gas reheat as efficiently as possible, to meet space humidity loads and prevent supply air temperature swings and overcooling of the space.

.3 BAS shall modulate heating with constant airflow to meet space temperature heating loads. Modulating heating capacity shall modulate based on supply air temperature.

## 2.13 ACCESSORIES

.1 Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

## 2.14 2.03 CURBS

.1 Curb adapters shall be provided with the unit to match the existing rooftop curbs. Measurements shall be taken on site prior to purchasing.

.2 Final curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished

within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.

.3 Curbs and curb adapters shall be fully assembled

.4 Curbs shall be seismically designed for the application. Job specific drawings stamped and signed by a professional engineer will be included as part of the submittal package

.5 Manufacturer shall provide unit weight, center of gravity, and recommended anchorage locations to enable the project seismic engineer to complete the seismic restraint design per Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment. Where required, manufacturer shall provide OSHPD pre-approved seismic anchorage details.

## PART 3 EXECUTION

### 3.1 INSTALLATION

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

.2 Install as per manufacturers' instructions on roof curbs provided by manufacturer.

.3 Use all factory provided lifting lugs to rig the units or modules. Ensure that spreader bars are used to prevent damaging the cabinets.

.4 Lift modules in an upright position.

.5 Ensure housekeeping pads or mounting bases are level and in accordance with approved dimensions. Air handling units or modules shall be level, shim if necessary.

.6 Install deep seal P trap and trap seal primer on drain lines sized per manufacturer’s recommendations. Disposal of condensate (cooling coil, steam or floor drains) shall be in accordance with local codes.

.7 Remove gussets, hold-down bolts and shipping fasteners.

.8 Remove fans' shipping restraints and level spring isolators. Adjust thrust restraints.

.9 Assemble modules together according to the installation manual. Mount and connect Hoods and other loose items.

.10 Provide all necessary field installed control wiring in a consistent manner with factory installed wiring. Terminate back to terminal strip.

.11 Check fan motors for rotation and amp draw for each phase. Record information on the start-up data sheets.

.12 Belt drives should be adjusted for tension and alignment.

.13 Install flexible connections at unit inlets and outlets as indicated. Ensure metal bands of connectors are parallel and not touching when fan is running and when fan is stopped.

.14 Insulate all piping and equipment mounted inside the units or within piping vestibules.

.15 Where alternate equipment is approved with different cabinet dimensions, contractor shall provide all required curb modifications, curb adapters, structural reinforcement, and architectural coordination at no additional cost to the Owner.

## 3.2 START UP AND COMMISSIONING

.1 Protect and keep the units clean throughout construction in accordance with 21 05 01 Common Work Results for Mechanical.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

.3 Balancing to be provided in accordance with 23 05 93 Testing, Adjusting and Balancing for HVAC

.4 Complete Commissioning activities in accordance with Section 01 91 13 - General Commissioning (CX) Requirements

**END OF SECTION**

# PART 1 GENERAL

## 1.1 GENERAL SUMMARY

.1 The Controls System Contractor shall supply and install a complete Direct Digital Control (DDC) System as required to accomplish the specified Sequences of Operation for control of heating, ventilating, air-conditioning, and other building equipment, and systems as described in this specification.

.2 System Requirements

.1 BACnet®. The control system shall consist of a high-speed, peer-to-peer internetwork of ANSI/ASHRAE Standard 135 native BACnet devices. The control system shall also incorporate input/output devices, mechanical/electrical automatic temperature control devices, enclosures, interconnecting conduit, and cabling.

.2 Performance Monitoring. The System shall provide the specified performance monitoring functionality, including required monitoring points and performance metrics, system accuracy, data acquisition and data management capabilities, as well as all required graphical and data displays.

.3 Browser-Based User Interface. The System shall support a Browser-based User Interface (BUI) to the System data. An Operator using a standard web browser shall be able to access the control system graphics and change adjustable setpoints.

.3 System Architecture

.1 BACnet internetwork. The System as provided and installed under this specification shall comprise a BACnet internetwork with a multitiered architecture.

.2 All communication shall conform to ANSI/ASHRAE Standard 135: BACnet.

.3 Tier 2 Building Level Communication Network (BLCN). This network architecture tier comprises the primary building-level infrastructure for the connection of building- and facility-level systems, and FLCNs.

.4 Tier 2 BLCNs shall be BACnet networks comprised of:

.1 Building-level BACnet controllers,

.2 Building-level data archival and analytics,

.3 Local workstations and operator interfaces,

.4 System-level integration,

.5 Routers for the interconnection of FLCNs, and

.6 Building-level BUI.

.5 Tier 2 BLCNs shall use one the following BACnet data links only:

.1 BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.

.2 B/VPN: BACnet Virtual Private Network.

.4 Drawings are diagrammatic only. Control equipment and labor not specifically referred to here or on the plans, which are required to meet the functional intent, interconnect controllers and associated systems to be controlled shall be provided without additional cost to the Owner.

## 1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 45 00 - Quality Control

.3 Section 01 61 00 - Common Product Requirements

.4 Section 01 78 00 - Closeout Submittals

.5 Section 01 91 13 - General Commissioning (CX)

## 1.3 REFERENCES

.1 All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, provincial, and federal authorities. Such codes, when more restrictive, shall take precedence over these drawings and specifications.

.2 At a minimum, the installation shall comply with the current editions in effect thirty (30) days prior to receipt of bids of the following applicable codes:
- .1 ANSI/ASHRAE Standard 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks.
- .2 Canadian Electrical Code, Part 1 (CSA C22.1-12).
- .3 National Building Code (NBC).
- .4 Underwriters Laboratories (UL).
  - .1 UL-916 – Energy Management Systems (EMS).
  - .2 UL-864/UUKL – Control Units and Accessories for Fire Alarm Systems.

## 1.4 SUBMITTALS

.1 Shop Drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submittals for all equipment, hardware and system network shall be submitted within 8 weeks from project award. Following approval of Controls equipment package, major Mechanical and Electrical equipment shop drawings, the Consultant through the DCC Representative may revised the sequence of operation so that the BAS contractor can use in preparation of the final BAS Submission which is to be inclusive of all schematics, graphics and sequences.
- .3 System Hardware Submittals. Submit the following at a minimum:
  - .1 A complete Bill of Materials of all equipment, controllers, devices, and sensors to be provided and/or used indicating unique equipment identifier, unique device identifier, manufacturer, model number, and quantity.
  - .2 A Protocol Implementation Conformance Statement (PICS) including a BACnet Interoperability Building Block (BIBB) table for each DDC device included in the submittal.
  - .3 Manufacturer’s technical data including product specification sheets, performance curves, and installation/maintenance instructions. When manufacturer’s cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly called out by other means.
  - .4 Schematic diagrams for all field sensors and controllers providing floor plans indicating the locations of all sensors, devices, and temperature control panels.
  - .5 Control enclosure details for each enclosure including panel identifier, location, physical lay-out, dimensions, instrumentation, labels, etc.
  - .6 Wiring diagrams and schematics for each control enclosure showing power source for each panel, secondary power, and network termination as well as all individual terminations, terminal numbers, point type, and mnemonic/name.
  - .7 Wiring diagrams for all packaged equipment, motor starters, relay wiring, equipment interlock, safety circuits, etc. clearly indicating all interconnecting wiring and termination of all conductors and cables including labels of all cables

and point mnemonics.

.8 Wiring diagrams and schematics for each sensor.

.4 Controlled System Submittals.

.1 Riser diagram showing the physical lay-out of the entire internetwork. The design shall take into account mechanical and electrical equipment locations and requirements.

.2 Riser diagram for each individual BACnet network including the ELCN, and each BLCN and FLCN including:

.1 Data link with physical characteristics and configuration.

.2 Each BACnet networked DDC device including location, service, device instance, MAC address, and network number.

.3 Each IP networking device including location, service, and IP address.

.4 Location of all interface devices including network interface jacks and workstation connections.

.5 Location of all MS/TP network termination points and End-of-Line (EOL) terminations.

.3 A schematic control flow diagram of each controlled system showing actual physical configuration and location of all control elements including each hardware point type, controller, and mnemonic.

.4 A schematic wiring diagram of each controlled system showing actual physical wiring and termination of all control elements including each hardware point type, controller, mnemonic, and terminal number.

.5 An instrumentation list for each controlled system displaying each control element, name, manufacturer, model, and product data sheet number in a tabular format.

.6 A complete description of the operation of the System including a specific Sequence of Operation for each controlled system. Sequences of Operation shall:

.1 Reference the submitted schematic of the controlled system.

.2 Refer to equipment and control devices by their specific unique identifiers pursuant with the Contract Documents and the System submittal package.

.3 Clearly represent actual application programming methodology and functional control operation not merely a copy of the Contract Document specified sequence of control.

.4 Include a concise description of functional system operation under specified normal and failure conditions.

.5 Include a complete hardware input and output (I/O) points schedule identifying for each point its instance, type, name/mnemonic, controller, equipment/function, location, termination, override, alarm, and display criteria.

.7 Operational deviation from the specified Sequences of Operation as outlined in Contract Documents shall not be permitted under any circumstances without prior written approval by the DCC Representative.

.8 A schedule of all control valves. This shall include the unique equipment identifier, valve size, dimensions and installation/maintenance clearance, model number (including pattern and connections), close-off rating, flow, CV, pressure drop, pressure rating, and location. The valve schedule shall also contain actuator selection data supported by calculations of the force required to move, close, and seal the valve at design conditions.

.9 A schedule of all control dampers. This shall include the unique equipment identifier, unique damper identifier, damper size, pressure drop, blade configuration, orientation and axis of frame, blade rotation, location and selection

criteria of actuators, nominal and actual sizes, manufacturer, and model number. The Damper Schedule shall include the AMCA 500-D maximum leakage rate at the operating static-pressure differential.

.10 Graphics; For each screen, provide a conceptual layout of pictures and data and show or explain which other screens can be directly accessed.

.11 It will absolutely not be necessary for the owner to sign any type of confidentiality agreement or contract or agreement to obtain control over the BAS System or BAS software. The software will become the property of the owner at time of building turnover.

.12 Quantities of items submitted shall be reviewed, but are the responsibility of the contractor.

.2 Schedules.

.1 Within one month of Contract award provide a schedule of work indicating at a minimum the intended sequence of work, start dates and durations for individual activities, delivery dates for major materials and equipment including anticipated lead times, and milestones indicating possible restraints on work by other trades or construction delays.

.3 Training.

.1 Provide training course outline and curricula at least six (6) weeks prior to training. The DCC Representative shall modify the curricula as necessary to meet the Owner's Project Requirements (OPR). Revised curricula shall be returned no later than three (3) weeks prior to the training.

.4 Closeout Submittals:

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

.2 Upon completion of installation and System commissioning activities submit record (as-built) documents for review to include:

.1 Testing and commissioning reports and checklists.

.2 Operation and Maintenance (O&M) manuals.

.3 As-built revisions of all submittal data updated to reflect actual field conditions, architecture and execution.

.4 Names and 24-hour contact information for installing contractors and service representatives.

.5 Operator's manual with administrator and operator level credentials and procedures for operating the System including logging-on/off, handling alarms, generating points reports, trending data, overriding automatic control, changing setpoints, and control variables.

.6 One set of programming manuals with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.

.7 Engineering, installation, and maintenance manual(s) that explain how to design and install new points, panels, and other hardware' preventive maintenance and calibration procedures' how to debug hardware problems' and how to repair or replace hardware.

.8 Installation and maintenance manuals describing how to install and configure new hardware as well as how to perform routine preventative maintenance and calibration together with corrective diagnostic troubleshooting procedures.

.9 Documentation of all programs created including setpoints, tuning parameters, and final database.

.10 Complete system database as functional after system commissioning and

functional testing including all graphics and images used by and/or created for System on electronic format as accepted by the Owner.

.11 Final Bill of Material with all installed parts, manufacturers, manufacturers' part numbers, and ordering information.

.12 A schedule of recommended spare parts with part numbers and supplier.

.13 All original-issue installation and maintenance manuals, user guides, and other documentation provided with all hardware and software provided as a part of this specification.

.14 Licenses, guarantees, and warrantee documentation for all equipment and systems.

.15 Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration), time between tasks, and task descriptions.

## 1.5 QUALITY ASSURANCE

.1 The DDC System Manufacturer shall be engaged full-time and shall have been engaged full-time in the manufacture of equipment and devices of the scope, size, and service consistent with the requirements for this project.

.2 The System Contractor shall specialize, and have experience in, the design, installation, programming, and operation of Systems consistent with the scope, size, and service specified; and shall:

.1 Be an officially authorized representative of the System Manufacturer with an established relationship.

.2 Assign to the project technicians and engineers who are officially trained and certified by the System Manufacturer in the design, installation, programming, and operation of the System components.

.3 Upon request, the System Contractor shall present certifications of completed training including hours of instruction and course outlines for all technicians and engineers assigned to, and/or otherwise employed on, the project.

.3 DDC System Manufacturer shall have in-place support personnel located within 3.5 hours of the site with technical staff, spare parts inventory, and all necessary test and diagnostic equipment.

.4 The BACnet internetwork shall be based upon, and installed according to, the System Manufacturer's standard integrated hardware and software product design and in accordance with the System Manufacturer's installation and application documentation.

## 1.6 WARRANTY

.1 Provide a comprehensive Labor and Materials warranty for the Direct Digital Control (DDC) System for a period of one (1) year from the date of substantial completion. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.

.2 The contractor shall respond to the Owner's request for warranty service within 24 hours.

.3 This warranty shall cover defects in materials and workmanship for the controls system inclusive of all 3rd party products that form part of the system.

.4 Submit warranty information in accordance with Section 01 78 00 – Closeout Submittals.

.5 Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies as identified by the contractor shall be provided at no charge during the warranty period. All corrective software modifications made during the warranty period shall be updated on all user documentation and on user and manufacturer archived software disks.

### 1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

### 1.8 OWNERSHIP OF PROPRIETARY MATERIAL

.1 Upon project acceptance all software and documentation delivered as a part of this specification shall become the exclusive property of the Owner; including but not limited to:
- .1 Project graphic images
- .2 Terminals
- .3 BAS Software and Components
- .4 Record drawings
- .5 Project database
- .6 Project-specific application programming code
- .7 All documentation

## PART 2 PRODUCTS

### 2.1 APPROVED CONTROL SYSTEM MANUFACTURERS FOR CFB KINGSTON VLN (V IRTUAL LOCAL AREA NETWORK)

.1 The VLAN is an existing network that allows for remote monitoring of CFB Kingston’s building control systems. This is the only network that shall be connected to and expanded to meet the requirements of this section.

.2 Existing systems included on the VLAN network are:
- .1 Johnson Controls Inc. – Metasys
- .2 Reliable Controls
- .3 Delta Controls

.3 This approval is based on product quality and similarity, however, confirmation that the final products selected meet the requirements of this specification is the responsibility of the Contractor.

.4 Contract shall have a fully licensed BAS software turned over to RPOp’s EMCS shop upon completion of the job. This shall include any programming software, graphics generation software, Operator workstation software, any third-party software such as ‘AutoCAD’, ‘visio’, or ‘Adobe’, etc. which is required to filly interact and make changes to the supplied BAS.

.5 Although it is preferred that associated DDC products specified herein (e.g., sensors, valve dampers, and actuators) originate from same manufacturer, this is not a requirement. Products will need to be selected to meet the requirements and performance standards noted within this specification.

.6 It is the responsibility of the BAS contractors noted above to review the tender documents to ensure they can provide the entire system, programming, integration, commissioning, labour and material in accordance with the drawings and related specification sections.

**2.2 GENERAL PRODUCT REQUIREMENTS**

.1 The System as provided and installed under this specification shall be comprised of BACnet devices including controllers, routers, operator workstations, operator displays, and supervisory software from a single manufacturer and product line or product family.

.2 The System Manufacturer product line selected shall be the most current and complete offering and shall currently be actively manufactured and supported and shall have been installed in a minimum of 25 installations at the time the bid date for this project.

.3 Any BAS being installed should have an RFC component submitted and approved to ensure that there is compliance with networks. This approval shall be required prior to any installation commencing. This RFC shall cover the BAS network design and how it connects to the LAN, as well as any software required to operate the system.

.4 There shall be no stand-alone switches, hubs, or network equipment supplied as part of the BAS installation. All Ethernet level OWS, or Lan controllers shall be connected to the MTR rooms assigned by Shared Services Canada and shall be connected to an assigned port on the EMCS LAN switch in the MTR room.

.5 This project shall not be used as a test site. First release and test version hardware, software, and firmware shall not be implemented on this project under any circumstances.

.6 The entirety of the System Manufacturer product line selected shall be designed and deployed specifically with standard provisions for integral backwards compatibility and extensibility.

.7 System Manufacturer shall certify that System devices, and spare or equivalent components shall be readily available for a minimum of five (5) years after the completion and final acceptance of this project.

.8 System Manufacturer shall certify that its own DDC product line in its entirety are supported. Support shall include complete viability and compatibility of the legacy components with the current mainstream product line; and availability of replacement or equivalent compatible components and/or repair services.

.9 OEM and/or private-labelled controllers or software manufactured or developed by a third-party and labelled or otherwise represented as being a product of the System Manufacturer shall not be accepted under this specification.

.10 Non-networked system components specified in this section (including sensors, valves, dampers, etc.) need not be manufactured by the System Manufacturer.

.11 Supply and installation of material as required for a complete Direct Digital Control (DDC) System as required to accomplish the specified Sequences of Operation, which generally includes:

- .1 All Building Automation System Controllers inclusive of software, power supplies and associated wiring
- .2 Equipment Cabinets
- .3 Control Valves
- .4 Control Damper Actuators
- .5 All sensors, thermostats, meters and end devices unless specifically noted by another

Division.

.6 All Low Voltage wiring required for control of equipment (ie: low water cutoffs, high limits, safeties etc…)
.7 Thermowells for sensors
.8 Control Pushbuttons and Timers where indicated.
.9 Control Pilot Lights
.10 Control Power for equipment by other divisions, but connected to the equipment of this division (ie: magnahelic gauges, air flow stations etc…)
.11 Relays where required to integrate with voltages different than supported by BAS equipment.
.12 BAS Surge Suppression Modules
.13 Relays where required to integrate with voltages different than supported by BAS equipment.
.14 IP Building Controls Network including rack mounted server, switches, ups and all IP cabling to connect to BAS controllers and 3rd party IP controllers
.15 Network Adapters (MODBUS RTU/MSTP, BACnet IP, etc…) as required for integration to other components of the system.

.12 Execution
.1 Engineering for systems configuration, shop drawings, and installation drawings.
.2 Complete programming for a fully operational system including specified integrations, system graphics, device programming and setup.
.3 System commissioning as described in within this specification and Div 1 for a completely functional system including all specified integration, training, as-built documentation, and 1 year parts and labour warranty.
.4 Electrical installation as follows;
.1 Div 25 to identify all line voltage power requirements as part of the system design and installation drawings. Coordinate all requirements with Div 26 to provide and utilize “controls” or “spare” breakers provisioned within local panels.
.2 Div 26 shall provide the installation of all line (120V) voltage connections to power BAS controllers, cabinets, actuators etc to suit final approved shop drawings.

.13 Additional Devices
.1 During shop drawing approval and finalization of the sequence of operations specific to the approved system it may become necessary to add a few controls devices and points. Include for incorporation of up to 5 additional controls devices/sensors (ie. Room thermostats, relays, pressure sensors, duct sensors etc) as may be required in addition to those shown in the drawings.
.2 Include for installation and low voltage wiring as required to install these additional controls devices/sensors.

.14 The BAS building management and control functions to be provided include:
.1 Building management and control
.2 Monitoring and control of BAS controllers, remote devices, and 3rd party controllers provided with HVAC equipment
.3 Operator interface to allow general supervision of room controls and access to Div. 26 lighting control system.
.4 Integration of Div. 26 electrical distribution power monitoring; refer to Electrical Drawings for scope of programming/integration of power monitoring and facility trending.
.5 Data collection and historization
.6 Alarm management
.7 Trending

.8 Report generation
.9 Building IP Network integration.

.15 At a minimum, the following data shall be accessible:
.1 Space temperature and humidity where applicable
.2 Space temperature set point
.3 Occupancy status
.4 Operating mode
.5 Speed (% or hz)
.6 Valve positions
.7 Air volume flow
.8 Percent terminal load
.9 Time schedules
.10 Zero energy bands
.11 Room name
.12 Terminal type, e.g., fan coil
.13 Div. 26 Lighting Control System (Lighting Control Interface Access from HMI and Occupancy status integration).
.14 Div. 28 Fire Alarm System Status (“Alarm” and “Supervisory” status).

## 2.3 SYSTEM PERFORMANCE

.1 Performance Standards. The System shall conform to the following minimum performance standards using the project-deployed, normal-service, production hardware, firmware, software, and network connections:
.1 Graphic Display. A minimum of 50 dynamic real-time data points shall be displayed within 10 seconds of the request and shall refresh with current data within 5 seconds.
.2 Operator Command. The maximum time between the command of a binary or analog object by the operator and the reaction initialization by the device shall be 2 seconds.
.3 Object Command. Devices shall respond to automatic command of a binary or analog object within 2 seconds.
.4 Object scan. Changes of state or analog values shall be transmitted such that reporting of a value is never more than 15 seconds old and is reported within 15 seconds of a change in value.
.5 Alarm Response. The maximum amount of time from when an object goes into alarm until it is annunciated at the workstation shall not exceed 20 seconds.
.1 Each workstation on the network shall receive alarms within 5 seconds of other workstations.
.6 Program Execution. All programs in all DDC devices shall be able to execute at a minimum of at least one time every second. Program execution time shall be configurable to be consistent with the process under control.
.7 Control Loop Performance. All DDC devices shall be able to execute control loops at a frequency at least one time every second. The controller shall update the process value and output generated by this calculation at this same frequency at a minimum or as appropriate for the mechanical process under control.

.2 Environmental Conditions. All System components provided under this specification shall operate under ambient environmental conditions of -20°C (-4°F) to 55°C (131°F) dry-bulb and 10% to 90% relative humidity, non-condensing at a minimum. Sensors and control elements shall be constructed of materials suitable and rated for the media sensed under the ambient environmental temperature, pressure, humidity, and vibration conditions typical for the installed location.

.3 Power Conditions. Networked components of the System shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

.4 Reporting Accuracy. System shall report values with minimum end-to-end accuracy as listed in Table 1 through Table 5.

.5 Control Stability and Accuracy. Control applications shall maintain process variables at setpoint within the tolerances listed in Table 1 through Table 5 inserted at the end of this specification section.
- .1 Combined system repeatability of sensors, controllers, and readout devices for a particular application shall be ±2% of full scale of the operating range.
- .2 Repeatability of overall combined system of sensor, controller, and readout device in a control loop application will be ±5% of full scale of the operating range.
- .3 Long-term electronic drift shall not exceed 0.4% per year.

## 2.4 COMMUNICATIONS

.1 The System as provided and installed under this specification shall comprise a BACnet internetwork.
- .1 All communication between System devices, including operator workstation and operator display communication, provided and/or installed under this specification shall conform to ANSI/ASHRAE Standard 135, BACnet using native BACnet communications.
- .2 All devices shall utilize a native BACstack embedded at the media access controller level.
- .3 Devices that require translation of data, gateways, or mapping of any kind for communication between System devices shall not be acceptable.

.2 BTL. All System devices provided and installed under this specification shall be tested, certified, clearly stamped, and listed by the BACnet Testing Laboratories (BTL).
- .1 BTL product listings are available from BACnet International (http://www.bacnetinternational.net/btl/).

.3 Extensibility. The System shall be modular in nature and implemented in such a manner that it can be expanded in functionality and in capacity to at least twice the required hardware through the addition of controllers, devices, and wiring. Expansion shall not require operator interface hardware additions, software revisions, firmware revisions, or additional licensing.

.4 IP Building Controls Network
- .1 Provide CAT 6 cabling from all BAS controllers, 3rd party IP controllers (ie. HVAC equipment), Div. 26 power monitoring system, BAS Server etc.. back to and punched down at network rack in IT Room and patched to associated Section 25 supplied/installed network switch.
- .2 Provide CAT 6 drops from network switch to proposed operator workstation locations (to be confirmed), to ensure building controls network is isolated from Owner IT network.
- .3 CAT 6 cable to be 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification to FT6 to CSA-C22.2 NO.214, Category 6 to: TIA/EIA-B.2.
- .4 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as PDF.
  - .1 Perform tests for Permanent Link on installed cables, including spares:
    - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
  - .2 Perform tests for Channel on all of cross-connected data horizontal cabling installed.
    - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.

.5 In exposed locations and in ceiling spaces with limited access from below CAT 6 cable to be installed in EMT conduit. Minimum size of 27mm trade-size conduit allowed.
.6 Install no more than the equivalent of two 90-degree bends in any conduit run. Support within 300 mm of changes in direction.
.7 Install pull wires in empty pathway. Use polypropylene line. Leave at least 300 mm of slack at each end of pull wire.
.8 Install pathways in maximum lengths of 23 m.
.9 In accessible enclosed ceiling space CAT 6 cable to be installed using “J” hooks. Support horizontal cables at intervals not exceeding 2 meters where not installed in conduit.

## 2.5 SOFTWARE

.1 Security. All operator workstation and reporting software shall support multilayered system security permissions that are defined for each individual operator to restrict/permit day-to-day operations and system configuration.

.2 Multitasking Environment. All System software provided under this specification must be designed to operate as a Microsoft Windows process or service in a multitasking environment concurrent with other common software applications.

.3 Graphical User Interface (GUI). The System shall provide a graphically-oriented user interface.
.1 The GUI shall have the ability to display the status of any object using dynamic values and animations.
.2 The GUI shall support at a minimum BMP, GIF, TIF, JPG, EMF, PNG, and DIB graphic file formats and allow for the use of custom animation objects and URL hyperlinks in each display.

.4 Browser-based User Interface (BUI). The System shall support delivery of the GUI via a browser-based user interface.
.1 The System shall use the same GUI and deliver a consistent operator experience between operator workstation software and BUIs delivered under this specification.
.2 The current versions of the following standard web browsers at a minimum shall be supported by all BUIs provided:
.1 Google Chrome.
.2 Microsoft Edge 83+.
.3 Custom HTML programming shall not be required to create or display system graphics or data on a web page.
.4 BUIs must support unlimited access for a minimum of five (5) simultaneous users.

.5 Alarm Processing. All operator workstation software shall display and log BACnet alarms and events from any object in the BACnet internetwork.
.1 Alarm and Event Log. All operator workstation software shall have the ability to display all alarms from any location in the internetwork.
.2 Alarm and Event Log shall be configurable per workstation and shall display at a minimum: alarm time, received time, state, notification class, priority, message, source, time acknowledged, acknowledged by user, and action.

.6 Schedules. All operator workstation software shall support viewing and modification of standard binary, analog, and multistate BACnet Schedule objects and parameters.
.1 All operator workstation software shall display the configuration of the weekly schedule for each schedule object graphically and in a tabular format. Each calendar day shall support up to a minimum of ten (10) transitions and each transition shall be modifiable via the workstation graphically or via manual entry.

.2 It shall be possible to specify time schedules for the control of all BAS points. A large number of individual points shall be controlled by a single time schedule.

.3 All operator workstation software shall display a calendar allowing for indication and modification of Exception Schedules for any day of the year.

.1 Each Exception Schedule and special event shall be individually configurable including name, priority, transition values, and times.

.2 The Operator shall have the ability to configure Exception Schedules to be active on specific dates, date ranges, recurring date patterns, or as commanded by BACnet Calendar objects or other override objects.

.3 The Operator shall be able to define an exception schedule a minimum of 10 years in advance.

.4 Once an exception schedule has been executed, it will be deleted.

.7 Trend Logs. All operator workstation software shall support viewing a custom trend log including any object in the system.

.1 All operator workstation software shall support both the standard BACnet Trend Log and the BACnet Trend Log Multiple objects for defining custom trend logs for any object in the system.

.8 Runtime. All operator workstation software shall support viewing logs used for reporting runtime of every binary object in the system.

.9 The following standard system displays shall be included as part of the system. In the case of the trend and group displays, configuration of these displays shall only require entry of a point name to completely configure the display. The alarm summary, event summary, point detail, communications status, and system status shall not require any configuration. Systems where standard graphical displays, showing all parameters for each system point do not exist will not be accepted.

.1 Alarm summary display
.2 Event summary display
.3 Point detail template displays (for each point in the database)
.4 Trend set template displays
.5 Group control and group trend template displays
.6 Communications status displays
.7 System status displays
.8 Operator scratch-pad display
.9 Face plates for all common point types
.10 Configuration displays

.10 Provide system status displays that display the following information:

.1 Points in alarm condition pending acknowledge command
.2 Points that remain in an alarm state, but which have been acknowledged
.3 Communication failures
.4 Operator workstations status
.5 Communication links status
.6 Controller status

.11 Provide system with the following full screen administrative displays:

.1 Master system menu
.2 Report summary
.3 Alarm summary
.4 Event summary
.5 Display summary

.6 System parameters configuration
.7 Operator workstation configuration
.8 Area assignment
.9 Time schedule assignment
.10 Holiday assignment
.11 History assignment
.12 Push-button assignment
.13 Operator definition
.14 Operator message board
.15 Events archive and retrieval
.16 Time period summary and configuration
.17 Point detail for every configured point

.12 Software applications shall reside and operate in the system controllers. Editing of applications shall occur at the operator workstation.

.13 In the event of a power failure or disconnection from the Operations Terminal, the controllers shall continue to be fully operational with full time program capability.

.14 Sequencing: Provide application software based upon the sequences of operation specified to properly sequence pumps, exhaust fans etc… Refer to controls drawings.

.15 Staggered start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment or groups of equipment is started, along with the time delay between starts, shall be user-selectable.

.16 Anti-short cycling: Digital output objects shall be protected from short cycling. This feature shall allow minimum on time and off time to be selected.

.17 On and off control with differential: Provide an algorithm that allows a digital output to be cycled based on a controlled variable and set point. Algorithm shall be direct acting or reverse acting and incorporate an adjustable differential.

.18 Duty cycle: Provide software to switch HVAC systems on and off at variable intervals to save energy while maintaining room conditions. Program shall have adjustable internal parameters for room comfort range, maximum off times, minimum off times, and motor cycle times.

.19 Optimum start and stop: Provide a software program that calculates optimized values for starting and stopping the heating plant. Optimized start-stop function shall consider the residual heat in a building to avoid unnecessary heating operation. Required room conditions are met at all times. Optimum start and stop program calculates required flow temperature with an integrated heating curve. Two techniques shall be available: optimization without room sensor or optimization with room sensor. Optimization without room sensor uses outdoor air temperature to determine optimum start (the preheat point). Optimization with room sensor uses room control and needs a time constant (time program) and dead time to calculate the preheat point.

.20 Zero energy band: Provide a software program that determines set points to maintain a predetermined comfort band divided into heating, cooling, and zero energy bands. ZEB subdivides a predetermined comfort band into: Heating band zero energy band cooling band. Zero energy band represents a temperature range in which the room temperature may vary without a need for heating or cooling.

.21 Run-time totalization: Provide software to totalize run times for all digital input objects. A high run-time alarm shall be assigned, if required, by the operator.

## 2.6 ENTERPRISE BACNET OPERTATOR WORKSTATION SOFTWARE (B-OWS)

.1 The enterprise BACnet operator workstation (B-OWS) provides day-to-day monitoring and operation of BACnet internetworks. The enterprise B-OWS is not intended for comprehensive configuration of the System.

.2 BACnet Device Profile. The enterprise B-OWS provided shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2010 Revision 12 Annex L a minimum of 30 days prior to the bid date for this project as follows: BACnet Operator Workstation (B-OWS).

.3 BACnet Networking. The enterprise B-OWS shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum: BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.

## 2.7 BACNET DATA ARCHIEVE SOFTWARE

.1 The BACnet data archive software shall automatically acquire and archive log data from standard BACnet Trend Log objects into a standard SQL database for long-term secure storage and multiyear analysis.
- .1 The BACnet data archive software shall be a BACnet device dedicated to this service.

.2 BACnet Device Profile. The BACnet data archive software shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2010 Revision 12 Annex L as follows:
- .1 BACnet General (B-GEN).
- .2 BACnet Data Archive Server shall support at a minimum the following BACnet Interoperability Building Blocks (BIBBs) as supported by a submitted PICS:
  - .1 Data Sharing-ReadProperty-A (DS-RP-A).
  - .2 Data Sharing-ReadProperty-B (DS-RP-B).
  - .3 Data Sharing-ReadProperyMultiple-A (DS-RPM-A).
  - .4 Data Sharing-ReadProperyMultiple-B (DS-RPM-B).
  - .5 Data Sharing-WriteProperty-A (DS-WP-A).
  - .6 Trending-Automated Trend Retrieval–A (T-ATR-A).
  - .7 Trending-Automated Multiple Value Retrieval-A (T-AMVR-A).
  - .8 Trending-Archival-A (T-A-A).
  - .9 Device Management-Dynamic Device Binding-A (DM-DDB-A).
  - .10 Device Management-Dynamic Device Binding-B (DM-DDB-B).
  - .11 Device Management-Dynamic Object Binding-B (DM-DOB-B).

.3 Online Help. The BACnet data archive software shall provide a context-sensitive online help system to assist the user in operation and modification of the system.

.4 Provide flexible trending allowing real-time, historical, or archived data to be trended in a variety of formats. In addition, trend data types shall be combined to allow for comparisons between data, e.g., current real-time data versus archived data. The system shall provide trending capability with the following functions

.5 It shall be possible to trend at least 500 control points continuously for at least 30 days. It shall be possible to set the trend length and frequency ie: 1 second, 5 second, 1 minute, COV etc…

## 2.8 OPERATOR SECURITY AND SIGN ON

.1 Each operator shall be assigned a user profile that defines the following:

.1 Security and control level
.2 Operator identifier
.3 Unique password
.4 Area assignment and area profile
.5 Start graphic for that operator
.6 Timeout value for that operator

.2 Actions initiated by the operator shall be logged in the event database by operator identifier. In addition, any control actions to a given point shall only be allowed if the control level configured in the operator's profile exceeds the level assigned to the controlled point.

.3 Utilities shall allow administration of the operator passwords.

.4 The system shall support at least six levels of operator security. The functions allowed from each security level shall be as follows:
.1 Level 1: Signed off mode—View start-up display only.
.2 Level 2: View only—The operator shall be able to view displays. Typically used for an inexperienced operator.
.3 Level 3: Permit all Level 1 and 2 functions and, in addition, permit the operator to control points such as start and stop, and disable and enable, and to acknowledge alarms as they occur.
.4 Level 4: Permit all Level 1 through Level 3 functions, in addition to the following: access master time schedules, allocate system peripherals, change point engineering parameters, build reports, and use most standard system configuration displays. This level shall be reserved for the building supervisor.
.5 Level 5: Permit all Level 1 through Level 4 functions, in addition to accessing engineering functions, such as building and linking displays, and allocating keyboard push button assignments. Reserved for the building consultant/engineer.
.6 Level 6: This is the highest level of station security. It shall allow the user unlimited access to all station functions. Reserved for the building manager.

.5 Operator shall be permitted to sign on to the system if the correct operator identity and password have been entered. This password shall be encrypted. System shall be linked to Windows so that the operator uses their Windows account name and password to sign on to the system.

.6 Primary access User access to the BAS will be through Web browser interface from any Operator Workstation connected to the BAS network:

- Operator interface shall be available through a web browser. Using a browser such as Microsoft's Internet Explorer, an operator shall be able to perform all functions on the same standard and custom graphics as used in the standard operator interface. Custom graphics, alarm graphics, and standard graphics shall be available without modification or reengineering through a browser user interface and be fully functional
- Browser interface shall not rely on java or flash programs for operation and shall be compatible with the following systems:
  - iOS devices such as iPad, iPhone, iMac, iPad, PowerMac etc…
  - Android Devices
- Browser interface shall provide login and security authentication in the same way as the standard operator interface. It shall be possible to operate the facility through the browser user interface in the same way as the standard user interface and to perform all functions described (operator functions)' for example, acknowledge alarms, view graphics, control points, execute reports, and modify configuration settings.

## 2.9 CONTROLLERS

.1 Provide an adequate quantity and types of controllers to achieve the performance specified in the System Performance and as required to provide the controls shown on the drawings and to meet the Sequence of Operation. In general the controllers shall;
- .1 Provide at a minimum 1 Building Level networked IP controller in M&E spaces
- .2 Provide additional Building Level and Unitary controllers in services spaces as required to meet the requirements of the controls system

.2 Controller shall support manual overrides and provide colored status LED's to distinguish analog and digital outputs, changing status, and analog output signal strength.

.3 Serviceability: Provide CPU diagnostic LEDs for normal, system error, transmit, receive, ground loop, LonWorks/BACnet service, and communications bus transmit and receive. Wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

.4 All Controllers used shall have an additional 15% points available for use. The additional points to be divided between analogue and digital inputs and outputs. Universal points are acceptable. Expansion boards installed to achieve this are acceptable as well. The cost for connection to and use of these additional points is not carried as part of this tender.

.5 Environment. All controllers shall be suitable for permanent installation in conditioned spaces and shall be rated for operation at -20°C to 55°C (-4°F to 131°F).
- .1 All controllers shall be suitable for permanent installation in the design location and ambient conditions.
- .2 Controllers shall not be installed outdoors or in wet conditions.

.6 Power & Noise. All controllers shall be able to operate at 90% to 110% of the nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
- .1 Controllers shall be certified in compliance with FCC/ICES-003 CFR47 Part 15/B.

.7 Serviceability. All controllers shall be provided with diagnostic LEDs to indicate power, communication, and processor status.

.8 Memory. All controllers shall have sufficient memory to support the operating system, database, and programming necessary to satisfy the specified Sequence of Operation and to comply with the requirements of all applicable System specifications.
- .1 Battery/capacitor shall maintain runtime values and clock memory following a loss of power for a minimum of 72 hours.
- .2 The database and programming shall be maintained without power for a minimum of 10 years.
- .3 All application programs shall be stored on individual controllers in non-volatile memory.

.9 Communication Port. Each individual DDC controller shall provide a communication port for the connection of an operator workstation.

.10 Universal Inputs. All physical inputs on all controllers shall support at a minimum the following physical characteristics:
- .1 Thermistor.
- .2 Dry-contact.
- .3 Current (4-20 mA).
- .4 Voltage (0-10 VDC).
- .5 150 Hz pulse counting.

.6 12-bit A/D resolution.
.7 24 VAC over-voltage protection.

.11 Outputs. Physical outputs on all controllers shall support at a minimum the following physical characteristics:
.1 Universal (0-12 VDC; 75 mA @ 12 VDC).
.2 12-bit D/A resolution.
.3 24 VAC over-voltage and short protection.

.12 Database. All controller programming, configuration, and modification shall be accomplished via the internetwork from the B-AWS. The complete operational database and application program shall reside in each individual controller.
.1 Each controller shall provide microprocessor-based, self-contained, stand-alone, fully-programmable operation of local process control loops.
.2 All controllers shall function in a real-time, multitasking, networked operating environment; able to display database values, programs, and control loops in real-time while functional and simultaneously available to the operator online from the B-AWS, B-OWS, or B-OD.

.13 Programmability. All controllers shall be freely-programmable and support custom control strategies, programs, and databases that are completely modifiable over the BACnet internetwork once installed.
.1 All controllers delivered as a part of this specification shall be programmed using one (1) common programming language, means, and method via the B-AWS or enterprise B-OWS. Devices that require separate custom applications for programming shall not be acceptable.
.2 Application specific and/or configurable devices are strictly prohibited.

.14 Schedules. All controllers shall support the standard BACnet Schedule and BACnet Calendar objects.
.1 Schedule objects shall reside in each individual device.
.2 Applications requiring schedule objects and/or parameters to be stored exclusively on a workstation or server shall be strictly prohibited.
.3 All controllers shall support binary, analog, and multi-state BACnet Schedule objects.

.15 Trend Logs. All controllers shall locally perform and manage historical data collection.
.1 All controllers shall support:
.1 The BACnet Trend Log object.
.2 The BACnet Trend Log Multiple object.
.3 Change Of Value (COV) trending.
.2 All trend log data shall be stored in non-volatile memory and be preserved through loss of power.
.3 All objects (both hardware and software) system-wide shall be assignable to user-definable trend logs with configurable sample rates and length.
.4 Trend log data shall be stored at each individual controller, and uploaded to hard disk storage by a BTL-Listed BACnet device dedicated for this service when long-term archiving is required.

.16 Runtime Logs. All controllers shall support logging and reporting of runtime for every binary object in the system.
.1 Runtime data shall be sampled and stored in each individual BACnet device using standard BACnet objects and published properties. A workstation shall not be required for storage of custom runtime logs.

.17 Operator Displays. All controllers featuring an operator display shall be aesthetically pleasing and specifically designed for permanent installation in a finished, occupied space.

.18 Communicating Sensors. All controllers, except as expressly permitted below, shall support and be capable of monitoring and controlling a network of communicating sensors without consuming physical hardware input/output points on the device.
.1 A minimum of four (4) communicating sensors shall be supported by each DDC controller.
.2 Space mounted terminal unit controllers with fewer than four (4) inputs and four (4) outputs shall not be required to support communicating space sensors.

.19 Alarm Annunciation. All IP-enabled controllers shall support Simple Mail Transfer Protocol (SMTP) and provide stand-alone remote annunciation of alarms via e-mail without additional hardware or software.

## 2.10 BUILDING LEVEL EQUIPMENT CONTROLLERS

.1 Building-level system controllers shall be provided in compliance with the requirements for Controllers and as required to achieve the performance prescribed in this specification as designated.
.1 Building-level system controllers are responsible for the control of major mechanical systems and central plants.
.2 Building-level system controllers are responsible for the execution of global strategies, systems and protocol integration, and network routing/management.

.2 BACnet Device Profile. Building-level system controllers shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2012 Revision 14 Annex L as follows:
.1 BACnet Building Controller (B-BC).

.3 BACnet Networking. Building-level system controllers shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum:
.1 BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.
.1 ISO 8802.3 Ethernet (10/100 BaseT).
.2 ISO 8802-3 (Ethernet): ANSI/ASHRAE Standard 135.7.
.1 ISO 8802.3 Ethernet (10/100 BaseT).
.3 Master Slave Token Passing (MS/TP): ANSI/ASHRAE Standard 135.9.
.1 TIA-485.

.4 Modbus Networking. Building-level system controllers shall natively support the following Modbus data links in compliance with the following physical layer standards at a minimum:
.1 Modbus/TCP as a Master or Slave.
.1 ISO 8802.3 Ethernet (10/100 BaseT).
.2 Modbus/RTU as a Master or Slave.
.1 TIA-485.

.5 Universal Inputs. Building-level system controllers shall be provided with a minimum of twelve (12) universal inputs dedicated for the connection of field devices compliant with the requirements for all controllers.
.1 The total number of universal inputs connected to the building-level system controller shall be capable of being increased to a minimum of 96.

.6 Outputs. Building-level system controllers shall be provided with a minimum of eight (8) physical outputs dedicated for the connection of field devices. In addition to the requirements for universal outputs on all controllers, building-level system controllers shall also support at a minimum the following physical characteristics:
- .1 Relay (500 mA @ 24 VAC/VDC).
- .2 TRIAC (500 mA @ 24 VAC).
- .3 The total number of universal outputs connected to the building-level system controller shall be capable of being increased to a minimum of 64.

## 2.11 UNITARY CONTROLLERS

.1 Field-level equipment controllers shall be provided in compliance with the requirements for Controllers and as required to achieve the performance prescribed in this specification as designated.
- .1 Field-level equipment controllers are responsible for control of individual equipment that comprises mechanical systems.
- .2 Field-level equipment controllers are responsible for control of individual equipment that executes indoor environmental quality control and monitoring strategies.
- .3 Field-level equipment controllers are responsible for the execution of global and local strategies, and local device integration.

.2 BACnet Device Profile. Field-level equipment controllers shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2012 Revision 14 Annex L as follows:
- .1 BACnet Building Controller (B-BC).

.3 BACnet Networking. Field-level equipment controllers shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum:
- .1 BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.
  - .1 ISO 8802.3 Ethernet (10/100 BaseT),
  - .2 ISO 8802.3af PoE (10/100 BaseT), or
  - .3 ISO 8802.11b/g/n Wi-Fi.
- .2 ISO 8802-3 (Ethernet): ANSI/ASHRAE Standard 135.7.
  - .1 ISO 8802.3 Ethernet (10/100 BaseT),
  - .2 ISO 8802.3af PoE (10/100 BaseT).
- .3 Master Slave Token Passing (MS/TP): ANSI/ASHRAE Standard 135.9.
  - .1 TIA-485.

.4 Power & Noise. In addition to the power and noise requirements for all controllers, field-level equipment controllers shall also support the following physical power link:
- .1 ISO 8802.3af PoE.

.5 Universal Inputs. Field-level equipment controllers shall be provided with a minimum of six (6) software-selectable universal inputs dedicated for the connection of field devices compliant with the requirements for all controllers.

.6 Integral Sensors. In addition to universal inputs dedicated for the connection of field devices, field-level equipment controllers shall support the following integral sensors at a minimum:
- .1 Temperature.
  - .1 Resolution: ± 0.1 °C (0.18 °F).
  - .2 Accuracy: ± 0.1 °C (0.18 °F).
- .2 Relative Humidity.

.1 Range: 10-90 %RH.
.2 Resolution: ± 0.1 %RH.
.3 Accuracy: ± 3 %RH.

.3 $CO_2$.
.1 Range: 400-2000 ppm.
.2 Accuracy: ± 35 ppm.
.3 Non-Linearity: < 1% of full scale.
.4 Technology: Non-Dispersive Infrared Optical Sensor.

.4 Occupancy.
.1 Range: 5 m (16.4').
.2 Angle: 100° horizontal/82° vertical.
.3 Technology: Passive Infrared Radiation (PIR).

.5 All integral sensors shall comply with the System performance criteria detailed elsewhere in this specification.

.7 Outputs. Field-level equipment controllers shall be provided with a minimum of six (6) jumper-selectable physical outputs dedicated for the connection of field devices. In addition to the requirements for universal outputs on all controllers, building-level equipment controllers shall also support at a minimum the following physical characteristics:

.1 Solid state relay (500 mA @ 24 VAC/VDC).
.1 The act of switching must not produce an audible noise discernable to the occupants of the space where the device is installed.

## 2.12 INPUT AND OUTPUT INTERFACE

.1 Hardwired inputs and outputs may tie into the system through general purpose, custom application, unitary controllers or distributed I/O devices.

.2 Input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to controller. Input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no damage to controller. Inputs and outputs shall be arranged on interchangeable modules or circuit boards to allow the replacement of a damaged module or board without replacing the entire controller.

.3 Digital inputs shall allow the monitoring of on and off signals from remote devices. Digital inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense dry contact closure without external power other than that provided by the controller being applied.

.4 Analog inputs for GPCs shall be minimum 12-bit resolution and allow the monitoring of low-voltage (0 to 10 VDC), current (0 to 20 mA), negative temperature coefficient (NTC), and resistance temperature detector (RTD). Analog inputs shall be compatible with and field-configurable to commonly available sensing devices. To prevent thermal loading, RTDs and thermistors shall be scanned rather than have continuous power applied.

.5 Inputs shall be electrically isolated from their associated field points.

.6 Digital outputs shall provide for on and off operation, or a pulsed low-voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.

.7 Analog outputs shall be minimum 8-bit resolution and provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on general purpose or custom application controllers shall have status lights and a two-position Auto and Manual switch and manually adjustable potentiometer with feedback for manual operation. Analog outputs shall not exhibit a drift of greater than 0.4 percent of range per year.

.8 Tri-State outputs: Provide tri-state outputs (two coordinated digital outputs) for control of three-point floating-type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation). Control algorithms shall run the zone actuator to one end of its stroke every 24 hours for verification of operator tracking.

## 2.13 CONTROL PANEL ENCLOSURES

.1 Temperature Control Panels. Pedestal base or wall mounted local control enclosures to be fully enclosed NEMA 1 (IEC IP20) at a minimum with hinged door, key-lock latch, and removable subpanels to house all control components appropriate to the environment, service, and/or as required by the code enforcing authorities and other AHJ.

.1 All enclosures shall be UL-Listed.

.2 Enclosures in mechanical rooms shall meet NEMA 2 (IEC IP21) requirements at a minimum or as directed by the AHJ.

.3 Enclosures in all locations not requiring NEMA 2 (IEC IP21) including occupied spaces, above ceilings, and plenums shall be the same NEMA (IEC) classification as other enclosures located in the same environment, except if location requires additional protection due to potential vandalism or environmental conditions or as directed by the AHJ.

.4 Enclosures exposed to moisture, in wet mechanical rooms or located outdoors shall be meet NEMA 4X (IEC IP66) requirements or as directed by the AHJ.

.5 Unless otherwise required by local codes and/or AHJ, all enclosures shall be a minimum of 16-gauge steel or aluminum, totally enclosed on all sides and powder coated or painted with a baked enamel finish.

## 2.14 BUILDING AUTOMATION SYSTEM FIELD CONTROL DEVICES

.1 Electric damper and valve actuators:

.1 Actuator shall have mechanical or electronic stall protection to prevent damage to the actuator through the rotation of the actuator.

.2 Where shown, for power-failure and safety applications, an internal mechanical spring-return mechanism shall be built into the actuator housing.

.3 Rotary spring-return actuators shall be capable of clockwise or counter-clockwise spring-return operation. Linear actuators shall spring-return to the retracted position.

.4 Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range

.5 Floating Signals are not acceptable.

.6 Power. All 24 VAC/VDC actuators shall operate on Class 2 circuits.

.7 Position Feedback. All actuators shall feature a visual position feedback indicator. All non-terminal unit actuators shall provide a 2-10 VDC or 4-20 mA feedback signal.

.8 Electric damper and valve actuators shall be of the direct-coupled type, sized for the required torque with a minimum safety factor of 125% of the design load.

.9 Actuators shall compatible with the BAS control system and sequence.

.10 Non-spring-return actuators shall have an external manual gear release to allow manual positioning of damper when actuator is not powered. Spring-return actuators with more

than 7 N.m [60 in-lb.] torque capacity shall have a manual crank for this purpose.

.11 Modulating actuators shall have an external, built-in switch to allow reversing of rotation direction.

.12 Provide actuators with a raceway fitting and a minimum 1m electrical cable pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

.13 Actuators shall be UL Standard 873 Listed as meeting correct safety requirements and recognized industry standards.

.14 Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque and 1.5 million repositions.

.15 Enclosure. Actuator casing and/or enclosures shall be appropriate to the application.

.1 Actuator housings shall be NEMA 2 and plenum rated.

.2 Actuators used in or near outdoor air streams shall have IEC IP21 (NEMA 2) housings.

.3 Actuators exposed to moisture, in wet mechanical rooms, or located outdoors shall be meet IEC IP66 (NEMA 4X) requirements or as directed by the AHJ.

.2 Control valves:

.1 Control valves shall be two-way or three-way type for two-position or modulating service as shown. Unless otherwise indicated, all valves shall have a minimum rangeability of 50:1.

.2 Close-Off/Differential Pressure Rating. All valves shall be guaranteed to have not more than 1% leakage of design flow rate at the pump shut-off pressure. All valve actuators and trim shall be furnished to provide the following minimum close-off pressure ratings unless otherwise specified or scheduled:

.1 Two-way: 200 percent of total system (pump) head.

.2 Three-way: 300 percent of pressure differential between ports A and B at design flow or 100 percent of total system (pump) head.

.3 Steam valves: 200 percent of operating (inlet) pressure.

.3 Water valves:

.1 Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, in compliance with the following at a minimum:

.1 Equal percentage ports for modulating service.

.2 Valve bodies shall meet or exceed pressure and temperature class rating based upon design operating temperature and 150% design operating pressure. Unless otherwise specified or scheduled, minimum body rating for any valve is 860 kPa (125 psi) and a maximum fluid temperature of 177˚C (350˚F).

.3 Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation.

.4 Globe valves shall have replaceable seats.

.2 Water Valves. Unless otherwise specified or scheduled, water valves shall follow the following criteria:

.1 Two-position service: Line size, unless otherwise shown.

.2 Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50 percent of the pressure difference between supply and return mains, or 5 psi, whichever is greater.

.3 Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa [5 psi] maximum.

.4 Valves ½ inch through 2 inch shall be bronze body or cast brass ANSI Class 250, spring-loaded, O-ring seal, EPDM packing, quick opening for

two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.

.5 2 ½ inch valves and larger shall be cast iron ANSI Class 125 with guided plug and EDPM O-ring or Teflon packing, unless otherwise shown.

.3 Water valves shall fail normally open or closed as scheduled on plans, or as follows:

.1 Water zone valves—normally opened preferred.

.2 Heating coils in air handlers—normally open.

.3 Chilled water control valves—normally closed.

.4 Other applications—as scheduled or as required by sequences of operation.

.3 Temperature sensors:

.1 Temperature sensors shall be analogue precision element thermistor type.

.2 Duct Sensors. Duct temperature sensors shall include junction box for wiring connections and gasket to prevent air leakage and vibration noise.

.1 Single point duct temperature sensor probe shall consist of 316 stainless steel extending to the center of the duct.

.2 Averaging duct temperature sensor shall consist of a copper or stainless-steel averaging element. Averaging sensors shall be a minimum of 1.5 m (5') in length per 1 m2 (10 ft2) of duct cross sectional area.

.3 Immersion Sensors. Liquid immersion temperature sensor shall be provided with a separable stainless steel well. The well must be designed to be consistent and appropriate with the system operating pressure and velocity.

.4 Space Sensors. Space temperature sensor shall consist of an element within a ventilated cover aesthetically pleasing and specifically designed for permanent installation in a finished, occupied space.

.1 Refer to drawings and schedules for space sensor types and locations

.2 In private and semi-private spaces that serve full-time or full-time-equivalent occupants including but not limited to offices, work rooms, meeting rooms, classrooms, conference rooms, etc., space sensors shall be provided with setpoint adjustment and occupancy bypass. Bypass not required in zones with occupancy sensors or applications that are constantly occupied.

.3 In public spaces without full-time or full-time-equivalent occupants including but not limited to lobbies, hallways, atriums, restrooms, theaters, gymnasiums, mechanical spaces, plenums, etc., simple temperature sensor without setpoint or bypass shall be provided.

.4 Sensors with operator interface keypads and displays shall be provided as indicated or scheduled elsewhere.

.5 Where sensors are noted on the drawings as '**Ta'**, provide integrated temperature sensing with humidity and $CO_2$ measurement and include local user interface with setpoint adjustment and occupancy override where indicated. All devices shall be fully compatible with the BACnet-based control system. The product shall be similar to Reliable SMART-Sensor SS3-E, Johnson Controls NS Series or TEC3000 Series, Delta Controls eZNS Series, or approved equal.

.6 Where sensors are noted on the drawings as '**Tb'**, provide sensors that consist of a flush-mounted stainless steel wall plate assembly with integral thermistor or RTD sensing element, suitable for vandal-resistant and institutional applications. Sensor output shall be specify: 10K Type II thermistor and shall be compatible with the building automation system. The product shall be similar to Honeywell C7772 series, Greystone TE200AS series, KMC STE-1400 series or approved equal.

.7 Where sensors are noted on the drawings as '**Tc'**, the sensors are to be provided

with equipment by the vendor and installed by Div. 25.

.8 Where sensors are noted on the drawings as Td, the sensors are to be provided by the equipment vendor as noted in the schedules and installed by Div. 25 in accordance with the manufacturer's instructions.

.5 Outdoor Air Temperature. Outdoor air temperature sensor shall consist of a single device sensor, ventilated non-metallic sun shield, utility box for terminations, and watertight gasket to prevent water seepage.

.6 Differential Temperature. Provide matched sensors for differential temperature applications.

.7 Low-Limit Thermostats. Low-limit airstream thermostats shall be UL-Listed, vapor pressure type, with an element of 6 m (20') minimum length.

.1 Provide one (1) low-limit thermostat for each 2 m2 (20 ft2) of coil face.

.2 Low-limit thermostat shall respond to the lowest temperature sensed in by any 30 cm (12") section of the element.

.3 Low-limit thermostats shall be manual-reset, DPDT-style with a minimum of one (1) normally-open contact and one (1) normally-closed contact.

.8 High-Limit Thermostats. High-limit airstream thermostats shall be UL-Listed, bimetal-operated, manual reset type.

.9 Low-voltage Thermostats. Low-voltage thermostats shall be 24 VAC, bimetal-operated or electronic type with adjustable fixed anticipation heater, concealed setpoint adjustment 13-30˚C (55-85˚F) setpoint range, 1˚C (2˚F) maximum differential and vented ABS plastic housing.

.10 Line-voltage Thermostat. Line-voltage thermostats shall be UL-Listed bi-metal actuated, open contact type, enclosed, snap-switch type or equivalent solid-state type with adjustable of fixed anticipation heater, concealed setpoint adjustment 13-30˚C (55-85˚F) range, 1˚C (2˚F) maximum differential, and vented ABS plastic housing.

.4 Humidity sensors:

.1 Duct Sensors. Duct-mounted humidity sensors shall have a sensing range of 20% to 80% RH and shall be provided with a sampling chamber.

.2 Space Sensors. Space sensors shall have a sensing range of 20 to 90% RH.

.3 Outdoor Air Sensors. Outdoor air humidity sensors shall have a sensing range of 20 to 95% RH and shall be suitable for ambient conditions of -40˚C to 75˚C (-40˚F to 170˚F).

.4 Drift. Sensor drift shall not exceed 1% of full scale per year.

.5 Flow switches:

.1 Flow-proving switches shall be either paddle or differential pressure type, as shown.

.2 Paddle type switches (water service only) shall be ULC/CSA Listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 7 enclosure unless otherwise specified. Honeywell MAMFS43 or equivalent or as specifically shown on the drawings.

.3 Differential pressure type switches (air or water service) shall be ULC/CSA Listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 2 enclosure, with scale range and differential suitable for intended application, or as specified.

.6 Relays:

.1 Control relays shall be CUL/CSA Listed plug-in type.

.2 Control relays shall be CUL/ CSA Listed, enclosed with LED energized indicator. Contact rating, configuration, and coil voltage shall be suitable for application. Coil current shall be less than 50 mA.

.3 Time delay relays shall be CU/CSA Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage suitable for application.

.4 Provide NEMA 1 enclosure when not installed in local control panel.

.7 Current transmitters:
.1 AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 200 A, and 200 A full scale, internal zero and span adjustment, and ±1 percent full-scale accuracy at 500 ohm maximum burden.
.2 Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be ULC/CSA Recognized.
.3 Unit shall be split-core type for clamp-on installation on existing wiring.

.8 Current transformers:
.1 AC current transformers shall be ULC and CSA recognized and completely encased (except for terminals) in approved plastic material.
.2 Transformers shall be available in various current ratios and shall be selected for ±1 percent accuracy at 5 A full scale output.
.3 Transformers shall be split-core type for installation on new or existing wiring, respectively.

.9 Voltage transmitters:
.1 AC voltage transmitters shall be self-powered single loop (two-wire) type, 4 to 20 mA output, with zero and span adjustment.
.2 Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with ±1 percent full-scale accuracy with 500 ohm maximum burden.
.3 Transmitters shall be ULC/CSA Recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.

.10 Voltage transformers:
.1 AC voltage transformers shall be ULC and CSA recognized, 600 VAC rated, complete with built-in fuse protection.
.2 Transformers shall be suitable for ambient temperatures of +4 degrees C to +55 degrees C [+40 to +130 degrees F] and shall provide ±0.5 percent accuracy at 24 VAC and a 5 VA load.
.3 Windings (except for terminals) shall be completely enclosed with metal or plastic material.

.11 Current switches:
.1 Current Switches. Current-operated switches shall be UL-Listed self-powered, solid-state, split-core type with adjustable trip current, status LED, and dry-contact output.
.2 Select switches to match the current of the application and output requirements of the DDC system.

.12 Pressure transducers:
.1 Transducers shall have linear output signal. Zero and span shall be field-adjustable.
.2 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50 percent greater than calibrated span without damage.
.3 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 200 psi minimum. Transducers shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
.4 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 200 psi minimum. Transducer shall be complete with 4 to 20 mA output,

required mounting brackets, and;.

.1 Gauge water pressure transducers shall be provided with block and bleed valves.

.2 Differential water pressure transducers over-range differential pressure limit and maximum static pressure shall be 2 MPa (300 psi).

.3 Differential water pressure transducers shall be provided with five-valve manifold for isolation, bypass and bleed.

.13 Pressure switches:

.1 Differential-pressure-type switches (air or water service) shall be ULC listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.

.2 Snubbers shall be provided for all water pressure transducer/switch connections to prevent system pressure hammers and surges from being fully transmitted to the pressure sensor.

.14 $CO_2$ Carbon dioxide sensors:

.1 Sensing of carbon dioxide shall incorporate the NDIR—non-dispersive infrared—sensing method. Sensor shall incorporate sampling tubes for duct mounting and have optional LCD readout. Range of sensing shall be 0-2000 PPM and field adjustable 0-1000 PPM, 0-2000PPM, 500-2000PPM, and 500-2000PPM, with an accuracy of ± 75 PPM from 0 to 2000 PPM and ± 5 percent above 2000 PPM. Annual drift shall be (20PPM nominal) and have a calibration interval of five years recommended. Output shall be 4-20 mA and have an operating temperature range of +32 to +122 degrees F and 0 to 95 percent RH, non-condensing.

.2 manifold.

.15 Water Leak Detectors

.1 KELE WD-18 – 24VAC supply power, N/C relay for output to BAS. Floor Mounted with Gold Plated probes

## 2.15 POWER SUPPLIES AND LINE FILTERING

.1 Power Supplies & Control Transformers. Control transformers and power supplies shall be UL-Listed. Provide Class 2 current-limiting type or over-current protection in both primary and secondary circuits for Class 2 service not to exceed 100 VA in accordance with the applicable following requirements or as directed by the AHJ.

.1 Ontario Electrical Safety Code (CSA C22.1-18 and Ontario amendments to the code) Rule 16-200.

## 2.16 INTERCONNECTING WIRING & RACEWAYS

.1 Wiring & Cable. All wiring regardless of service and/or voltage shall comply with the Contract Document Electrical System Specifications, CSA C22.1-18 and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ).

.1 All insulated wire to be copper conductors, UL labeled for 90 ˚C minimum service.

# PART 3 EXECUTION

## 3.1 EXAMINATION

.1 Project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the DCC Representative for resolution before rough-in work is started.

.2 Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the DCC Representative for resolution before rough-in work is started.

## 3.2 PROTECTION

.1 Contractor shall protect work and material from damage from its work or employees, and be liable for all damages thus caused.

.2 Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. Contractor shall protect material that is not immediately installed. Contractor shall close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

## 3.3 COORDINATION

.1 Submittals: Refer to Submittals Article in Part 1 of this Specification for requirements.

.2 Test and balance:
- .1 Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes.
- .2 Contractor shall provide training in the use of these tools. This training will be planned for a minimum of four hours.
- .3 In addition, the contractor shall provide a qualified technician to assist in test and balance process, until the first 20 terminal units are balanced.
- .4 Tools used during the test and balance process will be returned at completion of the testing and balancing.

.3 Coordination with controls specified in other sections or divisions: Other sections and divisions of this Specification include controls and control devices that are to be part of or interfaced to control system specified in this section. Controls shall be integrated into the system and coordinated by contractor as follows:
- .1 Communication media and equipment shall be provided as specified in Part 2: Communication of this Specification.
- .2 Each supplier of a control product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
- .3 Contractor shall coordinate and resolve any incompatibilities that arise between the control products provided under this section and those provided under other sections or divisions of this Specification.
- .4 Contractor is responsible for providing all controls as referenced in the related sections this work of contract documents.
- .5 Contractor is responsible for the interface of control products provided by multiple suppliers, as referenced in the related sections this work of contract documents.

## 3.4 GENERAL WORKMANSHIP

.1 Install equipment, piping, and wiring raceway parallel to the building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

.2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.3 Install equipment in readily accessible locations as defined by OESC.

.4 Verify wiring integrity to ensure continuity and freedom from shorts and grounds.

.5 Equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility, and be executed in strict adherence to local codes and standard practices.

## 3.5 CONTROL PANELS

.1 Unless otherwise directed by the DCC Representative, all control panels and enclosures shall be located in mechanical/electrical rooms and installed such that visual observation and adjustment can be accomplished while standing flatfooted on the floor in a convenient location adjacent to the equipment served. Install all equipment in readily accessible location as defined by Chapter1 Article 100 Part A of the NEC or CSA C22.1-12 Rule 2 (as applicable).

.2 All control panels shall have keyed, locking latches and shall be keyed commonly such that one key shall open all enclosures.

.3 Provide each DDC panel with a surge suppressor, electrical disconnect, control fuse, and control transformer; all sized and provided by the System Contractor.

.4 Interconnections between internal termination points and face and/or panel-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL-Listed for 600-volt service, individually identified per control drawings with adequate clearance for field connections.

.1 Provide insulated, modular, feed-through, clamp-style recessed captive screw-type terminal blocks suitable for rail-mounting with end plates and partitions for the termination of all field wiring in temperature control panels.

.2 Field wiring to equipment with integral terminals and/or unitary equipment shall not be required to have terminal blocks.

.5 All high-voltage wiring consistent with the definitions of NEC/CSA Class 1 must be strictly separated by barriers, raceways or sub-panels from low-voltage wiring consistent with the definitions of NEC/CSA Class 2 according to the requirements of the NEC Chapter 7 Article 725 – Class 1, Class 2 and Class 3 Remote-Control, Signaling and Power-Limited Circuits and the CSA Canadian Electrical Code, Part 1 Rule 16-212 Separation of Class 2 circuit conductors from other circuits.

.6 Provide laminated nameplates or tags for all control system components. Unless otherwise directed in this specification or by the AHJ, nameplates shall be minimum 1 inch by 3 inches (2.5 cm X 7.5 cm), with minimum ¼ inch (6 mm) high block lettering. Nameplates for devices smaller than 1 inch by 3 inches (2.5 cm X 7.5 cm) shall be attached to adjacent surface or connected to the device using a chain.

.7 A legible reproduction of the “As-built” application engineering for the system served shall be laminated in clear plastic and mounted within each enclosure.

.8 Power supplies and line filtering. No loads shall exceed 80% of faceplate rating for each power supply or transformer

## 3.6 INSTALLATION OF FIELD DEVICES

.1 Installation of sensors
- .1 Install sensors in accordance with the manufacturer's recommendations.
- .2 Mount sensors rigidly and adequately for the environment within which sensor operates.
- .3 Space sensors shall be installed on concealed junction boxes properly supported.
- .4 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings. Where necessary due to structural cavities, masonry walls, proximity to exterior openings, unconditioned spaces, etc. insulated mounting base shall prevent temperature of mounting location from affecting sensor temperature reading.
- .5 Wiring to the sensor shall not be required to be polarity sensitive. Design of sensor shall be modular, which allows for rough-in of wiring without presence of electronics or esthetic covering.
- .6 Sensors used in mixing plenums and in hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- .7 Install low-limit sensors used in mixing plenums in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 ft of sensing element for each square ft of coil area.
- .8 Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells. Assembly shall allow removal of sensor from well without loss of measured medium fluid.
- .9 Outdoor air sensors shall be mounted outside on a northern exposure as high as serviceable on the building. The sensor shall be mounted within a ventilated enclosure to shield the sensor from the effects of the sun. The sensor location shall be selected such that it may not be affected by artificial and/or mechanical airstreams (i.e., building exhaust, building relief, etc.).
- .10 In condensing environments use stainless steel sensing element and capillary mounting clips.
- .11 Sensor guards shall be provided to protect sensor from damage in high-impact and/or high-traffic areas and/or where vandalism is a concern.
- .12 Sensors shall be manually calibrated on site so that the wiring length and termination does not detract from the specified sensor accuracy.
- .13 Differential air static pressure:
  - .1 Supply duct static pressure: Pipe high pressure tap to the duct using a pito tube. Pipe low pressure port to a tee in the high pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high pressure tap and leave open to plenum.
  - .2 Return duct static pressure: Pipe high pressure tap to the duct using a pito tube. Pipe the low pressure port to a tee in the low pressure tap tubing of the corresponding building static pressure sensor.
  - .3 Building static pressure: Pipe the low pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high volume accumulator. Pipe the high pressure port to a location behind a thermostat cover.
  - .4 Piping to pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
  - .5 Pressure transducers other than those controlling VAV boxes shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without the use of ladders or

special equipment.

.6 Air and water differential pressure sensors shall have gauge tees mounted adjacent to all taps. Water gauges shall also have shutoff valves installed before the tee.

.2 Flow switch installation
- .1 Use correct paddle for pipe diameter.
- .2 Adjust flow switch in accordance with manufacturer’s instructions.

.3 Control Valves
- .1 Valves shall be installed in accordance with the manufacturer’s recommendations.
- .2 Two-way valves shall not be placed on branch or main hydronic circuits where these valves will cause a "dead-head" pumping condition.
- .3 Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position.
- .4 Ball type control valves shall be installed with the stem in the horizontal position.
- .5 Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- .6 Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system.
- .7 Unions shall be installed at all connections to screw-type control valves.
- .8 Provide tags for all control valves indicating service and number.
  - .1 Tags shall be brass, 4 cm (1.5”) in diameter, with 6.4 mm (1/2”) high letters.
  - .2 Securely fasten with chain and hook.
  - .3 Match identification numbers as shown on approved controls shop drawings.

.4 Actuators
- .1 Mount and link control damper actuators per manufacturer’s instructions.
  - .1 Check operation of damper and actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
  - .2 Provide mounting hardware and linkages for actuator installation.
  - .3 To compress seats when spring-return actuators are used on normally-closed dampers, power actuator to approximately 5˚ open position, manually close the damper, and then tighten linkages.
  - .4 Minimum torque and power output requirements of actuators shall not be less than 125% of the required design load.

.5 Electric and electronic actuators:
- .1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. Actuators shall be mounted following manufacturer’s recommendations.
- .2 Valves: Actuators shall be connected to valves with adapters approved by actuator manufacturer. Actuators and adapters shall be mounted following actuator manufacturer’s recommendations.
- .3 Total damper area operated by an actuator shall not exceed 80 percent of the manufacturer’s maximum area rating. Provide at least one actuator for each damper section. Damper actuator shall not power more than 2 m2 [20 ft ²] of damper.
- .4 Use line shafting or shaft couplings (jackshafting) in lieu of blade-to-blade linkages or shaft coupling when driving axially aligned damper sections.

.6 Flow Meters

.1 Mount meters such that they can be removed freely and without obstruction.
.2 Assembly shall allow removal of meter from piping system without loss of measured fluid.

.7 Gas Detection System
.1 Install the Gas Detection System in accordance with the manufacturers recommendation inclusive of all interconnecting low voltage and network cabling as required for a complete system.
.2 Integrate the Gas Detection System with BAS and provide all programing and interlocks to achieve the associated sequence of operation.
.3 Include for manufacturer start up and calibration of all sensors
.4 Provide system testing and validation

## 3.7 FIELD QUALITY CONTROL

.1 Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Specification.

.2 Contractor shall continually monitor the field installation for code compliance and quality workmanship.

.3 Contractor shall have work inspected by local or state authorities having jurisdiction over the work.

## 3.8 WIRING

.1 Control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.

.2 Low-voltage wiring shall meet OESC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.)

.3 Where Class 2 (current limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in the raceway may be used, provided cables are ULC Listed for intended application. For example, plenums shall be ULC Listed specifically for that purpose.

.4 Wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage—shall be installed in raceway at levels below 3m [10ft].

.5 Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two.

.6 Do not install wiring in raceway containing tubing.

.7 Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and neatly tied at 3m [10 ft] intervals.

.8 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

.9 Wire-to-device connections shall be made at a terminal block or terminal strip. Wire-to-wire connections shall be made at a terminal block or wire nut at junction box.

.10 Wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

.11 Maximum allowable voltage for control wiring shall be 24v. If only higher voltages are available, the contractor shall provide step-down transformers.

.12 Wiring shall be installed as continuous lengths, with no splices permitted between termination points.

.13 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

.14 Size of raceway and size and type of wire shall be the responsibility of contractor, in keeping with the manufacturer's recommendation and OESC requirements, except as noted elsewhere.

.15 Include one pull string in each raceway 2.5 cm [1 inch] or larger.

.16 Use coded conductors throughout with different colored conductors.

.17 Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 20 cm [6inch] from high-temperature equipment (e.g., steam pipes or flues).

.18 Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

.19 Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.

.20 Contractor shall terminate control and interlock wiring, and maintain updated wiring diagrams with terminations identified at the job site.

.21 Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1m [3 ft] in length and shall be supported at each end. Flexible metal raceway less than 1/2 in. electrical trade size shall not be used. In areas exposed to moisture—including chiller and boiler rooms—liquid-tight, flexible metal raceways shall be used.

.22 Raceway shall be rigidly installed, adequately supported, properly reamed at both ends and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations shall be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

**3.9 COMMUNICATION WIRING**

.1 Communication and network wiring shall adhere to the Wiring article in Part 3 of this specification and the manufacturer's recommendations for all twisted pair cabling, etc.

.2 Communication wiring shall not be installed in any raceway or conduit with Class 1 or Class 2 wiring.

.3 All communication wiring shall be installed as continuous lengths, with no splices permitted between termination points.

.4 All communication cabling shall be labelled to indicate origination and destination devices.

.5 All communications shielding shall be grounded as per manufacturer's recommendations and in accordance with the OESC/CSA (as applicable).

## 3.10 IDENTIFICATION OF HARDWARE AND WIRING

.1 Wiring, cabling, and tubing within factory-fabricated panels shall be labeled within 5 cm [2inch] of termination with point address or termination number.

.2 Manufacturers' name plates and ULC or CSA labels are to be visible and legible after equipment is installed.

.3 Identifiers shall match record documents.

.4 Permanently label or code each point of field terminal strips to show instrument or item served.

.5 Identify room sensors relating to terminal box or valves with nameplates.

.6 Label wiring and conduit, including wire within panels, on both ends with device name or point address location or terminal block number.

.7 Electrical devices such as transformers and power supplies shall be labeled with supply voltage and power circuit number.

.8 Terminal blocks shall be labeled to match the connected device.

.9 Label panel-mounted devices to match as built drawings.

.10 Wire and labels shall be clearly indicated on the control drawings. Method of labeling shall be logical and intuitive.

## 3.11 PROGRAMMING

.1 Provide sufficient internal memory for the specified sequences of operation and trend logging. **There shall be a minimum of 25 percent of available memory free for future use.**

.2 Point naming and point value: System point names and values shall be of sufficient size to allow flexibility in design, allowing easy operator interface without the use of a written point index or cryptic alphanumeric shorthand.

- .1 Point ID is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment. Point ID shall be a minimum of 40 characters in length.
- .2 Point descriptors shall be a minimum of 132 characters.
- .3 Point states shall be a minimum of 8 characters in length.
- .4 Point engineering units shall be a minimum of 6 characters in length.
- .5 Point values shall be a minimum of 20 characters in length with a variable decimal point.

.3 Operator interface:

- .1 Standard graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each air handler, terminal equipment and all life safety devices.

Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.

.2 Show terminal equipment information on a graphic summary table. Provide dynamic information for each point shown.

.3 Program graphic screens to show the location of, alarm points, and cameras. Set up these screens to provide automatic camera call up upon alarm.

.4 Where CCTV cameras will be used to qualify alarms, create links to allow both live and recorded viewing of the cameras through the alarm monitoring process.

.5 Contractor shall provide labor necessary to install, initialize, start up, and troubleshoot all operator interface software and their functions as described in this section. This includes any operating system software, operator interface database, and any third-party software installation and integration required for successful operation of the operator interface

.6 Division 25 contractor shall allow for 5 additional programming changes at the discretion of the consultant at no cost to the owner.

## 3.12 SYSTEM CHECK-OUT AND TESTING

.1 All testing listed in this Article shall be performed by Division 25 Contractor and make up part of the necessary verification of an operating control system. Testing shall be completed before the DCC Representative is notified of the system demonstration.

.2 The Contractor shall furnish all the necessary labor and test and calibration apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment provided under this specification.

.3 Verify that all control terminations are tight, and all control wiring is proper and free from shorts and faults.

.1 Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation. RING OUT ALL POINTS

.4 Enable normal operational control and verify calibration of all input devices individually according to manufacturer’s recommendations.

.5 Verify the operation of all output devices including action, normal positions, fail-safe positions, start and span, and travel.

.1 Verify that digital output devices (relays, solenoid valves, two-position actuators and control valves, and magnetic starters) operate properly and that normal positions are correct.

.2 Verify that analog output devices (I/Ps, actuators) are functional, that start and span are correct, and that direction and normal positions are correct. Contractor shall check all control valves and automatic dampers to ensure proper action and closure. Contractor shall make any necessary adjustments to valve stem and damper blade travel.

.6 Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation.

.1 Tune all control loops and optimum start/stop routines.

.2 Check each alarm separately by providing an appropriate signal to trip the alarm.

.3 Trip all safeties and interlocks to verify proper operation and fail-safe response.

.4 Ground all circuits and verify response of trouble signals.

.5 Check presence and audibility of tone at all alarm notification devices.

.7 As each device is tested, a log shall be completed showing the date, technician's initials, and any corrective action taken as a result of operational failures. This log shall be submitted prior to scheduling full system commissioning.

**3.13 COMMISSIONING**

.1 Commissioning for this Division shall be performed specifically in accordance with the respective Division 1, 21, 23, 26, 28, and 25 Sections.

.2 This Division shall coordinate efforts as required with the Commissioning Team, and other divisions to complete proper checkout and testing, and comply with all requirements set out in Section 01 91 13 and this section.

.3 This division shall assign a Controls Commissioning Coordinator to participate in all activities as required by the commissioning team (checklist creation, meetings, scheduling, reporting, installation verification, performance verification etc…)

.4 Prior to acceptance, control system shall undergo a series of performance tests to verify operation and compliance with this Specification. Tests shall occur after the contractor has completed the installation, started up the system, and performed its own tests.

.5 Tests described in this section are to be performed in addition to tests that contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the Control System Checkout and Testing Article in this Specification.

.6 Coordinate with the Commissioning team to schedule the work. Notify the and coordinate the performance verification schedule with the DCC Representative at least 10 days in advance of the start of the testing procedures.

.7 The Contractor shall provide at least two (2) qualified technical personnel equipped with means for two-way communication to participate in the performance verification of each system and to demonstrate the actual operation of all control operations and modes including occupied, unoccupied, seasonal changeover, and emergency/fail-safe operation etc as required to complete the commissioning forms.

.8 Compliance with this specification shall be demonstrated including all specification sections, schedules, drawings, and Sequences of Operation.

.9 Demonstrate compliance with the controls "System Performance" requirements.

.10 Demonstrate operator interface compliance with the requirements of the specification.

.11 Demonstrate the following items:

.1 DDC Loop response: Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. Test shall show the loop's response to a change in set point that represents a change in output of at least 25 percent of its full range. Sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. For each sample, the trend data shall show the process variable, set point, loop output and physical output position. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by contractor.

.2 Demand limiting (if implemented): Contractor shall supply a trend data output showing the action of demand limiting algorithm. Data shall document action on a minute-by-minute basis over a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.

.3 Optimum start and stop (if implemented): Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include output status of optimally started and stopped equipment, and area temperature sensor inputs.
.4 Interface to the building fire alarm system.
.5 Devices supplied by others connected to the system shall be checked out and commissioned by supplier, and verification of interface interoperability shall be conducted by this contractor.

.12 Operational logs for each system that demonstrate normal operation.
.1 Trends shall include the process variable, setpoint, loop output, physical output position, operational mode, and equipment status.
.2 Trends shall cover three (3) 48-hour periods with a sampling interval of not more than 10 minutes.

.13 At the discretion of the DCC Representative trends from a random sampling of 25% of unitary controllers/applications shall be submitted.

.14 Database backup of the entire network and database restoration for selected controllers.

.15 As each device is tested, a log shall be completed showing the date, technician's initials, and any corrective action taken as a result of operational failures.

.16 The Contractor shall display, using a third-party data packet analytical tool, that all System data transmission, including operator interface requests, are being performed using BACnet.

.17 Any tests that fail to demonstrate the operational compliance of the System shall be repeated, at a later date, after the issues have been resolved. The System Contractor shall be responsible for any necessary repairs or revisions to successfully complete all tests.

.18 Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be performed at the discretion of the Owner after acceptance and as a part of the warranty period.

## 3.14 CLEANING

.1 Contractor shall clean up all debris resulting from its activities daily.

.2 Contractor shall remove all cartons, containers, and crates under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

.3 At completion of work in any area, contractor shall clean all of its work and equipment, keeping it free from dust, dirt, and debris.

.4 At the completion of work, equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

## 3.15 TRAINING

.1 The Contractor shall provide instruction on the adjustment, operation and maintenance of the System including all hardware and software provided and installed in compliance with the requirements of this specification.
.1 Training shall be performed by a manufacturer's representative and/or instructor or a

manufacturer-trained application engineer and/or technician with a minimum of 5-years of experience in the installation, programming and operation of the System.

.2 All training equipment and material shall be provided by this Contractor.

.3 Provide a minimum of two on-site or classroom training sessions, 4 hours each, throughout contract period for personnel designated by the Owner.

.4 Provide two additional training sessions at 6 and 12 months following building's turnover to review Owners questions, sessional changes etc. Each session shall be 4 hours in length, on site and shall be coordinated with building Owner.

.2 Training in the operation of the System shall be performed utilizing a BACnet network of working controllers representative of the installed network and/or the Owner's facility and shall include:

.1 Overview of the installed system and network architecture.

.2 System components.

.3 Graphical User Interface (GUI) operation.

.4 Day-to-day operations including modification of system setpoints, schedules, calendars, manual overrides, trending, log retrieval, alarm handling, etc.

.5 Software operation, including navigating the workstation displays, database management, troubleshooting, diagnostics, report generation, etc.

.6 Database design and modification including adding objects, modifying routines, optimizing operation, etc.

.7 General operation of the workstation hardware and peripherals.

.8 Access graphics, point reports, and logs

.9 Adjust and change system set points, time schedules, and holiday schedules

.10 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals

.11 Access data from various network and control nodes.

.12 Understand system drawings and the Operation and Maintenance manual

.3 Training videos that describe the operation of the System shall be provided, and/or made accessible, to the Owner.

.4 On-site walk-through shall cover the deployment and execution of the complete System and components including:

.1 Sequences of Operation.

.2 Location of all panels, enclosures, controllers, devices, sensors, etc. and equipment and panel lay-out.

.3 Hardware preventive maintenance, calibration, troubleshooting, maintenance, and repair.

.4 Proper use of service tools and materials.

## 3.16 CONTROL STABILITY AND ACCURACY PERFORMANC REQUIREMENTS

.1 See Tables 1 through 5 on the following pages

TABLE 1: SENSOR, METER, & VALUE REQUIRED ACCURACIES

| TAG | SENSOR | TYPE | SENSOR DETAILS | REQUIRED END-TO-END ACCURACY | DISPLAY RESOLUTION | REFRESH INTERVAL (MIN) | TREND INTERVAL (MIN) | REQUIRED CONTROL ACCURACY |
|---|---|---|---|---|---|---|---|---|
| S1 | Outdoor Ambient dry-bulb temperature. | AI | 10K-ohm, NTC, thermistor. Locate in weather station or ventilated enclosure in fully shaded location away from thermal mass bodies. | ±0.2°C (±0.36°F) | 0.1°C (0.18°F) | 1 | 10 | ±1.0°C (±2.0°F) |
| S2 | Outdoor Ambient wet-bulb temperature. | AI | Locate in weather station or ventilated enclosure in fully shaded location away from thermal mass bodies. | ±0.3°C (±0.54°F) | 0.1°C (0.18°F) | 1 | 10 | ±1.5°C (±3.0°F) |
| S3 | Dewpoint | AI | Chilled mirror, infrared, capacitive. | ±1.5°C (±3.0°F) | 0.1°C (0.18°F) | 1 | 10 | ±1.5°C (±3.0°F) |
| S4 | Facility, main natural gas meter | BI | Positive displacement – pressure compensated; continuous output. | ±1% reading, >10:1 turndown | 0.05 L/s (0.1 scfm) | 1 | 1 | 0.05 L/s (0.1 scfm) |
| S5 | Natural gas flow rate | AI/BI | Positive displacement – pressure compensated; continuous output. | ±2% reading, >10:1 turndown | 0.05 L/s (0.1 scfm) | 1 | 1 | 0.05 L/s (0.1 scfm) |
| S6 | Facility, main power meter | AI/BI | True RMS to 50$^{th}$ harmonic. | ±1% reading | 0.1 kW | 1 | 1 | 0.1 kW |
| S7 | Electric power submeter | AI/BI | True RMS to 50$^{th}$ harmonic. | ±1% reading | 0.001 kW | 1 | 1 | 0.001 kW |
| S8 | Space temperature | AI | 10K-ohm, NTC, thermistor. | ±0.3°C (±0.54°F) | 0.1°C (0.18°F) | 1 | 10 | ±0.5°C (±1.0°F) |
| S9 | Carbon dioxide ($CO_2$) | AI | Nondispersive infrared sensor. | ±30 ppm to ±5% of reading | 50 ppm | 1 | 1 | 40 ppm |
| S10 | Carbon Monoxide (CO) | AI | Electrochemical sensor. | ±5 ppm | 50 ppm | 1 | 1 | 50 ppm |
| S11 | Air pressure (duct) | AI | | ±25 Pa (±0.1 inwc) | 125 Pa (0.5 inwc) | 1 | 1 | 25 Pa (0.1 inwc) |
| S12 | Air pressure (space) | AI | | ±3 Pa (±0.01 inwc) | 3 Pa (0.01 inwc) | 1 | 1 | ±3 Pa (±0.01 inwc) |
| S13 | Water pressure | AI | | ±2% of reading | 7 kPa (1 psi) | 1 | 1 | 3.5 kpa (0.5 psi) |

TABLE 2: SENSOR, METER, & VALUE REQUIRED ACCURACIES (*CONTINUED*)

| TAG | SENSOR | TYPE | SENSOR DETAILS | REQUIRED END-TO-END ACCURACY | DISPLAY RESOLUTION | REFRESH INTERVAL (MIN) | TREND INTERVAL (MIN) | REQUIRED CONTROL ACCURACY |
|---|---|---|---|---|---|---|---|---|
| S14 | Water temperature | AI | 10K-ohm, NTC, thermistor. | ±0.5°C (±1.0°F) | 0.1°C (0.18°F) | 1 | 1 | ±1.5°C (±3.0°F) |
| S15 | Δ Temperature | AI | 10K-ohm, NTC, thermistor. | ±0.2°C (±0.36°F) | 0.1°C (0.18°F) | 1 | 1 | ±0.2°C (±0.36°F) |
| S16 | Relative Humidity (RH) | AI | | ±5% RH | 5% | 1 | 1 | ±5% RH |
| S17 | Heating hot water flow | AI | | ±2% of reading | 1000 l/s (5 gpm) | 1 | 1 | ±0.032 l/s (±0.5 gpm) |
| S18 | Air temperature (ducted; not specified elsewhere) | AI | 10K-ohm, NTC, thermistor. | ±0.5°C (±1.0°F) | 0.1°C (0.18°F) | 1 | 1 | ±1.5°C (±3.0°F) |
| S19 | Electrical (A, V, W, PF; not specified elsewhere) | AI/BI | True RMS, three-phase, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1% of full-scale | 0.1 | 1 | 1 | 0.001 kW |
| S20 | Chiller power | AI/BI | True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1.5% of reading | 0.01 kW | 1 | 1 | 0.001 kW |
| S21 | Primary chilled water pump power | AI/BI | True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1.5% of reading; ±3%VFD reading | 0.01 kW | 1 | 1 | 0.001 kW |
| S22 | Chilled water condenser water pump power | AI/BI | True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1.5% of reading; ±3%VFD reading | 0.01 kW | 1 | 1 | 0.001 kW |

TABLE 3: SENSOR, METER, & VALUE REQUIRED ACCURACIES (*CONTINUED*)

| TAG | SENSOR | TYPE | SENSOR DETAILS | REQUIRED END-TO-END ACCURACY | DISPLAY RESOLUTION | REFRESH INTERVAL (MIN) | TREND INTERVAL (MIN) | REQUIRED CONTROL ACCURACY |
|---|---|---|---|---|---|---|---|---|
| S23 | Cooling tower fan power | AI/BI | True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1.5% of reading; ±3%VFD reading | 0.01 kW | 1 | 1 | 0.001 kW |
| S24 | Secondary chilled water pump power | AI/BI | True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1.5% of reading; ±3%VFD reading | 0.01 kW | 1 | 1 | 0.001 kW |
| S25 | Chilled water supply temperature | AI | 10K-ohm, NTC, thermistor (matched with S26). | ±0.5°C (±1.0°F) | 0.1°C (0.18°F) | 1 | 1 | ±0.5°C (±1.0°F) |
| S26 | Chilled water return temperature | AI | 10K-ohm, NTC, thermistor (matched with S25). | ±0.5°C (±1.0°F) | 0.1°C (0.18°F) | 1 | 1 | ±0.5°C (±1.0°F) |
| S27 | Chilled water plant flow rate | AI | Full-bore magnetic flowmeter (preferred); hot-tapped insertion flowmeter (alternate). | ±0.75% of reading<br>±2.0% of reading | 0.005 l/s (0.1 gpm) | 1 | 1 | ±0.75 of reading<br>±2.0 of reading |
| S28 | AHU supply fan airflow | AI | Vortex shedding sensor on fan inlet. | ±5% of reading down to 0.75 m/s (150 fpm) | 0.05 l/s (0.1 cfm) | 1 | 1 | ±5% of reading down to 0.75 m/s (150 fpm) |
| S29 | Airflow (measuring stations) | AI | Electronic or differential pressure. | ±5% of reading | 47 l/s (100 cfm) | 1 | 1 | ±5% of reading |
| S30 | Airflow (terminal) | AI | Electronic or differential pressure. | ±10% of reading | 47 l/s (100 cfm) | 1 | 1 | ±10% of reading |
| S31 | Airflow (pressurized spaces) | AI | Electronic or differential pressure. | ±3% of reading | 24 l/s (50 cfm) | 1 | 1 | ±3% of reading |

TABLE 4: SENSOR, METER, & VALUE REQUIRED ACCURACIES (*CONTINUED*)

| TAG | SENSOR | TYPE | SENSOR DETAILS | REQUIRED END-TO-END ACCURACY | DISPLAY RESOLUTION | REFRESH INTERVAL (MIN) | TREND INTERVAL (MIN) | REQUIRED CONTROL ACCURACY |
|---|---|---|---|---|---|---|---|---|
| S32 | AHU supply fan power | AI/BI | True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1.5% of reading; ±3%VFD reading | 0.1 kW | 1 | 1 | 0.001 kW |
| S33 | AHU return fan power | AI/BI | True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output. | ±1.5% of reading; ±3%VFD reading | 0.1 kW | 1 | 1 | 0.001 kW |
| S34 | AHU discharge air temperature | AI | 10K-ohm, NTC, thermistor. | ±0.2°C (±0.36°F) | 0.1°C (0.18°F) | 1 | 10 | ±0.5°C (±1.0°F) |
| S35 | AHU mixed air temperature | AI | 10K-ohm, NTC, thermistor. Use averaging sensor located in AHU mixed air section installed in a serpentine manner vertically across the duct. | ±0.2°C (±0.36°F) | 0.1°C (0.18°F) | 1 | 10 | ±0.5°C (±1.0°F) |
| S36 | AHU return air temperature | AI | 10K-ohm, NTC, thermistor. Locate upstream of AHU return air damper. | ±0.2°C (±0.36°F) | 0.1°C (0.18°F) | 1 | 10 | ±0.5°C (±1.0°F) |
| S37 | AHU outdoor air damper position | AO | | N/A | 0.1% | 1 | 10 | 0.1% |
| S38 | AHU return air damper position | AO | | N/A | 0.1% | 1 | 10 | 0.1% |
| S39 | Whole-facility total water flow rate | AI | Hot-tapped insertion flowmeter. | ±2% of reading >20:1 turndown | 0.005 l/s (0.1 gpm) | 1 | 1 | 0.005 l/s (0.1 gpm) |
| M1 | Whole-facility peak power | AI/BI | Maximum of measured value S6 over a specified time interval. | ±1% | 0.1 kW | 1 | 10 | 1 kW |
| M2 | Whole-facility area-normalized electric energy use intensity | AV | Measured value S6 divided by a constant (C1) equal to building area in $m^2$ ($ft^2$). | ±1% | 1.8 $kWh/m^2$ (0.1 $kWh/ft^2$) | 1 | 10 | ±1% |

TABLE 5: SENSOR, METER, & VALUE REQUIRED ACCURACIES (*CONTINUED*)

| TAG | SENSOR | TYPE | SENSOR DETAILS | REQUIRED END-TO-END ACCURACY | DISPLAY RESOLUTION | REFRESH INTERVAL (MIN) | TREND INTERVAL (MIN) | REQUIRED CONTROL ACCURACY |
|---|---|---|---|---|---|---|---|---|
| M3 | Whole facility natural gas heat rate | AV | Measured value S4 divided by a constant (C2) equal to 0.01 therm/standard cubic feet. | ±1.5% | 1.8 kW/s (0.1 therms/min) | 1 | 10 | ±1.5% |
| M4 | Whole-facility area-normalized gas energy use intensity | AV | Calculated value M3 integrated over a specified interval divided by a constant (C1) equal to building area in $m^2$ ($ft^2$). | ±1.5% | 315 kWh/$m^2$ (0.1 therms/$ft^2$) | 1 | 10 | ±1.5% |
| M5 | Average daily outdoor ambient temperature | AV | Average of instantaneous measured value(s) S1. | ±0.2°C (±0.36°F) | 0.1°C (0.18°F) | 1 | 10 | ±0.5°C (±1.0°F) |
| M6 | Chilled water plant chilled water ΔT | AV | Calculated difference between measured values S25 – S26; sensors must be matched pair. | 2% of reading or ±0.2°C (±0.36°F) | 0.1°C (0.18°F) | 1 | 1 | 0.1°C (0.18°F) |
| M7 | Chilled water plant power | AV | Sum of measured values S20, S21, S22, S23, S24. | ±1.5% | 0.1 kW | 1 | 10 | ±1 kW |
| M8 | Chilled water loop thermal cooling output | AV | Calculated value M6 multiplied by measured value S27 multiplied by a constant (C3) equal to 1.0 kW (500 min-tons/°F-gal). | ±3% | 0.3 kW | 1 | 10 | ±3% |
| M9 | Chilled water plant efficiency | AV | Calculated value M7 divided by calculated value M8. | ±4% | 0.03 COP (0.01 kW/ton) | 1 | 10 | ±4% |
| M10 | Total AHU power | AV | Sum of calculated values S32x. | ±1.5% | 0.1 kW | 1 | 10 | ±1.5% |
| M11 | Total AHU flow | AV | Sum of calculated values S28x. | ±5% | 0.05 l/s (0.1 cfm) | 1 | 10 | ±5% |
| M12 | Total AHU specific power | AV | Calculated value M10 divided by calculated power M11. | ±6% | 0.0002 kW/(l/s) 0.0001 kW/cfm | 1 | 10 | ±6% |
| M13 | AHU percentage outdoor air | AV | Instantaneous difference of measured values (S35-S36)/(S1-S36). | N/A | 0.1% | 1 | 1 | 0.1% |

**END OF SECTION**

## 1.0 Sequence of Operations - General Summary

The following sequences of operations illustrate the desired control and performance for each major mechanical system installed in this facility. All control points listed in the following Sequences of Operation & points shown on the Mechanical Schedules and the M6 series Controls Drawings must be displayed on the BAS graphics.

### 1.1 Air-Handling Units – Variable Volume (AHU-1,2,3,4,5,6)

**General:** These units serve the Level 1 and 2 spaces including offices, daycare rooms, corridors, etc. The units have natural gas heating and DX (direct expansion) cooling and are able to operate with Variable Air Volume based on duct static pressure reacting to Volume Boxes in the space. Each unit has a specific outside air requirement as indicated on the drawings but can also operate with up to 100% outside air with economizer.

**System Start/Stop:** Each unit shall operate on an occupancy schedule **(7:00 to 17:00 Mon-Fri, adjustable)**, unless overridden by Building Operator or by occupancy sensors in the space.

**Outside Air:** AHU's 1-6 are packaged recirculating units with the ability to operate at 100% outside air. The following outside air values are required during normal operation:

| Unit | Supply Air - CFM(L/s) | Outside Air – CFM (L/s) |
|---|---|---|
| AHU-1 | 2000 (945) | 300 (142) |
| AHU-2 | 3000 (1415) | 400 (189) |
| AHU-3 | 11,000 (5,195) | 2200 (1038) |
| AHU-4 | 7500 (3538) | 1600 (755) |
| AHU-5 | 1200 (565) | 150 (71) |
| AHU-6 | 3100 (1462) | 500 (236) |

Work with the balancing contractor to determine the appropriate damper positions on each unit to achieve these outside air values as well as the damper positions required for 100% outside air operation.

**Fan Start/Stop Control:** The supply fan(s) will be commanded ON based on the mode of operation (scheduled occupancy). The fan(s) will be inhibited from running whenever any of the safeties are in alarm (ie. freezestat, fan alarms etc.). The return fan(s) shall be enabled via proof of run (CT) from the supply fan(s). The fan commands will be compared with their status. Whenever a fan has been commanded ON and the status is OFF for **1 minute (adjustable),** an alarm will be generated. Display fan start/stop, status, and speed on BAS graphics.

**Fan Speed Control:** The supply fan(s) shall operate based on supply air static pressure. For normal operation, supply air static pressure setpoint will be determined during balancing once all grilles, registers, and diffusers are balanced to their full design airflow. As zones become unoccupied, their VAV boxes will close to provide minimum airflow values noted for the space, and the supply fan will ramp down to achieve the static pressure setpoint – return fan shall track supply fan to maintain space pressurization. Display airflow station status and airflow on BAS graphics.

**Occupied Mode:** Each unit shall operate at full airflow by default with the outside air values listed in the table above during all hours to satisfy ventilation requirements. The return air fan shall track the supply air fan and be set up at the time of commissioning and balancing to provide the same airflow as the supply fan.

**Supply Air Temperature (SAT) Control:** The temperature control PID will stage the gas heating section and DX cooling and associated dampers to maintain the supply air temperature at setpoint. The control will be enabled whenever the supply fan status is ON. The signals will prevent simultaneous overlapping of heating and cooling devices. The BAS shall monitor all connected zones and determine the Supply air temperature set point based on the priority of the various zones and the zones with the greatest demand. Space temperature is adjustable by the operator, with a range of **+/-2°C (adj.)** from a thermostat locally in each room. Refer to specific sequence of operations for the associated space temperature control and various space heating controls.

**Heating Mode:** Heating mode shall be enabled whenever the supply fan status is ON, and the OAT is less than **18°C (adjustable).** The BAS shall monitor the SAT set point and modulate the gas heating section to meet the SAT setpoint. Display heating stage status on BAS graphics.

**Cooling Mode:** Cooling mode shall be enabled whenever the supply fan status is ON, the OAT is greater than **13°C (adjustable)** and if the economizer mode is not able to meet the SAT setpoint. The BAS shall monitor the SAT setpoint and enable/disable compressor stages and/or modulate compressor speed (for variable speed compressors) to meet the SAT setpoint. Display compressor status on BAS.

**Dehumidification Mode:** This mode shall be enabled during the summer months, when RA humidity is above **70% RH (adjustable).** During dehumidification mode, the DX cooling shall be enabled to 100% and the gas heating section will be staged to maintain a SA discharge temperature of **20°C (adjustable).** When RA humidity drops to below **50% RH (adjustable)** for a period of **15 minutes (adjustable),** disable dehumidification mode and enable standard cooling mode.

**$CO_2$ Control**
The BAS shall monitor the $CO_2$ level of the space using the $CO_2$ sensor in the zone's thermostat. If the $CO_2$ level rises above **1,200ppm (adj.),** the volume box shall be opened to provide full design airflow and introduce more outside air to achieve a $CO_2$ level below the setpoint. If the $CO_2$ level remains above the setpoint for a period of **30 minutes (adj.)** or if the $CO_2$ level rises above **2,500ppm (adj.)** an alarm will be generated.

**Refrigeration Safeties**
The BAS shall monitor the alarm point from the AHU's integral refrigeration safety detection system. Upon alarm detection the AHU's will enact an internal sequence to bring the fan to full speed and bring the fresh air to 100%. Upon receipt of alarm from the AHU controller the BAS shall open all VAV boxes to full open position to purge the building and a critical alarm will be generated on the BAS to notify the operator.

**Economizer Mode:** The BAS shall monitor the Return Air Temperature (RAT) and Humidity (RAH), the Outside Air Temp (OAT) and Outside Air Humidity (OAH) and the desired Supply Air Temperature (SAT). When outside air enthalpy is below return air enthalpy, the system shall operate in economizer mode. The mixed air damper will modulate closed, and the outside air and exhaust air dampers shall modulate open to maintain SAT setpoint.

**Temperature and Humidity Sensors:** There are multiple temperature and humidity sensors on each unit as shown on the M6 series controls drawings. Display all on the BAS Graphics.

**Safeties and Alarms:** High and Low temperature alarm limits shall be programmed into the BAS and be adjustable by the building operator to alarm if parameters are not within a predefined range.

The SAT should be compared to its set point and if the actual SAT varies from set point by more than 5 degrees for more than **5 mins (adjustable),** an alarm shall be generated.

**Filters:** The filters will be monitored, and an alarm will be generated if the filters become dirty.

### 1.1.1 Associated AHU Space Temperature Control – VAV

The BAS will monitor the room temperatures relative to the heating and cooling set points in all modes.

**In Occupied Mode:**
When a zone calls for heat the BAS shall first use any available heating devices (i.e. perimeter heaters) for that zone as the primary source of heat. If the heating call cannot be satisfied by the zone's heating devices the BAS shall check the SAT of the RTU and use a PID loop to modulate the VAV damper position & gas heating section to satisfy the call. If the space temperature setpoint is not satisfied in **15 minutes (adjustable)** this zone should become a priority for determining SAT at the RTU.

Whenever the BAS calls upon the AHU for heating or cooling, or the AHU enables heating or cooling for SAT control, a signal shall be sent to the BAS to enable the system bypass damper to modulate to maintain duct static

and enable the AHU fan speed to go to full without impacting the zone level vav control. When the heating call is satisfied the bypass will be shut and the AHU fan speed will resume modulation with the duct static.

On a call for cooling, the BAS shall disable any heating devices in the zone and check the SAT on the RTU. If the SAT is less than space temp the BAS shall use a PID loop to modulate the damper position as required to achieve set point. If the SAT is greater than space temp the VAV should remain at the min set point and this zone should become a priority for determining SAT at the RTU.

**Unoccupied Mode:**
Outside of the scheduled occupancy period the RTU shall be disabled and associated VAV boxes shall be closed. If the space temperature rises or falls outside the unoccupied heating / cooling set points, the RTU will be re-enabled and used to bring the space temperature back into range.

Some spaces are equipped with thermostats including override buttons and occupancy sensors (as indicated on the drawings) and shall be integrated with the VAV controller to return the unit to occupied mode when movement is detected. A contact will be made available for VAV integration.

## 1.2 Air-Handling Unit – Constant Volume (AHU-7)

**General:** Air-Handling Units AHU-7 is a constant volume unit that serves the Gymnasium and provides heating, cooling, and ventilation. This unit is complete with DX cooling, hot gas reheat, and a hydronic heating coil. This unit has a specific outside air requirement but can also operate with up to 100% outside air when outdoor air conditions are adequate.

**System Start/Stop:** Each AHU will run based on a scheduled occupancy period, or if the space temperature exceeds the setback mode range **+/- 2°C (adj.)** from the setpoint. During the scheduled occupancy period, the system will run at *Occupied Minimum Supply* settings by default. When called for by Supply Air Temperature Control, or by user override from the BAS, the HVAC Unit will shift to operate at *Full Air Supply* settings.

**Outside Air:** These units are recirculating units with the ability to operate at 100% outside air. The following outside air values are required during normal operation:

| Unit | Full Supply Air - CFM(L/s) | Outside Air – CFM (L/s) |
|---|---|---|
| AHU-7 – Gymnasium | 9,500 (4485) | 2300 (1085) |

Work with the balancing contractor to determine the appropriate damper positions on each unit to achieve these outside air values as well as the damper positions required for 100% outside air operation.

**Fan Start/Stop & Speed Control:** The supply fan(s) will be commanded ON based on the mode of operation. The fan(s) will be inhibited from running whenever any of the safeties are in alarm (ie. freezestat, fan alarms etc.). The fan commands will be compared with their status. Whenever a fan has been commanded ON and the status is OFF for **1 minute (adjustable),** an alarm will be generated. Display fan start/stop, status, and speed on BAS graphics.

Based on mode of operation (Occupied Minimum Supply or Full Air Supply) the BAS shall command the VFD's to modulate supply fan speed accordingly:

- *Full Air Supply:* the fan should operate at full design airflows as shown in the Air Table above when in heating, cooling, dehumidification, or CO2 alarm.
- *Occupied Minimum Supply*: the fan should run at **~50% speed (adj.),** supplying ~4500CFM for AHU-7.

**Supply Air Temperature (SAT) Control:** Space temperature setpoints for AHU-7 are interlocked and are adjustable by the building operator. The BAS shall monitor the spaces served and determine each unit's supply air temperature set point based on the demand. The temperature control PID will modulate the heating coil and associated dampers to maintain the supply air temperature at setpoint. The control will be enabled whenever the fan status is ON. The BAS shall monitor all connected zones and determine the Supply air temperature set point based on the priority of the various zones and the zones with the greatest demand.

**Heating Mode:** The system shall operate in heating mode whenever the supply fan status is ON, and the OAT is less than **18°C (adjustable).** The BAS shall monitor the SAT set point and modulate the heating coil control valve to meet the SAT setpoint. Whenever the freeze stat is in ALARM or the Supply Air Temperature is lower than 5°C, the heating coil control valve shall be fully open. The unit shall be shut down through the BAS and provide an alarm. Display valve status and position on BAS graphics.

**Cooling Mode:** Cooling mode shall be enabled whenever the supply fan status is ON, the OAT is greater than **13°C (adjustable)** and if the economizer mode is not able to meet the SAT setpoint. The BAS shall monitor the SAT setpoint and enable/disable compressor stages and/or modulate compressor speed (for variable speed compressors) to meet the SAT setpoint. Display compressor status on BAS.

**Dehumidification Mode:** This mode shall be enabled during the summer months, when RA humidity is above **70% RH (adjustable).** During dehumidification mode, the DX cooling shall be enabled to 100%, with hot gas reheat mode being activated. The heating section will be controlled to maintain a SA discharge temperature of **20°C (adjustable).** When RA humidity drops to below **50% RH (adjustable)** for a period of **15 minutes (adjustable),** disable dehumidification mode and enable standard cooling mode.

**$CO_2$ Control**
The BAS shall monitor the $CO_2$ level of the space using the $CO_2$ sensor in the return duct. If the $CO_2$ level rises above **1,200ppm (adj.),** the unit shall provide full design airflow and introduce more outside air to achieve a $CO_2$ level below the setpoint. If the $CO_2$ level remains above the setpoint for a period of **30 minutes (adj.)** or if the $CO_2$ level rises above **2,500ppm (adj.)** an alarm will be generated.
**Economizer Mode:** The BAS shall monitor the Return Air Temperature (RAT) and Humidity (RAH), the Outside Air Temp (OAT) and Outside Air Humidity (OAH) and the desired Supply Air Temperature (SAT). When outside air enthalpy is below return air enthalpy, the system shall operate in economizer mode. The mixed air damper will modulate closed, and the outside air and exhaust air dampers shall modulate open to maintain SAT setpoint.

**Temperature and Humidity Sensors:** There are multiple temperature and humidity sensors on each unit as shown on Drawing 414. Display all on the BAS Graphics.

**Safeties and Alarms:** High and Low temperature alarm limits shall be programmed into the BAS and be adjustable by the building operator to alarm if parameters are not within a predefined range.

The SAT should be compared to its set point and if the actual SAT varies from set point by more than 5 degrees for more than **5 mins (adjustable),** an alarm shall be generated.

**Filters:** The filters will be monitored, and an alarm will be generated if the filters become dirty.

**Pressure Dampers:** The gym is complete with three louvers on the exterior wall, each with a motorized damper and actuator. These louvers will open to maintain a supply air static pressure in AHU-7, which will be determined at time of setup and balancing.

## 1.3 Exhaust Fans (EF-1,3,4)

**General:** There are various exhaust fans throughout the facility serving Washrooms, Locker Rooms, Mech Service Rooms, etc. that will run based on scheduled occupancy or upon activation of associated sensors (i.e. CO/$CO_2$, Occupancy, high temp, etc.). During the scheduled occupancy period, the fan will run to achieve design airflows as indicated on the HVAC drawings. In addition to schedules, exhaust fans shall be scheduled to run at least once a day at minimum speed for **30 minutes (adjustable).** When fan is commanded on, the associated motorized dampers (and louvers, where applicable) shall be fully opened.

Provide damper status, fan status, fan speed and remote enable/disable for exhaust fan on BAS Graphics. If fan or damper status does not match command, an alarm shall be generated.

## 1.4 Ceiling Exhaust Fans (EF-2)

**General:** There is a ceiling exhaust fan serving individual washrooms that will run on occupancy sensors. Upon detection of occupancy the fan will run to achieve design airflows as indicated on the HVAC drawings.

## 1.5 Air Conditioning Systems (EV(E) & CU(E))

**General:** These systems are located throughout the facility and consist of indoor wall hung or ceiling cassette evaporators, and outdoor condensing units. These units were added as additional cooling units, however, they are in fair condition and are set to be reused. The controls contractor shall provide all components necessary to integrate the existing split systems with the BAS.

**Unit Control:** The BAS shall lock-out cooling mode in all split systems while heating in its associated space is activated. Connect to the system for monitoring of alarm and status and to provide remote enable/disable and temperature setpoint override. Monitor space temperature from BAS thermostat and create alarms for out-of-range conditions.

## 1.6 Radiator Control

**General:** The boiler system serves all the radiators, force flow heaters, and the gymnasium air handling unit in the building. The system has a perimeter heating loop consisting of 100% hot water.

**System Enable/Disable:** The boiler system is enabled whenever outside air is below **18°C (adjustable)** or by a call for Dehumidification from the air handling units. The boiler controller shall be set up to run independent of the BAS receiving only a disable and a temperature set point. When enabled, the Boiler controller shall be set up to directly control the dedicated boiler pumps, modulate boiler firing, and shut down on alarm from any of the safeties (high limit, exhaust pressure, LWCO, air switch).

**Outside Air Reset:** The boiler plant shall modulate the leaving water temperature of the boiler system based on an outside air reset schedule. Minimum and maximum temperatures shall be 71.1°C and 82.2°C to maintain proper heating capacity within the perimeter heating loop.

**Perimeter Heating Loop:**
Existing hot water pumps shall be set to run on their existing controls. Pressure differential setpoints and balancing will require adjustment upon flushing and completion of hot water system. Flow balancing report shall be provided.

**Force Flow Heaters/Cabinet Heaters:** Enable fan and modulate control valve to maintain space temperature setpoint.

**Radiators:** Modulate control valve to maintain space temperature setpoint.

END OF SECTION

# PART 1 GENERAL

## 1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 OESC 27th Edition - CSA C22.1-18, Canadian Electrical Code, Part 1 (24th edition) Safety Standard for Electrical Installations and Ontario Ammendments to that Code.of Ontario Electrical Safety Code.
- .2 CSA C22.2 No 141.
- .3 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .4 CAN/CSA-B72-M87, Installation Code for Lightning Protection Systems

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
- .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
- .1 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
- .2 IEEE SP1122-[2000], The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.4 CAN/ULC-S524 – Standard for the Installation of Fire Alarm Systems

.5 CAN/ULC-S139 Standard Method of Fire Test for Evaluation of Integrity of Electrical Cables

.6 National Building Code of Canada

.7 All governing municipal requirements

## 1.2 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.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada, only for systems where required by Provincial or Federal Law.
- .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 copies of drawings and product data to authority having jurisdiction and inspection authorities as required.
- .6 If changes are required, notify DCC Representative of these changes before they are made.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
- .1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities 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 DCC Representative.
.7 Manufacturer's Field Reports: submit to DCC Representative manufacturer's written report, within 7 days of review, verifying compliance of Work as described in PART 3 - FIELD QUALITY CONTROL.

## 1.4 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.3 Site Meetings:
.1 In accordance with Section 01 32 16.19 - Construction Progress Schedule
.2 Site Meetings: as part of Manufacturer's Field Services, schedule site visits, to review Work, at stages listed.
.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of Work, after cleaning is carried out.
.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 70 12- Safety Requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: coordinate delivery of material to suit proposed construction schedule.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials in accordance with Section 01 74 00 – Cleaning & Waste Management.

## 1.6 SYSTEM STARTUP

.1 Instruct DCC 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 will aspects of its care and operation.

## 1.7 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

.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 Names and addresses of nearest suppliers for all items included in maintenance manuals.

.4 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.5 Post instructions where directed.

.6 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.7 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

### 1.8 WARRANTY

.1 All manufacturer product and contractor labour warranties **NOT** to commence until the issuance of a certificate of substantial performance once equipment is being utilized for its intended operational purpose.

## 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.

### 2.2 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

.3 Factory assembled control panels and component assemblies.

### 2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls between Divisions, as indicated.

**2.4 WARNING SIGNS**

.1 Warning Signs: in accordance with requirements of authority having jurisdiction, inspection authorities and DCC Representative.

.2 Porcelain enamel signs, minimum size 175 x 250 mm.

**2.5 WIRING TERMINATIONS**

.1 Ensure lugs, terminals, screws used for termination of wiring are 90 degrees Celsius rated suitable for either copper or aluminum conductors.

**2.6 EQUIPMENT IDENTIFICATION**

.1 Identify electrical equipment with nameplates and labels as follows:

.2 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: Lamacoid 3mm (1/8”) thick engraving sheet, BLACK face for normal/backup power equipment and RED face for life safety power equipment, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws or rivets.

.2 Printed adhesive backed labels in lieu of Lamacoid will NOT be considered as an acceptable alternate means of labeling.

.3 Labels: embossed plastic labels sized to suit mounting location and tag details, with 6mm high letters unless specified otherwise. Printed adhesive backed labels will NOT be acceptable.

.4 Wording on nameplates and labels to match equipment identifiers on plans and to be approved to suit DCC Representative’s preference if not indicated in labeling standard prior to manufacture.

.5 Allow for minimum of twenty-five 25 letters per nameplate and label.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Distribution switchboard(s), motor control centres, power panels, lighting panels, lighting control panels, indicate system and/or voltage characteristics and if for relay panel if fed from more than one power source indicating the source locations.

.8 Disconnects, starters, contactors and push-button control stations: indicate equipment being controlled and voltage.

.9 Terminal cabinets and pull boxes: indicate system and voltage.

.10 Transformers: indicate capacity, primary and secondary voltages.

.11 Motorized equipment and operable wall controls: indicate equipment being controlled and voltage.

.12 All power device components including switches, receptacles and junction boxes are to be labelled as indicated below:

.1 Provide clear printed adhesive label tags affixed to bottom front of faceplate in BLACK.

.2 Provide white printed adhesive label tags affixed to wall on inside of faceplate to indicate circuit feeding location to allow faceplates to be put back in the correct location if removed in the future.

**2.7 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.

**2.8 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.

.4

| | Prime | Auxiliary |
|---|---|---|
| up to 250 V | Yellow | Blue |
| up to 600 V | Yellow | Green |
| Telephone | Green | |
| Other Communication Systems | Green<br>Yellow | Blue |
| Fire Alarm | Red | |
| Emergency/ Life Safety | Orange | |
| Security System | Red | Yellow |

**2.9 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 normal/backup power switchgear and distribution enclosures light gray to ASA49.

## PART 3 EXECUTION

**3.1 INSTALLATION**

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

**3.2 NAMEPLATES AND LABELS**

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

.2 Nameplates to be in English.

## 3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.2 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.3 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.4 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

.5 Arrange with Division 7 for flashing and weatherproofing of holes through exterior walls.

.6 Provide wire with flame spread rating suitable for application. (ie FT1, FT4, FT6 or MI cable as required to suit 1 HR FRR [ULC S139]) where indicated on the drawings.

.7 Coordinate with all other Divisions through General Contractor for associated conduit rough-ins to avoid coordination issues and enable installation of products supplied by other Divisions to suit final approved systems shop drawings.

## 3.4 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centre-line 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: 1100 mm.to centre-line of device box
- .2 Thermostats: 1200mm. to centerline of device box
- .3 Wall receptacles:
  - .1 General: 400 mm to centre or as indicated.
  - .2 Systems Furniture locations: confirm rough-in location with DCC Representative.
  - .3 Above top of counters or counter splash backs: 200 mm.
  - .4 In mechanical/electrical rooms: 1000 mm.
  - .5 Wall receptacles mounted on building exterior: 600mm above finished grade
- .4 Panelboards: as required by Code or as indicated.
- .5 Communications outlets:
  - .1 General: 400 mm to centre or as indicated.
  - .2 Systems Furniture locations: confirm rough-in location with DCC Representative.
  - .3 Above top of counters or counter splash backs: 200 mm.
- .6 Fire alarm manual pull-stations: mounted 1200mm to center-line as required by Code.
- .7 Fire alarm wall mounted speakers/strobes: by Code or as indicated on drawings.
- .8 Television communication outlets: as indicated, confirm rough-in location with DCC Representative.

## 3.5 FIELD QUALITY CONTROL

.1 Load Balance:
- .1 Measure phase current to panel boards 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 - 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 Section 01 45 00 - Quality Control.

.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system and communications.

.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 DCC 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 - SUBMITTALS.

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

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

## 3.6 PROTECTION

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts 'LIVE 120 VOLTS' or with appropriate voltage.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision.

## 3.7 ACCESS DOORS

.1 Supply access doors for furred ceilings or spaces for access to electrical fitments for installation under section erecting the walls or ceilings. Supply Access doors in accordance with 08 31 00 – Access Doors and Panels.

.2 Access doors, unless otherwise specified or shown, shall be flush mounted 600 × 600 mm (24" × 24") for body entry, at least 12 gauge steel, finished prime coat only, with concealed hinges, screwdriver latches, anchor straps, rounded safety corners and shall open 180 degrees. Doors shall be of approved manufacturer with published literature.

**3.8 FIREPROOFING**

.1 Provision of all firestopping required for electrical service penetration of rated walls, floors and partitions shall be the responsibility of Division 7 as indicated on the life safety drawings.

**3.9 CLEANING**

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results Electrical

.2 Section 26 05 32 – Outlet Boxes, Conduits and Fittings

## 1.2 PRODUCT DATA

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

# PART 2 PRODUCTS

## 2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 120V Control circuits are permitted to be #14AWG Copper.

.3 Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE RWU90 XLPE where used underground or in floor slabs, both Jacketted.

.4 Type TWU, TWH, T90 Nylon not permitted.

## 2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Conductors:
- .1 Grounding conductor: copper, size as indicated.
- .2 Circuit conductors: copper, size as indicated.

.3 Insulation:
- .1 Cross-linked polyethylene XLPE.
- .2 Rating: 600V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking

.6 Overall covering: thermoplastic polyvinyl chloride, meeting requirements of UL Vertical Tray Fire Test FT4 with maximum flame travel of 1220mm (48”)

.7 Fastenings:
- .1 One hole steel or zinc straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables spaced at intervals required by OESC Code
- .3 Threaded rods: 12 mm diameter to support suspended channels.

.8 Connectors:
- .1 Watertight, approved for TECK cable.

**2.3 VFD RATED CABLE**

.1 Conductors: shall be annealed stranded tinned copper per ASTM B3, B8 and B33, insulation rated for 90 Degrees C, Wet/Dry operating temperature, size as indicated, CSA Approved.

.2 Insulation: Thickness shall have a minimum average wall thickness of 30mils. The insulation material shall be XLPE with a XHHW-2 listing per UL 44. Each insulated conductor shall be identified in accordance with ICEA Method 4 Colour Coding

.3 Insulation: 1000V

**2.4 ARMOURED CABLES**

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90

.3 Armour: interlocking type fabricated from galvanized steel strip.

.4 Connectors: anti short connectors.

**2.5 MINERAL INSULTATED CABLES**

.1 Conductors: solid bare soft-annealed copper, size as indicated.

.2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.

.3 Overall covering: annealed seamless copper sheath, Type M1 rated 600 V, 250°C.

.4 Overall jacket: PVC applied over the sheath and compliant to applicable Building Code classification for this project for direct buried and wet locations, as required.

.5 Two hour fire rating.

.6 Support and routing: steel support channel with clamps or threaded rod and tray, concealed routing coordinated on-site to suit coordination with all services.

.7 Connectors: watertight, field installed, approved for MI cable.

.8 Termination kits: field installed brass plates and accessories as required by approved manufacturers MI cable installation requirements.

**2.6 CONTROL CABLES**

.1 Type: LVT: 2, 4, 6 or 8 soft annealed copper conductors, sized as indicated:
- .1 Insulation: thermoplastic.
- .2 Sheath : cotton braid

**2.7 NON-METALLIC SHEATHED CABLE**

.1 Shall not be used on this project.

## PART 3 EXECUTION

### 3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform insulation tests before energizing electrical system.

### 3.2 GENERAL CABLE INSTALLATION

.1 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.

.2 Conductor length for parallel feeders to be identical.

.3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.4 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.

.5 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### 3.3 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.

### 3.4 INSTALLATION OF TECK90 CABLE (0 - 1000 V)

.1 Group cables wherever possible on channels.

.2 Not to be installed in lengths greater than 6’ unless with the written permission of the DCC Representative.

### 3.5 INSTALLATION OF VFD RATED CABLE

.1 Install VFD Rated cable on line and load sides of all VFDs and reactors.

### 3.6 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

.2 Type AC90 is only to be used in extremely short lengths (of 10’ or less) and are only to be used for fixture drops from conduit boxes.

.3 AC90 is never to be used for home runs for lighting or power devices and will be ordered to be removed if so installed.

.4 Use AC90 for this purpose only and only where specifically called out on the drawings.

### 3.7 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit from cable tray to devices

.2 Install control cables in cable tray

.3 Ground control cable shield.

## 3.8 INSTALLATION OF NON-METALLIC SHEATHED CABLE

.1 Never use Non Metallic Sheathed Cable.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

## 1.2 REFERENCES

.1 Canadian Standards Association, (CSA International)

# PART 2 PRODUCTS

## 2.1 EQUIPMENT

.1 Copper conductor: bare, soft annealed, stranded, untinned copper ground conductor for system and equipment ground, size as indicated, minimum as dictated by code.

.2 Rod electrodes: copper clad steel 19 mm dia by 3 m long, minimum.

.3 Grounding conductors: bare stranded copper, untinned, soft annealed, minimum 3/0 AWG copper conductor to each ground electrode.

.4 Insulated grounding conductors: green, type TWH or TWU, where indicated.

.5 Ground bus: copper, size as indicated, complete with 600V insulated supports, fastenings, connectors.

.6 Supply 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 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors
- .7 Compression ground connectors.

.7 Compression grounding connectors used to make permanent grounding connections must be rated for direct burial, embedding in concrete and for above grade applications
- .1 Compression connectors shall be made of pure, wrought copper, meeting ASTM B187, essentially the same as the conductors being connected.
- .2 Cast connectors shall be made of copper base alloy according to ASTM B30 (latest revision).
- .3 All connectors must be of heavy duty design and must be equivalent in current carrying capacity to the maximum size copper conductors being joined while maintaining high mechanical strength and electrical integrity.
- .4 Terminals and splices may accommodate only one conductor size. All other connectors must be range taking.
- .5 All connectors must be designed to provide high integrity connections.
- .6 Connectors must be pre-filled or filled at time of connection with a corrosion inhibiting compound which is compatible with the conductors being joined.

## PART 3 EXECUTION

### 3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous system and equipment grounding systems including, electrodes, conductors, connectors, accessories, as indicated.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solder-less lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Install separate ground conductor, green TW75 insulation to outdoor lighting standards.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end, provide non-metallic entry plate at load end.

.12 Ground secondary service pedestals.

.13 Ensure uniformity of grounding practices throughout installation.

### 3.2 ELECTRODES

.1 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.2 Install rod electrodes and make grounding connections.

.3 Bond separate, multiple electrodes together.

.4 Use size 3/0 AWG copper conductors for connections to electrodes.

### 3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to the neutrals of the electrical distribution system, as indicated.

### 3.4 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, cable trays, frames of

motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

## 3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall in Incoming Electrical, Incoming Comm and Shared Building Network and a total of three separate IT/LAN rooms, scope of work as indicated on the drawings.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG.

## 3.6 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

- .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
- .2 Sound, fire alarm, intercommunication systems as indicated.

## 3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of DCC Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

# PART 1 GENERAL

## 1.1 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 00 – Cleaning & Waste Management.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Fold up metal banding, flatten and place in designated area for recycling.

# PART 2 PRODUCTS

## 2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41mm (1 5/8”), 2.5 mm thick, surface mounted, suspended by ½” Threaded Rod or embedded in concrete as required outside of production areas/laboratories; within production and laboratory areas include sealed type with channel inserts as required.

.2 Galvanized Steel used indoors outside of production areas/laboratories.

.3 Stainless Steel where required outdoors.

# PART 3 EXECUTION

## 3.1 INSTALLATION

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.
- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.
- .1 Support individual cable or conduit runs with 12 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 12 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.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 DCC Representative

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.13 Where cutting of galvanized strut is required, touch up the cut ends with galvanizing paint.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED SECTIONS

.1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

## 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

## 1.3 SUBMITTALS

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

.2 Product Data:
.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

# 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 or connection blocks 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 turned edge covers.

## 2.3 CABINETS

.1 Construction: welded sheet steel, hinged door, handle, latch and catch

.2 Type E Empty: flush overlapping sides mounting as required.

.3 Type T Terminal: flush overlapping sides mounting as required containing 19 mm G1S plywood backboard.

## 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 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Install terminal block as indicated in Type T cabinets.

.4 Coordinate all main junction and pull boxes to suit conduit runs and wire sizes 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.

END OF SECTION

# PART 1 GENERAL

## 1.1 LOCATION OF CONDUITS

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only

## 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C22.1-12, Ontario Electrical Safety Code, Part 1

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

## 1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

# PART 2 PRODUCTS

## 2.1 CONDUIT

.1 Rigid PVC Conduit (RPVC)

.2 Rigid Galvanized Steel Conduit (RGSC)

.3 Electrical Metallic Tubing (EMT)

.4 Electrical Non-Metallic Tubing (ENMT)

.5 Flexible Metal Conduit and Liquidtight Flexible Metal Conduit

## 2.2 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 all 347 V line voltage switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

## 2.3 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 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster and tile walls.

**2.4 MASONRY BOXES**

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

**2.5 CONCRETE BOXES**

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

**2.6 CONDUIT BOXES**

.1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

**2.7 PULSTRINGS**

.1 Polypropylene nylon, 6mm (1/4”) for conduits to 1”

.2 Braided Nylon, 12mm (1/2”) for conduits to 4”.

**2.8 FITTINGS - GENERAL**

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35mm 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.

.7 Conceal conduit in walls, partitions and ceilings. Provide access panels in areas where access is required to junction boxes.

.8 Install EMT surface mounted in mechanical, electrical telecommunications rooms and the overhead link.

.9 Install Rigid Galvanized Conduit where subject to mechanical injury

.10 Provide Expansion Fittings where conduits pass over expansion joints.

.11 Seal conduits passing through an outside wall with duct seal a the closest outlet box on the outside wall. If the distance from the nearest outlet box to point where conduit passes through wall exceeds 1524mm (5',) install and outlet box just inside the wall and seal conduit at that location. Install duct seal after all wiring has been completed.

.12 Install rigid galvanized steel conduit 762mm (30") below finished grade and extend 75mm (3") beyond the outside wall surface where conduit runs pass through the foundation walls. Couple to rigid PVC conduit for continuation of underground electrical or telecommunication service to outdoor locations.

.13 Do not use perforated steel supports (all round)

.14 Make exposed conduit parallel to the building lines to present a neat and tidy appearance. Make offsets at similar locations and parallel in areas where two or more runs are together. Failure to coordinate conduit runs with each other will result in the DCC Representative rejecting the installation.

.15 Use liquidtight flexible conduit for final connections to motors and loads subject to vibration.

.16 Run conduit to avoid proximity to water or heating pipes. Do not run within 75mm of pipes, and where unavoidable, contact DCC Representative for direction. Proceed with direction from DCC Representative.

.17 Lengths of Flexible Metallic Conduit are not permitted to be longer than 6' unless prior permission has been obtained from the DCC Representative, under documented writing.

.18 Type AC90 has very limited use, refer to Section 26 05 21.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 26 05 21 – Wires and Cables

.2 Section 26 05 29 – Hangars and Supports

.3 Section 26 05 32 – Outlet Boxes, Conduits and Fittings

## 1.2 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. 45-M1981(R2003), Rigid Metal Conduit.
- .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
- .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
- .1 Submit cable manufacturing data.

.3 Quality assurance submittals:
- .1 Test reports: submit certified test reports.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.

## 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning & Waste Management.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

# PART 2 PRODUCTS

## 2.1 CABLES AND REELS

.1 Provide cables on reels or coils.
- .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

.3 Identify cables for exclusively dc applications.

.4 Reel and mark shielded cables rated 2,001 volts and above.

**2.2 CONDUITS**

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.4 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.5 Flexible metal conduit: to CSA C22.2 No. 56, steel, liquid-tight flexible metal.

.6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

**2.3 CONDUIT FASTENINGS**

.1 One hole steel straps to secure surface conduits NPS 2” (50 mm) and smaller.
.1 Two hole steel straps for conduits larger than NPS 2” 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at maximum length permitted for smallest conduit on rack by code.

.4 Threaded rods, 12 mm diameter, to support suspended channels.

**2.4 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 180 degrees bends for NPS 1” (25 mm) and larger conduits.

.3 EMT Connectors:
.1 Watertight connectors and couplings for EMT where routed below sprinkler heads, installed in location exposed to the weather or at exposed penetrations into the top of electrical equipment.
.2 Set screw type steel connectors are acceptable where EMT conduit is routed in walls, above ceiling and/or sprinkler heads where there is no possibility of direct water stream or ingress of moisture.

**2.5 EXPANSION FITTINGS FOR RIGID CONDUIT**

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

## 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 and in unfinished areas.

.3 Use epoxy coated conduit underground and in corrosive areas.

.4 Use electrical metallic tubing (EMT) except in cast concrete, above 2.4 m not subject to mechanical injury.

.5 Use rigid PVC conduit underground and in corrosive areas.

.6 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures, work in movable metal partitions.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.8 Use explosion proof flexible connection for connection to explosion proof motors.

.9 Install conduit sealing fittings in hazardous areas.
.1 Fill with compound.

.10 Minimum conduit size for lighting and power circuits: NPS 1/2”, (12 mm.)

.11 Bend conduit cold:
.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.12 Mechanically bend steel conduit over 35 mm diameter.

.13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.14 No Running of Threads Permitted

.15 Install fish cord in empty conduits.

.16 Run 2-NPS 1 (25 mm) spare conduits up to ceiling space and 2-NPS 1 (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.

.17 Remove and replace blocked conduit sections.
.1 Do not use liquids to clean out conduits.

.18 Dry conduits out before installing wire.

.19 Use flexible metal conduit exposed only where specifically indicated on drawings or with approval of DCC Representative, or for final fixture tails, not longer than 10’ and as above in .6.

**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 suspended or surface channels, where applicable

.5 Do not pass conduits through structural members except as indicated or with permission of DCC Representative.

.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.

**3.5 CONDUITS IN CAST-IN-PLACE CONCRETE**

.1 Locate to suit reinforcing steel.

.2 Install in centre one third of slab.

.3 Protect conduits from damage where they stub out of concrete.

.4 Install sleeves where conduits pass through slab or wall.

.5 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
.1 Use cold mastic between sleeve and conduit.

.6 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

.7 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.8 Organize conduits in slab to minimize cross-overs.

**3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

.1 Run conduits NPS 1 (25 mm) and larger below slab and encase in 75 mm concrete envelope.
.1 Provide 50 mm of sand over concrete envelope below floor slab.

**3.7 CONDUITS UNDERGROUND**

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

**3.8 CLEANING**

.1 Proceed in accordance with Section 01 74 00 – Cleaning & Waste Management.

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

END OF SECTION

# PART 1 GENERAL

## 1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit fuse time-current characteristics for each fuse type and size. Time-current characteristics to include: average melting time-current, $I^2t$ (for fuse coordination), and peak let-through current.

## 1.2 DELIVERY, STORAGE AND HANDLING

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in equipment.

.3 Store fuses in original containers in moisture-free storage cabinet.

## 1.3 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Three spare fuses of each type and size.

# PART 2 PRODUCTS

## 2.1 FUSES - GENERAL

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer.

## 2.2 FUSE TYPES

.1 Class J fuses.
- .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Type J2, fast acting.

.2 Class R -R fuses.
- .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
- .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

.3 Class C fuses.

## 2.3 FUSE STORAGE CABINET

.1 Fuse storage cabinet, manufactured from 2.0mm thick aluminum 750 mm high, 600mm wide, 300mm deep, hinged, lockable front access door finished in accordance with Section26 05 00 - Common Work Results for Electrical.

.2 Wall mounted in each main electrical room, in final location to be determined by the DCC Representative on-site.

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.
.1 Install rejection clips for Class R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

.5 Install spare fuses in fuse storage cabinet.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Reserved.

## 1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
- .1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Include time-current characteristic curves for breakers with ampacity of 30A and over.

# PART 2 PRODUCTS

## 2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters: 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 if applicable.

.6 Circuit breakers to have minimum 10,000A symmetrical rms interrupting capacity rating.

## 2.2 THERMAL MAGNETIC BREAKERS DESIGN A

.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.

## 2.3 MAGNETIC BREAKERS DESIGN B

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

## 2.4 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS DESIGN C

.1 Thermal magnetic breakers with current limiters.

.1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.
.2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.
.1 Breakers applied following manufacturer's guidelines and accepted best practice.

### 2.5 SOLID STATE TRIP BREAKERS

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time and instantaneous tripping for phase and/or ground fault short circuit protection.

### 2.6 OPTIONAL FEATURES

.1 Include where necessary to meet design intent indicated on the drawings:
.1 Shunt trip.
.2 Shunt close
.3 Auxiliary switch.
.4 Motor-operated mechanism c/w time delay unit.
.5 Under-voltage release.
.6 On-off locking device.
.7 Handle mechanism.

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 Install circuit breakers in appropriate location to suit equipment type as indicated.

END OF SECTION

# PART 1 GENERAL

## 1.1 REFERENCES

.1 Canadian Standards Association (CSA International).
- .1 CAN/CSA C22.2 No.4, Enclosed Switches.
- .2 CSA C22.2 No.39, Fuseholder Assemblies.

## 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

## 1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for in accordance with Section 01 74 00 – Cleaning & Waste Management.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal of packaging material or for recycling in accordance with Waste Management Plan.

.4 Fold up metal banding, flatten and place in designated area for recycling.

# PART 2 PRODUCTS

## 2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure one, to CAN/CSA C22.2 No.4, size as indicated and as required.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated and/or as required to suit manufacturer supplied equipment, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.

.5 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse required.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Provide auxiliary contact for elevator disconnects as noted on plans.

.9 DS-1 – 600V, 30A, 3P, 3W, heavy duty, NEMA 3R enclosure, fused disconnect with fuses sized as per single line diagram or drawings, CSA listed.

.10 DS-2 – 600V, 60A, 3P, 3W, heavy duty, NEMA 3R enclosure, fused disconnect with fuses sized as per single line diagram or drawings, CSA listed.

### 2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification to suit DCC Representative labelling requirements in accordance with Section 26 05 00 - Common Work Results – 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.

.2 Ensure all disconnect switches are installed in locations acceptable for operation from standing position without need for ladder, etc. and include 1 meter of clearance in accordance with OESC and ESA inspector requirements, confirm with inspector prior to rough-in as necessary.

END OF SECTION

# PART 1 GENERAL

## 1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

.3 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings

.4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings

## 1.2 SUMMARY

.1 Section Includes:
- .1 Materials and installation for fire alarm systems.
- .2 Automatic alarm initiating devices.
- .3 End-of-line devices.
- .4 Ancillary devices.

## 1.3 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 CSA C22.1 – Canadian Electrical Code, Part I (26th Edition)

.2 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
- .2 CAN/ULC-S525, Audible Signal Device for Fire Alarm Systems.
- .3 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems.
- .4 CAN/ULC-S527, Control Units.
- .5 CAN/ULC-S528, Manual Stations for Fire Alarm Systems.
- .6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
- .7 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
- .8 CAN/ULC-S531, Standard for Smoke Alarms.
- .9 CAN/ULC-S536, Standard for Inspection and Testing of Fire Alarm Systems
- .10 CAN/ULC-S537, Standard for Verification of Fire Alarm Systems
- .11 CAN/ULC-S561, Standard for Installation and Services for Fire Signal Receiving Centers and Systems
- .12 CAN/ULC-S1001, Integrated System Testing of Fire Protection and Life Safety System

.3 National Fire Protection Agency
- .1 NFPA 72, National Fire Alarm Code.
- .2 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

## 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Shop drawings: stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 The shop drawings shall clearly specify all components of the system and system interconnections. This information shall include:
- .1 Complete schematic and riser diagrams showing the interconnection of field devices, control units, annunciators, ancillary devices (isolator modules, I.O devices, etc) and external power supplies to control units or transponders.
- .2 Schematic and detailed wiring diagrams showing all connections between equipment and devices with number of wires, cables, sizes and types
- .3 Specifications of all components of the system.
- .4 Layout of equipment if different from drawings.
- .5 Zoning or trouble and alarm codes.
- .6 Sequence of operation

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
- .3 Manufacturer's Field Reports: manufacturer's field reports specified.

.4 Closeout Submittals:
- .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
- .2 Submit following:
  - .1 Manufacturer's Data for:
    - .1 Duct smoke detectors.
    - .2 Wiring.
    - .3 Conduit.
    - .4 Outlet boxes.
    - .5 Fittings for conduit and outlet boxes.
    - .6 Mark data which describe more than one type of item to indicate which type will be provided.
    - .7 Submit original for each item and clear, legible, first-generation photocopies for remainder of specified copies.
  - .2 System wiring and riser diagrams:
    - .1 Submit complete As-built wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
    - .2 Show modules, relays, switches and lamps in control panel.
  - .3 Design data: Power Calculations:
    - .1 Submit design calculations for new work specified to substantiate that battery capacity exceeds supervisory and alarm power requirements.
    - .2 Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.
    - .3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.
  - .4 Schedules:
    - .1 Conductor wire marker schedule.
  - .5 Test Reports:
    - .1 Duct smoke detectors.

## 1.5 QUALITY ASSURANCE

.1 Qualifications:
- .1 Installer: company or person specializing in fire alarm system installations,

approved by manufacturer.

.2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

.2 Maintenance Service:

.1 Provide one year's free maintenance commencing on the date of Substantial Performance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit copies of inspection report to the DCC Representative.

### 1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

.1 Acceptable Manufacturers:

.1 Mircom (existing system)

.2 All Fire Alarm System components shall be the products of one manufacturer.

### 2.2 MATERIALS

.1 Equipment and devices: ULC listed and labeled and supplied by single manufacturer as indicated on the drawings.

.2 Power supply: to CAN/ULC-S524.

.3 Smoke detectors: to CAN/ULC-S529.

### 2.3 SYSTEM DESCRIPTION

.1 The Fire Alarm System shall is a single stage, zoned, non-coded, fully electronically supervised, conventional, user configurable system.

.2 The major components of the renovated Fire Alarm System shall be:

.1 Smoke detectors.

.2 End of line resistors

.3 All work on system after being brought on-line will be coordinated with the DCC Representative/Tenant through the DCC Representative, for all connections, programming, etc. impacting existing system operation will require 24 hour supervision by this Division for any system downtime associated with fire alarm work and connections.

### 2.4 SYSTEM OPERATION

.1 Provide separate circuits from control panel to each zone of initiating devices. Transmission of signals from more than one zone over common circuit to control panel is prohibited.

.2 Single stage operation. Operation to actuation following:
- .1 Smoke detector.

.3 Actuation of single operation device to initiate following:
- .1 Building evacuation alarm devices to operate in temporal pattern.
- .2 Transmit signal to fire department via fire alarm dialer/transmitter supplied by local Fire Department as indicated on the drawings.
- .3 Zone of alarm device to be indicated on control panel and annunciators.
- .4 Fire doors and smoke control doors if normally held open, to close automatically controlled using method of control as indicated on the drawings.
- .5 Operations to remain in alarm mode (except alarm notification appliances if manually silenced) until system is manually restored to normal.
- .6 Automatic signals to 3rd Party ULC S561 approved Fire Alarm Monitoring centre for "alarm" event and restoration and "trouble" event and restoration and "supervisory" condition.

.4 Initiation of Trouble Condition
- .1 The "Trouble" condition can be initiated by any of the following:
- .2 Open circuit, short circuit, or ground fault in the wiring of any alarm zone.

.5 Trouble Condition
- .1 Trouble buzzer signal in the FACP and Remote Annunciator sounds in temporal pattern.
- .2 Trouble zone affected is visually indicated on the FACP and the Remote Annunciator.
- .3 "Trouble" signal is transmitted to fire alarm monitoring company.

## 2.5 DUCT SMOKE DETECTORS

.1 Provide detectors installed in ducts, type as noted on the plans and listed by ULC duct installation.

.2 Provide integral control and power modules required for operation with main control panel.

.3 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit.

.4 Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.

.5 Provide a separate, fused power circuit for each smoke detection initiating circuit.

.6 Failure of power circuit: indicated as a trouble condition on corresponding initiating circuit.

.7 Provide duct detectors for locations as indicated on the drawings and in accordance with NFPA 90A.

.8 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.

.9 Activation of duct detectors to cause shutdown of associated air handling unit annunciation at control panel and tripping of fire department dialer and sounding of building evacuation alarms.

.10 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.

.11 Provide remote indicator lamp for each detector.

.12 Permanently label remote indicator with description of associated air handling unit(s).

.13 Provide each detector with remote test switch. Mount switch not more than1.8 m above finished floor.

.14 Permanently label test switch with description of associated air handling unit(s).

**2.6 END-OF-LINE DEVICES**

.1 End-of-line devices to control supervisory current in alarm circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel.

**2.7 CONDUIT**

.1 Electrical Metallic Tubing (EMT): as required to suit installation as indicated on the drawings.

**2.8 WIRING**

.1 Install end of line resistors in flush boxes with vented brushed stainless-steel covers. Refer to Section 26 05 00 for mounting heights.

.2 Following approval of shop drawings giving the Manufacturer's recommended wiring methods and wiring system, design, plan and provide the complete Fire Alarm System wiring.

.3 Conductors shall be solid copper. Provide wire sizes, connections, and fire rated raceway systems in accordance with the applicable Codes and Standards (see 1.3 above).

.4 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.

.5 Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor or as required to suit manufacturer requirements.

.6 Wire to existing fire alarm panels: as indicated on the drawings and required to meet manufacturer’s requirements.

.7 Insulation 90 degrees C minimum with nylon jacket.

.8 Colour code wiring.

**2.9 AS-BUILT RISER DIAGRAM**

.1 Provide complete As-Built riser diagram (in glazed frame minimum size 600 x 900 mm) of existing and new fire alarm system and associated field installation in accordance with CAN/ULC requirements.

## 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 systems in accordance with CAN/ULC-S524.

.2 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of 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 Connect signaling circuits to main control panel.

.5 Install end-of-line devices at end of alarm circuits.

.6 Locate and install remote relay units to control fan shut down.

## 3.3 FIELD QUALITY CONTROL

.1 Site Tests:
- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - for Electrical, CAN/ULC-S537 and CAN/ULC-S1001 in accordance with Sentence 3.2.9.1.(1) of Division B of the National Building Code.
- .2 Fire alarm system:
  - .1 Test each device and alarm circuit to ensure smoke detectors transmit alarm to control panel and actuate alarm and general alarm ancillary device.
  - .2 Check annunciator panels to ensure zones are shown correctly.
  - .3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of system.
  - .4 Class A circuits.
    - .1 Test each conductor on circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

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

.3 System verification:
- .1 The Contractor shall engage and include in the tender price for the complete Verification of the Fire Alarm System and all of its components and functions, by the manufacturer of the Fire Alarm System components.
- .2 The manufacturer shall perform and document the complete Verification of the Fire Alarm System as required under the Standards listed in 1.3 above.
- .3 The Verification shall include for any and all repeat testing and any follow-up work required to verify that all system elements are operating correctly.
- .4 System verification documentation:

.1 Provide a bound Verification Report written and signed/sealed by the Fire Alarm System equipment manufacturer, in triplicate. The report shall include:
.2 Certification that the entire system and all components and wiring have been tested, verified, and commissioned by the manufacturer in accordance with the requirements of Standards.
.3 Documentation and identification of each individual device and its status.
.4 Beginning and completion dates for the Verification.
.5 Name, business address, and tel/fax no. of manufacturer's representative.
.6 Provide Letter of Assurance in accordance with Section 26 05 00.

**3.4 TRAINING**

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

**3.5 CLEANING**

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION