







**DRDC HVAC COMPLIANCE UPGRADES
BUILDING 201A & 201B
TORONTO, ON**

**SPECIFICATIONS – ISSUED FOR TENDER
Document No. BE21207056-0000-SPE-0001**

Prepared for:

**DEFENCE CONSTRUCTION CANADA
PROJECT NO. TT210006**

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Part 1 General

1.1 LIST OF DRAWINGS

.1

<u>Drawing No.</u>	<u>Description</u>	
<u>STRUCTURAL - PACKAGE #1</u>		
S201	Roof Top Unit Replacement Curb Rehabilitation	
S202	Dive Shop Air Handling Unit Replacement – Exterior Wall Rehabilitation	
<u>ARCHITECTURAL - PACKAGE #1</u>		
A300	Site Plan	
A301	Demolition	
A302	Opening in Wall	
A303	Wall Closure	
A304	Roof Details	
<u>ARCHITECTURAL - PACKAGE #2</u>		
A300	Site Plan	
A303	Roof Details	
<u>MECHANICAL - PACKAGE#1</u>		
M400	Mechanical Legends and Notes	
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M406	Package 1 - New Ductless AC Units Roof Plan	

DRDC HVAC Compliance Upgrade**1133 Sheppard Ave. W,
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List of Drawing Sheets

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M408	Package 1 - Mechanical Details	
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M400	Mechanical Legends and Notes	
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E506	Package 1 - Level 1 Electrical Layout	
E507	Package 1 - Level 2 Electrical Layout	
E508	Package 1 - Room 2219 Air Handling Unit Replacement Electrical Layout	
E509	Package 1 - Power Panel Schedule I	
E510	Package 1 - New Ductless AC Units Roof Electrical Layout	
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E500	Electrical Legend & Notes	
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E513	Package 2 - Level 2 Electrical Layout	
E514	Package 2 - New Ductless AC Units Roof Electrical Layout	
E515	Package 2 - Power Panel Schedule	

Part 2 Products

2.1 NOT USED

.1 Not Used

Part 3 Execution

3.1 NOT USED

.1 Not Used

END OF SECTION

Section 00 10 05 General Instructions

Part 1 General

1.1 REFERENCES

- .1 National Building Code of Canada (NBC) Latest Edition including all amendments up to Tender Closing Date.

1.2 CONTRACT DOCUMENTS IDENTIFICATION

- .1 Contract Documents are identified as:

- .1

Project Title:	DRDC HVAC Compliance Upgrades
File Number:	TT210006
Located at:	DRDC1133 Sheppard Ave. W.Toronto, ON M3M 3B9

1.3 SCOPE OF WORK

- .1 Work under this Contract covers the supply of all labour, materials and equipment required to carry out Construction in accordance with the Contract Documents. Work includes but is not limited to the following:
 - .1 Preparation:
 - .1 Establish lockable construction work site, erect construction barriers in accordance with Section 01 56 00 – Temporary Barriers and Enclosures, to applicable standards and as indicated on drawings.
 - .2 When there are occupants in the same building as construction or the building becomes occupied prior to substantial completion, the Contractor must maintain a 1 hour fire separation as required by Section 01 56 00 – Temporary Barriers and Enclosures.
 - .3 Post all construction signage and safety signage as required by regulatory agency.
 - .2 Construction:
 - .1 Refer to specification Section 00 01 10 – Table of Contents and Section 00 01 15 – List of Drawing Sheets describing the Scope of Work.
 - .2 Removal of materials from the site must meet Section 01 35 43 - Environmental Procedures.
 - .3 Contractor will be responsible for obtaining a licensed hauler and receiver for the transport and recycling of any hazardous materials.

- .4 Contractor will submit a manifest upon completion of the work in accordance with Section 01 35 43 - Environmental Procedures.
- .5 Upon Completion of work, transport any hazardous material waste off-site to approved receiver. Submit manifest prior to submission of final progress claim.

1.4 CODES AND STANDARDS

- .1 Perform work in accordance with the National Building Code of Canada Latest Edition (NBC) and any other code of Provincial or local application provided that in any case of conflict or discrepancy the most stringent requirements shall apply.
- .2 Meet or exceed requirements of:
 - .1 Contract Documents.
 - .2 Specified standards, codes and referenced documents. (Latest Editions).

1.5 WORKMANSHIP

- .1 All tradesman to be licensed or certified where applicable.
- .2 All work to be concealed shall be inspected by DCC Representative before concealment. Give DCC Representative 48 hours notice prior to inspection.
- .3 Workmanship to be of uniformly high quality and in accordance with standard practice. All work to be completed to the satisfaction and approval of the DCC Representative.
- .4 Contractor to make good any building surface, material, equipment, fitting or furnishing disturbed or damaged due to transportation of equipment or materials through the building or the Work of this Contract.
- .5 Contractor to make good existing roadways, landscaping, façade and grassed areas damaged by vehicles or due to the transportation of storage of equipment or materials on site or the Work of this Contract.

1.6 SITE CONDITIONS

- .1 Examine existing site for conditions that may impede prompt execution of the Work and advise the DCC Representative accordingly.

1.7 EXISTING CONDITIONS

- .1 Contractor to visit the site prior to tender closing to check conditions affecting the work. Where parameters of work are shown, Contractor will be responsible for verifying the magnitude of the work.
- .2 Contractor to attend the site upon award and document existing conditions and identify existing damage or deficiencies not to be addressed as part of this project. Applicable only to access to and areas of work.
- .3 Locations for storage of materials and equipment will be determined at the pre-construction meeting.

1.8 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Owner's continued use of premises during construction.

- .2 Maintain fire access/control.

1.9 CONTRACTOR'S USE OF SITE

- .1 Use of site: restricted to immediate access to and area(s) of work.
- .2 Coordinate use of premises under direction of DCC Representative.
- .3 Obtain and pay for use of additional storage or work areas.

1.10 OWNER OCCUPANCY

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Co-ordinate with DCC Representative in scheduling operations to minimize conflict and to facilitate Owner usage.
- .3 Refer to Section 01 70 12 Safety Requirements for further details.

1.11 PROJECT MEETINGS

- .1 DCC Representative shall record meeting minutes. DCC Representative to distribute minutes to the General Contractor. General Contractor shall distribute to all Sub-trades.
- .2 Site meetings shall be scheduled bi-weekly with all major trades present.

1.12 ADDITIONAL DRAWINGS

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

1.13 SIGN-IN & SIGN-OUT LOG BOOK

- .1 Contractor shall provide and maintain during the entire project, a contractor sign-in and sign-out log book.
- .2 Contractor to keep log book on site and will include sign-in/sign-out of all personnel, Sub-Trades and all visitors.
- .3 Contractor to turn log book over to DCC Representative upon final completion of work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 11 00 Summary of Work

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises DRDC HVAC Compliance Upgrade, located at 1133 Sheppard Ave. W., Toronto, Ontario.
- .2 Work includes mechanical, electrical, structural, and architectural work to support the project. Includes modification to the building envelope, new ductless air conditioning units, and air handling units and other work as described in the project documents.
- .3 The work of this Contract is designated DCC Project # KN74988.
- .4 The mechanical scope of work is consisted of 2 (two) packages for the building that describes the requirements for the supply of equipment, material, labor and services for relocation of existing equipment and installation of new equipment as indicated:
 - .1 Package 1 (RTU-7, RTU-8, RTU-9, RTU-10,Rm.2219 , Rm.1100, Rm. 1516, Rm.1700, Rm.2020C, Rm.2102 and Rm.2213 I).
 - .1 Decommission and remove four (4) existing rooftop air handling units , RTU-7, RTU-8, RTU-9 AND RTU-10 as indicated on the drawings.
 - .2 Decommission and remove existing air handling unit in Rm.2219 as indicated on the drawings.
 - .3 Disassemble and remove the associated ductwork to the extent as indicated on the drawing. Disconnect the air handling unit from the associated services.
 - .4 Decommission and remove existing condensing units on the roof related to Rm.2219 Air handling unit as indicated on the drawings.
 - .5 Decommission and remove existing supply grilles, exhaust fans, fan coil , VAV box and associated branches, thermostats and wiring as indicated on the drawings to accommodate for installation of new AC split ductless units.
 - .6 Decommission and remove existing AC units as indicated on the drawings.
 - .7 Supply and install three (3) new roof top units as indicated on the drawings and specifications.
 - .8 Supply and install new ductwork and modify the existing ductwork related to the new roof top units as indicated on the drawings and specifications.
 - .9 Supply and install a new air handling unit for Rm.2219 as indicated on the drawings and specifications.
 - .10 Supply and install two (2) new condensing units for Rm.2219 air handling unit and locate on the roof for Rm.2219 as indicated on the drawings and specifications.

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- .11 Supply and install new ductwork and modify the existing ductwork for the new Rm.2219 air handling unit as indicated on the drawings and specifications.
- .12 Supply and install the refrigerant piping, refrigerant specialties and all the ancillaries including pipe supports and secondary steel to make complete and continuous refrigerant piping system for the new Rm.2219 air handling unit and new roof located condensing units. The refrigerant piping from the DX indoor unit shall extend to the outdoor air cooled condensing unit and shall be field run indoors at low level and shortest route as indicated on drawings. The refrigerant piping and specialties shall be insulated. Provide installation of refrigerant valves and specialties in accessible locations to allow for service and inspection.
- .13 Reconnect the new Rm.2219 air handling unit to the hydronic heating system.
- .14 Supply and install six (6) new air conditioning ductless indoor units in dedicated rooms and associated new condensing units on the roof as indicated on the drawings and specifications.
- .15 Supply and install the refrigerant piping, refrigerant specialties and all the ancillaries including pipe supports and secondary steel to make complete and continuous refrigerant piping system for the AC ductless split system. The refrigerant piping from the DX indoor unit shall extend to the outdoor air cooled condensing unit and shall be field run indoors at low level and shortest route as indicated on drawings. The refrigerant piping and specialties shall be insulated. Provide installation of refrigerant valves and specialties in accessible locations to allow for service and inspection.
- .16 Supply and install condensate drainage pipes from the interior ductless AC units to the drainage points as indicated on the drawings and specifications.
- .17 Reconnect, wire and modify the electrical power for the new roof top units as required and indicated on the drawings.
- .18 Connect and wire electrical power for the AC units (ductless indoor units and outdoor condensing units) as required and indicated on the drawings.
- .19 Reconnect, wire and re-configure the BAS automated controls for all new installed equipment as required to integrate and provide communication with the existing HVAC systems.
- .20 Perform HVAC pre-commissioning, test , start-up assistance, balance and commission the new and associated existing HVAC systems and ductwork as per the drawings, schematics and specifications.
- .2 Package 2 (Rooms 1205A, 2205 and 2232):
 - .1 Decommission and remove existing supply grilles, exhaust fans, and associated branches, thermostats and wiring as indicated on the drawings to accommodate for installation of new AC split ductless units.

- .2 Supply and install three (3) new air conditioning ductless indoor units in dedicated rooms and associated new condensing units on the roof as indicated on the drawings and specifications.
 - .3 Supply and install the refrigerant piping, refrigerant specialties and all the ancillaries including pipe supports and secondary steel to make complete and continuous refrigerant piping system for the AC ductless split system. The refrigerant piping from the DX indoor unit shall extend to the outdoor air cooled condensing unit and shall be field run indoors at low level and shortest route as indicated on drawings. The refrigerant piping and specialties shall be insulated. Provide installation of refrigerant valves and specialties in accessible locations to allow for service and inspection.
 - .4 Supply and install condensate drainage pipes from the interior ductless AC units to the drainage points as indicated on the drawings and specifications.
 - .5 Connect and wire electrical power for the AC units (ductless indoor units and outdoor condensing units) as required and indicated on the drawings.
 - .6 Reconnect, wire and re-configure the BAS automated controls for all new installed equipment as required to integrate and provide communication with the existing HVAC systems.
 - .7 Perform HVAC pre-commissioning, test, start-up assistance, balance and commission the new and associated existing HVAC systems and ductwork as per the drawings, schematics and specifications.
- .5 The electrical scope of work includes:
- .1 Replace the roof HVAC units and connect the power to the new Units following Electrical drawings provided (Demolition and New Installation).
 - .2 Install ductless AC units at required rooms and connect them to the power according to Electrical drawings provided.
- .6 The architectural and structural scope of work includes:
- .1 Opening in existing envelope for access to 2219 room and new enclosure.

1.2 CONTRACT METHOD

- .1 Construct Work under stipulated pricecontract.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures
- .2 Submit Project construction progress schedule in accordance with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Planhighlighting recycling and salvage requirements

- .4 Submit site-specific and Work Plan Health and Safety Plan in accordance with Section 01 70 12 - Safety Requirements.

1.4 WORK BY OTHERS

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

1.5 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Owner's continued use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.
- .3 Maintain fire access/control.
- .4 Protect workers and public safety.

1.6 CONTRACTOR USE OF PREMISES

- .1 Limit use of premises for Work, and for access, to allow:
 - .1 Owner occupancy.
 - .2 Work by other contractors.
- .2 Co-ordinate use of premises under direction of DCC Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .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 Ensure that operations conditions of existing work at completion are still the same, equal to or better than that which existed before new work started.

1.7 OWNER OCCUPANCY

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

1.8 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.9 EXISTING SERVICES

- .1 Notify, DCC Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give 96 hours 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 governing authorities with minimum disturbance to tenant operations.
- .3 Provide alternative routes for personnel and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify DCC Representative of findings.
- .5 Submit schedule for approval by 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.
- .6 Provide temporary services when directed by DCC Representative to maintain critical building and tenant services.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Where unknown services are encountered, immediately advise DCC Representative and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.

1.10 DOCUMENTS REQUIRED

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

Part 2 Products

2.1 NOT USED

DRDC HVAC Compliance Upgrade

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Summary of Work

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.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Section 01 14 00 Work Restrictions

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 15 - Industrial Security.
- .2 Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
- .3 Section 01 70 12 - Safety Requirements.
- .4 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.3 ACCESS AND EGRESS

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

1.4 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.
- .4 Contractor to provide sanitary facilities for own work force in accordance with governing regulations and ordinances.
- .5 Designated existing elevators or dumbwaiters may not be used by construction personnel or for transporting of construction materials.
- .6 Closures: protect work temporarily until permanent enclosures are completed.

1.5 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.

1.6 EXISTING SERVICES

- .1 Notify, DCC Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give DCC Representative hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

- .3 Where Work involves breaking into or connecting to existing services, give DCC Representative 1 week of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .4 Provide for personnel and vehicular traffic.
- .5 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.7 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.

1.8 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security on Contracts:
 - .1 For all Contracts where security has been identified. Contractor must follow all requirements of Section 01 35 15 – Industrial Security. Including but not limited to:
 - .1 Security Requirement Checklists (SRCL) for Contract.
 - .2 Sub SRCL for all Sub Contractors.
 - .3 Security Implementation Plan.
 - .4 Contractor organization and employee screening and clearances, for own employees and all Sub Contractor employees.
 - .5 Visit Clearance Requests (VCR).
 - .6 Positive Control.
 - .7 Meetings.
 - .8 Reporting.
 - .3 Security escort for the project will not be permitted in lieu of security clearance, however, access to the rooms for the ductless AC installation must require escort by Facility Management. Contractor to arrange for escort via DCC Representative.

1.9 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is allowed only in areas indicated by DCC Representative.

1.10 WORK SITE REQUIREMENTS

- .1 Work site restrictions and outlining of work site shall be in accordance with Section 01 70 12 - Safety Requirements.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Section 01 29 83

Payment Procedures for Testing Laboratory Services

Part 1 General

1.1 RELATED SECTIONS

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

1.2 APPOINTMENT AND PAYMENT

- .1 DCC Representative will appoint for services of testing laboratory except for the following:
 - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
 - .3 Inspection and testing performed exclusively for Contractor's convenience.
 - .4 Mill tests and certificates of compliance.
 - .5 Tests specified to be carried out by Contractor under supervision of DCC Representative.
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with Contract Requirements, Contractor shall pay costs for additional tests or inspections as required by DCC Representative may require, to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

- .1 Furnish 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 sufficiently 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 approved 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

Section 01 32 16.07

Construction Progress Schedule - Bar (GANTT) Chart

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.3 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
 - .1 Weekend Work: Contractor may request to work weekends to accelerate or to regain slippage in the schedule. These requests will be reviewed with DND who retains final say on approvals.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Hours of Operation: 0800h – 1600h Monday to Friday.
 - .1 Extended Hours: Contractor may request to work extended hours to accelerate or to regain slippage in the schedule. These requests will be reviewed with DND who retains final say on approvals.
 - .2 Noisy activities such as coring to be conducted outside of typical hours of operation. Timing to be coordinated with DCC Representative.
- .7 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .8 Milestone: significant event in the Project, usually completion of major deliverable or phasing of construction due to unrelated scope of work on two different areas.

1.4 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.5 SUBMITTALS

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

1.6 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Excavation.
 - .6 Backfill.
 - .7 Building footings/foundations.
 - .8 Slab on grade.
 - .9 Structural Steel.
 - .10 Framing.
 - .11 Façade, and Roofing.
 - .12 Interior Architecture (Walls, Floors and Ceiling).
 - .13 Plumbing.
 - .14 Lighting.
 - .15 Electrical.
 - .16 Piping.
 - .17 Controls.
 - .18 Heating, Ventilating, and Air Conditioning.
 - .19 Inspections by Authorities having jurisdiction.
 - .20 Millwork.
 - .21 Fire Systems.
 - .22 System Start-Ups
 - .23 System Commissioning.

- .24 System Training.
- .25 Supplied equipment long delivery items.
- .26 Engineer supplied equipment required dates.
- .27 Installation of Scaffolding.
- .28 Removal of building envelope components for HVAC removal Room 2219. Day that separate access from the exterior is established.
- .29 Removal of existing HVAC equipment, waterproofing, new curb built-up, existing curb closing and weatherproofing to be coordinated with delivery of new rooftop HVAC units.
- .30 Mechanical room removal, exterior cladding and removal coordinated with delivery of air handling units.
- .31 Installation of air handling units.
- .32 Installation of ductless systems.
- .33 Building closed in and weatherproofed.
- .34 Interior finishing and fitting, mechanical and electrical work completed.
- .35 Substantial Completion (Interim Certificate).
- .3 Breakdown activities so that maximum duration of activities shown on schedule is 10 working days.
- .4 Ensure detailed Project Schedule shows the critical path.

1.7 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule as scope is added, activities are completed, slip or are ahead of schedule. Updates are to be submitted on weekly basis reflecting these activity changes and completions, as well as activities in progress to DCC Representative.
- .2 Include as part of Project Schedule, narrative report identifying work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 PROJECT MEETINGS

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

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

2023-02-17

Section 01 32 16.07
Construction Progress Schedule - Bar (GANTT) Chart

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.1 Not used.

END OF SECTION

Section 01 33 00 Submittal Procedures

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 45 00 - Quality Control.
- .2 Section 01 78 00 – Closeout Submittals.

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.3 SECTION INCLUDES

- .1 Shop drawings and product data.
- .2 Samples.
- .3 Certificates and transcripts.

1.4 ADMINISTRATIVE

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

1.5 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 produced by the Contractor, supplier, manufacturer, subcontractor, or fabricator to provide clear illustration of the requirements of the project. “Shop drawings” are required for all pre-fabricated items, but also are required for illustrating coordination and installation of mechanical, electrical and plumbing trades, generally referred to as “Interference Drawings”. Shop Drawing are to be first reviewed, stamped and signed by the General Contractor for compliance with project requirements.
- .2 Shop Drawings are to be purposely created for the project and therefore DCC will not provide electronic drawings for use in creation of shop drawings, the only exclusion to this point will be for use in Interference Drawings, where general layout plans may be provided and will be at the DCC Representative’s Discretion.
- .3 Shop Drawings are not intended to be “catch all” drawings, they are to be produced for this project, with correct dimensioning, indicating materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 The approval of shop drawings and product data by DCC Representative and Designer of Record is for the sole purpose of ascertaining conformance with the general concept. This review shall not mean that the DCC Representative and Designer of Record approves the detail design inherent, content in the shop drawings or product data or responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of responsibility for errors or omissions or responsibility for meeting all requirements of the construction and contract documents.
- .5 Without restricting the generality of the foregoing with respect to shop drawings and product data, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes, or to techniques of construction and installation and for co-ordination of the work of all sub-trades.
- .6 Allow 7 days for DCC Representative's review of each submission.
- .7 Adjustments made on shop drawings by DCC Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DCC Representative before to proceeding with Work.
- .8 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.
- .9 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data, and sample.
 - .5 Other pertinent data.

- .10 Submissions to include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of site measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified site 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.
- .11 After DCC Representative's review, distribute copies.
- .12 Submit 1 electronic copy of shop drawings for each requirement requested in specification Sections and as DCC Representative may reasonably request.
- .13 Submit 1 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.
- .14 Delete information not applicable to project.
- .15 Supplement standard information to provide details applicable to project.
- .16 If upon review by DCC Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of work may proceed. If shop drawings are noted "revise and re-submit" or "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.

1.6 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to DCC Representative's business address.
- .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 Adjustments made on samples by DCC Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DCC Representative before proceeding with Work.
- .6 Make changes in samples which DCC Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.7 MOCK-UPS

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

1.8 PROGRESS PHOTOGRAPHS

- .1 Submit progress photographs weekly, highlighting status of project, key components, site and building safety / environmental precautions/protections, materials, installations and any other pertinent details or items that should be part of the project record.
 - .1 Photographs are to be taken with a 4 mega pixel camera. Date stamped and saved to current electronic media.
 - .2 The contractor shall only take photos of their project, photography within existing buildings (if required) are not permitted and photography of DND/CAF personnel and vehicles are not permitted.

1.9 CERTIFICATES AND TRANSCRIPTS

- .1 Refer to the General Conditions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 35 15 Industrial Security Contractor

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 provide 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 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 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 Security Requirement Checklist (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 a VCR approval.
- .2 All employees of the successful bidder who will be working on 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 site 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.
 - .3 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. When a Private Sector Organization Screening (PSOS) is required:
 - .1 Contractors shall allow for 50 business days (from the date on which a complete and correct PSOS is submitted to CSP) for sub-contractors to be cleared to the level of DOS; and
 - .2 Contractors shall allow 124 business days (from the date on which a complete and correct PSOS is submitted to CSP) for sub-contractors to be cleared to the level of Secret.
 - .4 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 the site 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.

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 Contractors' 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

Section 01 35 35 DND Fire Safety Requirements

Part 1 General

1.1 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.2 FIRE INSPECTOR BRIEFING

- .1 DCC Representative shall coordinate arrangements for Contractor for briefing on Fire Safety at pre-work conference by Chief Fire Inspector or his appointed designated representative before work is commenced.

1.3 CONSTRUCTION FIRE SAFETY

- .1 Contractor is responsible for construction fire safety in accordance with NFC.

1.4 REPORTING FIRES

- .1 The Contractor shall inform the DCC Representative and Chief Fire Inspector or his appointed designated representative of all fire incidents at the construction site, regardless of size.
- .2 Know location of nearest fire alarm box and telephone, including emergency phone number.
- .3 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm box.
 - .2 Telephone.
- .4 Person(s) activating fire alarm box shall make themselves available to direct Fire Department to scene of fire.
- .5 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

1.5 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

- .1 Fire protection and alarm system will not be:
 - .1 Obstructed; and/or
 - .2 Shut-off;
 - .1 Should the fire protection system be isolated, FMD4006 needs to be applied.
 - .2 Should any portion of the fire protection or alarm system need to be shut off or bypassed as a direct requirement of the work, the Contractor shall:
 - .1 Provide a qualified technician, acceptable to DCC Representative.

- .2 Coordinate shutdown / bypass with the local fire department, Building Maintenance Technician (BMT, DND Chief Fire Inspector and DCC Representative.
 - .3 Inform all occupants of the building of the shutdown / bypass and of the revised fire reporting requirements.
 - .4 Post notification of impaired status of fire protection / alarm system and modified reporting requirements at each entrance / exit and each pull station throughout building.
 - .5 Keep duration of shutdown / bypass to a minimum. Shutdown / bypass shall not extend beyond regular working hours without authorization from Chief Fire Inspector.
 - .6 Provide under the Contract for Firewatch for the building for the duration of the shutdown / bypass.
 - .7 Where the Contract includes security requirements, the Contractor must provide security cleared personnel to maintain the Firewatch.
- .2 Fire hydrants, standpipes and hose systems will not be used for other than fire-fighting purposes unless authorized by Chief Fire Inspector.

1.6 FALSE ALARMS

- .1 Contractor will be responsible for reimbursement of all associated costs of false alarms due to failure to comply with requirements of 1.4, or through lack of due diligence resulting in a false alarm due to Contractor activities. Costs may include but are not limited to:
 - .1 Fire Department Response.
 - .2 Building Maintenance Technician Response.
 - .3 Chief Fire Inspector Response.
 - .4 Other associated charges to Owner.

1.7 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as scaled by Chief Fire Inspector or his appointed designated representative, 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 Chief Fire Inspector:
 - .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 Chief Fire Inspector or his appointed designated representative.
- .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.

1.8 FIRE SAFETY PLAN

- .1 Submit a Fire Safety Plan 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 submitted to the DCC Representative for review by Chief Fire Inspector or his appointed designated representative. Any comments by local fire department shall be implemented by the Contractor.
- .3 The Fire Safety Plan shall be limited to the area of construction only. Contractor is not responsible for amending fire safety plans in existing buildings.
- .4 Post the Fire Safety Plan at the entrance to the construction site or near the 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 the fire alarm sounds.
 - .4 Evacuating occupants, including special provisions for persons requiring assistance.
 - .5 Confining, controlling and extinguishing fires.
 - .6 The appointment and organization of designated supervisory staff to carry out fire safety duties.
 - .7 The training of supervisory staff and other occupants in their responsibilities for fire safety.
 - .8 Documents including diagrams, showing the type, location and operation of building fire emergency systems.
 - .9 The holding of fire drills (where applicable).
 - .10 The control of fire hazards in the building.
 - .11 The inspection and maintenance of building facilities provided for the safety of occupants.

1.9 ACCESS FOR FIRE FIGHTING

- .1 Access for firefighting shall be provided in accordance with the National Fire Code of Canada.

- .2 Advise the Chief Fire Inspector of work that would impede fire apparatus response. This includes violation of minimum horizontal and overhead clearance, as prescribed by the Chief Fire Inspector or his appointed designated representative, erecting of barricades and digging of trenches.
- .3 Minimum horizontal clearance: clear width of not less than 5m, or as defined by the Chief Fire Inspector or his appointed designated representative.
- .4 Minimum vertical clearance: overhead height of not less than 6m, or as defined by the Chief Fire Inspector or his appointed designated representative.

1.10 SMOKING PRECAUTIONS

- .1 Smoking is **not permitted** in DND buildings.
- .2 Smoking permitted in designated areas only.
- .3 Observe smoking regulations at all times.

1.11 RUBBISH AND WASTE MATERIALS

- .1 Rubbish and waste materials are to be kept to a minimum.
- .2 Burning and burying of rubbish is prohibited.
- .3 Removal:
 - .1 Remove all rubbish from work site at end of work day or shift or as directed.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove as required in 1.11.3.1.
 - .3 Contractor shall provide waste containers for their own use.

1.12 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handling, storage and use of flammable and combustible liquids are to be governed by current national Fire Code of Canada.
- .2 Flammable and combustible liquids such as gasoline, kerosene and naphtha will be kept 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. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires permission of Chief Fire Inspector or his appointed designated representative.
- .3 Transfer of flammable and combustible liquids is prohibited within buildings or jetties.
- .4 Transfer of flammable and combustible liquids will not be carried out in vicinity of open flames or any type of heat-producing devices.
- .5 Flammable liquids having a flash point below 38° C such as naphtha or gasoline will not be used as solvents or cleaning agents.
- .6 Flammable and combustible waste liquids, for disposal, will be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum and

Chief Fire Inspector or his appointed designated representative is to be notified when disposal is required.

1.13 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 Chief Fire Inspector or his appointed designated representative prior to and at completion of such work.

1.14 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 Departmental or Canadian Forces personnel. 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 the National Fire Code.
- .3 A watch, with tours at intervals of not less 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 or similar 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.

1.15 FIRE INSPECTION

- .1 Co-ordinate site inspections by Chief Fire Inspector or his appointed designated representative will be coordinated through DCC Representative.
- .2 Allow Chief Fire Inspector or his appointed designated representative unrestricted access to work site.
- .3 Co-operate with Chief Fire Inspector or his appointed designated representative during routine fire safety inspection of work site.
- .4 Immediately remedy unsafe fire situations observed by Chief Fire Inspector or his appointed designated representative.

1.16 SITE DELINEATION

- .1 When there are occupants in the same building as construction or the building becomes occupied prior to substantial completion, the Contractor must maintain a 1 hour fire separation as required by Section 01 56 00 – Temporary Barriers and Enclosures.

Part 2 Products

2.1 NOT USED

.1 NOT USED

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

COMPANY NAME

HOT WORK PERMIT

**CAN THIS JOB BE DONE WITHOUT HOT WORK, OR IN THE SHOP?
IF NOT, ENSURE PRECAUTIONS ARE IN PLACE!**

MAKE SURE SPRINKLERS ARE IN SERVICE AND FIRE EXTINGUISHERS ARE READILY AVAILABLE!

This Hot Work Permit is required for any operation involving open flames or producing heat and/or sparks.

This includes, but is not limited to, Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch-Applied Roofing, and Welding.

Note: The Required Precautions are not optional. They are required for fire-safe hot work. Please explain all "No" responses below.

Instructions**The Permit-Authorizing Individual must:**

- Verify precautions listed at right (or do not proceed with the work)
- Complete and retain this page
- Give the second page to the person doing the work.

Who, When, and Where?**Hot Work Being Done By**

- Employee
 Contractor

Date

Job/Work Order No.

Location/Building and Floor

Nature of Job/Object

Name of Person(s) Doing Hot Work

I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for work.

Signature of Permit-Authorizing Individual

Permit Expiration

Expiration Date

Expiration Time

- AM
 PM

Name of Assigned Fire Watch

**THIS PERMIT IS GOOD FOR
24 HOURS ONLY!**

Required Precautions Checklist

- Available Sprinklers in Normal Automatic mode and valve open.
 Hot Work equipment in good repair.

Assess 11 m/ 35 ft radial "sphere" of work for potential fire hazards:

- Floors, work level and below, cleaned or protected.
 All other combustibles removed or shielded from sparks.
- Clean horizontal surfaces (e.g. building structures, equipment, ducts, cable trays, etc.) above and below where possible.
 - Remove flammable liquids, dust, lint, combustible waste, oil deposits, etc., where possible.
 - If removal/cleaning is impractical, protect with fire-retardant covers, or shield with fire-retardant guards and/or curtains.
- Transmission or conveying of sparks to adjacent areas eliminated or protected.
- Tightly cover wall/floor openings with fire-retardant material.
 - Where openings cannot be sealed, suspend fire-retardant tarpaulins to help protect areas beneath.
 - Isolate or shut down fans and conveyors to prevent the capturing and conveying sparks to other areas.
- Explosive atmosphere eliminated or potential not present.

Work on walls, ceilings or enclosed equipment:

- Construction materials verified as noncombustible and without combustible covering or insulation.
 Combustibles on other side of walls relocated or protected.
 Enclosed equipment cleaned and protected from all combustibles.
 Containers purged of flammable liquids/vapors.

Fire watch/hot work area monitoring requirements:

- Continuous fire watch provided during and for *at least 30 minutes* after hot work, including all breaks.
 Fire watch supplied with suitable extinguishers/hoses.
 Fire watch trained in the use of fire equipment and sounding alarm.
 Area to be monitored hourly for a *minimum 30 minutes* after job is completed or longer if required.

Other precautions that may be required:

- Fire watch provided for adjoining areas, above, or below.
 Confined Space or Lock-Out-Tag-Out required/used.
 Area smoke or heat detection disabled to eliminate false trip.

Other: _____

Comments: _____

COMPANY NAME

HOT WORK PERMIT**WARNING! HOT WORK IN PROGRESS
WATCH FOR FIRE!**

- Person doing hot work:** Indicate time started and post permit at hot work location. After hot work, indicate time completed and leave permit posted for Fire Watch.
- Fire Watch:** Prior to leaving area, do final inspection, sign, leave permit posted and notify Permit-Authorizing Individual.
- Monitor:** After 30 mins, do final inspection, sign, and return to designated area.

Who, When, and Where?**Hot Work Being Done By**

- Employee
 Contractor

Date	Job/Work Order No.
------	--------------------

Location/Building and Floor

Nature of Job/Object

Name of Person(s) Doing Hot Work

I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for work.

Signature of Permit-Authorizing Individual

Time Started	<input type="checkbox"/> AM <input type="checkbox"/> PM	Time Finished	<input type="checkbox"/> AM <input type="checkbox"/> PM
--------------	--	---------------	--

Expiration Date	Expiration Time	<input type="checkbox"/> AM <input type="checkbox"/> PM
-----------------	-----------------	--

Work area and all adjacent areas to which sparks and heat might have spread were inspected during the fire watch period and were found fire safe.

Signature of Fire Watch	Time
-------------------------	------

Work area was monitored for a minimum of 30 minutes following hot work and found fire safe.

Signature of Monitor	Time
----------------------	------

Required Precautions Checklist

(must be retained as record of hot work activity for 6 months minimum).

Copy of this Permit to be send to William.MacDonald2@forces.gc.ca

General Precautions

- Available Sprinklers in Normal Automatic mode and valve open.
 Hot Work equipment in good repair.

Assess 35 ft radial "sphere" of work for potential fire hazards:

- Floors, work level and below, cleaned or protected.
 All other combustibles removed or shielded from sparks.
- Clean horizontal surfaces (e.g. building structures, equipment, ducts, cable trays, etc.) above and below where possible.
 - Remove flammable liquids, dust, lint, combustible waste, oil deposits, etc., where possible.
 - If removal/cleaning is impractical, protect with fire-retardant covers, or shield with fire-retardant guards and/or curtains.
- Transmission or conveying of sparks to adjacent areas eliminated or protected.
- Tightly cover wall/floor openings with fire-retardant material.
 - Where openings cannot be sealed, suspend fire-retardant tarpaulins to help protect areas beneath.
 - Isolate or shut down fans and conveyors to prevent the capturing and conveying sparks to other areas.
- Explosive atmosphere eliminated or potential not present.

Work on walls, ceilings or enclosed equipment:

- Construction materials verified as noncombustible and without combustible covering or insulation.
 Combustibles on other side of walls relocated or protected.
 Enclosed equipment cleaned and protected from all combustibles.
 Containers purged of flammable liquids/vapors.

Fire watch/hot work area monitoring requirements:

- Continuous fire watch provided during and for *at least 30 minutes* after hot work, including all breaks.
 Fire watch supplied with suitable extinguishers/hoses.
 Fire watch trained in the use of fire equipment and sounding alarm.
 Area to be monitored hourly for a *minimum 30 minutes* after job is completed, or longer if required.
 Arc welding
- Applicable Safety Equipment Required example Arc Shield

Other precautions that may be required:

- Fire watch provided for adjoining areas, above, or below.
 Confined Space or Lock-Out-Tag-Out required/used.
 Area smoke or heat detection disabled to eliminate false trip.

Other: _____

Comments: _____

COMPANY NAME

WARNING!

HOT WORK IN PROGRESS WATCH FOR FIRE!

IN CASE OF EMERGENCY:		FIRE WATCH/MONITOR RECORD		
		Checked by (initials)	Date	Time
CALL:				
AT:				

Fire Safety Precaution & Hot Process Roofing Work Permit Reverse Side

Hot Work Permit

Hot Roofing _____ Fiesta Heaters _____

Other _____

Location _____

Fire Watch Required: Yes No

Site Personnel Standby: Yes No

Provided by Contractor: Yes No

Fire Safety Precautions

- All fire incidents require an emergency response and must be reported immediately to Construction Engineering Help Desk by the following means:
 - activate the nearest fire alarm pull station and call 911, give the site location and your name
 - phone Construction Engineering Help Desk at local (416) 633-6200 Ext 3887
 - contact DCC Project Manager/ Coordinator
- The person initiating an alarm by fire alarm or telephone shall remain outside the building and direct the Fire Department members to the location of the fire.
- Before commencing the hot work, ensure adequate fire extinguishers are available, and note the location of the nearest fire alarm and telephone.

4. When required, Construction Engineering Help Desk or RP Op's Toronto Chief Fire Inspector or designated Authority will be contacted to notify the monitoring company to place the fire alarm systems in test mode. The site foreman or delegated authority will be responsible to notify the occupants of the building or facility to call 911 in case of an emergency and to investigate any alarm while the system is in test mode. Systems will be placed back online at the end of the workday unless authorized by the Chief Fire Inspector or designated Authority.

I have received a copy of the Hot Work Permit, and understand and agree to comply with all requirements. RP Op's (Toronto) Help Desk shall be notified immediately of any change affecting the operation authorized by the Hot Works Permit and comply to **CSA W11 7.2 Safety** in Welding, Cutting and Allied Processes. **NFPA 51B** Fire Prevention in use of Cutting and Welding Processes. **NFPA 241**, Safe Guarding Roofing Operations. Failure to comply with these safety precautions and pertinent codes may result in you or your company being held for any damages incurred.

CONTRACTOR CHECKLISTS

FIESTA HEATERS, ROOFING TAR HEATERS, STEAM JENNIES

All users of this equipment must exercise extreme care

- All operators are thoroughly trained and qualified in the proper start-up, shut-down and refuel procedures of the equipment in accordance with manufacturers instructions and applicable regulations.
- Fire extinguisher(s) present at the unit(s).

HOT PROCESS ROOFING WORK PERMIT

SPECIAL PRECAUTIONS THAT SHALL BE ADHERED

HOT ROOF TARRING (TAR KETTLE)

- Kettles equipped with thermometer on gauge
- Kettle to be Manned Continuously while in use distance a minimum of 15 ft. (5m) from buildings and supplies.
- Kettle must have metal cover to smother flames
- Fire extinguisher (20-B rating) within 7.6 m of tar kettle
- Fire extinguisher (2-A: 20-BC rating) on roof being repaired
- Kettle watch man must keep area clear and orderly
- Only glass fiber roofing mops
- Mops to be removed from roof daily after workday
- Mops must be stored away from combustible materials by at least 3 m from any building
- All roofing material shall be stored in locations at least 3 m from any building
- Fire Watch will be supplied by contractor doing work and be maintained for 30 minutes (.5 hour) after work completed

HOT ROOFING PERMIT PROPANE CYLINDERS & TORCHES

- Propane cylinders used on roof to be secured in upright position at all times
- Propane cylinders must be at least 4.5 m away from kettle at all times
- Larger, mobile tanks must be at least 7.6 m away from kettle
- Stored propane tanks must be at least 3 m from building
- Fire extinguisher (2-A: 20-BC rating) within 6.1 m of torch-applied roofing equipment
- All contractor's materials must be at least 3 m from building
- If torches used, special pre-cautions should be made around any combustible material and building
- Fire extinguishers shall be readily available when propane torches are in use
- Fire Watch will be supplied by contractor doing work and be maintained for 60 minutes (1 hour) after torches have been extinguished

Note: This permit is to be returned to RP Op's Toronto Chief Fire Inspector

1 **References**

FEDERAL

- .1 Applicable Base/Wing Environmental Administrative Instructions (AI) or Base Standing Orders (BSOs) will be provided to the Contractor after award.
 - .1 6.102 Spill Prevention and Response
 - .2 6.103 Environmental Assessment
 - .3 6.104 Species at Risk
 - .4 6.106 Halocarbon Management
 - .5 6.107 Storage Tank Management
 - .6 6.108 Solid Waste Diversion
 - .7 6.111 PCB Management
 - .8 Directorate Contaminated Sites (DCS) Contaminated Sites Instruction (CSI.004.001)- Imported Fill. 15 June 2020.
 - .9 DCS CSI (CSI.004.001) - Soil Management. V. 2.0, 20 Jan 2021.
- .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 Council of Ministers of the Environment. (CCME). *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products*. PN 1326. 2003.
- .4 *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.
 - .3 Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations. SOR/2008-197.

- .5 *Canada Labour Code- Canadian Occupational Health and Safety Regulations* (SOR/86-304). 2019.
- .6 *Canada Occupational Health and Safety Regulations* (SOR/86-304).
Canada Labour Code.
- .7 *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.
- .8 *Code of Practice for the Environmental Sound Management of End-of-Life Lamps Containing Mercury*. Environment and Climate Change Canada. 2017.
- .9 *Migratory Birds Convention Act, 1994*.
- .10 *Species at Risk Act*, 2003. Chapter 25-29, no.3.
- .11 *Transportation of Dangerous Goods Act* and pursuant regulations.

PROVINCIAL

- .12 *Ontario Water Resources Act*. Revised Statutes of Ontario 1990, Chapter O.40.
- .13 *Technical Standards and Safety Act, 2000* and pursuant regulations, codes, and standards. Statutes of Ontario 2000, Chapter 16.
- .14 *Environmental Protection Act*. Revised Statutes of Ontario 1990, Chapter E.19.
 - .1 Ontario Regulation 102/94. *Waste Audits and Waste Reduction Work Plans*.
 - .2 Ontario Regulation 103/94. *Industrial, Commercial, and Institutional Source Separation Programs*.
 - .3 Ontario Regulation 153/04. *Records of Site Condition*. Part XV.1 of the Act.
 - .4 Ontario Regulation 347. *General—Waste Management*. Revised Regulations of Ontario 1990
 - .5 Ontario Regulation 362. *Waste Management – PCB’s*.

- .6 Ontario Regulation 406/19. *On-site and Excess Soils.*
- .7 Ontario Regulation 407/19. *Records of Site Condition.* Part XV.1 of the Act.
- .8 Ontario Regulation 903. *Wells.*
- .15 *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.*
- .16 Ontario Ministry of Labour. 2011. *Lead on Construction Projects.*
- .17 Ontario Ministry of Labour 2011. *Silica on Construction Projects.*
- .18 Ontario Provincial Standard Specifications. Ontario Ministry of Transportation.

MUNICIPAL

- .19 City of Toronto - Municipal Sewer Use By-laws
- .20 City of Toronto - Municipal Noise By-laws

2 Related Sections

- .1 02 73 12 Halocarbon Management
- .2 02 82 00.01 Asbestos Abatement – Minimum Precautions
- .3 02 82 00.02 Asbestos Abatement – Intermediate Precautions
- .4 02 82 00.03 Asbestos Abatement – Maximum Precautions
- .5 02 83 10 Lead-Based Paint Abatement – Minimum Precautions
- .6 02 83 11 Lead-Based Paint Abatement – Intermediate 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 Response Plan (SRP).
 - .2 Hazardous Materials Abatement and Management Plan (HMAMP).
 - .3 Waste Management and Disposal Plan (WMDP).

Record of Abatement and as-built drawings identifying abatement to be completed, as identified in specification section(s) 02.82.00.01, 02.82.00.02, and 02.82.00.03 (Asbestos Abatement).
- .4 Submit other data, information and documentation upon request by the DCC Representative and as stipulated elsewhere in this section.

4 Designated Substances

- .1 Designated Substances and Hazardous Materials are outlined in Section 2, Related Sections.
- .2 In accordance with Section 30 of Ontario's *Occupational Health and Safety Act*, Investigations into the potential presence of designated substances and hazardous materials were completed at Defence Research and Development Canada Toronto (the "Site") with results documented in the report entitled: "*Designated Substances and Hazardous Materials Survey – HVAC Compliance Upgrades Defence Research and Development Canada Toronto, 1133 Sheppard Avenue West, Toronto Ontario*", dated April 25, 2023, prepared by Arcadis Canada Inc. The following is a summary of the asbestos-containing materials understood to exist at the site within the project area and which may be expected to be disturbed as part of the work:
 - .1 Asbestos-containing materials present and quantities expected to be disturbed or abated in order to complete the work:
 - .1 Non-friable asbestos-containing vinyl floor tiles from Rooms 1100 and 1516.

- .2 Non-friable asbestos-containing cement board in the pipe chase in Room 2102 and assumed to be behind the wall panels.
- .3 Non-friable asbestos-containing drywall joint compound in Rooms 1100, 1102, 1205A, 1213, hallway adjacent to 1213, Room 1516, A3, 1542, 1700, 2020C, 2024, 2102, 2205, 2209, 2213i, 2221 & Adjacent hallway, 2232, and 2209.
- .4 the estimated asbestos abatement required in each area listed in 4.2.1 above includes the following:
 - .1 Rooms 1100 and 1102 - one ceiling penetration into Room 2102 and the installation of five feet of electrical conduit onto drywall walls or ceilings with asbestos-containing drywall joint compound.
 - .2 Rooms 1205A, 1213 & Adjacent Hallway - two ceiling penetrations and installation of 150 feet of electrical conduit onto drywall walls or ceilings with asbestos-containing drywall joint compound.
 - .3 Rooms 1516 and A3 - one wall penetration, one ceiling penetration and the installation of 30 feet of electrical conduit onto drywall walls or ceilings with asbestos-containing drywall joint compound.
 - .4 Room 1700 - one ceiling penetration and installation of 50 feet of electrical conduit onto drywall walls or ceilings with asbestos-containing drywall joint compound.
 - .5 Room 2020C - three wall penetrations, one ceiling penetration and the installation of 50 feet of electrical conduit onto drywall walls or ceilings with asbestos-containing drywall joint compound.
 - .6 Room 2024 - five square feet of drywall with asbestos-containing drywall joint compound to be abated, six penetrations to roof above, including four for the unit below and two for the unit in Room 2020C.
 - .7 Room 2102 - four ceiling penetrations, including two for the unit below and two for the unit in Room 2102C, and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound.

- .8 Rooms 2205, 2209, 2221 & Adjacent Hallway - two ceiling penetrations in Room 2205/2209 and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound.
- .9 Room 2213i - two ceiling penetrations, one wall penetration and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound, and
- .10 Rooms 2232 and 2209 - two roof/ceiling penetrations, three wall penetrations, and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound.
- .5 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 00.01 Asbestos Abatement – Minimum Precautions
 - .2 02 82 00.02 Asbestos Abatement – Intermediate Precautions
 - .3 02 82 00.03 Asbestos Abatement – Maximum Precautions
- .2 Lead, mercury, and/or arsenic in paints:
 - .1 Lead, mercury, and/or arsenic are present in paints in the project area as follows:
 - .1 Yellow paint on piping on the Roof and contains 602 µg/g of lead.
 - .2 White wall paint on drywall in Rooms 1205A, 2205, 2132, 2213i and 2232 containing 16.1 µg/g mercury.
 - .3 Grey wall paint on drywall in Room 1542 containing 12.5 µg/g arsenic.
 - .4 Lead may also be present in pipe, mortar, glazing on ceramic tiles, in the solder on the seals of bell joints, and any cast iron drainpipes and in the solder of sweated on joints between copper pipes and fittings.
 - .2 Disturbances to lead and/or lead painted surfaces shall be conducted in accordance with the Ministry of Labour Guideline “*Lead on Construction Projects*” (2011).

- .3 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.
- .4 Leachate toxic lead paint is present on surfaces at the project site. Refer to specification Section 02 83 00.01 Lead Abatement for removal and disposal procedures.
- .5 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.
- .3 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).
- .4 Mercury Containing Lamps and Thermostats:
 - .1 Mercury is present within lighting lamps and bulbs, thermostats, thermometers, manometers and mechanical controls throughout the building.
 - .2 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).
 - .3 Lighting tubes contain mercury, must not be released to the environment. Therefore, the tubes must not be broken.
 - .4 Recycle all surplus mercury containing thermostats, lighting lamps and bulbs at a facility equipped to recover mercury.
- .3 Inform all workers and sub trades of the presence of designated substances and hazardous materials identified in the contract documents.
- .4 Immediately notify the DCC Representative of potential asbestos containing material (ACM) discovered during the work and not apparent from the drawings, specifications, or reports pertaining to the Work. Do not disturb such material.

- .5 For additional reference information, refer to report entitled: “*Designated Substances and Hazardous Materials Survey – HVAC Compliance Upgrades Defence Research and Development Canada Toronto, 1133 Sheppard Avenue West, Toronto Ontario*”, dated April 25, 2023, prepared by Arcadis Canada Inc.

5 General

- .1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, including in 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 In accordance with the City of Toronto 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: roles and responsibilities, contact information, spill notification procedure, emergency spill response measures, project and site-specific clean up measures for spills, waste disposal, restoration activities, and reporting requirements.
- .3 Identify storage locations of materials or wastes that may require emergency spill response. Identify spill control kit inventory and location(s).
- .4 SPRP shall identify equipment fueling location, methodology and control measures. Refueling operations shall be conducted within a secondary containment area. Refuel equipment no closer than 30 metres from water bodies.
- .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 Spill Incident Report shall be completed by the Contractor for all spill or release incidents.
- .6 Emergency Response:
 - .1 With respect to liquid spills, provide enough on-site equipment to control for one hour a liquid spill of 110% of any material brought on to—or handled at—the site.
 - .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. A spill control kit shall be located wherever significant 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 SPR Plan and make immediate notifications as per Administrative Instruction 6.102.

- .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 Establish and submit to the DCC Representative a Hazardous Materials Abatement and Management Plan (HMAMP) prior to work on-site.
- .2 The HMAMP will address the details of how designated substance(s) and hazardous material(s) will be abated and managed.
 - .1 Identify all municipal, provincial and federal permits and notifications required to complete the Work.
 - .2 Detail the approach to the execution of abatement work, including the equipment, tools, materials and actions to be employed for each type of hazardous material.
 - .3 A Layout Drawing identifying existing conditions with location of proposed enclosure(s), barricades and/or warning signs to restrict access, waste and personal decontamination facilities, and proposed location of waste bin.
 - .4 Proposed schedule accounting for day(s) projected for enclosure set up, abatement work, cleaning and lockdown, and enclosure tear down.

- .5 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 en-route to the waste bin.
- .3 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 of required abatement inspections is to be coordinated with the environmental consultant (contracted by Others) and the DCC Representative.
- .4 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).
- .5 Inform all workers and sub trades of the presence of designated substances and hazardous materials identified in the contract documents.
- .6 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.
- .7 Fire alarm suspension can be coordinated on week days between 7:30am and 3:30pm daily. Notification to DCC Representative, via submission of completed Request for Fire Alarm Shut Down form, is required a minimum of 5 days in advance of temporary fire alarm shut down
- .8 Written notification to DCC Representative required a minimum of 5 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.
- .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.
- .3 The Plan is to comply with legislation, best practices, and with the requirements of the specifications.
- .4 Provide evidence in the WMDP that all proposed temporary storage procedures, transport methods, and disposal sites are licensed where applicable.
- .1 Include copies of licenses.
- .5 The WMDP is to include handling, storage, transportation, disposal, and emergency response. Specific minimum requirements to be addressed are listed below.
- .6 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.
- .7 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.
- .8 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.
- .9 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.
- .10 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 days prior to transport:
 - .1 Description and approximate quantity of waste material, including substrate if applicable.
 - .2 Waste carriers' business name, address, contact information, and Ministry of Environment, Conservation and Parks (MECP) Certificate of Approval(s) listing the hazardous materials approved for transport.
 - .3 Contractor proposed date and time for hazardous waste material shipment.
 - .4 Hazardous waste receivers name, address, contact information, and MECP Certificate of Approval(s) listing the hazardous materials approved for their receiving site.
 - .5 Correspondence from the approved hazardous waste receiver, indicating agreement and intent to accept the specified hazardous materials waste on specified date.
- .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.
- .11 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 Mechanical flushing liquids shall not be discharged to a sanitary sewer (or other sewer). All flushing liquids must be collected and disposed of in accordance with all applicable regulation and requirements.
- .12 Special Wastes:
- .4 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.
- .13 Do not bury rubbish or waste materials on DND Property.
 - .14 Do not dispose of waste into any waterways, storm or sanitary sewers, drainage system, or onto land.
 - .15 Divert unused asphalt material from landfill to be reused offsite or recycled.
 - .16 All solid and liquid hazardous waste material generated by work are to be taken off site and disposed of in a lawful manner and at appropriately accredited facilities.
 - .17 All expenses incurred for the handling, storage, analysis, transport and disposal/recycling of all wastes will be incurred by the Contractor.

9 Unanticipated Soil Contamination

- .1 Refer to General Condition GC 4.4
- .2 Should unanticipated soil contamination be discovered:
 - .1 Stop work and assess the situation for safety.
 - .2 If situation does not appear to be safe, evacuate workers from area.
 - .3 If safe to do so, take immediate steps to control any spread of contamination, in accordance with Contractor's spill response plan.
 - .4 Immediately contact the DCC Representative for direction on how to proceed.

10 Pollution Prevention - Water

- .1 Protection of Storm Drains:
 - .1 Protect storm drains within work site and within roadway that borders work site (which may be outside of work site) against entry by sediment, debris, oil, or chemicals prior to any work on-site and maintain until completion of work.
 - .2 Discharge of sediment-laden water to storm sewer is not permitted.
 - .3 Catch basins and catch basin manholes within work site and within roadway that borders work site (which may be outside of work site) to have a double layer of geotextile placed under lids to prevent sedimentation of storm sewer system. The geotextile shall be maintained until the completion of work.
 - .4 Ditch inlets to be protected by flow check dam immediately upstream of ditch inlet until all areas draining into the ditch inlet have been permanently stabilized.
- .2 Protection of Drinking Water:
 - .1 In the event of a water main break, leak or disruption, Contractor is to stop work and notify the DCC Representative immediately.
 - .2 Water mains are to be disinfected with a 12% solution of sodium hypochlorite specific for drinking water supplies.

- .3 Coordinate with DCC Representative to have the Department of National Defence’s water authority; Water, Fuel and Environment (WFE) witness the connection, disinfection and flushing procedures as well as collect residual chlorine and bacteria samples.
- .4 Repeat disinfection procedure of water main as required in order to achieve acceptable test results.
- .3 Protection of Groundwater Monitoring Wells:
 - .1 Protect any and all existing groundwater monitoring wells at the site.
 - .2 The Contractor is responsible to repair any damage to existing monitoring wells. Work to be completed in compliance with Ontario Regulation 903.
 - .3 The DCC Representative will, upon request, show the Contractor the location of all known monitoring wells.

11 Pollution Prevention - Land

- .1 Take all measures necessary to prevent dust and mud tracking on adjacent roads and streets.
 - .1 Use mechanical sweepers as often as necessary to keep adjacent roads and streets clean of dust and mud that is deposited from this project.
- .2 Spray water to minimize the release of dust from paved areas or exposed soils.
 - .1 Chemical dust suppressants to be used only as approved by the DCC Representative.
- .3 Maintain temporary erosion and pollution control features installed under this Contract, and those in place pre-dating the Contract.
- .4 If materials are to be transported between sites, prevent any loss of material during transit.
- .5 Cover or wet down dry materials or rubbish to prevent blowing dust and debris.
 - .1 Cover or otherwise contain loose materials that have potential to release airborne particulates during their transport, installation or removal.

- .2 Stabilize soil and other material storage piles against wind erosion.
- .3 Minimize vehicle traffic on exposed soils and stabilize high traffic areas with clean gravel surface layer or other suitable cover material.
- .4 Avoid excavation, or other construction activity with potential to release airborne particulates, during windy and prolonged dry periods.
- .5 Restore disturbed areas as soon as possible to minimize the duration of soil exposure.
- .6 Lawn care pesticides are prohibited.
- .7 Secure covers on waste bins and dumpsters at the end of each working day so as to prevent unauthorized use.
- .8 Secure covers on waste bins and dumpsters so as to shed rain.

12 Pollution Prevention - Air

- .1 Prevent material from sandblasting, saw-cutting, and other operations from contaminating air beyond application area, by providing temporary enclosures.
- .2 Use new or well-maintained heavy equipment and machinery, preferably fitted with muffler/exhaust system baffles, engine covers.
- .3 Comply with operating specifications for heavy equipment and machinery.
- .4 Minimize the operation and idling of vehicles and avoid operating and idling vehicles and gas-powered equipment during smog advisories.
- .5 Control emissions from equipment and plant to conform with federal, provincial, and municipal requirements.
- .6 Products and Materials:
 - .1 Use products and materials that are as free as possible of noxious or toxic volatile emissions or emissions of irritating or toxic particles, so that the interior air of the completed building is as pollution-free as possible. For example, products emitting benzene, mercury, lead, or other known toxic compounds are not acceptable.

- .2 Where odourless products are not available, choose products where possible so that odours are minimized. Set ventilation levels during the construction period sufficiently high to encourage the off-gassing of materials to their minimum levels prior to occupancy of the building, where possible.
- .3 Choose products for installation within the air-handling and distribution systems to minimize the introduction of pollutants into the fresh air supply to the building.
- .4 Remove oily rags and other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.

13 Archaeology

- .1 Refer to General Condition GC 6.3
- .2 Artifacts can include broken housewares, garbage, bits of uniforms, ships or boats, timber, ammunition, building materials, building foundations, cut stone, stone drains, animal bones, human bones, coins or tokens, ash pits, fire pits, encampments, Aboriginal materials, pottery, etc.
- .3 During excavations, watch for the following: patterns; off-colour soils (either light or dark); any sorts of the artifacts noted above.
- .4 Excavations must coincide with the archaeology field period, from April until November.
- .5 Upon discovery of artifacts, stop work in that area and notify the DCC Representative.
- .6 An archaeologist licensed in Ontario will monitor all excavation work or disturbance of the existing ground.
 - .1 Coordinate through the DCC Representative for monitoring of excavations by the archaeologist.
 - .2 A minimum 48 hours notice is required for any excavation in which archaeological monitoring has been stipulated.
- .7 Expect interruptions of excavation work by the archaeologist of up to 2 hours per day. Interruptions for longer periods will be negotiated between the General Contractor and the DCC Representative, in accordance with the General Conditions of the contract.

14 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 Facilities Maintenance Contractor.
- .5 The following are the only halocarbons that are acceptable as refrigerants (non-halocarbon refrigerants are also acceptable):
 - .1 HFC 410A;
 - .2 HFC 134A;
 - .3 HFC 404A.
- .6 Document **all** work—installation, maintenance, decommissioning, leak testing on refrigeration and air conditioning systems using *Refrigeration and Air Conditioning Service Form (See below)*. 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 and provide to DCC Representative within 24 hours.

- .2 Complete Halon Release Report - Annex C to AI 6.106 Halocarbon Management, and submit to DCC Representative.
- .9 Leak-test all halocarbon-containing equipment within 24 hours of arrival at the Site, in accordance with the FHR 2022 and the *Refrigeration Code of Practice*.
- .10 Leak-test all nitrogen-charged or “empty” equipment within 24 hours of arrival at the Site, 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 Site 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 Site 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 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;

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

.14 Halocarbon Service/Activity Log Form

Refrigeration and Air Conditioning Service Version:16 Oct 14

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, 4.0	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 # _____ Operator: _____
 Room # Location _____ Owner: _____
 Local Equipment ID # _____ Owner Address: _____
 Equipment Description _____

SECTION B.

Work Order No. _____ Service Date (DD/MM/YY) _____
 Model Number _____ Serial Number _____
 Manufacturer _____
 DND/FM HVAC Contracting Company (print) _____
 DND/FM Technician Contractor Technician (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			Approximate Release Amount: Releases shall be reported to Grn Env within 24 hrs of detection
1.2 Leak(s) Repaired			
2.1 Halocarbon Recovered From System			
2.2 Halocarbon Isolated In System			
3.0 System Charged With Halocarbon			FACTORY <input type="checkbox"/> FIELD <input type="checkbox"/>
4.0 Leak Test Method			Enter Method Used: _____

SECTION D.

1. Technician's ODP Card # _____ Expiry Date _____
2. Type of Halocarbon _____
3. Total Halocarbon Charge Capacity (Factory and Field Charge) _____ (kg) (lb) (oz)
4. Charged by: Contractor Factory DND Amount of Halocarbon Charged _____ (kg) (lb) (oz)
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 (Mass Balance) DND/FM HVAC (Mass Balance) _____
10. Final Destination of Equipment: _____
11. Final Destination of Halocarbon: _____
12. Final Destination of Refrigerant Oil: _____
13. Technician Signature _____

Note: Minimum 2 Service Logs MUST Remain Affixed to the System, both displaying date of last leak test.
 Questions regarding this form can be directed to the local Grn Environment Office

WHITE (Top) – Attach to equipment YELLOW (Petawawa only) – Grn Pet ESS PINK – HVAC Team Leader (Grn Pet) or FM Contractor (Grn Tor)

Annex C to
 AI 6.106 - Halocarbon Management

HALOCARBON/ HALON RELEASE REPORT

(All fields in bold are required fields)

Date and Time of Occurrence:		hrs
Date and Time of Discovery:		hrs
Release Stopped Date & Time:		hrs
Reported By:		Local:
Location:		
Source of Spill (System/Cylinder Serial Number):		
Location of Spill (Building Number/Vehicle CFR):		
Type and Description of System:	<input type="checkbox"/> refrigeration <input type="checkbox"/> solvent system <input type="checkbox"/> air conditioning <input type="checkbox"/> halon cylinder <input type="checkbox"/> fire extinguishing <input type="checkbox"/> Other: _____	
System Name (for systems only):		
Unit Name (for vehicle cylinders only):		
Release Information:		
Material Released (Type of Halocarbon/Halon):		
Quantity Released:	lbs <input type="checkbox"/>	kg <input type="checkbox"/>
Quantity Recovered:	lbs <input type="checkbox"/>	kg <input type="checkbox"/>
Released by Unit:		
Significant Incident Report Required/Generated:	Y <input type="checkbox"/> or N <input type="checkbox"/>	
Cause of Spill (i.e. accidental discharge):		
Corrective Action:		
Technician Name:		
Technician ODP Number:		
Additional Comments: (i.e. replacement bottle serial number)		

****Note** The Local Garrison Environment Office must be notified immediately for a release of halocarbon that is 100kg (220lbs) or greater and for a release of any amount of halon (fire extinguishers). All other releases must be reported within 24 hours of detection.**

15 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

Section 01 41 00 Regulatory Requirements

Part 1 General

1.1 REFERENCES AND CODES

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

1.2 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: Demolition asbestos is hazardous to health. Should material resembling asbestos be encountered in course of demolition work, immediately stop work and notify DCC Representative.
- .2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify DCC Representative.
- .3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify DCC Representative.

1.3 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.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 45 00 Quality Control

Part 1 General

1.1 RELATED SECTIONS

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

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other divisions of this Project Manual.

1.3 SECTION INCLUDES

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Tests and mix designs.
- .3 Mock-ups.
- .4 Equipment and system adjust and balance.

1.4 INSPECTION

- .1 Review and inspection of the Work as per GC 2.5 of the General Conditions.
- .2 Give timely notice requesting inspection if the Work is designated for special tests, inspections or approvals by DCC Representative instructions, or law of Province of Ontario.
- .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 shall pay cost of examination and replacement.

1.5 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by the Contractor for purpose of inspecting and/or testing portions of the Work. Cost of such services will be borne by the Contractor. Cost of such services will be included in the Tender Price.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform the 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/Owner. Pay costs for retesting and re-inspection.

1.6 ACCESS TO WORK

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

1.7 PROCEDURES

- .1 Notify appropriate agency and DCC Representative 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.

1.8 REJECTED WORK

- .1 Remove defective work, whether result of poor workmanship, use of defective products or damage and whether incorporated in the 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.
- .3 If in opinion of DCC Representative it is not expedient to correct defective work or work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between work performed and that called for by Contract Documents, amount of which will be determined by DCC Representative.

1.9 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, manufacturer or fabricator of material being inspected or tested.

1.10 TESTS AND MIX DESIGNS

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

1.11 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 and as specified in specific Section.
- .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 Approved mock-ups may remain as part of the Work.

1.12 EQUIPMENT AND SYSTEMS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Section 01 51 00 Temporary Utilities

Part 1 General

1.1 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.2 RELATED SECTIONS

- .1 Section 01 35 35 – DND Fire Safety Requirements.
- .2 Section 01 52 00 – Construction Facilities.
- .3 Section 01 56 00 – Temporary Barriers and Enclosures.

1.3 POWER AND WATER SUPPLY

- .1 DND can provide free of charge temporary electric power for construction purposes.
- .2 If the potable water is available, DND can provide continuous supply of potable water for construction use.
- .3 The DCC Representative will determine delivery points and quantitative limits. The DCC Representative's written permission is required before any connection is made. Connect to existing power supply in accordance with Canadian Electrical Code.
- .4 Provide at no cost to DND, all Equipment and temporary lines to bring these services to the project site.
- .5 Supply of temporary services by DND is subject to DND requirements and may be discontinued by DND at any time without notice, without acceptance of any liability for damage or delay caused by such withdrawal of temporary services.
- .6 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 Lx.
- .7 Use of temporary power by DND is not to be used for temporary heating or ventilation. Contractor will arrange and pay for required temporary heating and ventilation during construction.
- .8 Shut downs of existing electrical building services must be kept at a maximum of 8 hrs. Notify the DCC Representative 5-working days prior to the shut down day.
- .9 The Contractor shall provide all necessary labour and materials to provide temporary power to all buildings involved during any shut downs lasting longer than the specified time frame.
- .10 The Contractor shall provide GFI's for all tools and extension cords.

1.4 INSTALLATION AND REMOVAL

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

1.5 DEWATERING

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

1.6 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Consult DCC Representative to see if permanent heating system of building may be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 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.

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

1.7 TEMPORARY COMMUNICATION FACILITIES

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

1.8 FIRE PROTECTION

- .1 Refer to Section 01 35 35 – DND Fire Safety Requirements.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

END OF SECTION

Section 01 52 00 Construction Facilities

Part 1 General

1.1 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other divisions of this Project Manual.

1.2 RELATED SECTIONS

- .1 Section 01 51 00 – Temporary Utilities.
- .2 Section 01 56 00 – Temporary Barriers and Enclosures.

1.3 SECTION INCLUDES

- .1 Construction aids.
- .2 Office and sheds.
- .3 Parking.
- .4 Project identification.

1.4 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CGSB 1.189, Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59, Alkyd Exterior Gloss Enamel.
 - .3 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .4 CSA-0121-M, Douglas Fir Plywood.
 - .5 CAN/CSA-S269.2-M, Access Scaffolding for Construction Purposes.
 - .6 CAN/CSA-Z321, Signs and Symbols for the Occupational Environment.

1.5 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 Indicate use of supplemental or other staging area.
- .3 Provide construction facilities in order to execute work expeditiously.
- .4 Remove from site all such work after use.

1.6 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs. Remove promptly when no longer required.

- .3 Scaffolding system designs above certain heights will have to be stamped by a Professional Engineer registered in the Province of Ontario.

1.7 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.
- .3 Provide proof of insurance for crane subcontractors.

1.8 ELEVATORS

- .1 Designated existing and permanent elevators may not be used by construction personnel and transporting of materials.

1.9 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.

1.10 CONSTRUCTION PARKING

- .1 DCC Representative will determine if parking is available on site.
 - .1 If available, parking will be permitted on site provided it does not disrupt performance of Work. Maintain and administer these spaces as directed.
- .2 Provide and maintain adequate access to project site.
- .3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

1.11 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.12 SANITARY FACILITIES

- .1 Contractor to provide sanitary facilities for own work force in accordance with governing regulations and ordinances.
- .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.

1.13 CLEAN-UP/SITE MAINTENANCE

- .1 Maintenance / restoration of existing site features within contractor compounds are the responsibility of the Contractor, including but not limited to:
 - .1 Snow / Ice removal on roadways and walkways.

- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Grass cutting.
- .4 Clean-up of flower beds and gardens.
- .5 Restoration of grassed areas.
- .2 Remove construction debris, waste materials, packaging material from work site daily.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 56 00 Temporary Barriers And Enclosures

Part 1 General

1.1 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.2 RELATED SECTIONS

- .1 Section 01 51 00 – Temporary Utilities.
- .2 Section 01 52 00 – Construction Facilities.
- .3 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

1.3 SECTION INCLUDES

- .1 Barriers.
- .2 Environmental Controls.
- .3 Traffic Controls.
- .4 Fire Routes.

1.4 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 [CGSB 1.59](#), Alkyd Exterior Gloss Enamel.
 - .2 [CAN/CGSB 1.189](#), Exterior Alkyd Primer for Wood.
- .2 CSA Group (CSA)
 - .1 [CSA-O121](#) Douglas Fir Plywood.
- .3 Ministry of Transportation, Ontario (MTO).
 - .1 Ontario Traffic Manual, Book 7: Temporary Conditions [2022]

1.5 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 and as indicated.

1.6 INSTALLATION AND REMOVAL

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

1.7 HOARDING

- .1 Erect temporary site enclosure using minimum 1.8 m high interlocking self-supporting fence. Provide one lockable truck gate and one lockable man gate. Maintain fence in good repair. Provide ballast to fence base and dust screening on full perimeter of fencing.

- .2 Erect temporary site enclosures using 38 x 89mm construction grade lumber framing at 600mm centres and 1200 x 2400 x 13mm exterior grade fir plywood to CSA O121.
- .3 Apply plywood panels vertically flush and butt jointed.
- .4 Provide one lockable truck entrance gate and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.
- .5 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .6 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.
- .7 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m on centre. Provide one lockable truck gate. Maintain fence in good repair.
- .8 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.8 HOARDING WITHIN OCCUPIED BUILDING

- .1 When there are occupants in the same building as construction or the building becomes occupied prior to substantial completion, the Contractor must maintain a 1 hour fire separation between the site and the occupied portion of the building.

1.9 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.

1.10 DUST TIGHT SCREENS

- .1 Provide dust tight screens or insulated partitions 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.
- .3 Room X contains sensitive IT equipment that is dust sensitive and costly to repair or replace. In addition to general dust control measures as outlined in this contract, the contractor shall establish additional dust control measures (for example fully sealed dust enclosures) to ensure dust is contained within the immediate worksite and construct hoarding to protect sensitive equipment in the room. The enclosure(s) shall:
 - .1 Protect the equipment inside the room from damage due to dust, debris and accidental impact and,
 - .2 Allow for continued and unimpeded access and use of the equipment by DND/DRDC personnel.

- .4 The Contractor shall include allowances in their bid for coordination with DRDC for the abovementioned enclosure. The Contractor shall allow for a minimum of two (2) weeks for DCC/DND/DRDC to review the constructed enclosure prior to the start of work and shall make alterations as required at no additional cost to DND. Work shall not commence in this area until the Contractor's dust and debris control measures have been reviewed and any alterations required have been completed.

1.11 ACCESS TO SITE

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

1.12 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.

1.13 FIRE ROUTES

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

1.14 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.

1.15 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 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 61 00 Common Product Requirements

Part 1 General

1.1 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.2 SECTION INCLUDES

- .1 Product quality, availability, storage, handling, protection and transportation.
- .2 Manufacturer's instructions.
- .3 Quality of Work, coordination and fastenings.
- .4 Existing facilities.

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

1.4 AVAILABILITY

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

1.5 STORAGE, HANDLING AND PROTECTION

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

- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of 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.

1.6 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Owner. Unload, handle and store such products.

1.7 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.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 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 directed.

1.13 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.

1.14 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.

1.15 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.

1.16 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute work in accordance with Section 01 14 00-Work Restrictions.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 70 03 Safety Requirements

Part 1 General

1.1 SUBMITTALS

- .1 Submit to the DCC Representative copies of the following documents, including updates issued:
 - .1 Site-specific Health and Safety Plan (including hazard assessment) 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 As a minimum, comply with the Canada Labour Code Part II Part 125(1)(l) and 125(1)(w), and the Canada Occupational Safety and Health Regulations made under Part II of the Canada Labour Code.
- .3 A copy of the Canada Labour Code Part II may be obtained by contacting:

Canadian Government Publishing

Communication Canada

Ottawa, Ontario, K1A 0S9

Telephone: (613) 941-5995 or 1-800-635-7943)

Catalogue No. L31-85-2003 (E or F)

ISBN 0-660-18897-X

A condensed version can be viewed on-line at <http://laws.justice.gc.ca/en/index.html>

- .4 Where the Garrison Toronto Health and Safety Program may stipulate more stringent requirements than identified in the Canada Labour Code Part II and the Canada Occupational Safety and Health Regulations made under Part II of the Canada Labour Code, the DCC Representative shall provide the Contractor with the applicable excerpts from the Health and Safety Program.
- .5 Observe and enforce construction safety measures required by:
 - .1 National Building Code of Canada (latest edition).
 - .2 Provincial Worker's Compensation Board.
 - .3 Municipal statutes and ordinances.
- .6 In event of conflict between any provisions of above authorities the most stringent provision shall apply. Should a dispute arise in determining the most stringent requirement, the DCC Representative shall advise on the course of action to be followed. In the case of direct conflict between the federal and provincial/territorial regulatory Health and Safety instruments noted above in paragraphs 1.2.1 and 1.2.2, the Canada Labour Code shall be the default regulatory instrument.
- .7 Provide and maintain Worker's Compensation Board 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 letter [certificate] of Clearance from the Workers' Compensation Board indicating that the Contractor's account is in good standing.

1.3 RESPONSIBILITY

- .1 In accordance with the Canada Labour Code Part II, the obligations and responsibilities for safety reside with the Department of National Defence. The DCC Representative on behalf of the Department of National Defence will monitor safety on the Work Site in accordance with the Canada Labour Code Part II and the Canada Occupational Safety and Health Regulations made under Part II of the Canada Labour Code.
- .2 Carry out work placing emphasis on health and safety of the public, building employees, site personnel and protection of the environment.
- .3 The Contractor is responsible to enforce compliance by its employees and sub-contractors accessing the Work Site with safety requirements of Contract Documents, and all applicable federal, provincial, local statutes, regulations, and ordinances.
- .4 The Contractor is responsible to manage safety of the work site to ensure that any persons, including but not limited to, building employees and the general public circulating adjacent to the work operations are protected against harm due to the extent that they may be affected by conduct of the work.
- .5 Contractors are required under the Canada Labour Code Part II to conduct site specific occupational health and safety meetings. For the purpose of this contract, the Contractor is responsible to establish and conduct site specific occupational health and safety meetings on a monthly basis, with no less than one (1) meeting for contracts that are less than one (1) month in duration.
- .6 The Contractor is responsible to record and post minutes of all site specific occupational health and safety meetings in plain view on the work site. Make copies available to the DCC Representative upon request.

- .7 The Contractor is responsible to designate a competent person or persons to be present on site at all times during the work as the site health and safety representative. The designated person(s) shall be required to conduct regularly scheduled safety inspections of the work site as follows:
 - .1 Informal inspections on a minimum weekly basis noting deficiencies and remedial actions taken in a log book or diary. Make the log book and/or diary available for the DCC Representative's viewing as requested.
 - .2 Formal inspections on a minimum monthly basis, with no less than one (1) inspection for contracts that are less than one (1) month in duration and is provide a written report to the DCC Representative for each formal inspection, document deficiencies, remedial action needed and assign responsibility for rectification to the appropriate party.
- .8 The Contractor is responsible to ensure Contractor employees and sub-contractors accessing the work site are in possession of and wear appropriate personnel protective equipment (PPE).
- .9 Daily or weekly field level hazard assessment shall be completed by the Contractor and communicated to all employees and occupant representative with the intent to identify known and potential hazards associated with current and future work tasks. The Contractor shall establish and implement control measures for known and potential hazards that have been identified.
- .10 Should an unforeseen or peculiar safety related hazard or condition become evident during performance of work, the Contractor is responsible to immediately take measures to rectify the situation and prevent damage or harm and to advise the DCC Representative verbally and in writing of the hazard or condition.

1.4 SITE CONTROL AND ACCESS

- .1 The Contractor shall be responsible after consultation with the DCC Representative to control all work site access points and work site activities.
- .2 Delineate and isolate the work areas where possible from adjacent and surrounding occupied areas to separate the construction from the building occupants with a rigid physical and visual separation or protection. Infrastructure will remain operational, occupied and utilized by the Department of National Defence throughout the duration of the work of this contract.
- .3 On behalf of the Department of National Defence, Defence Construction Canada will be performing a safety monitoring function as required by the Canada Labour Code in order to verify that the Contractor is fulfilling all of the required responsibilities and duties as identified above. This monitoring function will be performed throughout the duration of the contract.
- .4 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.:

1.5 FILING OF NOTICE

- .1 File Notice of Project and any other required Notices with the Provincial/Territorial Authorities 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.
- .2 Post all permits, licenses and compliance certificates on work site and provide copies to the DCC Representative.

1.7 PROJECT/SITE CONDITIONS

- .1 Refer to Section 01 35 43 Environmental Protection for details on Designated Substances and Hazardous Materials.
- .2 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.
- .3 Obtain from the DCC Representative, a copy of the MSDS data sheets of the existing hazardous materials stored on site or being used by facility personnel in the course of their operations.
- .4 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 the Contractor's site superintendent. The DCC Representative will arrange to have the Contractor's site superintendent and designated site health and safety representative briefed on the specific content of the Base Health and Safety Program where it requires more stringent requirements than stipulated in the Canada Labour Code Part II and the Canada Occupational Safety and Health Regulations made under Part II of the Canada Labour Code. The DCC Representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.
- .2 The Contractor is responsible to conduct safety meetings as required by paragraph 1.3.5 above.

1.9 HEALTH AND SAFETY PROGRAM

- .1 The Canada Labour Code Part II and the Canada Occupational Safety and Health Regulations made under Part II of the Canada Labour Code provides the Contractor with the overall program of health and safety for operations on the project site. For the purpose of this contract, the Contractor shall perform a hazard assessment of the work site in order to acknowledge, assess and address the hazardous substances and/or hazardous conditions known and identified in paragraph 1.7, and to develop a written site-specific Health and Safety Plan as related to these known hazards. The Contractor

shall be required to write the site-specific Health and Safety Plan for review by the DCC Representative. The site-specific Health and Safety Plan shall include provisions for on-going hazard assessments performed during the progress of work identifying and documenting new or potential health risks and safety hazards not previously known and identified.

- .2 The format of the site-specific Health and Safety Plan shall at a minimum for the purpose of this contract contain the following three (3) parts:
 - .1 Part 1: Detailed description of the project and a list of individual health risks and safety hazards identified by the contractor's detailed site specific hazard assessment(s).
 - .1 List of critical construction activities to be communicated with the DCC Representative which could affect infrastructure operations, or pose a risk to the health and safety of the occupants, Contractor employees and to the general public.
 - .2 Part 2: List of specific measures to control or mitigate each hazard and risk identified in part one of the Plan. Describe the engineering controls, personnel protective equipment, safe work practices and any other applicable means to be implemented and followed when performing work related to each identified hazard or risk. Part 2 of the Plan must also include:
 - .1 In the management of safety responsibility, provide the name of the competent employee(s) assigned as site safety representative(s) who is (are) to be present on site at all times during work..
 - .2 A written statement, where applicable, that the Contractor has been made aware of known hazards and hazardous substances referred to under paragraph 1.7, and that the Contractor will inform all Contractor employees, sub-contractor employees and any persons affected or potentially affected by the work of this contract of the known hazards.
 - .3 A written statement confirming that Contractor employees, sub-contractors and other authorized persons accessing the work site are trained and have been fully instructed in:
 - .1 Safe operation of tools and equipment.
 - .2 Proper wearing and use of personnel protective equipment (PPE) as applicable to the purpose and activities to be conducted on site.
 - .3 Safe work practices and procedures to be followed during the performance of their given work tasks or function on the work site.
 - .4 Work site conditions and minimum site safety rules provided through safety orientation sessions.
 - .4 A copy of the Contractor's health and safety policy and disciplinary policy that will be followed to enforce compliance by Contractor employees and sub-contractors with safety requirements of contract documents, applicable regulations and the Contractor's site-specific Health and Safety Plan.

- .3 Part 3: Emergency Measures and Communications Procedures as follows:
- .1 Emergency Measures: On-site operating procedures, evacuation measures and emergency response to be implemented in the occurrence of an accident or incident. Procedures to be specific and relevant to identified hazards. Measures to complement and be integrated with the Facility Emergency Response Plan(s) in place at site.
 - .2 Confirmation of the location of nearest fire alarm activation box and telephone.
 - .3 A map depicting the location of the nearest emergency medical facility.
 - .4 The location of emergency equipment and supplies including but not limited to first aid kits, emergency eye wash stations, spill kits/equipment and fire extinguishers. Including confirmation that equipment and supplies have been verified/certified for use.
 - .5 The names of all persons assigned responsibility by the Contractor as a first aid attendant at the project.
 - .6 An inventory listing the common name of all controlled products (WHMIS Products) that the Contractor knows or intends to bring to the project site. List to be updated as necessary as project proceeds.
 - .7 A copy of the Contractor's accident/incident investigation policy and incident and accident report form(s) to be used by the Contractor to document any incident or accident that might occur during the course of project work.
 - .8 Communication procedures:
 - .1 List of names and telephone numbers of designated official(s), to be contacted should an incident or emergency situation occur, including the following:
 - .1 Contractor and all sub-contractors.
 - .2 Federal and Provincial departments and local emergency resources organizations, as applicable to the hazards identified and type of accident or incident which might occur, in accordance with applicable laws and regulations.
 - .2 Procedures implemented at site to communicate and share information between Contractor employees, sub-contractors, and the Contractor on work site activities, and in particular those which might endanger employees and facility occupants and infrastructure users.
 - .3 The procedure to be followed by contract personnel to initiate emergency response by fire, police and medical personnel.
 - .4 Post a copy, including all updates, of the Health and Safety Plan in a common visible location at work site.
- .3 Provide one copy of the site-specific Health and Safety Plan 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 both Canada Labour Code Part II and the Canada Occupational Safety and Health Regulations made under Part II of the Canada Labour Code and the contract requirements related to the known hazardous substances and/or hazardous conditions.

- .4 Provide and maintain one copy of the site-specific Health and Safety Plan at the work site, in a location that is easily accessible by all Contractor employees, sub-contractor employees and any persons affected or potentially affected by the work of this contract.

1.10 MINIMUM SITE SAFETY RULES

- .1 Notwithstanding the requirement to abide by federal and provincial health and safety regulations, the following safety rules shall be considered minimum requirements at the work site and obeyed by all persons accessing the work site:
 - .1 Wear PPE appropriate to the function and task while on the work site.
 - .2 Immediately report unsafe activities, conditions, near miss accidents, injuries and damages.
 - .3 Maintain the work site in a tidy condition.
 - .4 Obey warning signs and safety tags.

1.11 ACCIDENT REPORTING

- .1 Investigate and report incidents and accidents as required by Canada Labour Code Part II and the Ontario Occupational Safety and Health Act, and the Regulations made pursuant to the Act.
- .2 For the purpose of this contract immediately investigate and provide a report 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 Near misses or other incidents.
 - .3 Exposure to toxic chemicals or substances.
 - .4 Property damage.
 - .5 Interruption to adjacent and/or integral infrastructure operations with potential loss implications.

1.12 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.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

2023-02-17

Section 01 70 03
Safety Requirements

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3.1 NOT USED

.1 Not Used.

END OF SECTION

Section 01 71 00 Examination And Preparation

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 32 16.07 Construction Progress Schedule –Bar Chart.

1.2 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practice in Province of Ontario, acceptable to DCC Representative.

1.3 SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on Drawings.
- .2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to DCC Representative.
- .4 Report to DCC Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

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

1.5 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify DCC Representative of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by DCC Representative.
- .3 Prior to any excavation, the Contractor is to obtain all Utility line locates.

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 when required by DCC Representative.

1.7 RECORDS

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

1.8 SUBMITTALS

- .1 Submit name and address of Surveyor to DCC Representative.
- .2 On request of DCC Representative, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform to Contract Documents.

1.9 SUBSURFACE CONDITIONS

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

1.10 RECORDS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

2023-02-17

Section 01 71 00
Examination And Preparation

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END OF SECTION

Section 01 73 03 Execution

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 00 10 05 – General Instructions.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Individual product Sections: cutting and patching incidental to work of section. Advance notification to other sections required.

1.2 SUBMITTALS

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

Part 2 Products

2.1 MATERIALS

- .1 Required for original installation.

2.2 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 may be exposed by uncovering work; maintain excavations free of water.

Part 3 Execution

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

END OF SECTION

Section 01 74 11 Cleaning

Part 1 General

1.1 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 43 – Environmental Procedures.
- .3 Section 01 77 00 – Closeout Procedures.
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.3 SECTION INCLUDES

- .1 Project cleanliness.
- .2 Final cleaning.

1.4 PROJECT CLEANLINESS

- .1 Contractor to comply with applicable requirements of Section 01 35 43 regarding the storage, transport and disposal of construction waste materials.
- .2 Contractor to provide on-site containers for collection of waste materials and debris. Containers to be provided by a licensed hauler.
- .3 Contractor to submit a waste management and disposal plan in accordance with Sections 01 33 00, 01 35 43, & 01 74 21 for approval by DCC Representative. Storage, transport and disposal of construction waste and debris to be in accordance with approved plan.
- .4 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other contractors.
- .5 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by DCC Representative. Do not burn or bury waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Provide on-site containers for collection of waste materials and debris.
- .8 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .9 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .10 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

- .11 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .12 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .13 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .14 Contractor shall clean up on a daily basis building surfaces outside the construction area that get construction debris or dust.

1.5 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by Owner or other contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by DCC Representative. Do not burn or bury waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 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.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fittings, walls, floors and ceiling.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .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.
- .20 Complete full professional duct cleaning as required.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 74 21

Construction/Demolition Waste Management And Disposal

Part 1 General

1.1 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.2 WASTE MANAGEMENT GOALS

- .1 Accomplish maximum control of solid construction waste.
- .2 Preserve environment and prevent pollution and environment damage.

1.3 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures

1.4 DEFINITIONS

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Demolition Waste Audit (DWA): relates to actual waste generated from project. Refer to as "Schedule C".
- .3 Inert Fill: inert waste - exclusively asphalt and concrete.
- .4 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .5 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .6 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .7 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .8 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .9 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .10 Separate Condition: refers to waste sorted into individual types.
- .11 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

- .12 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to as "Schedule A".
- .13 Waste Management Coordinator (WMC): Contractor Representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .14 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to as "Schedule B". WRW is based on information acquired from WA (Schedule A).

1.5 WASTE MANAGEMENT GOALS

- .1 Prior to start of Work conduct meeting with DCC Representative to review and discuss Waste Management Plan and goals.
- .2 Provide DCC Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environmental damage.

1.6 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Audit.
 - .2 Waste Reduction Workplan.
 - .3 Material Source Separation Plan.
 - .4 Schedules [A] [B] [C] (defined below) completed for project.

1.7 SUBMITTALS

- .1 Submit required information in accordance with Section Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit prior to project start-up:
 - .1 Submit 1 electronic copy of completed Waste Audit (WA): Schedule A.
 - .2 Submit 1 electronic copy of completed Waste Reduction Workplan (WRW): Schedule B.
 - .3 Submit 1 electronic copy of completed Demolition Waste Audit (DWA): Schedule C.
 - .4 Submit 1 electronic copy of Materials Source Separation Program (MSSP) description.
- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
 - .1 Failure to submit could result in hold back of final payment.

- .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
- .3 For each material reused, sold or recycled from project, include amount in tonnes and size of items and the destination.
- .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.8 WASTE AUDIT(WA) - SCHEDULE A

- .1 Conduct WA prior to project start-up.
- .2 Prepare WA: Schedule A.
- .3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

1.9 WASTE REDUCTION WORKPLAN (WRW) - SCHEDULE B

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
 - .1 Destination of materials listed.
 - .2 Deconstruction/disassembly techniques and sequencing.
 - .3 Schedule for deconstruction/disassembly.
 - .4 Location.
 - .5 Security.
 - .6 Protection.
 - .7 Clear labeling of storage areas.
 - .8 Details on materials handling and removal procedures.
 - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.10 DEMOLITION WASTE AUDIT (DWA) - SCHEDULE C

- .1 Prepare DWA prior to project start-up. Audit (DWA): Schedule C, is included with this Section. Edit to suit Project Requirements.

- .2 Complete DWA: Schedule C.
- .3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

1.11 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

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

1.12 STORAGE, HANDLING AND PROTECTION

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

1.13 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner, into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:

- .1 Number and size of bins.
- .2 Waste type of each bin.
- .3 Total tonnage generated.
- .4 Tonnage reused or recycled.
- .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.14 SCHEDULING

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 APPLICATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
- .2 Provide separate disposal bins for each material removed from demolition area, do not mix materials.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.3 WASTE AUDIT(WA) - SCHEDULE A

- .1 Schedule A – Waste Audit (WA):
- .2

Material Category	Material Quantity Unit	Total Quantity of Waste (Unit)	Generation Point	Recycled	Reused
Wood & Plastics Material Description					
Off-cuts					
Warped Pallet Forms					
Plastic Packaging					
Cardboard					
Packaging					

Doors & Windows Material Description					
Painted Frames					

.3

Material Category	Material Quantity Unit	Estimate Waste	Total Quantity of Waste (Unit)	Generation Point	Recycled	Reused
Glass						
Wood						
Metal						
Other						

3.4 WASTE REDUCTION WORKPLAN (WRW) - SCHEDULE B

.1 Schedule B – Waste Reduction Work plan (WRW):

.2

Material Category	Person Responsible	Total Quantity of Waste (Units)	Reused Amounts Projected	Reused Amounts Actual	Recycled Amount (Unit) Projected	Recycled Amount (Unit) Actual	Materials Destination
Wood & Plastics Material Description							
Chutes							
Warped Pallet Forms							
Plastic Packaging							
Cardboard Packaging							
Doors & Windows Material							

Descript ion							
Painted Frames							
Glass							
Wood							
Metal							
Other							

3.5 DEMOLITION WASTE AUDIT (DWA) - SCHEDULE C

.1 Schedule C – Demolition Waste Audit (DWA):

.2

Material Category	Quantity	Unit	Total	Volume	Weight	Remarks and Assumptions
Wood						
Wood Stud						
Plywood						
Baseboard d-wood						
Door trim wood						
Cabinet						
Doors and Windows						
Panel Regular						
Slab Regular						
Wood Laminate						
By Fold Closet						
Glazing						

END OF SECTION

Section 01 77 00 Closeout Procedures

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 01 91 13 - Commissioning.

1.2 INSPECTION AND DECLARATION

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify DCC Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request DCC Representative inspection.
 - .2 DCC Representative Inspection: DCC Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
 - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted and balanced and fully operational.
 - .4 Certificates required by Boiler Inspection Branch, Fire Commissioner, Utility companies: submitted.
 - .5 Certificates required by Contract Documents as identified in specific sections of this specification, eg. TSSA inspection reports: submitted.
 - .6 Operation of systems: demonstrated to Owner's personnel.
 - .7 Commissioning of mechanical systems: completed in accordance with 01 91 13 - Commissioning and 1 hard or 3 electronic copies of final Commissioning Report included in Operation and Maintenance Manual: submitted to DCC Representative.
 - .8 Work is complete and ready for Final Inspection.
- .2 Final Inspection: when items noted above are completed, request final inspection of Work by DCC Representative and Contractor. If Work is deemed incomplete by DCC Representative, complete outstanding items without delay and request re-inspection.

1.3 FINAL CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 78 00 Closeout Submittals

Part 1 General

1.1 SECTION INCLUDES REFERENCES

- .1 As-built, samples and specification.
- .2 Equipment and systems.
- .3 Product data, materials, finishes and related information.
- .4 Warranties.
- .5 Operation and maintenance data.

1.2 SUBMISSION

- .1 An organized compilation of Operating and Maintenance Data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections.
- .2 Submit one (1) complete hard copy and (3) electronic PDF Format of the "Operation & Maintenance (O&M) Manuals" to the DCC Representative, one (1) week prior to application for Interim Certificate of Completion (ICC) of project.
- .3 Hard copy shall be bound in accordance with paragraph 1.3.
- .4 The DCC Representative will not issue the interim certificate of completion until the O&M Manuals and as-built drawings are submitted, reviewed, and accepted by the DCC Representative.
 - .1 The DCC Representative will retain funds as security against incomplete or non-submission of the O&M manuals and as-built drawings. No partial payment will be made against these items.

1.3 FORMAT

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

- .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in DWG format on current Electronic media.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Cover Sheet:
 - .1 Project Title, Location and Project Number.
 - .2 Names, Addresses and Telephone number of General Contractor.
 - .3 Date of Submission.
- .2 Table of Contents for Each Volume: provide title of project.
- .3 All applicable warranties and guarantees.
- .4 List of Sub-Contractors complete with addresses and Telephone number.
- .5 Copies of approvals and certificates.
- .6 Provide Data as specific in individual Sections.
 - .1 List of equipment in format specified by DCC Representative including:
 - .1 New equipment.
 - .2 Modified Equipment.
 - .3 Decommissioned Equipment.
 - .4 Service depot.
 - .5 Nameplate information including equipment number, make, size, capacity, model number and serial number.
 - .6 Parts List.
 - .7 Installation Details.
 - .8 Operating Instructions.
 - .9 Maintenance Instructions for Equipment.
 - .10 Maintenance Instructions for Finishes.
 - .11 Complete set of approved shop drawings.
 - .2 As-built drawings.
- .7 **Training:** Refer to Section 01 79 00 - Demonstration and Training.

1.5 AS-BUILT DOCUMENTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for DCC Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.

- .5 Reviewed shop drawings, product data and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by DCC Representative.
- .6 Near completion of the project the DCC Representative shall submit an 'AutoCAD' electronic drawing to Contractor for recording all as-built conditions on drawings.
- .7 As-built Drawings.
 - .1 Contractor shall keep one copy on site to maintain project record drawings and record accurately any deviations from Contract Documents.
 - .1 Field changes of dimension and detail.
 - .2 Changes made by change orders.
 - .3 Details not on original Contract Drawings.
 - .4 References to related shop drawings and modifications.
 - .2 Record all as-built conditions in red. Mark all changes on one set of prints prior to interim completion of project and prior to final inspection, neatly transfer notations to second set and submit both sets to the DCC Representative for review and acceptance.

1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line drawings, provided by DCC Representative.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

- .4 Field changes of dimension and detail.
 - .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 orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide single-line schematic drawings for any new work completed to the building systems as follows:
 - .1 Electrical Schematic.
 - .2 Water lines.
 - .3 Sewage lines.
 - .4 HVAC schematic.

1.7 EQUIPMENT AND SYSTEMS

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

- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .12 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .13 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 00 - Commissioning.
- .14 **Additional requirements:** As specified in individual specification sections.

1.8 MATERIALS AND FINISHES

- .1 **Building Products, Applied Materials, and Finishes:** include product data, with catalogue number, size, composition, and colour and texture designations.
- .2 **Instructions for cleaning agents and methods:** precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 **Moisture-protection and Weather-exposed Products:** include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 **Additional Requirements:** as specified in individual Specifications Sections.

1.9 SPARE PARTS

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

1.10 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to DCC Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.11 SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.

- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to DCC Representative. Include approved listings in Maintenance Manual.

1.12 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of DCC Representative.

1.13 WARRANTIES, BONDS AND GUARANTEES

- .1 All Warranties / Bonds / Guarantees are to be made out to:
Department of National Defence
Engineering Officer - RPOps
1 Yukon Lane
Toronto, ON
M3K 1A0
- .2 Separate each warranty, bond or guarantee with index tab sheets keyed to Table of Contents listing.
- .3 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .4 Obtain warranty, bond or guarantee, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
- .5 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
- .6 Verify that documents are in proper form, contain full information, and are notarized.
- .7 Co-execute submittals when required.
- .8 Retain warranty, bond or guarantee until time specified for submittal.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 79 00 Demonstration And Training

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 01 91 13 - Commissioning.

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 1 Sections take precedence over technical specification sections in other Divisions of the Project Manual.

1.3 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of Substantial Performance.
- .2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.4 QUALITY CONTROL

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

1.5 SUBMITTALS

- .1 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.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.6 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation.
- .2 Testing, adjusting, and balancing has been performed, equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.7 PREPARATION

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

1.8 DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled agreed upon times, at the equipment location.
- .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .3 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

1.9 TIME ALLOCATED FOR INSTRUCTIONS

- .1 Ensure amount of time required for instruction of each item of equipment or system is adequate.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 91 13 General Commissioning Requirements

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Related Sections:
 - .1 Division 01 45 00 Quality Controls.
 - .2 Division 01 35 43 Environmental Procedures.
 - .3 Division 01 41 00 Regulatory Requirements.
 - .4 Division 01 91 13.16 Commissioning Forms.
 - .5 Division 23 Heating, Ventilation and Air Conditioning.
 - .6 Division 26 Electrical.
 - .7 Division 28 Electronic and Security.
- .3 Acronyms:
 - .1 AFD - Alternate Forms of Delivery, service provider.
 - .2 BMM - Building Management Manual.
 - .3 CPS - Commissioning Plan Schedule.
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 ESR - Equipment Start-Up and Acceptance Report.
 - .6 O&M - Operation and Maintenance.
 - .7 SFPTF - System Functional Performance Test Form.
 - .8 SVF - System Verification Form.
 - .9 TAB - Testing, Adjusting and Balancing.
 - .10 TC - Team Coordinator (DCC Representative).

1.2 GENERAL

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

- .1 To bring mechanical and electrical systems from a state of static completion to a state of dynamic operation.
 - .2 To verify conformance to contract requirements.
 - .3 To verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .4 To ensure that the completed facility meets user stated requirements and effectively train O&M staff; and
 - .5 To ensure appropriate documentation is compiled into the BMM.
 - .6 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to interact with each other as intended in accordance with Contract Documents and design criteria.
 - .7 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria:
- .1 As per client's requirements or determined by designer.
 - .2 To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 For commissioning responsibilities refer to the Contractor's Commissioning Plan.
- .2 Commissioning to be a line item of Contractor's cost breakdown.
- .3 Commissioning activities supplement field quality and testing procedures described in relevant technical sections.
- .4 Commissioning is conducted in concert with activities performed during stage of project delivery. Commissioning identifies issues in Planning and Design stages which are addressed during construction and commissioning stages to ensure the built facility and systems are constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Commissioning activities includes transfer of critical knowledge to facility operational personnel.
- .5 Defence Construction Canada will issue Interim Acceptance Certificate when:
 - .1 Completed commissioning documentation has been received, reviewed for suitability, and approved by Defence Construction Canada.
 - .2 Equipment, components, and systems have been commissioned.
 - .3 Final Air or Hydronic Balance reports have been submitted, reviewed and accepted/approved.
 - .4 ASBUILT Drawings have been submitted, reviewed and accepted.
 - .5 Submittals of final ESA Certifications, TSSA Certifications and any other systems certifications required under the systems installation in the contract.
 - .6 O&M training has been completed.

1.4 NON-CNFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

1.5 PRE-COMMISSIONING REVIEW

- .1 During Construction:
 - .1 Co-ordinate provision, location, and installation of provisions for commissioning.
- .2 Before Start of Commissioning:
 - .1 Have completed Commissioning Plan to date.
 - .2 Ensure installation of related components, equipment, systems, and sub-systems is complete.
 - .3 Fully understand commissioning requirements and procedures.
 - .4 Have commissioning documentation shelf ready (Binder on site).
 - .5 Understand completely the design criteria and intent and special features.
 - .6 Submit complete start-up documentation to Defence Construction Canada.
 - .7 Have commissioning schedules up to date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems and submit TAB reports to Defence Construction Canada for review and approval;
 - .10 Ensure "As-Built" system schematics are available.
- .3 Inform Defence Construction Canada in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

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

1.7 SUBMITTALS

- .1 Submittals: in accordance with Division 1.
- .2 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Commissioning Provider;
 - .2 Draft commissioning documentation; and

.3 Preliminary commissioning schedule.

.3 Request in writing to Defence Construction Canada for changes to submittals and obtain written approval at least 8 weeks prior to start of commissioning.

.4 Submit proposed commissioning procedures to Defence Construction Canada where not specified and obtain written approval at least 8 weeks prior to start of commissioning.

.5 Provide additional documentation relating to Commissioning process required by Defence Construction Canada.

1.8 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 13.16 - Commissioning Forms Items 1.2 Installation/Start-Up Checklists or Equipment Start Up and Acceptance Reports (ESR), 1.3 Product Information Report and Item 1.4 Performance Verification Forms or System Verification Forms (SVF), and System Functional Performance Test Forms (SFPTF) for requirements and instructions for use. The Mechanical and Electrical Contractor can submit their own company forms if available.

.2 Defence Construction Canada to review and approve commissioning documentation.

.3 Provide completed and approved commissioning documentation to Defence Construction Canada.

1.9 COMMISSIONING PLAN SCHEDULE

.1 The contractor shall prepare the CPS with the construction schedule and submit the CPS to DCC representative for review and coordination.

.2 The CPS will be updated every month. Copies of this schedule and updates will be distributed to Defence Construction Canada.

.3 Provide adequate time for commissioning activities prescribed in technical sections and commissioning sections including:

.1 Approval of commissioning reports.

.2 Verification of reported results.

.3 Repairs, re-testing, re-commissioning, re-verification; and

.4 Training.

1.10 COMMISSIONING MEETINGS

.1 Purpose: to resolve issues, monitor progress, identify deficiencies relating to commissioning.

.2 Commissioning meetings shall be scheduled bi-weekly unless noted otherwise by the DCC Representative to plan, discuss, and review commissioning activities. Continue commissioning meetings on a regular basis until commissioning deliverables have been addressed.

.3 Meetings shall take place until work has been completed.

.4 The construction schedule, commissioning plan schedule, and the commissioning plan shall be reviewed and updated as required. Upcoming tests and equipment start-ups shall be reviewed and completed test results will be evaluated.

- .5 Defence Construction Canada will take minutes of meetings and distribute copies to all team members within one week of a meeting.

1.11 STARTING AND TESTING

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

1.12 WITNESSING OF STARTING AND TESTING

- .1 Contractor's Commissioning Provider to be present at tests performed and documented by sub-trades, suppliers, and equipment manufacturers. Defence Construction Canada to be notified on dates and times of the start-ups.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing:
 - .1 Equipment manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by Defence Construction Canada.
 - .3 Arrange for Defence Construction Canada to witness tests if required in the contract documents; and
 - .4 Obtain written approval of test results and documentation from Defence Construction Canada 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 Defence Construction Canada.
 - .3 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .4 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
 - .5 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.
 - .3 Manufactures Start-up documentation to be completed and submitted to Defence Construction Canada .
 - .6 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation, and operation of equipment and systems.
 - .2 Ability to interpret test results accurately; and
 - .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of SVF.
 - .2 Visual inspection of quality of installation.
 - .3 Refrigeration Equipment is required to be leak checked on arrival to site as per specification section Halocarbon Management WSO 5-16 Section 01 35 43.
 - .2 Equipment Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System Functional Performance Testing: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Defence Construction Canada after distinct phases have been completed and before commencing next phase.
- .4 Document required tests on approved SFPTF forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Defence Construction Canada. 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 Defence Construction Canada.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Defence Construction Canada.
 - .3 If evaluation report concludes that major damage has occurred, shall reject equipment. Defence Construction Canada.
 - .1 Rejected equipment to be removed from site and replaced with new.
 - .2 Subject new equipment or systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Defence Construction Canada 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 to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 Operate and maintain systems for length of time required for commissioning to be completed.
- .3 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Commissioning:
 - .1 Under [actual] [accepted simulated] operating conditions, over entire operating range, in all modes; (Once building construction is complete and clean).
 - .2 On independent systems and interacting systems.
- .2 Commissioning 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.

1.18 WITNESSING COMMISSIONING

- .1 Defence Construction Canada to witness activities and verify results.

1.19 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, ESA, TSSA, Life Safety Systems Verification Reports (DCC/ DND Fire Service) or any other certifications required in the contract documents.
- .3 Provide copies to Defence Construction Canada within 5 days of test and with commissioning report.

1.20 COMMISSIONING CONSTRAINTS

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete commissioning of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.21 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 100 % of reported results control point to point and sequence of operation.
- .2 Balancing verification of 30 % of testing readings by Defence Construction Canada on site locations of testing verification will be decided at time of site verification.

- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment and instrumentation.

1.22 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and commissioning to satisfaction of Defence Construction Canada.

1.23 COMPLETION OF COMMISSIONING

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

1.24 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings.

1.25 TRAINING

- .1 To be video taped for all Major Mechanical, Electrical and Communication System as per specification requirements.
- .2 Major Equipment Training to be on site when systems have been fully commissioned and operational.
- .3 BAS Controls systems will be onsite with the building front end after commissioning of sequence of operation and graphic have been completed.
- .4 If the contract documents require remote BAS operation from another building training will need to be completed at that site to ensure communication connection is operational.
- .5 Training must be completed before contract substantial completion.

1.26 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

Part 2 Products

2.1 COMMISSIONING SAMPLE FORMS

- .1 To be supplied by Defence Construction Canada and need to be project specific. Refer and coordinate with 01 91 13.16 – Commissioning Forms

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 01 91 13.16 Commissioning Forms

Part 1 General

1.1 SUMMARY

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

1.2 INSTALLATION/START-UP CHECK LISTS

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

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

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

1.4 PERFORMANCE VERIFICATION (PV) FORMS

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

1.5 SAMPLES OF COMMISSIONING FORMS (INCLUDES PI AND PV FORMS)

- .1 DCC Representative will provide to the Contractor sample Commissioning forms in electronic format if requested by the contractor.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date can be provided to the Contractor upon request.

1.6 CHANGES AND DEVELOPMENT OF NEW COMMISSIONING FORMS

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

1.7 LANGUAGE

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

2023-02-17

Section 01 91 13.16
Commissioning Forms

Page 3 of 3

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Section 02 41 16 Structure Demolition

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for the following:
 - .1 Demolition and removal of buildings and structures.
 - .2 Demolition and removal of site improvements adjacent to a building or structure being demolished.
 - .3 Demolition and removal of concrete foundations and piles.
 - .4 Disconnecting, capping or sealing, and removing site utilities.
- .2 This section does not include the removal of Hazardous Substances or asbestos abatement, or selective demolition of interior building components and finishes.
- .3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this Project ; contractor representative is required to develop these details further by submitting a demolition plan prepared by a professional engineer.

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 19.13 - Selective Building Demolition
- .2 Section 02 41 19.16 - Selective Interior Demolition

1.3 DEFINITIONS

- .1 Demolition: Rapid destruction of building following removal of Hazardous Substances.
- .2 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: asbestos PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, 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 including latest amendments.
- .3 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .4 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 21 - Construction/Demolition Waste Management and Disposal and as follows:
 - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
- .5 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

- .6 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 21 - Construction/Demolition Waste Management and Disposal.

1.4 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 [CSA S350- M1980](#), Code of Practice for Safety in Demolition of Structures
- .2 Department of Justice Canada (Jus):
 - .1 Canadian Environmental Protection Act (CEPA), 1999
 - .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 Substances Information Review Act, 1985
 - .2 Hazardous Products Act, RSC 1985, c H-3
- .3 National Fire Protection Association (NFPA)
 - .1 [NFPA 241- 21](#), Standard for Safeguarding Construction, Alteration, and Demolition Operations
- .4 National Research Council Canada (NRC):
 - .1 National Building Code of Canada 2015 (NBC)
- .5 Underwriters' Laboratories of Canada (ULC):
 - .1 [CAN/ULC-S660- 08](#), Standard for Nonmetallic Underground Piping for Flammable and Combustible Liquids
 - .2 ULC/ORD-C58.15- 1992, Overfill Protection Devices for Flammable Liquid Storage Tanks
 - .3 ULC/ORD-C58.19- 1992, Spill Containment Devices for Underground Flammable Liquid Storage Tanks

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's 's property, demolished materials shall become Contractor 's property and shall be removed from Project site.
 - .2 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 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 operations.
- .2 Pre-Demolition Meetings:
 - .1 Convene pre-installation meeting 1week before beginning work of this Section, with DCC Representativein accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Verify existing site conditions adjacent to demolition work.
 - .3 Coordination with other construction subtrades.
 - .2 Hold project meetings every week.
 - .3 Ensure key personnelattend.
 - .4 WMCmust provide verbalreport on status of waste diversion activity at each meeting.
 - .5 DCC Representativewill provide writtennonotification of change to meeting schedule established upon contract award 24hours before scheduled meeting.
- .3 Scheduling:
 - .1 Employ necessary means tomeet project time lines without compromising specified minimum rates of material diversion.
 - .1 In event of unforeseen delay notify DCC Representative.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Provinceas follows:
 - .1 Submit for review and approval demolition drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning.
 - .2 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .3 WMC is responsible for fulfilment of reporting requirements.
 - .4 Schedule of Demolition Activities: Coordinate with Section 01 32 16.07 - Construction Progress Schedule - BAR (GANTT) Method, and indicate the following:
 - .1 Detailed sequence of 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

- .4 Locations of temporary partitions and means of egress
- .5 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction.
- .6 Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation.
- .7 Inventory: Submit a list of items that have been removed and salvaged after demolition is complete.
 - .1 Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 - .2 Pre-demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements before starting Work. Include finish surfaces that may be misconstrued as damage caused by demolition operations.
- .2 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Certificates: Submit Statement of Refrigerant Recovery as follows:
 - .1 Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to regulations of Authority Having Jurisdiction.
 - .2 Include name and address of technician and date refrigerant was recovered.
 - .2 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of references, for work of similar complexity and extent.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management: Submit project CWM Plan highlighting recycling and salvage requirements in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and as follows:

1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: Ensure Work is performed in compliance with applicable Provincial/Territorial and Municipal regulations.
 - .1 Comply with hauling and disposal regulations of Authority Having Jurisdiction.
 - .2 Standards: Comply with [ANSI A10.6](#) and [NFPA 241](#)
- .2 Regulatory Requirements: Perform work of this Section in accordance with the following:
 - .1 Provincial/Territorial Workers' Compensation Boards/Commissions and Federal Workers' Compensation Service.

- .2 Government of Canada, Labour Program: Workplace Safety and Provincial/Territorial Occupational Health and Safety Standards and Programs.

1.8 SITE CONDITIONS

- .1 Environmental protection:
 - .1 Ensure Work is done in accordance with Section 01 35 43 - Environmental Procedures.
 - .2 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
 - .3 Fires and burning of waste or materials is not permitted on site.
 - .4 Do not bury rubbish waste materials.
 - .5 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .6 Ensure proper disposal procedures are maintained throughout project.
- .2 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.
- .4 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .5 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
- .6 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.
- .7 Conduct structure demolition so Owner 's operations will not be disrupted:
 - .1 Provide not less than 72hours' notice to Ownerof activities that will affect operations.
 - .2 Maintain access to existing walkways, exits, and other adjacent occupied or used facilities:
 - .1 Do not close or obstruct walkways, exits, or other occupied or used facilities without written permission from DCC Representative.
- .8 DCC Representativeassumes no responsibility for buildings and structures being demolished:
 - .1 Conditions existing at time of inspection for bidding purpose will be maintained by DCC Representativeas far as practical.
 - .2 Remove, protect and store salvaged items as directed by DCC Representativebefore structure demolition.
 - .3 Salvage items as identified by DCC Representative.
 - .4 Deliver to DCC Representativeas directed.

1.9 EXISTING CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- .2 Existing Hazardous Substances: Owner has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Hazardous substances are as defined in the Hazardous Products Act.
 - .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .3 Discovery of Hazardous Substances: Immediately notify DCC Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
 - .1 Hazardous substances will be as defined in the Hazardous Products Act.
 - .2 Stop work in the area of the suspected hazardous substances.
 - .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
 - .4 Proceed only after written instructions have been received from DCC Representative.

Part 2 Products

2.1 EQUIPMENT

- .1 Equipment and Heavy Machinery:
 - .1 On-road vehicles to: CEPA-SOR/2003-2 and CEPA-SOR/2006-268.
 - .2 Off-road vehicles to: EPA CFR 86.098-10 and EPA CFR 86.098-11.
 - .3 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

2.2 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.

Part 3 Execution

3.1 EXAMINATION

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of structure demolition required.
- .2 Review Project Record Documents of existing construction provided by DCC Representative.
- .3 DCC Representative does not guarantee that existing conditions are the same as those indicated in Project Record Documents.
- .4 Inventory and record the condition of items being removed and salvaged.

- .5 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.
- .6 Promptly submit a written report to DCC Representative.
- .7 Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during structure demolition operations.
- .8 Verify that Hazardous Substances have been remediated before proceeding with structure demolition operations.

3.2 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Work in accordance with Section 01 35 43 - Environmental Procedures.
 - .2 Prevent movement, settlement or damage of adjacent parts of existing building to remain.
 - .1 Provide bracing, shoring and underpinning as required.
 - .2 Repair damage caused by demolition as directed by DCC Representative.
 - .3 Support affected structures and, if safety of structure being demolished or services appears to be endangered, take preventative measures, stop Work and immediately notify DCC Representative and Owner.
 - .4 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
- .2 Surface Preparation:
 - .1 Disconnect and cap designated mechanical services.
 - .1 Natural gas supply lines: remove in accordance with gas company requirements.
 - .2 Do not disrupt active or energized utilities traversing premises.
 - .3 Remove rodents and vermin.

3.3 DEMOLITION

- .1 Blasting operations not permitted during demolition.
- .2 Do blasting operations in accordance with [CSA S350](#).
- .3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
- .4 Before start of Work remove contaminated or hazardous materials as directed by [DCC Representative] from site and dispose of at designated disposal facilities in safe manner and in accordance with TDGA and other applicable requirements. Refer Existing Conditions in PART 1.
- .5 Demolish parts of structure.

- .6 To permit construction of addition.
- .7 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
- .8 At end of each day's work, leave Work in safe and stable condition.
 - .1 Protect interiors of parts not to be demolished from exterior elements at all times.
- .9 Demolish to minimize dusting. Keep materials wetted as directed by DCC Representative.
- .10 Demolish masonry and concrete walls in pieces suitable for reuse as specified.
- .11 Contain fibrous materials to minimize release of airborne fibres while being transported within facility.
- .12 Only dispose of material specified by selected alternative disposal option [DCC Representative].
- .13 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.
- .14 Use natural lighting to do Work where possible.
 - .1 Shut off lighting except those required for security purposes at end of each day.

3.4 SITE RESTORATION

- .1 Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes.
- .2 Provide a smooth transition between adjacent existing grades and new grades.

3.5 REPAIRS

- .1 General: Promptly repair damage to adjacent construction caused by structure demolition operations.
- .2 Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- .3 Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.6 CLEANING

- .1 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Divert excess materials from landfill to site approved DCC Representative.
- .4 Designate appropriate security resources / measures to prevent vandalism, damage and theft.
- .5 Locate stockpiled materials convenient for use in new construction. Eliminate double handling wherever possible.

- .6 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.
 - .1 Label stockpiles, indicating material type and quantity.
- .7 Separate from general waste stream each of following materials. Stockpile materials in neat and orderly fashion in location and as directed by DCC Representative for alternate disposal. Stockpile materials in accordance with applicable fire and safety regulations.
 - .1 Wiring and conduit.
 - .2 Outlets/switches.
 - .3 Metal duct work, baffles, HVAC equipment.
 - .4 Miscellaneous metals.
- .8 Supply separate, clearly marked disposal bins for categories of waste material. .
- .9 Remove stockpiled material as directed by DCC Representative, when it interferes with operations of project construction.
- .10 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.
- .11 Transport material designated for alternate disposal using approved receiving organizations listed in Waste Reduction Workplan and in accordance with applicable regulations.
 - .1 Written authorization from DCC Representative is required to deviate from receiving organizations listed in Waste Reduction Workplan.
- .12 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.
 - .1 Disposal facilities must be those approved of and listed in Waste Reduction Workplan.
 - .2 Written authorization from Departmental Representative is required to deviate from disposal facilities listed in Waste Reduction Workplan.

END OF SECTION

Section 02 41 19.13 Selective Building Demolition

Part 1 General

1.1 SUMMARY

- .1 This Section includes the following:
 - .1 Demolition and removal of selected portions of exterior building components or structural elements.
 - .2 Demolition of mechanical and electrical equipment.
 - .3 Demolition and removal of selected site elements.
 - .4 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 interior building components and finishes.
- .3 Choice of all exterior landscape materials will be determined by the DCC Representative, and materials not re used at other locations will be turned over to the local municipality tree re planting program.
- .4 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.

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition

1.3 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 ready for reuse.
- .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 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.

1.4 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 [ANSI A10.8](#) 2011, Safety Requirements for Scaffolding
- .2 Canadian Green Building Council (CaGBC)
 - .1 LEED Reference Guide for Building Design and Construction, Version 4
- .3 CSA Group (CSA)
 - .1 [CSA S350](#) M1980 (R2003), Code of Practice for Safety in Demolition of Structures
- .4 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .5 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
- .6 National Fire Protection Association (NFPA)
 - .1 [NFPA 241](#) 13, Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: 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.
- .2 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's property, demolished materials shall become Contractor's property and shall be removed from Project site.
 - .2 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.
- .3 Pre Demolition Meeting: Conduct a pre demolition meeting at Project site in accordance with requirements listed in Section 01 31 19 - Project Meetings to confirm extent of salvaged and demolished materials; and to review Contractor's demolition plan prepared by a professional engineer.

1.6 ACTION AND INFORMATION SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Schedule of Selective Demolition Activities: Coordinate with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart, 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.
 - .4 Use of elevator and stairs.
 - .5 Locations of temporary partitions and means of egress, including for others affected by selective demolition operations.
 - .6 Coordination with DCC Representative's continuing occupancy of portions of existing building Owner's partial occupancy of completed Work.
 - .2 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction, and as follows:
 - .1 Proposed Dust Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. DCC Representative reserves the right to make modifications where proposed methods interfere with the Owner's ongoing operation
 - .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.
- .2 Informational Submittals: Provide the following submittals when requested by the DCC Representative:
 - .1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of architects and owners, for work of similar complexity and extent.

.3 Sustainable Design Submittals:

1.7 QUALITY ASSURANCE

.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 Regulations.
- .2 Conform to provincial Workers' Compensation Board Regulations.
- .3 Conform to the local municipal bylaws and regulations governing this type of work.

1.8 SITE CONDITIONS

.1 Owner will occupy portions of building immediately adjacent to selective demolition area:

- .1 Conduct selective demolition so that Owner's operations will not be disrupted.
- .2 Provide not less than 72 hours notice to DCC Representative of activities that will affect Owner's operations.

.2 Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities and as follows:

- .1 Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission 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.

.4 Discovery of Hazardous Substances: The work area has been assessed for the presence of hazardous materials. Refer to Environmental Protection Section 01 35 43 for details on the location and type of hazardous materials known to be present in the work area. Should other materials suspected of containing hazardous substances be encountered in the Work which are not noted in the above-mentioned Section; immediately notify DCC Representative and perform the following activities:

- .1 Do not disturb Hazardous materials, may need to be removed by DCC Representative under a separate contract or as a change to the Work.
- .2 Review the Designated Substances and Hazardous Materials Survey – HVAC Compliance Upgrades Defence Research and Development Canada Toronto, 1133 Sheppard Avenue West, Toronto Ontario”, dated April 25, 2023, prepared by Arcadis Canada Inc.
- .3 Refer to Section 01 41 00 – Regulatory requirements for directives associated with specific material types. Hazardous materials will be as defined in the Hazardous Materials Act.

.5 Hazardous Materials: Hazardous materials are present in building to be selectively demolished. A report on the presence of hazardous materials is available for review and use:

- .1 Examine report to become aware of locations where hazardous materials are present.
- .2 Coordinate with Section 02 81 00 - Hazardous Materials

- .3 Do not disturb hazardous materials or items suspected of containing hazardous materials.
- .6 Storage or sale of removed items or materials on site will not be permitted.
- .7 Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- .8 Maintain fire protection facilities in service during selective demolition operations.

Part 2 Products

2.1 MATERIALS

- .1 Temporary Support Structures: 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 Repair Materials: 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 materials whose installed performance equal or surpasses that of existing materials.
 - .3 Comply with material and installation requirements specified in individual technical specification Sections.

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 Engage a professional engineer to survey condition of building when removing elements that may result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- .6 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.
- .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.
- .5 Existing Utilities:
 - .1 Abandon existing utilities and below grade utility structures; cut utilities flush with grade.
 - .2 Demolish existing utilities and below grade utility structures that are within 1500 mm outside of footprint indicated for new construction; abandon utilities outside this area, fill abandoned utility structures with satisfactory soil materials.
 - .1 Piping: Disconnect piping at unions, flanges, valves, or fittings
 - .2 Wiring Ducts: Disassemble into unit lengths and remove plug in and disconnecting devices

3.3 PREPARATION

- .1 Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- .2 Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities:
 - .1 Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from DCC Representative and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - .2 Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - .3 Protect existing site improvements, appurtenances, and landscaping to remain.

- .4 Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- .3 Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain in accordance with Section 01 51 00 - Temporary Utilities, and as follows:
 - .1 Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - .2 Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - .3 Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - .4 Cover and protect furniture, furnishings, and equipment that have not been removed.
- .4 Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities in accordance with Section 01 52 00 - Construction Facilities
 - .1 Provide temporary weather tight enclosure for building exterior.
 - .2 Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures.
 - .3 Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- .5 Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise in accordance with Section 01 51 00 - Temporary Utilities
- .6 Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished:
 - .1 Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- .1 Dust Control: Provide water mist, temporary enclosures or other suitable methods reviewed and accepted by the DCC Representative to limit spread of dust and dirt. Comply with governing environmental protection regulations, and as limited below:
 - .1 Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 - .2 Wet mop floors to eliminate tracking of dirt, wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- .2 Remove and transport debris to prevent spillage on adjacent surfaces and areas.
- .3 Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

- .4 Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

- .1 Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - .1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - .2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - .3 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - .4 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations. Maintain fire watch and portable fire suppression devices during flame cutting operations.
 - .5 Maintain adequate ventilation when using cutting torches.
 - .6 Remove decayed, vermin infested, or otherwise dangerous or unsuitable materials and promptly dispose of off site.
 - .7 Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - .8 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - .9 Dispose of demolished items and materials promptly.
 - .10 Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- .2 Existing Items to Remain:
 - .1 Protect construction indicated to remain against damage and soiling during selective demolition
 - .2 Items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete
- .3 Masonry:
 - .1 Demolish in small sections
 - .2 Cut masonry at junctures with construction to remain, using power driven saw, then remove masonry between saw cuts

- .4 Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to Section Applicable Division 7 Section for new roofing requirements.
- .5 Air Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 CLOSEOUT ACTIVITIES

- .1 Patching and Repairs: Promptly repair damage to adjacent construction caused by selective demolition operations and as follows:
 - .1 Patch to produce surfaces suitable for new materials where repairs to existing surfaces are required,
 - .2 Completely fill holes and depressions in remaining existing masonry walls remain with an approved masonry patching material applied according to manufacturer's written recommendations.
 - .3 Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing 02 41 19.16 - Selective Interior Demolition.
- .2 DemolitionWaste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Section and as follows:
 - .1 Promptly dispose of demolished materials.
 - .2 Do not allow demolished materials to accumulate onsite.
 - .3 Do not burn demolished materials.

END OF SECTION

Section 02 41 19.16 Selective Interior Demolition

Part 1 General

1.1 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.

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition

1.3 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 ready for reuse.
- .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.
- .6 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 21 - Construction/Demolition Waste Management and Disposal and as follows:
 - .1 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 21 - Construction/Demolition Waste Management and Disposal
- .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 21 - Construction/Demolition Waste Management and Disposal
- .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.

1.4 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 [ANSI A10.8](#) 2011, Safety Requirements for Scaffolding
- .2 ASTM International (ASTM)
 - .1 [ASTM C475/C475M-15](#), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
- .3 Canadian Green Building Council (CaGBC)
 - .1 LEED Reference Guide for Building Design and Construction, Version 4
- .4 CSA Group (CSA)
 - .1 [CSA S350](#) M1980 (R2003), Code of Practice for Safety in Demolition of Structures
- .5 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
- .6 National Fire Protection Association (NFPA)
 - .1 [NFPA 241](#) 13, Standard for Safeguarding Construction, Alteration, and Demolition Operations

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's 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 DCC Representative in accordance with 01 31 19 - Project Meetings 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 week.
- .4 Ensure key personnel 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:
 - .1 Schedule of Selective Demolition Activities: Coordinate with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart, and indicate the following:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

- .2 Coordinate with DCC Representative's building manager and user group ongoing site operations, and limit the number of interruptions during regular business hours.
 - .3 Interruption of utility services.
 - .4 Coordination for shutoff, capping, and continuation of utility services.
 - .5 Use of elevator and stairs.
 - .6 Locations of temporary partitions and means of egress, including for others affected by selective demolition operations.
 - .7 Coordination with Owner's continuing occupancy of portions of existing building
- .2 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction, and as follows:
- .1 Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. DCC Representative reserves the right to make modifications where proposed methods interfere with the Owner's ongoing operation
 - .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.
 - .4 Pre demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by selective demolition operations.
- .2 Informational Submittals: Provide the following submittals when requested by the DCC Representative:
- .1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of architects and owners, for work of similar complexity and extent.

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: Provide proof of qualifications when requested by DCC Representative:
 - .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 Owner will occupy portions of building immediately adjacent to selective demolition area:
 - .1 Conduct selective demolition so that Owner's operations will not be disrupted.
 - .2 Provide not less than 72 hours notice to DCC Representative of activities that will affect Owner'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.
- .4 Discovery of Hazardous Substances: The work area has been assessed for the presence of hazardous materials. Refer to Environmental Protection Section 01 35 43 for details on the location and type of hazardous materials known to be present in the work area. Should other materials suspected of containing hazardous substances be encountered in the Work which are not noted in the above-mentioned Section; immediately notify DCC Representative and perform the following activities:
 - .1 Do not disturb Hazardous materials, may need to be removed by DCC Representative under a separate contract or as a change to the Work.
 - .2 Review the Designated Substances and Hazardous Materials Survey – HVAC Compliance Upgrades Defence Research and Development Canada Toronto, 1133 Sheppard Avenue West, Toronto Ontario”, dated April 25, 2023, prepared by Arcadis Canada Inc.
 - .3 Refer to Section 01 41 00 – Regulatory requirements for directives associated with specific material types. Hazardous materials will be as defined in the Hazardous Materials Act.

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 radiation cabinets, bent and profiled to match existing radiation cabinets.
- .5 Gypsum Board Patching Compounds: Joint compound to [ASTM C475/C475M](#), 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 CONCRETE SLAB REINFORCING

- .1 Locate location of reinforcing steel in concrete slabs prior to cutting or coring using non destructive, non ionizing radio frequency locators.
- .2 Core concrete slabs to avoid reinforcing steel, electrical conduit or water pipes; adjust core location and coordinate with Engineer where slab features interfere with core drilling.
- .3 Notify the Engineer immediately for further instructions where coring or cutting will damage existing slab features.

3.5 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 carpet, resilient flooring and adhesive remnants as follows:
 - .1 Vacuum existing carpet thoroughly, prior to removal, using vacuum equipped with power head/sweeper.
 - .2 Apply fine mist water spray to carpet as required to minimize dust generation during removal. Avoid spraying near electrical outlets.

- .3 Demolish existing carpet and resilient floor finishes, remove and dispose of off site.
- .4 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 Lightly shot blast or grind floor using machine designed for purpose to remove adhesive remnants.
 - .3 Vacuum floor ready for application of skim coating.
 - .4 Repair all slab depressions and damage with cementitious patching compound.
 - .5 Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.
- .5 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.
- .6 Recycle materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .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 Demolish completely all ceiling panels and grid as indicated.
- .11 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.
- .12 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.
- .13 Patch and repair all radiation cabinets, mechanical equipment and electrical fixtures damaged or exposed during demolition to match adjacent finished surfaces.

3.6 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.

3.7 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.

3.8 CLEANING

- .1 Develop Construction Waste Management Plan related to Work of this Section and in accordance with 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Waste Management: Separate waste materials for recycling recycling in accordance with 01 74 21 - Construction/Demolition Waste Management and Disposal, 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 facilities listed in CWM Plan and in accordance with applicable regulations.
 - .1 Written authorization from DCC Representative is required to deviate from facilities listed in CWM Plan.
- .8 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

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- .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 Comply with requirements of this Section when performing the following work when wetted and using non-powered, hand-held tools only.
 - .1 Removing non-friable asbestos-containing vinyl floor tiles from Rooms 1100 and 1516, if affected.
 - .2 Removing non-friable asbestos-containing cement board in the pipe chase in Room 2102 and assumed to be behind the wall panels; if affected, and
 - .3 Removing small quantities, if required, (<1m²) of drywall with asbestos-containing joint compound from Rooms 1100, 1102, 1205A, 1213 & Adjacent Hallway, 1516, A3, 1542, 1700, 2020C, 2024, 2102, 2205, 2209, 2213i, 2221 & Adjacent Hallway, 2232 and 2209.
 - .4 **As per information provided by DCC**, the estimated abatement required in each area listed in 1.1.1.3 above includes the following:
 - .1 Rooms 1100 and 1102 (one ceiling penetration into Room 2102 and the installation of five feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .2 Rooms 1205A, 1213 & Adjacent Hallway (two ceiling penetrations and installation of 150 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .3 Rooms 1516 and A3 (one wall penetration, one ceiling penetration and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .4 Room 1542 (no abatement required).
 - .5 Room 1700 (one ceiling penetration and installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .6 Room 2020C (three wall penetrations, one ceiling penetration and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound);.
 - .7 Room 2024 (five square feet of drywall with asbestos-containing drywall joint compound to be abated, six penetrations to roof above, including four for the unit below and two for the unit in Room 2020C).
 - .8 Room 2102 (four ceiling penetrations, including two for the unit below and two for the unit in Room 2102C, and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound. Asbestos-containing pipe insulation and asbestos cement board are not affected).

- .9 Rooms 2205, 2209, 2221 & Adjacent Hallway (two ceiling penetrations in Room 2205/2209 and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
- .10 Room 2213i (two ceiling penetrations, one wall penetration and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound), and
- .11 Rooms 2232 and 2209 (two roof/ceiling penetrations, three wall penetrations, and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).

1.1 Related Requirements

- .1 Section 02 82 00.02 – Asbestos Abatement – Intermediate Precautions.
- .2 Section 02 82 00.03 – Asbestos Abatement – Maximum Precautions.
- .3 Section 02 83 10 – Lead-based Paint Abatement – Minimum Precautions.
- .4 Section 02 83 11 – Lead-based Paint Abatement – Intermediate Precautions.

1.2 Reference

- .1 O. Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.
- .2 O. Reg. 490/09, Designated Substances.
- .3 O. Reg. 632/05, Confined Spaces.
- .4 DND/CF, Asbestos Management Directive, November 20, 2007.
- .5 The Canada Labour Code COHSR SOR/86-304.
- .6 Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada Toronto – 1133 Sheppard Avenue West, Toronto, Ontario*” dated May 2023
- .7 A Guide to the Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007, <http://www.labour.gov.on.ca/english/hs/asbestos/index.html>.
- .8 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.205-[94], Sealer for Application to Asbestos-Fibre-Releasing Materials.
- .9 Canadian Standards Association (CSA International).
- .10 Department of Justice Canada
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
 - .2 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
- .11 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).

- .12 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .13 Underwriters' Laboratories of Canada (ULC).
- .14 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH)
 - .1 NIOSH 94-113-August 1994, NIOSH Manual of Analytical Methods (NMAM), 4th Edition.

1.4 Definitions

- .1 HEPA Vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97%
- .2 Amended Water: water with nonionic surfactant wetting agent added to reduce water tension to allow thorough wetting of fibres.
- .3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.
- .4 Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.
- .5 Authorized Visitors: Engineers, Consultants or designated representatives, and representatives of regulatory agencies.
- .6 Competent Person: 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.
- .7 Consultant: Regarding This specification, “Consultant” refers to a 3rd Party consultant contracted independently by DCC/DND.
- .8 Friable material: means material that:
 - .1 When dry, can be crumbled, pulverized or powdered by hand pressure, or
 - .2 is crumbled, pulverized or powdered.
- .9 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .10 Occupied Area: any area of the building or work site that is outside Asbestos Work Area.
- .11 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .12 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for work.

1.5 Submittals

- .1 Submittals in accordance with Section 01 33 00 and 01 35 43 – Environmental Protection.
- .2 Submit proof satisfactory to DCC Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.
- .3 Submit Provincial and/or local requirements for Notice of Project Form.
- .4 Submit to DCC Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.
- .5 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.
- .6 Submit proof satisfactory to DCC Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.6 Quality Assurance

- .1 Regulatory Requirements: comply with Federal, Provincial, 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 time Work is performed.
- .2 Health and Safety:
 - .1 Perform construction occupational health and safety in accordance with Section 01 35 29.
 - .2 Safety Requirements:
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a

respirator. A worker not to be assign physically able to perform the operation while using the respirator.

- .2 Disposable-type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.
- .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.
- .4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.
- .5 Ensure workers wash hands and face when leaving Asbestos Work Area.
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

1.7 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Sections 01 74 21 and 01 35 43.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan 01 35 43.
- .4 Separate for reuse and recycling and place in designated containers metal and plastic waste in accordance with Waste Management Plan 01 35 43.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with the Canadian Environmental Protection Act (CEPA), Transportation of Dangerous Goods Regulation (TDGR), Federal, Provincial, Regional and Municipal regulations, and Waste Management Plan 01 35 43.
- .7 Fold up metal banding, flatten and place in designated area for recycling.
- .8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial and Municipal regulations. Dispose of asbestos waste in sealed double thickness

0.15 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.

- .9 Provided documentation describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 Existing Conditions

- .1 The Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada Toronto – 1133 Sheppard Avenue West, Toronto, Ontario*” dated May 2023, indicates the locations of hazardous materials present. Areas requiring special handling under hazardous material precautions are outlined in this Specification package. Asbestos-containing materials identified in the above-referenced report include:
 - .1 Thermal insulation applied to pipe fittings contains 55% Chrysotile asbestos.
 - .2 Thermal insulation (“Antisweat”) applied to pipe straights contains 55% Chrysotile asbestos.
 - .3 Cement parging applied to ducts contains 55% Chrysotile asbestos.
 - .4 Vinyl floor tiles (12” x 12” beige) contain 1% Chrysotile asbestos.
 - .5 Drywall Joint Compound contains 2% Chrysotile asbestos.
 - .6 Cement Board contains 8% Chrysotile asbestos.
- .2 Notify the DCC Representative of suspect asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by DCC Representative.

1.9 Scheduling

- .1 Hours of Work: perform work during normal working hours (8:00 to 16:00) according to DCC instructions. Hourly rates are to be provided should after hours work be required.

1.10 Owner’s Instructions

- .1 Before beginning Work, provide DCC Representative 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 as required by O.Reg. 278/05.
- .2 Instruction and training related to respirators includes, following minimum requirements:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by a competent, qualified person.

Part 2 - Products

2.1 Materials

- .1 Drop Sheets:
 - .1 Polyethylene: 0.15 mm thick.

- .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in a concentration to provide thorough wetting of asbestos-containing material.
- .3 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site. Both sides of every waste container must display in large easily legible letters the words **‘ASBESTOS, WHITE, PRODUCT IDENTIFICATION NUMBER 2590’**.
- .4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
- .5 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.

Part 3 - Execution

3.1 Preparation

- .1 Conduct construction occupational health and safety in accordance with Section 01 35 29.
- .2 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm).
- .2 Before beginning Work, isolate Asbestos Work Area using, minimum, preprinted cautionary asbestos warning signs in sizing as per O. Reg. 278/05 in both official languages that are visible at access routes to Asbestos Work Area.
 - .1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.
 - .2 Use HEPA vacuum or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.
 - .3 Do not use compressed air to clean up or remove dust from any surface.
- .3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in Asbestos Work Area where dust and contamination cannot otherwise be safely contained. Drop sheets are not to be reused.

- .4 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity fine - mist sprayer, or an airless sprayer if necessary.
 - .2 Perform Work to reduce dust creation to lowest levels practicable.
 - .3 Work will be subject to visual inspection and air monitoring, if required.
 - .4 Contamination of surrounding areas indicated by visual inspection or air monitoring, if required, will require complete enclosure and clean-up of affected areas.
- .5 Frequently and at regular intervals during Work and immediately on completion of work:
 - .1 Dust and waste to be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in a waste container, and
 - .2 Drop sheets to be wetted and placed in a waste container as soon as practicable.
- .6 Cleanup:
 - .1 Place dust and asbestos containing waste in sealed dust-tight waste bags (0.15 mm thick (6 mil) bags or leak proof drums). Label containers with appropriate warning labels. Treat drop sheets and disposable protective clothing as asbestos waste; wet and fold these items to contain dust, and then place in plastic bags. Vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.
 - .3 Seal waste bags and remove from site. Dispose of in accordance with requirements of Provincial and Federal Authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that the appropriate guidelines and regulations for asbestos disposal are followed.
 - .4 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum and/or wet-wiping.

END OF SECTION

Part 1 General**1.1 Summary**

- .1 Comply with requirements of this Section when performing the following when wetted and using power tools connected to a dust-collecting device equipped with a HEPA filter where non-powered hand tools cannot be used.
 - .1 Removing small quantities ($<1\text{m}^2$), if required, of asbestos-containing thermal insulation applied to pipe fittings from Rooms 1100, 2102 and 2219.
 - .2 Removing small quantities ($<1\text{m}^2$), if required, of asbestos-containing thermal insulation applied to pipe straights from Rooms 2102.
 - .3 Removing large quantities ($>1\text{m}^2$), if required, of drywall with asbestos-containing joint compound from Rooms 1100, 1102, 1205A, 1213 & Adjacent Hallway, 1516, A3, 1542, 1700, 2020C, 2024, 2102, 2205, 2213i, 2221 & Adjacent Hallway, 2232 and 2209.
 - .4 **As per information provided by DCC**, the estimated abatement required in each area listed in 1.1.1.3 above includes the following:
 - .1 Rooms 1100 and 1102 (one ceiling penetration into Room 2102 and the installation of five feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .2 Rooms 1205A, 1213 & Adjacent Hallway (two ceiling penetrations and installation of 150 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .3 Rooms 1516 and A3 (one wall penetration, one ceiling penetration and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound),
 - .4 Room 1542 (no abatement required).
 - .5 Room 1700 (one ceiling penetration and installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .6 Room 2020C (three wall penetrations, one ceiling penetration and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
 - .7 Room 2024 (five square feet of drywall with asbestos-containing drywall joint compound to be abated, six penetrations to roof above, including four for the unit below and two for the unit in Room 2020C).

- .8 Room 2102 (four ceiling penetrations, including two for the unit below and two for the unit in Room 2102C, and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound. Asbestos-containing pipe insulation and asbestos cement board are not affected)
- .9 Rooms 2205, 2209, 2221 & Adjacent Hallway (two ceiling penetrations in Room 2205/2209 and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).
- .10 Room 2213i (two ceiling penetrations, one wall penetration and the installation of 30 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound), and
- .11 Rooms 2232 and 2209 (two roof/ceiling penetrations, three wall penetrations, and the installation of 50 feet of electrical conduit onto drywall walls with asbestos-containing drywall joint compound).

1.2 Related Requirements

- .1 Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions.
- .2 Section 02 82 00.03 – Asbestos Abatement – Maximum Precautions.
- .3 Section 02 83 10 – Lead-based Paint Abatement – Minimum Precautions.
- .4 Section 02 83 11 – Lead-based Paint Abatement – Intermediate Precautions.

1.3 Reference Standards

- .1 O. Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.
- .2 O. Reg. 490/09, Designated Substances.
- .3 O. Reg. 632/05, Confined Spaces.
- .4 DND/CF, Asbestos Management Directive, November 20, 2007.
- .5 The Canada Labour Code COHSR SOR/86-304.
- .6 Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada Toronto – 1133 Sheppard Avenue West, Toronto, Ontario*” dated May 2023.
- .7 A Guide to the Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007, <http://www.labour.gov.on.ca/english/hs/ asbestos/index.html>.
- .8 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.205-[94], Sealer for Application to Asbestos-

Fibre-Releasing Materials.

- .9 Canadian Standards Association (CSA International).
- .10 Department of Justice Canada
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
 - .2 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
- .11 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .12 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Regulation, 2020 (TDGR).
- .13 Underwriters' Laboratories of Canada (ULC).
- .14 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 9400-August 1994, NIOSH Manual of Analytical Methods (NMAM), 4th Edition.

1.4 Definitions

- .1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.
- .2 Asbestos Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.
- .3 Asbestos Work Area: area where work takes place which will or may disturb ACMs.
- .4 Authorized Visitors: Engineers, or designated third parties retained by the Crown, and representatives of regulatory agencies.
- .5 Competent person: 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.
- .6 Consultant: Regarding This specification, “Consultant” refers to a 3rd Party consultant contracted independently by DCC/DND.
- .7 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .8 Glove Bag: prefabricated glove bag as follows:

- .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
- .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
- .3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.
- .4 Straps for sealing ends around pipe.
- .9 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.
- .10 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .11 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .12 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .13 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.5 Action and Informational Submittals

- .1 Submittals in accordance with Sections 01 33 00 – Submittal Procedures and 01 35 43.
- .2 Submit proof satisfactory to the DCC Representative that suitable arrangements have been made to dispose of asbestos containing waste in accordance with requirements of authority having jurisdiction.
- .3 Submit Provincial and/or local requirements for Notice of Project Form.
- .4 Submit to the third party retained by the Crown necessary permits for transportation and disposal of asbestos containing waste and proof that asbestos containing waste has been received and properly disposed.
- .5 Submit proof satisfactory to the DCC Representative that all asbestos workers have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.
- .6 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by the DCC Representative. Minimum of one supervisor for every ten workers.
- .7 Submit Worker's Compensation Board status and transcription of insurance.

- .8 Submit documentation including test results, fire and flammability data, and WHMIS Safety Data Sheets (SDS) for chemicals or materials including:
 - .1 Encapsulants;
 - .2 Amended water;
 - .3 Spray Glues;
 - .4 Slow drying sealer.
- .9 Submit proof satisfactory to the DCC Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.6 Quality Assurance

- .1 Regulatory Requirements: comply with Federal, Provincial 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 work is performed.
- .2 Health and Safety:
 - .1 Complete construction occupational health and safety in accordance with Section 01 70 12 – Health and Safety Requirements.
 - .2 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while

using the respirator.

- .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and is to be repaired or replaced if torn.
- .3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .4 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.
- .5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing will be determined at the site.
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
- .7 Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
 - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 Waste Management and Disposal

- .1 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Federal, Provincial and Municipal regulations.
- .2 Waste Management and Disposal to follow instructions provided in Section 01 35 43 – Environmental Protection.
- .3 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial and Municipal regulations. Dispose of asbestos waste in sealed double thickness (6 mils) bags or leak proof drums. Label containers with appropriate warning labels.

- .4 Provide documentation describing and listing waste created. Transport containers by approved means to licenced landfill for disposal.

1.5 Existing Conditions

- .1 The Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada Toronto – 1133 Sheppard Avenue West, Toronto, Ontario*” dated May 2023, indicates the locations of hazardous materials present. Areas requiring special handling under hazardous material precautions are outlined in this Specification package. Asbestos-containing materials identified in the above-referenced report include:
 - .1 Thermal insulation applied to pipe fittings contains 55% Chrysotile asbestos.
 - .2 Thermal insulation (“Antisweat”) applied to pipe straights contains 55% Chrysotile asbestos.
 - .3 Cement parging applied to ducts contains 55% Chrysotile asbestos.
 - .4 Vinyl floor tiles (12” x 12” beige) contain 1% Chrysotile asbestos.
 - .5 Drywall Joint Compound contains 2% Chrysotile asbestos.
 - .6 Cement Board contains 8% Chrysotile asbestos.
- .2 Notify the DCC Representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by the DCC Representative.

1.6 Scheduling

- .1 Hours of Work: perform work during normal working hours (8:00 to 16:00) according to DCC instructions. Hourly rates are to be provided should after hours work be required.

1.7 Personnel Training

- .1 Before beginning Work, provide the DCC Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.

Part 2 Products

2.1 Materials

- .1 Drop and Enclosure Sheets:

- .1 Polyethylene: 0.15 mm thick.
- .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .1 Glove bag:
 - .1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during tendering period in accordance with Instructions to Tenderers.
 - .2 The glove bag to be equipped with:
 - .1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.
 - .2 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.
 - .3 A tool pouch with a drain.
 - .4 A seamless bottom and a means of sealing off the lower portion of the bag.
 - .5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.
- .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.
- .3 Waste Containers/Bags: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm 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 thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site. Both sides of every waste container must display in large easily legible letters the words '**ASBESTOS, WHITE, PRODUCT IDENTIFICATION NUMBER 2590**'.
- .4 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.
- .5 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
- .6 Sealer: flame spread and smoke developed rating less than 50.

Part 3**Execution**

3.1 Supervision

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

3.2 Procedures

- .1 Complete construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.
- .2 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm).
- .3 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.
 - .1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air to clean up or remove dust from any surface or at any time during the course of the abatement.
- .4 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.
 - .2 When removing asbestos-containing material from piping or equipment and "glove bag" method is not used, erect enclosure of polyethylene sheeting around work area, shut off mechanical ventilation system serving work area and seal ventilation ducts to and from work area.
- .5 Remove any loose materials by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.
 - .2 Perform Work in a manner to reduce dust creation to lowest levels practicable.
- .6 Separate the work areas using rope barriers, signage and other appropriate methods.
- .7 Construct a two-chamber decontamination facility/frame for the enclosure from 50 mm x 100 mm (2" x 4") studs or other suitable material.

- .8 Cover all sides of the enclosure with clear 0.15 mm opaque polyethylene sheeting sealed with duct tape. Curtains of polyethylene sheeting must be fitted on each side of the entrance of the enclosure (curtain flaps may require weights at the bottom to ensure proper closing).
- .9 Wear an appropriate respirator approved for use with asbestos and suitable protective equipment. Only persons wearing protective clothing and equipment shall be allowed to enter the work area.
- .10 Do not use compressed air.
- .11 Do not eat, drink or smoke in the work area.
- .12 Only power tools connected to a dust-collecting device equipped with a HEPA filter are permitted to be used.
- .13 Work is subject to visual inspection. Contamination of surrounding areas indicated by visual inspection will require complete enclosure and clean-up of affected areas.

3.3 Cleanup

- .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
- .2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
- .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
- .4 Seal and remove double bagged waste from site. Dispose in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction and Section 01 35 43. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
- .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum and/or wet wiping.

3.4 Air Monitoring

- .1 From beginning of Work until completion of cleaning operations, the Consultant is to take air samples on daily basis outside of work area enclosure in accordance with Section 10.26.8 of the Canada Occupational Health and Safety Regulations.
 - .1 An employer shall ensure that a qualified person takes air samples to test for airborne asbestos fibres:
 - (a) in the vicinity of the containment system during any work activity that involves asbestos-containing material and, in the case of a work

- activity that lasts longer than 24 hours, at least daily (with the exception of weekends or other days when no work is occurring);
- (b) in the clean room during removal and clean-up operations and, in the case of removal and clean-up operations that last longer than 24 hours, at least daily (with the exception of weekends or other days when no work is occurring); and
- (c) in contaminated areas that are inside the containment system as necessary during removal and clean-up operations.
- .2 The employer shall ensure that the following air samples are taken:
- (a) two samples for every area in an enclosure that is 10 m² or less;
- (b) three samples for every area in an enclosure that is more than 10 m² and not more than 500 m²; and
- (c) five samples for every area in an enclosure that is more than 500 m².
- .2 Air monitoring to be completed in accordance with applicable Provincial Occupational Health and Safety Regulations and COHSR.
- .3 Contractor will be responsible for monitoring outside the enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations and COHSR.
- .1 If air monitoring shows that areas outside the Asbestos Work Area have airborne fibres exceeding 0.1 fibres per cubic centimetre (f/cc), enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area.
- .2 Stop work and clean areas outside of Asbestos Work Area when Phase Contrast Microscopy measurements exceed 0.1 f/cc of airborne fibres, and correct procedures.
- .3 Conduct required cleaning, re-cleaning, additional air testing and/or inspections will be at no extra cost to the Crown.
- .4 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations and COHSR.
- .5 Use results of air monitoring inside work area to establish type of respirators to be used. Workers may be required to wear sample pumps for up to full-shift periods.
- .1 If fibre levels are above safety factor of respirators in use, stop abatement, apply means of dust suppression, and use higher safety factor in respiratory protection for persons inside enclosure.
- .2 If air monitoring shows that areas outside work area enclosures are contaminated, enclose, maintain and clean these areas, in same manner as that applicable to work areas.
- .6 Within 24 hours after obtaining air sampling results, the Consultant shall post a copy of the results in a conspicuous place in the workplace; and make the results available to the

policy committee (if any), the work place committee and the health and the safety representative.

- .7 Ensure that respiratory safety factors are not exceeded.

3.5 Clearance Air Sampling

- .1 Final air monitoring, if required, to be conducted as follows: After Asbestos Work Area has passed visual inspection and an acceptable coat of slow-drying sealer has been applied to surfaces within enclosure, and appropriate settling period has passed, the Consultant will perform air monitoring within the Asbestos Work Area as detailed in O. Reg. 278/05. Air monitoring requirements also need to comply with section 10.26.9 of the Canada Occupational Health and Safety Regulations.
 - .1 Before dismantling a containment system and after all asbestos dust, waste and debris have been cleaned up, removed or encapsulated, an employer shall ensure that clearance air samples are taken inside the enclosure and that the concentration of airborne asbestos fibres is determined in accordance with Method 7400 set out in the document entitled NIOSH Manual of Analytical Methods, published by the National Institute for Occupational Safety and Health, as amended from time to time, or in accordance with a scientifically proven method used to collect and analyze a representative sample of airborne asbestos fibres.
 - .2 When conducting clearance air sampling, the Consultant shall ensure that forced air is used inside the enclosure to dislodge any asbestos fibres from all surfaces and keep them airborne.
 - .3 Clearance air sampling shall be taken until the concentrations of airborne asbestos fibres do not exceed the value of 0.01 f/cc as prescribed in O. Reg. 278/05.
- .2 Final air monitoring results must show airborne asbestos fibres levels less than 0.01 f/cc, or, must show that airborne fibres are not detected above the analytical detection limit.
- .3 If air monitoring results show airborne asbestos fibre levels in excess of 0.01 f/cc, or detects airborne fibres above the analytical detection limit, re-clean Asbestos Work Area and apply another acceptable coat of lock down agent to surfaces.
- .4 Repeat as necessary until airborne asbestos fibre levels are less than 0.01 f/cc, or when airborne fibres are not detected above the analytical detection limit.
- .5 Within 24 hours after obtaining air sampling results, the Consultant shall post a copy of the results in a conspicuous place in the workplace; and, make the results available to the policy committee (if any), the work place committee and the health and the safety representative and have a copy of the results sent to the Minister.

END OF SECTION

Part 1- General

1.1 Summary

- .1 Comply with requirements of this Section when performing following Work.
 - .1 Removing large quantities ($>1\text{m}^2$), if required, of asbestos-containing thermal insulation applied to pipe fittings from Rooms 1100 and 2102.
 - .2 Removing large quantities ($>1\text{m}^2$), if required, of asbestos-containing thermal insulation applied to pipe straights from Rooms 2102.
 - .3 Removing all asbestos-containing duct parging insulation applied to air handling unit and all thermal insulation applied to piping from Room 2219.
 - .4 As per information provided by DCC, the estimated abatement required in Room 2219 includes all duct insulation at connection points to be removed and replaced, including vibration dampeners. AHU to be disassembled and removed, existing ducts to be closed and capped. Assume two ceiling penetrations, removal of vibration dampeners, and some asbestos-containing pipe insulation (approximately 15 linear feet will need to be removed as part of disconnections).

1.2 Related Requirements

- .1 Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions.
- .2 Section 02 82 00.02 – Asbestos Abatement – Intermediate Precautions.
- .3 Section 02 83 10 – Lead-based Paint Abatement – Minimum Precautions.
- .4 Section 02 83 11 – Lead-based Paint Abatement – Intermediate Precautions.

1.3 References

- .1 O. Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.
- .2 O. Reg. 490/09, Designated Substances.
- .3 O. Reg. 632/05, Confined Spaces.
- .4 O. Reg. 860/90, Workplace Hazardous Materials Information System (WHMIS).
- .5 O. Reg. 213/91, Construction Projects.
- .6 O. Reg. 347/90, General – Waste Management.
- .7 US Environmental Protection Agency (EPA).
- .8 CSA Z94.4.1:21, Performance of Filtering Respirators.
- .9 Waste Management and Disposal, Section 01 35 43.
- .10 DND/CF, Asbestos Management Directive, November 20, 2007.
- .11 The Canada Labour Code, COHSR SOR/86-304.
- .12 Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada*”

Toronto – 1133 Sheppard Avenue West, Toronto, Ontario” dated May 2023.

- .13 A Guide to the Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007,
<http://www.labour.gov.on.ca/english/hs/asbestos/index.html>.
- .14 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.205-[94], Sealer for Application to Asbestos-Fibre-Releasing Materials.
- .15 Canadian Standards Association (CSA International).
- .16 Department of Justice Canada
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
 - .2 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
- .17 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .18 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Regulations, 2020 (TDGR).
- .19 Underwriters' Laboratories of Canada (ULC).
- .20 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 7400-August 1994, NIOSH Manual of Analytical Methods (NMAM), 4th Edition.

1.4 Definitions

- .1 Airlock: system for permitting ingress or egress without permitting air movement between contaminated area and uncontaminated area, typically consisting of two curtained doorways at least 2 m apart.
- .2 Amended Water: water with a non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.
- .3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.
- .4 Asbestos Work Areas: area where work takes place which will or may disturb ACMs.
- .5 Authorized Visitors: DCC Representatives and representatives of regulatory agencies.
- .6 Competent worker person: 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.
- .7 Consultant: Regarding This specification, “Consultant” refers to a 3rd Party consultant contracted independently by DCC/DND.
- .8 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:
 - .1 Place two overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet along one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.
 - .2 Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing.
 - .3 Overlap each polyethylene sheet at openings not less than 1.5 m on each side.
- .9 DOP Test: testing method used to determine integrity of Negative Pressure unit using dioctyl phthalate (DOP) HEPA-filter leak test.
- .10 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .11 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .12 Negative pressure: system that extracts air directly from work area, filters such extracted air through High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building.
 - .1 System to maintain minimum pressure differential of 0.025 mm (0.001 inches) WC relative to adjacent areas outside of work areas, be equipped with alarm to warn of system breakdown, and be equipped with instrument to continuously monitor and automatically record pressure differences.
 - .2 Exhaust units fitted with High Efficiency Particulate Aerosol (HEPA) filters used to affect a negative pressure differential in the work area as compared to the immediate surrounding or clean area. The filtering system must be capable of collecting and retaining asbestos fibres to an efficiency of 99.97% for fibres of 0.3 um or larger. The HEPA filters must have been individually tested and certified by the manufacturer and bear a label certifying performance. The unit is to be fitted with instrumentation to indicate pressure differential across the HEPA filter with an audible alarm to sound at a preset low differential pressure.
 - .3 Construction of HEPA filter/fan cabinet units shall be airtight and all joints shall be caulked. The gasket seal between the filter housing and the retaining frame inside the cabinet shall provide a zero-leakage seal to avoid filter bypassing.
 - .4 Each negative pressure unit shall be DOP tested at the work site prior to commencement of asbestos removal. The procedure must include the testing of the integrity of the entire cabinet. Written confirmation of the test results are to be provided to the DCC Representative. Retesting may be requested by the

DCC Representative and performed by the Contractor should the unit be damaged or modified during the work.

.5 Differential Pressure Recorder/Manometer:

.1 Instrument to monitor and record the differential pressure between the Work Area and Clean Area.

- | | | |
|----|------------------|---|
| .1 | sensitivity: | 0.025 mm (0.001 inches) WC increments between +0.25 mm to -2.5 mm (+0.010 to 0.100 inches) WC |
| .2 | accuracy: | +/- 1 % |
| .3 | pressure alarms: | audible high and low level alarm programmable within operating range |
| .4 | printout: | minimum 24 hour period at 15 minute intervals |

.13 Non-Friable Materials: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.14 Occupied Areas: any area of building or work site that is outside Asbestos Work Area.

.15 Polyethylene sheeting sealed with tape: polyethylene sheeting of type and thickness specified sealed with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide continuous polyethylene membrane to protect underlying surfaces from water damage or damage by sealants, and to prevent escape of asbestos fibres through sheeting into clean area.

.16 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.

1.5 Submittals

.1 Submittals in accordance with Sections 01 33 00 – Submittals and 01 35 43.

.2 Before beginning work:

.1 Obtain from appropriate agency and submit to the DCC Representative necessary permits for transportation and disposal of asbestos waste. Ensure that dump operator is fully aware of hazardous nature of material being dumped, and proper methods of disposal. Submit proof satisfactory to the third party retained by the Crown that suitable arrangements have been made to receive and properly dispose of asbestos waste.

.2 Submit proof satisfactory to the DCC Representative that all asbestos workers have received appropriate training and education by a competent person on hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Submit a letter certifying that:

(a) *every worker involved in a Type 3 operation has successfully completed*

the Asbestos Abatement Worker Training Program (253S) approved by the Ministry of Training, Colleges and Universities: and

(b) every supervisor of a worker involved in a Type 3 operation has successfully completed the Asbestos Abatement Supervisor Training Program (253S) approved by the Ministry of Training, Colleges and Universities. O.Reg. 278/05, s. 20(1).

- .3 Ensure supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by the DCC Representative. Submit proof of attendance in form of certificate. Minimum of one Supervisor for every ten workers. Supervisor must remain on site at all times asbestos removal or cleanup is occurring.
 - .4 Prior to work commencing, submit layout of proposed enclosures and decontamination facilities to the DCC Representative for review.
 - .5 Prior to work commencing, submit documentation including test results for sealer proposed for use.
 - .6 Prior to work commencing, submit Provincial and/or local requirements for Notice of Project form.
 - .7 Prior to work commencing, submit proof satisfactory to the DCC Representative that employees have respirator testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.
 - .8 Prior to work commencing, submit Workplace Safety and Insurance Board status and transcription of insurance.
 - .9 Prior to work commencing, submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including but not limited to following:
 - .1 Encapsulants.
 - .2 Amended water.
 - .3 Slow drying sealer.
 - .4 Mastic Removal product.
 - .10 Prior to work commencing, submit proof that each negative pressure filter/fan unit has been DOP tested at the work site (and passed the test criteria) prior to commencement of asbestos removal operation.
3. Submittals upon completion of work:
- .1 Asbestos waste haulage and disposal documentations including Bills of Lading, waste transfer documents and dump receipts within 24 hours of removal from DND property.

1.6 Quality Assurance

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Health and Safety:
 - .1 Complete construction occupational health and safety in accordance with Section 01 70 12 – Health and Safety Requirements.
 - .2 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area includes:
 - .1 Air purifying full face-mask respirator or Powered air purifying respirator (PAPR) with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
 - .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.

Requirements for each worker:

 - .1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters that have been tested as satisfactory, clean coveralls and head

- covers before entering Equipment and Access Rooms or Asbestos Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.
- .2 Remove gross contamination from clothing before leaving work area then proceed to Equipment and Access Room and remove clothing except respirators. Place contaminated work suits in receptacles for disposal with other asbestos - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. Still wearing the respirator, proceed naked to showers. Using soap and water, wash body and hair thoroughly. Clean outside of respirator with soap and water while showering; remove respirator; remove filters and wet them and dispose of filters in container provided for purpose; and wash and rinse inside of respirator. When not in use in work area, store work footwear in Equipment and Access Room. Upon completion of asbestos abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from work area or from Equipment and Access Room.
 - .3 After showering and drying off, proceed to clean change room and dress in street clothes at end of each day's work, or in clean coveralls before eating, smoking, or drinking. If re-entering work area, follow procedures outlined in paragraphs above.
 - .4 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers must not use this system as means to leave or enter work area.
- .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
 - .3 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual asbestos abatement.
 - .4 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.
 - .5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
 - .6 Visitor Protection:

- .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.
- .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
- .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 35 43.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Section 01 35 43.
- .4 Separate for reuse and recycling and place in designated containers in accordance with Section 01 35 43.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Federal, Provincial and Municipal regulations.
- .7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose asbestos waste in sealed double thickness 0.152 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.
- .8 Provide Bills of Lading to the DCC Representative describing and listing waste created and final disposal location. Transport containers by approved means to licensed landfill for burial.

1.8 Existing Conditions

- .1 The Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada Toronto – 1133 Sheppard Avenue West, Toronto, Ontario*” dated May 2023, indicates the locations of hazardous materials present. Areas requiring special handling under hazardous material precautions are outlined in this Specification package. Asbestos-containing materials identified in the above-referenced report include:
 - .1 Thermal insulation applied to pipe fittings contains 55% Chrysotile asbestos.
 - .2 Thermal insulation (“Antisweat”) applied to pipe straights contains 55% Chrysotile asbestos.
 - .3 Cement parging applied to ducts contains 55% Chrysotile asbestos.
 - .4 Vinyl floor tiles (12” x 12” beige) contain 1% Chrysotile asbestos.
 - .5 Drywall Joint Compound contains 2% Chrysotile asbestos.
 - .6 Cement Board contains 8% Chrysotile asbestos.
- .2 Notify the DCC Representative of suspect asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do

not disturb such material until instructed by the DCC Representative.

1.9 Scheduling

- .1 Not later than ten (10) days before beginning Work on this Project notify following in writing:
 - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
 - .2 Regional Office of Labour Canada.
 - .3 Ontario Ministry of Labour.
 - .4 Disposal Authority.
- .2 Inform sub-trades of presence of asbestos-containing materials identified in Existing Conditions.
- .3 Submit to the third party retained by the Crown copy of notifications prior to start of Work.
- .4 Hours of Work: perform abatement work according to normal working hours (8:00 AM to 4:00 PM), as approved by DCC. Include in Contract Sum additional costs for any work to be performed outside of normal hours.

1.10 Personnel Training

- .1 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.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Proper fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

Part 2 - Products

2.1 Materials

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

conditions and wet conditions using amended water.

- .4 Wetting agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether, or other material approved by the third party retained by the Crown, mixed with water in concentration to provide adequate penetration and wetting of asbestos containing material.
- .5 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene bag [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 thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site. Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site. Both sides of every waste container must display in large easily legible letters the words '**ASBESTOS, WHITE, PRODUCT IDENTIFICATION NUMBER 2590**'.
- .6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

2.2 Equipment

- .1 All equipment brought on site must be thoroughly clean and free of all fibre, asbestos or otherwise, to the satisfaction of the DCC Representative. The Contractor will be fully responsible for the replacement of equipment rejected by the DCC Representative and for all costs resulting from site contamination due to dirty or faulty equipment.
- .2 Airless Sprayer:
 - 1 Spray equipment for the application of amended water and sealant Hydro spray:
 - .1 Fine atomizing spray nozzle: Nozzle for airless sprayer capable of delivering not less than 4.5 L per minute of fine particle spray of amended water.
- .3 Garden Sprayer:
 - .1 Hand pump-type pressure-can garden sprayer fabricated out of either metal or plastic equipped with a wand at the end of a hose that can deliver a stream or spray of liquid under pressure.
- .4 Ground Fault Panel:
 - .1 Electrical Panel equipped with ground fault circuit breakers of sufficient capacity to power all electrical equipment and lights in work area. All breakers shall have 5 mA ground fault protection. Panel should be complete with all necessary accessories including ground fault

interruption lights, test switch to ensure unit is working, and reset switch. Ground fault receptacles on extension cords shall not be used.

- .2 The GFI Panel must be constructed under the direction of a licensed Electrician and inspected by a licensed Electrician on a regular basis. Evidence of such construction and inspection shall be submitted to the DCC Representative prior to installation of the Panel on site.

Part 3 - Execution

3.1 Preparation

- .1 Complete construction occupational health and safety measures in accordance with Section 01 70 12 – Health and Safety Requirements.
- .2 Work Areas:
 - .1 Plumbing and drainage
 - .1 Provide a constant supply of water by means of copper or PVC pipe, fittings and valves to the worker area, equipment decontamination room and the shower facility. High pressure hose with appropriate connections may be used with the approval of the DCC Representative. A master shut-off valve shall be installed adjacent to, and on the clean side, of the decontamination facility. Any hose and hose connections must have a high-pressure rating and be limited to downstream of the master shut-off valve and are not to be left under pressure unattended.
 - .2 Water will be made available to the Contractor within the building, location to be determined during the prior to project commencement. The Contractor is responsible for all tie-ins to existing systems, providing hot water including supply and installation of a temporary hot water tank, as necessary, and making good on completion.
 - .3 The effluent from the shower may be disposed of, through a filter, to the sanitary sewer, location to be determined prior to project commencement. Only shower water may be disposed in this fashion, no asbestos-containing debris, cleaning solutions, encapsulants, sealants, body wastes, etc., may be disposed in the shower. The Contractor is responsible for all tie-ins to the existing systems and making good on completion. Free flowing shower effluent on to the floor or ground is not acceptable.
 - .4 All Work shall be carried out in accordance with the Ontario Plumbing Code.
 - .2 Electrical
 - .1 The Contractor shall become completely familiar with the existing electrical installation prior to project commencement.
 - .2 The Contractor is responsible to provide and install all electrical requirements for the project including but not limited to:
 - .1 de-energize and lockout all electrical circuits in the work area

wherever practicable;

- .2 identify all systems that cannot be de-energized, and all low voltage systems such as controls and alarms;
 - .3 identify any electrical conditions which need special protection or consideration during the work;
 - .4 disconnect, if practicable, or provide suitable protection for, smoke and heat detectors, if any, and advise the authorities;
 - .5 protect existing electrical equipment including but not limited to: transformers, circuit breakers, switch gear, panels, buss ducts, fixtures, conduits, etc., within the work area, de-energized or not. Cover with a minimum of two independently sealed layers of poly, at least one of the layers to be of reinforced poly;
 - .6 provide all additional transformers, circuit breakers, switch gear, panels, ground fault protection and temporary lighting required for the project. The ground fault panel is to have sufficient capacity to service the project needs and have two spare circuits to serve as backup. The work area lighting is to provide appropriate levels of illumination for the work, with a minimum of two separate circuits. Bulbs are to be fitted with cages or other suitable protection against breakage and/or direct contact with insulation materials (wood, plastic, etc.).
 - .7 All electrical power within the work area must be ground fault protected.
 - .1 The power cable to the Ground Fault Panel and the panel itself is not typically protected by an interrupter and, as such, it must be located outside the work area or suitably protected from water and physical damage.
 - .2 All Work shall be performed by a licensed electrician and comply with the latest edition of the Ontario Electrical Safety Code and any other local codes and requirements which may govern the installation. The Contractor is responsible for, and shall arrange for, all inspections and approvals which may be required by government regulations, Electrical Safety Authority (ESA) or any other authorities having jurisdiction. The Client is to receive copies of all inspection reports.
- .3 Heat detectors
- .1 Protect and seal heat detectors with 0.04 mm (1.5 mil) polyethylene, sealed with tape. Tape is not to interfere with function of the unit.
 - .2 System is to be activated and deactivated as arranged with monitoring agency and the DCC Representative with the intent of leaving the entire system active when the Contractor is not on site.

- .3 Provide an emergency name and contact number to the DCC Representative and monitoring agency.
- .4 Shut off and isolate air handling and ventilation systems to prevent fibre dispersal to other building areas during work phase. Conduct smoke tests to ensure that duct work is airtight. Seal and caulk joints and seams of active return air ducts within Asbestos Work Area.
- .5 Preclean fixed casework, plant, and equipment within proposed work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.
- .6 Clean proposed work areas using, where practicable, HEPA vacuum cleaning equipment. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum equipment.
- .7 The spread of dust from the work area to be prevented by:
 - .1 Using enclosures of polyethylene or other suitable material that is impervious to asbestos (including, if the enclosure material is opaque, one or more transparent window areas to allow observation of the entire work area from outside the enclosure), if the work area is not enclosed by walls.
 - .2 Using curtains of polyethylene sheeting or other suitable material that is impervious to asbestos, fitted on each side of each entrance or exit from the work area.
- .8 Cover ground and wall surfaces, where required, with polyethylene sheeting sealed with tape. Use two layers of FR polyethylene on floors. Cover floors first so that polyethylene extends at least 300 mm up walls then cover walls to overlap floor sheeting.
- .9 Build airlocks at entrances to and exits from work areas so that work areas are always closed off by one curtained doorway when workers enter or exit.
- .10 At each access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used: "CAUTION ASBESTOS HAZARD AREA (25 mm) NO UNAUTHORIZED ENTRY (19 mm) WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)".
- .11 Maintain emergency and fire exits that may exist from work areas, or establish alternative exits satisfactory to the DND PM and Fire Chief via the DCC Representative and Provincial/Territorial Fire Marshall Authority having jurisdiction.
- .12 Where application of water is required for wetting asbestos containing materials, shut off electrical power, provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard and Section 2.2.2 of this specification. Ensure safe installation of electrical lines and equipment.

- .13 After preparation of work areas and Decontamination Enclosure Systems, as described below in Section 3.1.2.4.3, for the removal of all asbestos-containing materials, remove within work area and dispose as contaminated waste in specified containers. Spray asbestos debris and immediate work area with amended water to reduce dust, as work progresses.
- .3 Worker Decontamination Enclosure System:
 - .1 Worker Decontamination Enclosure System includes Equipment and Access Room, Shower Room, and Clean Room, as follows:
 - .1 Equipment and Access Room: build Equipment and Access Room between Shower Room and work areas, with two curtained doorways, one to Shower Room and one to work areas. Install portable toilet, waste receptor, and storage facilities for workers' shoes and protective clothing to be re-worn in work areas. Build Equipment and Access Room large enough to accommodate specified facilities, other equipment needed, and at least one worker allowing him /her sufficient space to undress comfortably.
 - .2 Shower Room: build Shower Room between Clean Room and Equipment and Access Room, with two curtained doorways, one to Clean Room and one to Equipment and Access Room. Provide one shower for every five workers. Provide constant supply of hot and cold or warm water. Cold and hot water will be provided at the site. Drains to common sewers are available at the site. Provide piping and connect to water sources and drains. Pump waste water through 5 micrometre filter system acceptable to the third party retained by the Crown before directing into drains. Provide soap, clean towels, and appropriate containers for disposal of used respirator filters.
 - .3 Clean Room: build Clean Room between Shower Room and clean areas outside of enclosures, with two curtained doorways, one to outside of enclosures and one to Shower Room. Provide lockers or hangers and hooks for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly.
- .4 Container and Equipment Decontamination Enclosure System:
 - .1 Container and Equipment Decontamination Enclosure System consists of Staging Area within work area, Washroom, Holding Room, and Unloading Room. Purpose of system is to provide means to decontaminate waste containers, scaffolding, waste and material containers, vacuum and spray equipment, and other tools and equipment for which Worker Decontamination Enclosure System is not suitable.
 - .1 Staging Area: designate Staging Area in work area for gross removal of dust and debris from waste containers and equipment, labelling and sealing of waste containers, and temporary storage pending removal to Washroom. Equipment Staging Area with curtained doorway to

Washroom.

- .2 Washroom: build Washroom between Staging Area and Holding Room with two curtained doorways, one to Staging Area and one to Holding Room. Provide high - pressure low - volume sprays for washing of waste containers and equipment. Pump waste water through 5 micrometre filter system before directing into drains. Provide piping and connect to water sources and drains.
 - .3 Holding Room: build Holding Room between Washroom and Unloading Room, with two curtained doorways, one to Washroom and one to Unloading Room. Build Holding Room sized to accommodate at least two waste containers and largest item of equipment used.
 - .4 Unloading Room: build Unloading Room between Holding Room and outside, with two curtained doorways, one to Holding Room and one to outside.
- .5 Construction of Decontamination Enclosures:
- .1 Build suitable framing for enclosures, and line with polyethylene sheeting sealed with tape. Use two layers of FR polyethylene on the floor.
 - .2 Build curtained doorways between enclosures so that when people move through or when waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.
- .6 Separation of Work Areas from Adjacent Areas:
- .1 Separate parts of building required to remain in use from parts of building used for asbestos abatement by means of airtight barrier system constructed as follows:
 - .1 Build suitable floor to ceiling lumber (50 mm x 100 mm spruce studs) or metal stud framing at 600 mm centres, cover with polyethylene sheeting sealed with tape, and apply 9 mm minimum thick plywood. Seal joints between plywood sheets and between plywood and adjacent materials with surface film forming type sealer, to create airtight barrier.
 - .2 Cover plywood barrier with polyethylene sealed with tape, as specified for work areas.
- .7 Maintenance of Enclosures:
- .1 Maintain enclosures in tidy condition.
 - .2 Ensure that barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.
 - .3 Visually inspect enclosures at beginning of each working period.
 - .4 Use smoke methods to test effectiveness of barriers when directed by the DCC Representative.
- .8 Do not begin Asbestos Abatement work until:

- .1 Arrangements have been made for disposal of waste.
- .2 For wet stripping techniques, arrangements have been made for containing, filtering, and disposal of waste water.
- .3 Work areas and decontamination enclosures and parts of building required to remain in use are to be effectively segregated.
- .4 Tools, equipment, and materials waste containers are on hand.
- .5 Arrangements have been made for building security.
- .6 Warning signs are displayed where access to contaminated areas is possible.
- .7 Notifications have been completed and other preparatory steps have been taken.
- .8 A pre-contamination inspection has been performed and passed by the DCC Representative.

3.2 Supervision

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

3.3 Asbestos Removal

- .1 Before removing asbestos:
 - .1 Spray asbestos materials with water containing specified wetting agent, using airless spray equipment capable of providing "mist" application to prevent release of fibres. Spray asbestos material repeatedly during work process to minimize asbestos fibre dispersion.
 - .2 Apply amended water on all materials to be removed to reduce dust. Remove materials and immediately place into waste receptor. Double bag when removing debris from work area.
 - .3 Any grinding equipment used shall be attached to a dust-collecting device equipped with a HEPA filter.
 - .4 Remove saturated asbestos material in small sections. Do not allow waste materials to dry out. As it is being removed pack material in sealable plastic bags 0.15 mm minimum thick and place in labelled containers for transport.
 - .5 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure that containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.
 - .6 After completion of stripping work, wire brushed and wet sponged surfaces from which asbestos has been removed to remove visible material. During this work keep surfaces wet.

- .7 After wire brushing and wet sponging to remove visible asbestos, wet clean entire work area including Equipment and Access Room, and equipment used in process. After 24 hour period to allow for dust settling, wet clean these areas and objects again. During this settling period no entry, activity, or ventilation will be permitted. After inspection by the DCC Representative, apply continuous coat of slow drying sealer to surfaces of work area. Allow at least 16 hours with no entry, activity, ventilation, or disturbance other than operation of negative pressure units during this period.
- .8 Work is subject to final visual inspection and air monitoring by the DCC Representative. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.
- .9 Cleanup:
 - .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
 - .4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
 - .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.4 Final Cleanup

- .1 Following cleaning specified above, and when final air clearance sampling (as detailed in Section 3.7) shows that asbestos levels do not exceed 0.01 fibres/cc as determined by membrane filter method at 400-500X magnification phase contrast illumination, as described in NIOSH Method 7400 or equivalent, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible asbestos containing particles observed during cleanup, immediately, using HEPA vacuum equipment.
- .3 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .4 Include in clean-up Work areas, Equipment and Access Room, Washroom, Shower Room, and other contaminated enclosures.
- .5 Include in clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.

- .6 As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled containers containing asbestos waste and dispose of at an authorized disposal site in accordance with requirements of disposal authority. Ensure that each shipment of containers transported to an MECP licensed disposal site is accompanied by Contractor's representative to ensure that dumping is done in accordance with governing regulations.

3.5 Re-Establishment of Objects and Systems

- .1 Not Applicable.

3.6 Air Monitoring

- .1 From beginning of Work until completion of cleaning operations, the Consultant is to take air samples on daily basis outside of work area enclosure in accordance with Section 10.26.8 of the Canada Occupational Health and Safety Regulations.
 - .1 An employer shall ensure that a qualified person takes air samples to test for airborne asbestos fibres:
 - (a) in the vicinity of the containment system during any work activity that involves asbestos-containing material and, in the case of a work activity that lasts longer than 24 hours, at least daily (with the exception of weekends or other days when no work is occurring);
 - (b) in the clean room during removal and clean-up operations and, in the case of removal and clean-up operations that last longer than 24 hours, at least daily (with the exception of weekends or other days when no work is occurring); and
 - (c) in contaminated areas that are inside the containment system as necessary during removal and clean-up operations.
 - .2 The employer shall ensure that the following air samples are taken:
 - (a) two samples for every area in an enclosure that is 10 m² or less;
 - (b) three samples for every area in an enclosure that is more than 10 m² and not more than 500 m²; and
 - (c) five samples for every area in an enclosure that is more than 500 m².
- .2 Air monitoring to be completed in accordance with applicable Provincial Occupational Health and Safety Regulations and COHSR.
- .3 Contractor will be responsible for monitoring outside the enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations and COHSR.
 - .1 If air monitoring shows that areas outside the Asbestos Work Area have airborne fibres exceeding 0.1 fibres per cubic centimetre (f/cc), enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area.
 - .2 Stop work and clean areas outside of Asbestos Work Area when Phase Contrast Microscopy measurements exceed 0.1 f/cc of airborne fibres, and correct procedures.

- .3 Conduct required cleaning, re-cleaning, additional air testing and/or inspections will be at no extra cost to the Crown.
- .4 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations and COHSR.
- .5 Use results of air monitoring inside work area to establish type of respirators to be used. Workers may be required to wear sample pumps for up to full-shift periods.
 - .1 If fibre levels are above safety factor of respirators in use, stop abatement, apply means of dust suppression, and use higher safety factor in respiratory protection for persons inside enclosure.
 - .2 If air monitoring shows that areas outside work area enclosures are contaminated, enclose, maintain and clean these areas, in same manner as that applicable to work areas.
- .6 Within 24 hours after obtaining air sampling results, the Consultant shall post a copy of the results in a conspicuous place in the workplace; and, make the results available to the policy committee (if any), the work place committee and the health and the safety representative.
- .7 Samples will be analyzed on a rush/one day turnaround time basis.
- .8 Ensure that respiratory safety factors are not exceeded.

3.7 Clearance Air Sampling

- .1 Final air monitoring to be conducted as follows: After Asbestos Work Area has passed visual inspection and an acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate settling period has passed, the Consultant will perform air monitoring within the Asbestos Work Area as detailed in O. Reg. 278/05. Air monitoring requirements also need to comply with section 10.26.9 of the Canada Occupational Health and Safety Regulations.
 - .1 Before dismantling a containment system and after all asbestos dust, waste and debris have been cleaned up, removed or encapsulated, an employer shall ensure that clearance air samples are taken inside the enclosure and that the concentration of airborne asbestos fibres is determined in accordance with Method 7400 set out in the document entitled NIOSH Manual of Analytical Methods, published by the National Institute for Occupational Safety and Health, as amended from time to time, or in accordance with a scientifically proven method used to collect and analyze a representative sample of airborne asbestos fibres.
 - .2 When conducting clearance air sampling, the employer shall ensure that forced air is used inside the enclosure to dislodge any asbestos fibres from all surfaces and keep them airborne.
 - .3 Clearance air sampling shall be taken until the concentrations of airborne asbestos fibres do not exceed the value of 0.01f/cc as prescribed in O. Reg. 278/05.
- .2 When conducting clearance air sampling, forced air is to be used inside the enclosure to dislodge any asbestos fibres from all surfaces and keep them airborne.

- .3 Final air monitoring results must show airborne asbestos fibres levels less than 0.01 f/cc, or, must show that airborne fibres are not detected above the analytical detection limit.
- .4 If air monitoring results show airborne asbestos fibre levels in excess of 0.01 f/cc, or detects airborne fibres above the analytical detection limit, re-clean Asbestos Work Area and apply another acceptable coat of lock down agent to surfaces.
- .5 Repeat as necessary until airborne asbestos fibre levels are less than 0.01 f/cc, or when airborne fibres are not detected above the analytical detection limit.
- .6 Within 24 hours after obtaining air sampling results, the Consultant shall post a copy of the results in a conspicuous place in the work place; and, make the results available to the policy committee (if any), the work place committee and the health and the safety representative and have a copy of the results sent to the Minister.

3.8 Inspection

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

END OF SECTION

Part 1 General**1.1 Summary**

- .1 Comply with requirements of this Section when performing following Work.
 - .1 Removal of lead-containing paint using power tools connected to a dust-collecting device equipped with a HEPA filter under Class 2A protocols (MOL *Guideline, Lead on Construction Projects*, dated April 2011).
 - .2 Removal of lead-containing paint by scraping and sanding with non-powered hand tools, under Class 2A protocols (MOL).
 - .3 Removal of lead-containing paint with a chemical gel or paste and fibrous laminated cloth wrap, under Class 1 protocols (MOL).
- .2 Related Requirements
 - .1 Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions.
 - .2 Section 02 82 00.02 – Asbestos Abatement – Intermediate Precautions.
 - .3 Section 02 82 00.03 – Asbestos Abatement – Maximum Precautions.
 - .4 Section 02 83 11 – Lead-based Paint Abatement – Intermediate Precautions.

1.2 Reference Standards

- .1 Department of Justice Canada
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .2 Health Canada
 - .1 Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .3 Human Resources and Social Development Canada (HRSDC)
 - .1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.
- .4 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Regulations, 2020 (TDGR).
- .5 United States Environmental Protection Agency (EPA)
 - .1 EPA 747-R-95-007-(1995), Sampling House Dust for Lead.
- .6 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)
 - .1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).
- .7 Underwriters' Laboratories of Canada (ULC)

- .8 Province of Ontario
 - .1 Ontario Ministry of Labour
 - .1 Occupational Health and Safety Branch, Guideline Lead On Construction Projects, September 2004 (updated April 2011), and O. Reg. 490/09 respecting Designated Substances - Lead made under the Occupational Health and Safety Act, as amended by O. Reg. 148/12 and O. Reg. 149/12.
- .9 Environmental Abatement Council of Canada (EACC) – Lead Abatement Guideline, 2015.

1.3 Definitions

- .1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Authorized Visitors: DCC Representative or other designated representatives.
- .3 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects over cuts and tears, and elsewhere as required to provide protection and isolation. For protection of underlying surfaces from damage and to prevent lead dust entering in clean area.
- .4 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.
- .5 Action level: employee exposure, without regard to use of respirators, to airborne concentration of lead of 0.05 milligrams per cubic metre of air (0.05 mg/m^3) calculated as 8-hour time-weighted average (TWA). Minimum precautions for lead abatement are based on airborne lead concentrations less than 0.05 milligrams per cubic metre of air for removal of lead-based paint by methods noted in paragraph 1.1.
- .6 Competent person: DCC Representative capable of identifying existing lead hazards in workplace taking corrective measures to eliminate them.
- .7 Consultant: Regarding This specification, “Consultant” refers to a 3rd Party consultant contracted independently by DCC/DND.
- .8 Lead dust: 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.

1.4 Action and Informational Submittals

- .1 Provide submittals in accordance with Sections 01 33 00 – Submittal Procedures and 01 35 43.
- .2 Provide proof satisfactory to the DCC Representative that suitable arrangements have been made to dispose of lead-based paint waste in accordance with requirements of authority having jurisdiction.

- .3 Quality Control:
 - .1 Provide the DCC Representative necessary permits for transportation and disposal of lead-based paint waste and proof that lead based paint waste has been received and properly disposed of.
 - .2 Provide proof satisfactory to the DCC Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, and aspects of work procedures and protective measures.

1.5 Quality Assurance

- .1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to lead paint, provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Health and Safety:
 - .1 Complete construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
 - .2 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers and visitors in Work Area include:
 - .1 NIOSH approved respirator and equipped with replaceable HEPA filter cartridge with an assigned protection factor of 10, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure. Provide sufficient amount of filter replacements.
 - .2 Half mask respirator: half-mask particulate respirator with N, R, or P-series filter, and 95, 99 or 100 % efficiency could be provided.
 - .2 Eating, drinking, chewing, and smoking are not permitted in work area.
 - .3 Ensure workers wash hands and face when leaving work area. Facilities for washing must be provided.
 - .4 Visitor Protection:
 - .1 Provide approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors the procedures to be followed in entering and exiting the work area.

1.6 Waste Management and Disposal

- .1 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Federal, Provincial and Municipal regulations.

- .2 Waste management and disposal to be completed in accordance with Section 01 35 43 – Environmental Protection.
- .3 Disposal of lead waste generated by removal activities must comply with Federal, Provincial and Municipal regulations. Dispose lead waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.
- .4 Provide manifests, as per the requirements of Section 01 35 43, describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.7 Existing Conditions

- .1 The Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada Toronto – 1133 Sheppard Avenue West, Toronto, Ontario*” dated May 2023, indicates the locations of hazardous materials present. Areas requiring special handling under hazardous material precautions are outlined in this Specification package. Lead-containing materials identified in the above-referenced report include:
 - .1 Yellow pipe paint on the roof containing 602 µg/g lead.
 - .2 White wall paint on drywall in Rooms 1205A, 2205, 2132, 2213i and 2232 containing 16.1 µg/g mercury.
 - .3 Grey wall paint on drywall in Room 1542 containing 12.5 µg/g arsenic.
 - .4 Lead may also be present in lead pipe, mortar, glazing on ceramic tiles, in the solder on the seals of bell joints of any cast iron drainpipe and in the solder of on the sweated-on joints between copper pipe and fittings.
- .2 Building materials which contain or may contain other designated substances (i.e. asbestos, mercury and silica; and arsenic, mercury and PCBs in paints) as well as hazardous materials including PCBs, ODS’, UFFI and biological hazards well as hazardous materials are outlined in the report referenced in Section 1.7.1 above.

1.8 Scheduling

- .1 Not later than ten days before beginning Work on this Project notify following in writing:
 - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
 - .2 Provincial Ministry of Labour.
 - .3 Disposal Authority.
- .2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.
- .3 Provide the DCC Representative copy of notifications prior to start of Work.
- .4 Hours of Work: perform work during normal business hours (8:00 to 16:00).

1.9 Personnel Training

- .1 Provide the DCC Representative satisfactory proof that every worker has had instruction and training in hazards of lead exposure, in personal hygiene, in aspects of work procedures, and in use, cleaning, and disposal of respirators.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Proper fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

Part 2 Products

2.1 Materials

- .1 Polyethylene (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 lead paint residue.
- .4 Lead waste containers: A type acceptable to dump operator with tightly fitting covers and 0.15 mm minimum thickness sealable polyethylene liners.
 - .1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

Part 3 Execution

3.1 Supervision

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

3.2 Preparation

- .1 Remove and store items to be salvaged or reused.
 - .1 Protect and wrap items and transport and store in area specified by the DCC Representative.
- .2 Work Area:
 - .1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas. Conduct smoke tests to ensure duct work is airtight.

- .2 Pre-clean fixed casework and equipment within work area, using HEPA vacuum and cover and seal with polyethylene sheeting and tape.
 - .3 Clean work area using HEPA vacuum. If not practicable, use wet cleaning method. Do not raise dust.
 - .4 Seal off openings with polyethylene sheeting and seal with tape.
 - .5 Protect surfaces within work areas with a covering of polyethylene sheets.
 - .6 Maintain emergency fire exits or establish alternatives satisfactory to Authority having jurisdiction.
 - .7 Where water application is required for wetting lead containing materials, provide temporary water supply appropriately sized for application of water as required.
 - .8 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24-volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical cables and equipment.
- .3 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 Lead Abatement

- .1 Removal of identified lead-containing paint, if required, using methods described in Section 1.1.1.
- .2 Remove lead-based paint and place directly into sealable 0.15 mm thick plastic bags and place in labelled containers for transport.
- .3 Seal filled containers. Clean external stripped surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external stripped 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.
- .4 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.
- .5 After wire brushing and wet sponging to remove visible lead -based paint, and after encapsulating lead containing material impossible to remove, wet clean entire stripping work area, and equipment used in process. After inspection by the Consultant, apply continuous coat of slow drying sealer to surfaces of work area. Do not disturb work area

for at least eight (8) hours -no entry, activity, ventilation, or disturbance during this period.

3.4 Inspection

- .1 Perform inspections, as required, to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by the Consultant will result in work stoppage, at no cost to Owner.
- .2 The Consultant will inspect work for:
 - .1 Adherence to specific procedures and materials.
 - .2 Final cleanliness and completion.
 - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.5 Lead Surface Sampling - Work Areas

- .1 Final lead surface sampling on areas subject to stripping to be conducted as follows:
 - .1 After work area has passed a visual inspection for cleanliness approved and accepted by the Consultant. Apply coat of lock-down agent to surfaces within enclosure, and appropriate setting period of at least 8 hours, the Consultant may conduct lead wipe sampling.
 - .1 Final lead wipe sampling results from horizontal and vertical surfaces must show lead levels of less than 40 micrograms of lead in dust per square foot. Samples collected and analyzed in accordance with EPA 747-R-95-007.
 - .2 If wipe sampling results show levels of lead in excess of 40 micrograms per square foot, re-clean work area at contractor's expense and apply another acceptable coat of lock-down agent to surfaces.
 - .3 Repeat as necessary until lead levels are less than 40 micrograms per square foot.

3.6 Final Cleanup

- .1 Following cleaning and when lead wipe surfaces sampling are below acceptable concentrations, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum.
- .3 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .4 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

3.7 Re-Establishment of Objects and Systems

.1 Not Applicable.

END OF SECTION

Part 1 General**1.1 Summary**

- .1 Comply with requirements of this Section when performing following Work.
 - .1 Removal of lead-containing paint using power tools connected to a dust-collecting device equipped with a HEPA filter under Class 2A protocols (MOL *Guideline, Lead on Construction Projects*, dated April 2011).
 - .2 Removal of lead-containing paint by scraping and sanding with non-powered hand tools, under Class 2A protocols (MOL *Guideline*).
- .2 Related Requirements
 - .1 Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions.
 - .2 Section 02 82 00.02 – Asbestos Abatement – Intermediate Precautions.
 - .3 Section 02 82 00.03 – Asbestos Abatement – Maximum Precautions.
 - .4 Section 02 83 10 – Lead-based Paint Abatement – Minimum Precautions.

1.2 Reference Standards

- .1 Department of Justice Canada
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .2 Health Canada
 - .1 Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .3 Human Resources and Social Development Canada (HRSDC)
 - .1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.
- .1 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Regulations, 2020 (TDGR).
- .2 United States Environmental Protection Agency (EPA)
 - .1 EPA 747-R-95-007-[1995], Sampling House Dust for Lead.
- .3 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)
 - .1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).
- .4 Underwriters' Laboratories of Canada (ULC)
- .5 Province of Ontario
 - .1 Ontario Ministry of Labour

- .1 Occupational Health and Safety Branch, Guideline Lead On Construction Projects, September 2004 (updated April 2011), and O. Reg. 490/09 respecting Designated Substances - Lead made under the Occupational Health and Safety Act, as amended by O. Reg. 148/12 and O. Reg. 149/12.

- .10 Environmental Abatement Council of Canada (EACC) - Lead Abatement Guideline, 2014

1.3 Definitions

- .1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Authorized Visitors: The third party retained by the DCC Representative or designated representatives.
- .3 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects over cuts and tears, and elsewhere as required to provide protection and isolation. For protection of underlying surfaces from damage and to prevent lead dust entering in clean area.
- .4 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.
- .5 Action level: employee exposure, without regard to use of respirators, to airborne concentration of lead of 0.05 milligrams per cubic metre of air (0.05 mg/m^3) calculated as 8-hour time-weighted average (TWA). Minimum precautions for lead abatement are based on airborne lead concentrations less than 0.05 milligrams per cubic metre of air for removal of lead-based paint by methods noted in paragraph 1.1.
- .6 Competent person: The DCC Representative capable of identifying existing lead hazards in workplace taking corrective measures to eliminate them.
- .7 Consultant: Regarding This specification, “Consultant” refers to a 3rd Party consultant contracted independently by DCC/DND.
- .8 Lead dust: 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.

1.4 Action and Informational Submittals

- .1 Provide submittals in accordance with Sections 01 33 00 - Submittal Procedures and 01 35 43.
- .2 Provide proof satisfactory to the third party retained by the Crown that suitable arrangements have been made to dispose of lead-based paint waste in accordance with requirements of authority having jurisdiction.
- .3 Quality Control:

- .1 Provide the DCC Representative necessary permits for transportation and disposal of lead-based paint waste and proof that lead based paint waste has been received and properly disposed of.
- .2 Provide proof satisfactory to the DCC Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, and aspects of work procedures and protective measures.

1.5 Quality Assurance

- .1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to lead paint, provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Health and Safety:
 - .1 Complete construction occupational health and safety in accordance with Section 01 35 43 – Environmental Protection- as it relates to WHMIS and Waste Management/Disposal and 01 70 12 - Health and Safety Requirements.
 - .2 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers and visitors in Work Area include:
 - .1 NIOSH approved respirator and equipped with replaceable HEPA filter cartridge with an assigned protection factor of 10, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure. Provide sufficient amount of filter replacements.
 - .2 Half mask respirator: half-mask particulate respirator with N, R, or P-series filter, and 95, 99 or 100 % efficiency could be provided.
 - .2 Eating, drinking, chewing, and smoking are not permitted in work area.
 - .3 Ensure workers wash hands and face when leaving work area. Facilities for washing shall be provided by the abatement contractor.
 - .4 Visitor Protection:
 - .1 Provide approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors the procedures to be followed in entering and exiting the work area.

1.6 Waste Management and Disposal

- .1 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

- .2 Waste management and disposal to be completed in accordance with Section 01 35 43 – Environmental Protection.
- .3 Disposal of lead waste generated by removal activities must comply with Federal, Provincial and Municipal regulations. Dispose of lead waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.
- .4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.7 Existing Conditions

- .1 The Arcadis Canada Inc. report “*Designated Substances Survey and Hazardous Materials Survey, HVAC Compliance Upgrades, Defence Research and Development Canada Toronto – 1133 Sheppard Avenue West, Toronto, Ontario*” dated May 2023, indicates the locations of hazardous materials present. Areas requiring special handling under hazardous material precautions are outlined in this Specification package. Lead-containing materials identified in the above-referenced report include:
 - .1 Yellow pipe paint on the roof containing 602 µg/g lead.
 - .2 White wall paint on drywall in Rooms 1205A, 2205, 2132, 2213i and 2232 containing 16.1 µg/g mercury.
 - .3 Grey wall paint on drywall in Room 1542 containing 12.5 µg/g arsenic.
 - .4 Lead may also be present in lead pipe, mortar, glazing on ceramic tiles, in the solder on the seals of bell joints of any cast iron drainpipe and in the solder of on the sweated-on joints between copper pipe and fittings.
- .2 Building materials which contain or may contain other designated substances (i.e. asbestos, mercury and silica; and arsenic, mercury and PCBs in paints) as well as hazardous materials including PCBs, ODS’, UFFI and biological hazards well as hazardous materials are outlined in the report referenced in Section 1.7.1 above.

1.8 Scheduling

- .1 Not later than ten days before beginning Work on this Project notify following in writing:
 - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
 - .2 Provincial Ministry of Labour.
 - .3 Disposal Authority.
- .2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.
- .3 Provide the third party retained by the Crown copy of notifications prior to start of Work.
- .4 Hours of Work: perform work during normal business hours (8:00 to 16:00).

1.9 Personnel Training

- .1 Provide the DCC Representative satisfactory proof that every worker has had instruction and training in hazards of lead exposure, in personal hygiene, in aspects of work procedures, and in use, cleaning, and disposal of respirators.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Proper fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

Part 2 Products

2.1 Materials

- .1 Polyethylene (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 lead paint residue.
- .4 Lead waste containers: A type acceptable to dump operator with tightly fitting covers and 0.15 mm minimum thickness sealable polyethylene liners.
 - .1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

Part 3 Execution

3.1 Supervision

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

3.2 Preparation

- .1 Remove and store items to be salvaged or reused.
 - .1 Protect and wrap items and transport and store in area specified by the DCC Representative.
- .2 Work Area:
 - .1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas. Conduct smoke tests to ensure duct work is airtight.

- .2 Pre-clean fixed casework and equipment within work area, using HEPA vacuum and cover and seal with polyethylene sheeting and tape.
 - .3 Clean work area using HEPA vacuum. If not practicable, use wet cleaning method. Do not raise dust.
 - .4 Seal off openings with polyethylene sheeting and seal with tape.
 - .5 Protect surfaces within work areas with a covering of polyethylene sheets.
 - .6 Maintain emergency fire exits or establish alternatives satisfactory to Authority having jurisdiction.
 - .7 Where water application is required for wetting lead containing materials, provide temporary water supply appropriately sized for application of water as required.
 - .8 Provide electrical power and shut off (for operation of powered tools and equipment). Provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical cables and equipment.
- .3 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 Lead Abatement

- .1 Removal of identified lead-containing paint as identified in Section 1.1.1.
- .2 Remove lead-based paint and place directly into sealable 0.15 mm thick plastic bags and place in labelled containers for transport.
- .3 Seal filled containers. Clean external stripped surfaces thoroughly by wet sponging. Remove from immediate work area to staging area. Clean external stripped surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside. Ensure enclosures are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .4 After completion of stripping work, wire brush and wet sponge surface from which lead-based paint has been removed to remove visible material. During this work keep surfaces wet.
- .5 After wire brushing and wet sponging has been completed, and after encapsulating any paint that could not be removed, wet clean entire stripping area and equipment used in the process. After inspection by the Consultant, apply continuous coat of slow drying sealer to surfaces of work area. Do not disturb work area for at least eight (8) hours – no entry, activity, ventilation or disturbance during this period.

3.4 Inspection

- .1 Perform inspections, as required, to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by the Consultant will result in work stoppage, at no cost to Owner.
- .2 The Consultant will inspect work for:
 - .1 Adherence to specific procedures and materials.
 - .2 Final cleanliness and completion.
- .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.5 Lead Surface Sampling – Work Areas

- .1 After work area has passed a final visual inspection for cleanliness approved and accepted by the third party retained by the Crown. Apply coat of lock-down agent to surfaces within enclosure, and appropriate settling period of at least 8 hours, the Consultant may conduct lead wipe sampling.
 - .1 Final lead wipe sampling results from horizontal and vertical must show lead levels of less than 40 micrograms of lead in dust per square foot. Samples collected and analyzed in accordance with EPA 747-R-95-007.
 - .2 If wipe sampling results show levels of lead in excess of 40 micrograms per square foot, re-clean work areas at contractor's expense and apply another acceptable coat of lock-down agent.
 - .3 Repeat as necessary until lead levels are less than 40 micrograms per square foot.

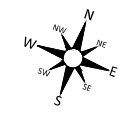
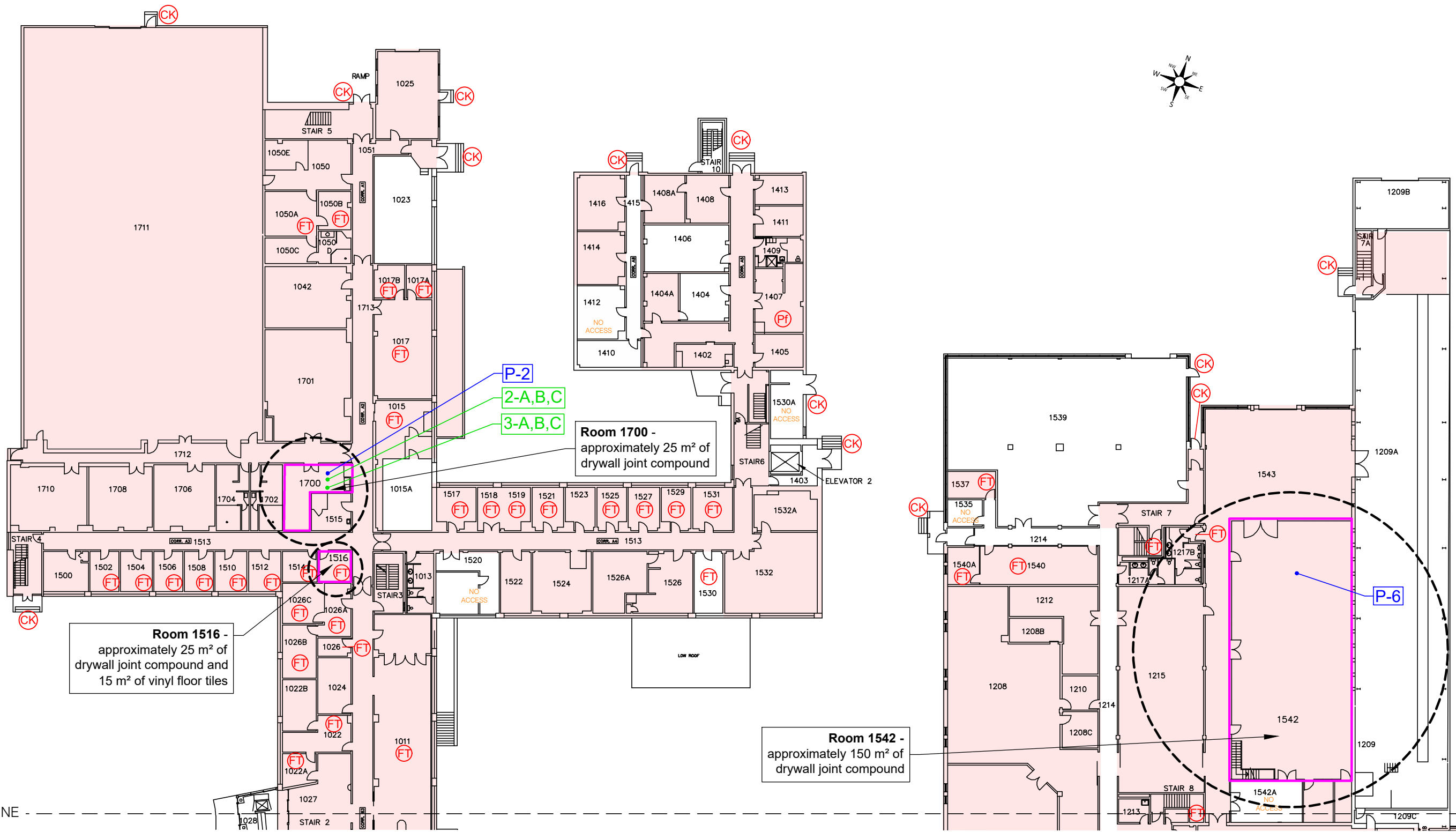
3.6 Final Cleanup

- .1 Following passing inspection from the Consultant, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum.
- .3 Place used polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .4 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

3.7 Re-Establishment of Objects and Systems

- .1 Not Applicable.

END OF SECTION



Room 1516 -
approximately 25 m² of
drywall joint compound and
15 m² of vinyl floor tiles

Room 1700 -
approximately 25 m² of
drywall joint compound

Room 1542 -
approximately 150 m² of
drywall joint compound

FIG. 1A

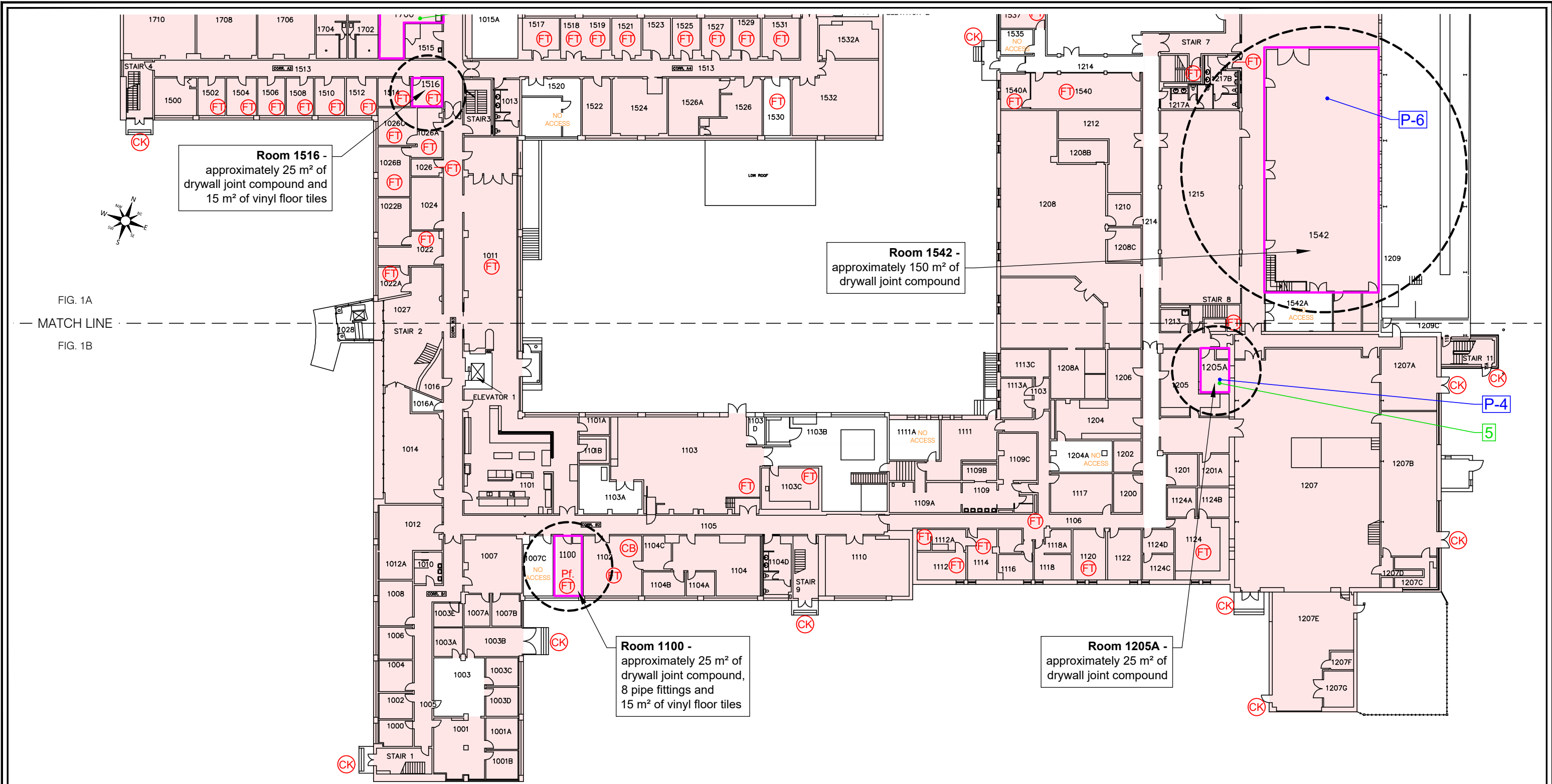
FIG. 1B

LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023

- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- THROUGHOUT FUNCTIONAL SPACE
- FT** ASBESTOS-CONTAINING FLOOR TILES
- Pf** ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB** ASBESTOS-CONTAINING CEMENT BOARD
- CK** ASBESTOS CAULKING

Title: DRDC - BLDG 201A/B, 1st FLOOR, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO	
Project: DESIGNATED SUBSTANCES AND HAZARDOUS MATERIAL SURVEYS	
Client: DEFENCE CONSTRUCTION CANADA	
Date:	October 2023
FIGURE 1A	



Room 1516 - approximately 25 m² of drywall joint compound and 15 m² of vinyl floor tiles

Room 1542 - approximately 150 m² of drywall joint compound

Room 1100 - approximately 25 m² of drywall joint compound, 8 pipe fittings and 15 m² of vinyl floor tiles

Room 1205A - approximately 25 m² of drywall joint compound

LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023

- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- THROUGHOUT FUNCTIONAL SPACE
- FT ASBESTOS-CONTAINING FLOOR TILES
- Pf ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB ASBESTOS-CONTAINING CEMENT BOARD
- CK ASBESTOS CAULKING

Title: **DRDC - BLDG 201A/B, 1st FLOOR, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO**
 Project: **DESIGNATED SUBSTANCES AND HAZARDOUS MATERIAL SURVEYS**
 Client: **DEFENCE CONSTRUCTION CANADA**

Date: **October 2023**
ARCADIS
FIGURE 1B

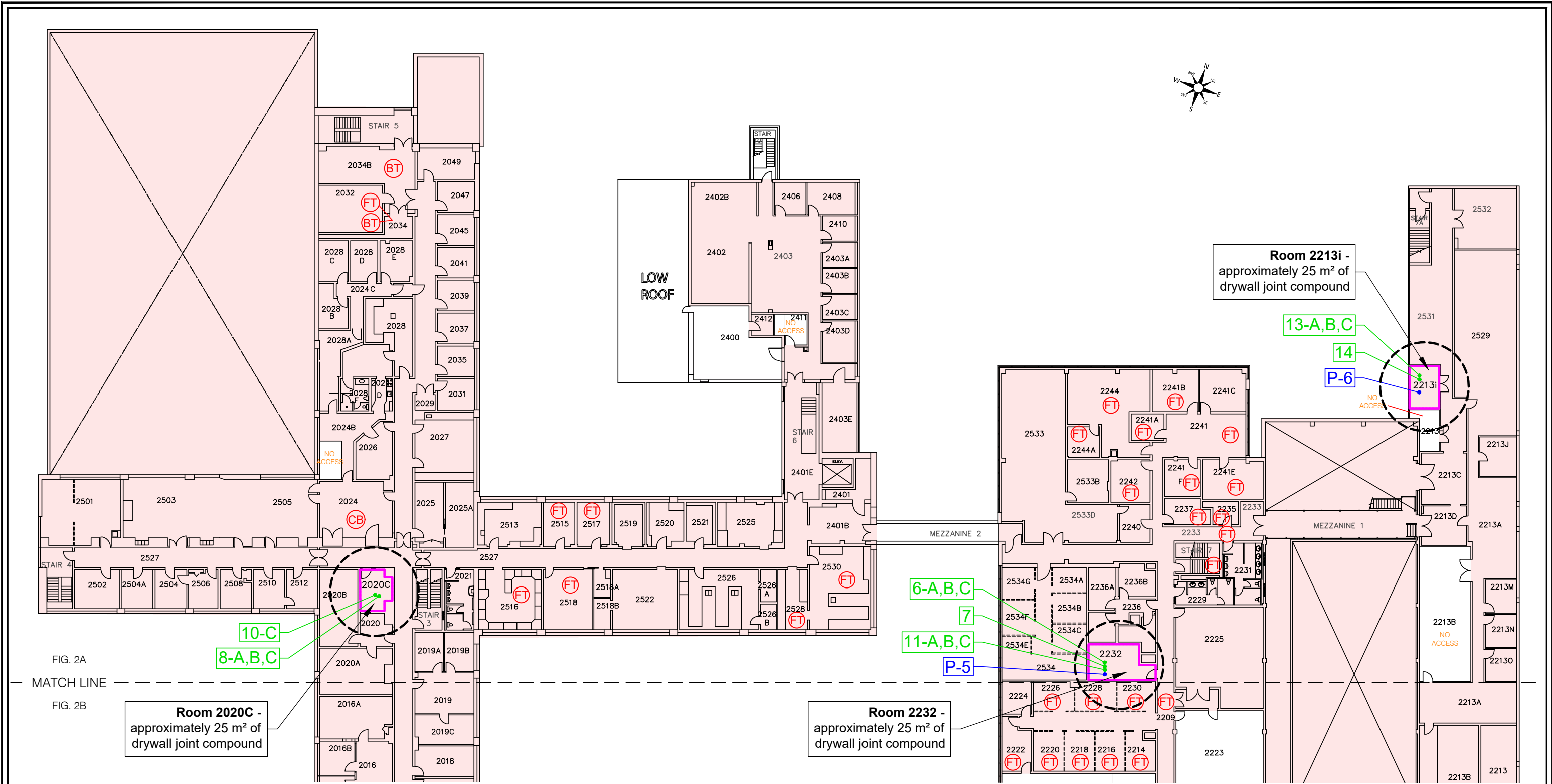


FIG. 2A
MATCH LINE
FIG. 2B

Room 2020C -
approximately 25 m² of
drywall joint compound

Room 2232 -
approximately 25 m² of
drywall joint compound

Room 2213i -
approximately 25 m² of
drywall joint compound

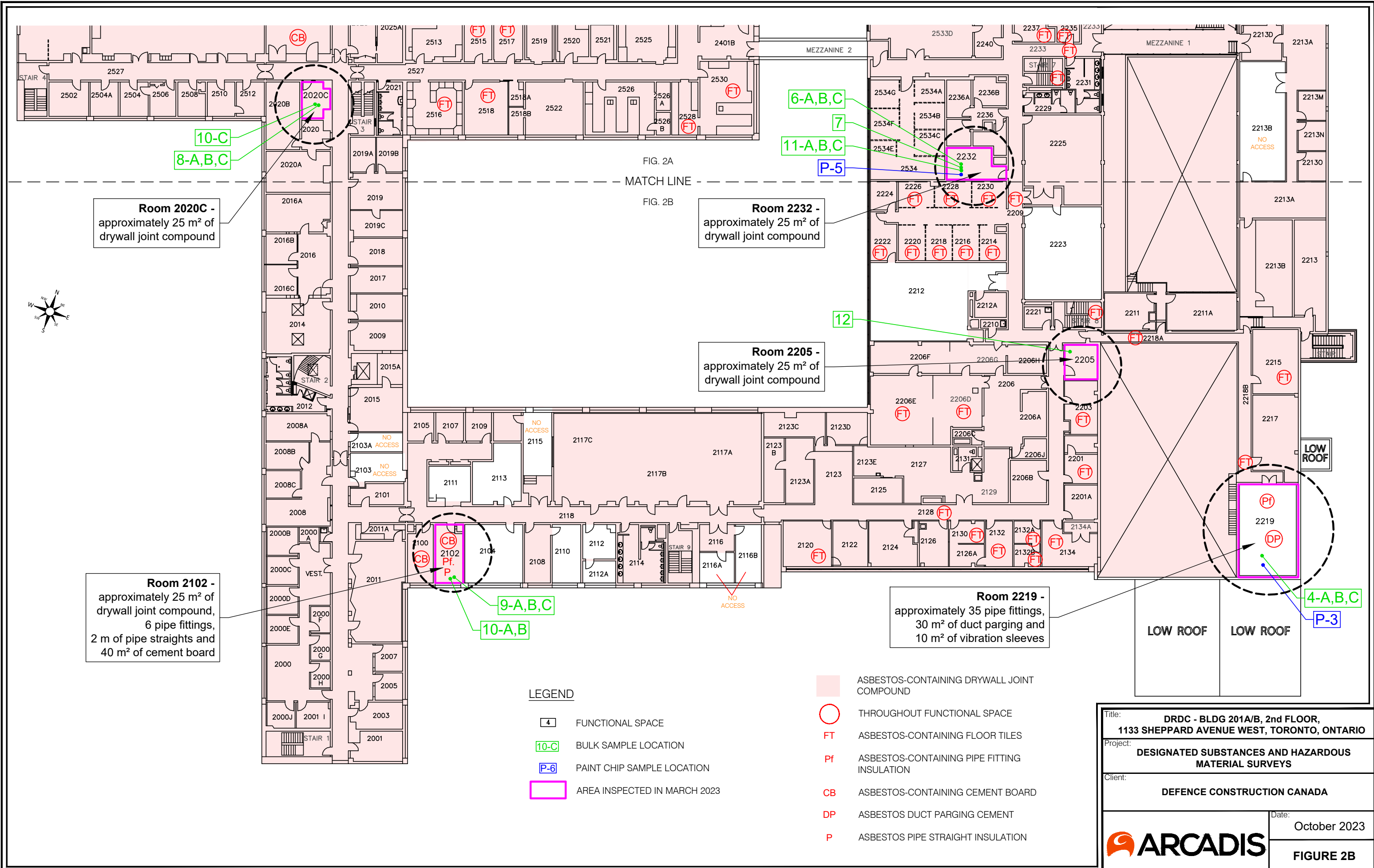
LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023
- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- THROUGHOUT FUNCTIONAL SPACE
- FT ASBESTOS-CONTAINING FLOOR TILES
- Pf ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB ASBESTOS-CONTAINING CEMENT BOARD

Title: **DRDC - BLDG 201A/B, 2nd FLOOR,
1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO**
Project: **DESIGNATED SUBSTANCES AND HAZARDOUS
MATERIAL SURVEYS**

Client: **DEFENCE CONSTRUCTION CANADA**

Date: **October 2023**
ARCADIS
FIGURE 2A



Room 2020C - approximately 25 m² of drywall joint compound

Room 2232 - approximately 25 m² of drywall joint compound

Room 2205 - approximately 25 m² of drywall joint compound

Room 2102 - approximately 25 m² of drywall joint compound, 6 pipe fittings, 2 m of pipe straights and 40 m² of cement board

Room 2219 - approximately 35 pipe fittings, 30 m² of duct parging and 10 m² of vibration sleeves

LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023

- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- O THROUGHOUT FUNCTIONAL SPACE
- FT ASBESTOS-CONTAINING FLOOR TILES
- PF ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB ASBESTOS-CONTAINING CEMENT BOARD
- DP ASBESTOS DUCT PARGING CEMENT
- P ASBESTOS PIPE STRAIGHT INSULATION

Title: DRDC - BLDG 201A/B, 2nd FLOOR, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO	
Project: DESIGNATED SUBSTANCES AND HAZARDOUS MATERIAL SURVEYS	
Client: DEFENCE CONSTRUCTION CANADA	
Date: October 2023	FIGURE 2B

Section 05 12 23

Structural Steel for Buildings

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 91 23 - Interior Painting

1.2 DEFINITIONS

- .1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 [ASTM A36/A36M-19](#), Standard Specification for Carbon Structural Steel
 - .2 [ASTM A193/A193M-20](#), Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications
 - .3 [ASTM A307-21](#), Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .4 [ASTM A325-07a](#), Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - .5 [ASTM A325M-08](#), Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric
 - .6 [ASTM A490M-04ae](#), Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric
- .2 Canadian General Standards Board (CGSB):
 - .1 [CAN/CGSB-85.10-99](#), Protective Coatings for Metals
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA):
 - .1 Handbook of the Canadian Institute of Steel Construction
 - .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel
- .4 CSA Group (CSA):
 - .1 [CSA G40.20/G40.21-13](#), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .2 [CAN/CSA-G164-18](#), Hot Dip Galvanizing of Irregularly Shaped Articles
 - .3 [CAN/CSA-S16-14](#), Limit States Design of Steel Structures
 - .4 [CAN/CSA-S136-16](#), North American Specifications for the Design of Cold Formed Steel Structural Members

- .5 [CSA W47.1:19](#), Certification of Companies for Fusion Welding of Steel
- .6 [CSA W48-18](#), Filler Metals and Allied Materials for Metal Arc Welding
- .7 [CSA W55.3-08](#), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings
- .8 [CSA W59-18](#), Welded Steel Construction (Metal Arc Welding)
- .5 The Master Painters Institute (MPI):
 - .1 MPI-INT 5.1, Structural Steel and Metal Fabrications
 - .2 MPI-EXT 5.1, Structural Steel and Metal Fabrications
- .6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
 - .1 NACE No. 3/SSPC SP-6-07, Commercial Blast Cleaning

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide 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 Ontario, Canada.
- .3 Erection drawings:
 - .1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
 - .1 Description of methods.
 - .2 Sequence of erection.
 - .3 Type of equipment used in erection.
 - .4 Temporary bracings.
- .4 Fabrication drawings:
 - .1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Ontario, Canada.
- .5 Samples:
 - .1 Prepare sample of typical exposed structural connections in accordance with CISC Specifications of Architecturally exposed structural steel for approval of DCC Representative. Samples to be judged upon alignment of surfaces, uniform contact between surfaces, smoothness and uniformity of finished welds. When approved, sample units will serve as a standard for workmanship, appearance and material acceptable for the entire Project.

1.5 QUALIFICATIONS

- .1 Experience with successful projects of similar work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of [CAN/CSA-S16](#) to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
 - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
 - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 For composite construction select or design minimum end connection to resist reaction resulting from factored movement resistance as tabulated in the "Handbook of the Canadian Institute of Steel Construction" assuming 100% shear connection with depth of steel deck and/or slab shown on drawings.
- .4 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Ontario, Canada for non standard connections.

2.2 MATERIALS

- .1 Structural Steel: To [CSA-G40.20/G40.21](#).
- .2 Anchor Bolts: To , Grade 300W.
- .3 High strength anchor bolts: to [ASTM A193/A193M](#), Grade 350W.
- .4 Bolts, nuts and washers: to [ASTM A325](#).
- .5 Welding Materials: To [CSA W59](#) and certified by Canadian Welding Bureau.
- .6 Shop Paint Primer: To [CISC/CPMA2-75](#) solvent reducible alkyd, grey.
- .7 Hot Dip Galvanizing: Galvanize steel, where indicated, to [CAN/CSA-G164](#), minimum zinc coating of 600 g/m².
- .8 Shear Studs: To [CSA W59](#), Appendix H

2.3 FABRICATION

- .1 Fabricate structural steel in accordance with [CAN/CSA-S16](#) and shop drawings.

2.4 SHOP PAINTING

- .1 Clean, prepare surfaces, and shop prime structural steel in accordance with MPI.
- .2 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 2 to 4 mils, except:
 - .1 Surfaces to be encased in concrete.

- .2 Surfaces to receive site installed stud shear connections.
- .3 Surfaces and edges to be site welded.
- .4 Faying surfaces of slip-critical connections.
- .5 Below grade surfaces in contact with soil.
- .3 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .4 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .5 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 Execution

3.1 GENERAL

- .1 Structural Steel Work: In accordance with [CAN/CSA-S16](#).
- .2 Welding: in accordance with [CSA W59](#)
- .3 Companies to be certified under Division 1 or 2.1 of [CSA W47.1](#) for fusion welding of steel structures and/or [CSA W55.3](#) for resistance welding of structural components

3.2 CONNECTION TO EXISTING WORK

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

3.3 MARKING

- .1 Mark materials in accordance with [CSA G40.20/G40.21](#). Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection
- .2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.4 ERECTION

- .1 Site cutting or altering structural members: to approval of Consultant.
- .2 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .3 Continuously seal members by continuous welds where indicated. Grind smooth.

3.5 SITE QUALITY CONTROL

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

.4 Contractor will pay costs of tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

.5 Test shear studs in accordance with [CSA W59](#)

3.6 SITE PAINTING

.1 Paint in accordance with Section 09 91 23 - Interior Painting.

.1 Touch-up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual

3.7 CLEANING

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

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

END OF SECTION

Section 06 10 53 Miscellaneous Rough Carpentry

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 84 00 - Fire Stopping
- .2 Section 07 92 00 Joint Sealants
- .3 Section 07 62 00 Sheet Metal Flashing and Trim
- .4 Section 07 42 13.13 Formed Metal Wall Panels
- .5 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 The American Society of Mechanical Engineers (ASME):
 - .1 [ASME B18.6.1- 1981](#), Wood Screws (Inch Series)
- .2 American National Standards Institute/Telecommunication Industry Association (ANSI/TIA):
 - .1 ANSI/TIA/EIA 569 B- 2004, Commercial Building Standard for Telecommunications Pathways and Spaces
- .3 ASTM International (ASTM):
 - .1 [ASTM A307- 21](#)Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - .2 [ASTM C954- 11](#), Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
 - .3 [ASTM D7612- 10](#), Standard Practice for Categorizing Wood and Wood-Based Products According to their Fiber Sources
 - .4 [ASTM F1482-21](#), Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
 - .5 [ASTM F1667- 13](#)Standard Specification for Driven Fasteners: Nails, Spikes and Staples
- .4 Canadian General Standards Board (CGSB):
 - .1 [CAN/CGSB-71.26- M88](#), Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems
- .5 CSA Group (CSA):
 - .1 [CSA O86- 14](#)Engineered Design in Wood
 - .2 [CSA O112.9- 10](#), Evaluation of Adhesives for Structural Wood Products (Exterior Exposure)
 - .3 [CSA O121- 08](#), Douglas Fir Plywood

- .4 [CSA O141- 05](#), Softwood Lumber
- .5 [CSA O151- 09](#), Canadian Softwood Plywood
- .6 [CSA O153- 13](#), Poplar Plywood
- .7 [CSA O325- 07](#), Construction Sheathing
- .8 [CSA-O437 Series- 93](#), Standards on OSB and Waferboard
- .9 [CSA O452 Series- 94](#), Design Rated OSB
- .10 [CAN/CSA-Z809- 16](#), Sustainable Forest Management
- .6 Canadian Wood Council:
 - .1 Wood Design Manual 2010edition
 - .2 Engineering Guide for Wood Frame Construction 2014
- .7 National Lumber Grades Authority (NLGA):
 - .1 Standard Grading Rules for Canadian Lumber 2017
 - .2 NLGA SPS-1-2013, Fingerjoined Structural Lumber
 - .3 NLGA SPS-2-2013, Machine Graded Lumber
 - .4 NLGA SPS-4-2020, Fingerjoined Machine Graded Lumber
- .8 ULC Standards/UL Canada (ULC):
 - .1 [CAN/ULC-S101- 14](#), Standard Methods for Fire Endurance Tests of Building Construction and Materials
 - .2 [CAN/ULC-S102- 10](#), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals (to be submitted before starting any work of this Section):
 - .1 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit certified test reports for prefabricated structural members from an approved independent laboratory indicating compliance with specifications for specified performance characteristics and physical properties.
 - .3 Submit Canadian Construction Materials Centre (CCMC) Product Evaluation Report number for engineered wood products.
 - .4 Submit manufacturer's installation instructions.
 - .2 Shop Drawings:

- .1 For structural applications or conditions beyond the scope of the manufacturer's pre-engineered design information, submit drawings stamped and signed by professional engineer registered or licensed in Ontario , Canada.
- .2 Include on drawings:
 - .1 Design data in accordance with [CSA O86](#) and CWC Engineering Guide for Wood Frame Construction.
 - .2 Indicate configuration and spacing of pre-engineered timber members, hanger and connector types, fasteners, locations and design values; bearing details.
 - .3 Indicate allowable load and stress increase.
 - .4 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
- .3 Informational Submittals (to be submitted during the course of Work):
 - .1 Material Certificates: Submit certificates for machine-graded and fingerjoined dimensional lumber indicating species and grade selected for each use and design values approved by the NLGA.
- .4 Sustainable Design Submittals (to be submitted during the course of the Work):
 - .1 Submit in accordance with Section 01 33 00 Submittal Procedure to confirm that products and procedures conform to specified sustainability requirements.
- .5 Low-Emitting Materials:
 - .1 Submit listing of adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restriction requirements.
 - .2 Submit listing of composite wood products used in building, stating that they contain no added urea-formaldehyde resins, and laminating adhesives used in building, stating that they contain no urea-formaldehyde.
 - .3 Include SDS sheets indicating resin type for structural composite lumber and agrifibre materials.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Material and Equipment 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 Delivery and Acceptance Requirements: Protect materials from weather conditions while in transit and while on the jobsite
- .4 Storage and Handling Requirements:
 - .1 Store materials using pallets or blocking a minimum of 150 mm from the ground and covered with protective waterproof sheets allowing for air circulation and ventilation under the covering.

- .2 Protect edges and corners of sheet materials from damage during handling and storage.
- .3 Protect kiln-dried and seasoned wood materials from conditions that will cause an increase to moisture content.
- .4 Store engineered lumber on its edge.
- .5 Stack, lift, brace, cut and notch engineered lumber products in accordance with manufacturer's instructions and recommendations.
- .6 Store separated reusable wood waste convenient to cutting station and work areas.
- .5 Packaging Waste Management: Perform In accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 STRUCTURAL FRAMING

- .1 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard SPS, are acceptable for studs.
- .3 Plant fabricated structural wood:
 - .1 Proprietary prefabricated trusses of solid, laminated veneer lumber glue laminated lumber.
 - .2 Adhesive: Exterior rated phenol-formaldehyde or phenol-resorcinol: to CSA O112.9.
 - .3 Compressive strength: Minimum kPa in accordance with ASTM D1621.
- .4 Structural Composite Lumber (SCL) in accordance with ASTM D 5456, for following uses:
 - .1 Laminated veneer lumber (LVL): headers, beams, hip and valley rafters as indicated.
 - .2 Parallel strand lumber (PSL): beams and headers as indicated.
 - .3 Laminated strand lumber (LSL): studs as indicated.
 - .4 Oriented strand lumber (OSL): studs as indicated.
- .5 Framing and board lumber: in accordance with NBC.

2.2 FURRING AND BLOCKING

- .1 Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing and sleepers:
 - .1 Board sizes: "Standard" or better grade.

- .2 Dimension sizes: "Standard" light framing or better grade.
- .3 Post and timbers sizes: "Standard" or better grade.
- .2 Where indicated, provide pressure treated materials for furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing and sleepers in accordance with Section 06 05 73 - Wood Treatment.

2.3 PANEL MATERIALS AND APPLICATION

- .1 Roof sheathing: Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, T&G square edge, 19 mm thick.
- .2 Exterior wall sheathing Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, 16 mm thick.
- .3 Electrical equipment mounting boards:
 - .1 Plywood, DFP or CSP, square edge 16 mm thick.
 - .2 Fire retardant treated in accordance with Section 06 05 73 - Wood Treatment.
- .4 Where indicated, provide pressure treated panel materials in accordance with Section 06 05 73 - Wood Treatment.

2.4 ACCESSORIES

- .1 General purpose adhesive: to CSA O112.9.
- .2 Nails, spikes and staples: to ASTM F 1667.
- .3 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .5 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.
- .6 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by DCC Representative
- .7 Fastener Finishes:
 - .1 Galvanizing: to ASTM A 123/A 123M, ASTM A 653, use galvanized fasteners for exterior work.
 - .2 Proprietary corrosion resistant fasteners for treated lumber: as recommended by manufacturer for material and service conditions and as specified in Section 06 05 73 - Wood Treatment.
- .8 Sill Plate Gasket: Closed cell polyethylene foam gasket in width to match sill plate width, 6 mm thick.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed are acceptable for product installation in accordance with manufacturer's instructions.

- .1 Visually inspect substrate in presence of DCC.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied DCC Representative..

3.2 SYSTEMS INTEGRATION

- .1 Install air barrier and vapour retarder sheeting around framing members to ensure continuity of protection and to lap and seal to main sheets.
- .2 Install insulation in exterior wall framing cavities that will not be accessible after completion of framing.
- .3 Install sill plate gasket in continuous lengths between concrete surfaces and wood framing.

3.3 FRAMING INSTALLATION

- .1 Install engineered framing and plant fabricated structural wood components, including all hangers, connectors and fasteners, in accordance with accepted shop drawings and manufacturers' instructions.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length.
- .4 Install spanning members with "crown-edge" up.
- .5 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .6 Countersink bolts where necessary to provide clearance for other work.
- .7 Install specified panel product for each application.
- .8 Install wall sheathing in accordance with manufacturer's printed instructions and accepted shop drawings.
- .9 Install roof sheathing in accordance with requirements of NBC and accepted shop drawings.
- .10 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.4 FURRING AND BLOCKING INSTALLATION

- .1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.
- .2 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.
 - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .3 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .4 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.

- .5 Install sleepers as indicated.

3.5 CLEANING

- .1 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools and equipment.

3.6 WASTE MANAGEMENT

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Re-use scrap lumber to the greatest extent possible. Separate scrap lumber for use on site as accessory components, including: shims, bracing, and blocking.
- .3 Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill. Prevent saw dust and wood shavings from entering the storm drainage system.
- .4 Do not burn scrap lumber that has been pressure treated.
- .5 Do not send lumber treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

3.7 PROTECTION

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

END OF SECTION

Section 07 21 16 Blanket Insulation

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 42 13.13 Formed metal Wall Panels.
- .2 Section 07 62 00 - Sheet metal flashing and trim
- .3 Section 07 92 00 - Joint Sealants

1.2 DEFINITIONS

- .1 Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life cycle assessment information. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - .1 Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.
 - .2 Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 [ASTM C167-18](#), Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
 - .2 [ASTM C423-17](#) Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .3 [ASTM C553-19](#), Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications
 - .4 [ASTM C665-17](#), Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .5 [ASTM C1320-20](#), Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction
 - .6 [ASTM E90-09](#), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .7 [ASTM E413-16](#), Classification for Rating Sound Insulation
 - .8 [ASTM F1667-18a](#), Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- .2 CSA Group (CSA):
 - .1 [CSA B111-1974](#), Wire Nails, Spikes and Staples

- .2 [CSA B149](#) PACKAGE-20, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 ULC 102- 18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies ([CAN/ULC S102](#))
 - .2 ULC 114-18, Standard Method of Test for Determination of Non-Combustibility in Building Materials
 - .3 ULC 604, Standard for Factory-Built Type A Chimneys ([CAN/ULC-S604-16](#))
 - .4 ULC 702, Standard for Mineral Fibre Insulation for Buildings ([CAN/ULC-S702-15](#))

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate building envelope commissioning with Section 01 91 13 - General Commissioning Requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, product literature and data sheets for blanket insulation. Include product characteristics, performance criteria, physical sizes, and limitations.
- .3 Certificates: When requested, submit manufacturer's product certificates certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports: When requested, submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .5 Sustainable Design Submittals:
 - .1 Environmental Product Declaration (EPD): Submit an Industry-wide EPD and identify which insulation product described in the EPD correspond to the specified insulation types. Submit EPD with at least a cradle to gate scope, identifying the following impact categories (minimum):
 - .1 Global Warming Potential (GWP): Submit GWP information in the form of kgCO₂e.
 - .2 Ozone Depletion Potential (ODP): Submit ODP information in the form of kgCFC-11e.
 - .3 Acidification Potential (AP): Submit AP information in the form of kgSO₂e.
 - .4 Eutrophication Potential (EP): Submit EP information in the form of kgN eq. or kg PO₄e.
 - .5 Photochemical Ozone Creation/Smog Formation Potential (SFP): Submit SFP information in the form of kg NO_x or kg O₃ eq.

- .6 Abiotic depletion potential - Fossil resources (ADP_f): All ADP_f information submitted in the form of MJ.
- .2 Recycled Content: 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 content, and total cost of materials for the Project.
- .3 Regional Materials: submit evidence that project incorporates required percentage of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for the Project.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in a clean dry location and in accordance with manufacturer's recommendations.
 - .2 Store and protect blanket insulation from moisture, fire and damage.
- .3 Packaging Waste Management: Perform in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 INSULATION

- .1 Batt and blanket mineral fibre: Non-combustible, stone wool batt insulation to [CAN/ULC-S702](#).
 - .1 Type: 1.
 - .2 Fire performance:
 - .1 Non-combustibility: To [CAN/ULC S114](#).
 - .1 Flame spread: 0
 - .2 Smoke developed: 5
 - .2 Surface Burning Characteristics: To [CAN/ULC S102](#).
 - .1 Flame spread: 0
 - .2 Smoke developed: 0
 - .3 Density: 64kg/m³ to [ASTM C167](#)
 - .4 Thermal Resistance: RSI - value 0.74/ 25 mm
 - .5 Thickness: as existing approx. 150mm (including corrugation)

2.2 ACCESSORIES

- .1 Insulation clips:

- .1 Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.
- .2 Nails: galvanized steel, length to suit insulation plus 25 mm, to [CSA B111](#)
- .3 Staples: minimum 12 mm leg.
- .4 Tape: as recommended by manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed are acceptable for blanket insulation application in accordance with manufacturer's instructions.
 - .1 Verify all in wall construction is complete.
 - .2 Verify building substrates are dry.
 - .3 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .4 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to [ASTM C1320](#).
- .2 Install insulation with factory applied vapour barrier facing warm side of building spaces and vapour permeable membrane facing cold side. Lap ends and side flanges of membrane over framing members. Retain in position with insulation clips installed as recommended by manufacturer. Tape seal butt ends and lapped side flanges. Do not tear or cut vapour barrier.
- .3 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .4 Fill stud space of exterior framed walls with insulation full depth of stud only where no insulation/vapour retardant indicated on exterior face of stud walls.
- .5 Do not compress insulation to fit into spaces.
- .6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from [CAN/ULC-S604](#).
- .7 Do not enclose insulation until it has been reviewed and is acceptable by DCC Representative.

END OF SECTION

Section 07 42 13.13 Formed Metal Wall Panels

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 62 00 - Sheet Metal Flashings and Trim
- .2 Section 07 92 00 - Joint Sealants

1.2 DEFINITIONS

- .1 Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life cycle assessment information. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - .1 Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.
 - .2 Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA):
 - .1 AA DAF 45-03, Designation System for Aluminum Finishes
- .2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IES Standard 90.1-2016
- .3 ASTM International (ASTM):
 - .1 [ASTM A653/A653M-18](#), Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 [ASTM A792/A792M-10](#), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - .3 [ASTM D523-14](#), Standard Test Method for Specular Gloss
 - .4 [ASTM D822/D822M-13](#), Standard Practice, For Conducting Test on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus
 - .5 [ASTM D2832-92](#), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings
- .4 Canadian General Standards Board (CGSB):
 - .1 [CAN/CGSB-93.1-M85](#), Sheet, Aluminum Alloy, Prefinished, Residential
- .5 CSA Group (CSA):

- .1 [CAN/CSA S136-16](#), North American Specification for the Design of Cold-Formed Steel Structural Members
- .6 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 [CSSBI 20M-2017](#), Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications
 - .2 CSSBI S8-2018, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products
- .7 Green Seal Environmental Standards (GS):
 - .1 GS-11-2021, Standard for Paints, Coatings, Stains and Sealers

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 building panels, hardware, and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS. Indicate VOC's for materials as follows:
 - .1 Indicate VOC's for material as follows:
 - .1 Sealant materials during application and curing.
 - .2 Finishing materials.
 - .3 Insulation adhesives.
 - .4 Paints.
 - .5 Isolation coatings.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Dimensions, wall openings, head, jamb, sill and mullion detail, materials and finish, anchor details, compliance with design criteria and requirements of related work.
- .4 Samples:
 - .1 Submit duplicate 300 x 300mm samples of wall system, representative of materials, finishes and colours.
- .5 Manufacturer's Site Reports:
 - .1 Submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - SITE QUALITY CONTROL.

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 composite metal building panels for incorporation into manual.

1.6 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 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 Storage and Handling Requirements:
 - .1 Store materials indoors and off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal building panels, hardware and accessories from nicks, scratches, and blemishes.
- .3 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Design metal panel wall system in accordance with [CSA S136](#).
- .2 Design metal panel wall to allow for thermal movement of component materials caused by ambient temperature range of 60 degrees C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .3 Include expansion joints to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
- .4 Design members to withstand dead load and wind loads calculated in accordance with National Building Code of Canada (NBC) and applicable local regulations, to maximum allowable deflection of 1/180th of span.
- .5 Allow for positive drainage of condensation occurring within wall construction and water entering at joints, to exterior face of wall in accordance with NRC "Rain Screen Principles".
- .6 Thermal resistance: RSI 2.1 W/m²K minimum calculated with design wind loads in accordance with ASHRAE procedures.
- .7 Permeance through wall system: 1 ng/(Pa.s.m²) maximum.

- .8 Design wall system to accommodate specified erection tolerances of structure.
- .9 Design wall system to allow for movement of air between exterior and interior side of metal cladding.
- .10 Include air barrier, to prevent infiltration and exfiltration of air through wall assembly.

2.2 MATERIALS

- .1 Sheet steel: cladding, structural quality, grade 230to [ASTM A653](#), with Z275 zinc coating:
 - .1 Nominal Core Thickness: 0.76 mm or thicker to meet design loads.
 - .2 Finish: Factory precoated with polyvinylchloridefinish.
 - .3 Colour: selected colour from manufacturer's standard range.
 - .4 Dry film thickness: on exposed surface .025mm minimum thick, on reverse side .3mm minimum thick.
- .2 Sheet steel: liner sheet, structural quality, grade 230to [ASTM A653](#), with Z275 zinc coating:
 - .1 Light duty modified silicone finish.
 - .2 Dry film thickness: 0.025mm minimum.
 - .3 Gloss 25.
 - .4 Colour selected colour from manufacturer's standard range.
- .3 For copings and flashings provide prefinished, formedmaterial to match cladding in accordance with Section 07 62 00 - Sheet Metal Flashings and Trim.

2.3 INSULATION

- .1 Batt and blanket mineral fibre insulation: Section 07 21 16 - Blanket Insulation .

2.4 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied polyvinylidene fluoride.
 - .1 Class F1S.
 - .2 Matchcolour selected by DCC Representative.
 - .3 Specular gloss: 30units +/- in accordance with [ASTM D523](#)
 - .4 Coating thickness: minimum 22micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade maximum 5units and erosion rate maximum 20 % to [ASTM D822](#)as follows:
 - .1 Outdoor exposure period 2500hours minimum.
 - .2 Humidity resistance exposure period 5000hours minimum.

2.5 COMPONENTS

- .1 Exterior sheet: factory preformed coated metal, to profile as indicated, interlocking edges, vinyl gasket shop fitted into one side of interlocking joint, of 0.50mm minimum base metal thickness.

- .2 Exterior corners: of same profile, material and finish as adjacent cladding material, factory built and brake formed to required angle, concealed corner brace, hairline exposed joint, pop rivet connections with painted head to match cladding.
- .3 Exposed joint (perpendicular to profile): ends of cladding sheet shop cut clean and square, backed with tight fitting filler lapping back of joint, exposed components colour matched to cladding.
- .4 Liner sheet: factory formed profiled, to match existing module, interlocking joint profile, shop installed seal material one side of interlocking joint.

2.6 ACCESSORIES

- .1 System Accessories: cap flashings, drip flashings, internal corner flashings, copings and closures for head, jamb, sill and corners, of same material, thickness and finish as exterior cladding, brake formed to shape.
- .2 Clips and Connectors: As recommended by manufacturer for complete installation of siding.
- .3 Thermally Broken Clip System: Low-conductivity thermal spacers. Confirm all clips with structural engineer and loads in accordance with regulations.
- .4 Girts: Fabricated from minimum 1.27 mm thickness galvanized steel to [ASTM A653](#), Grade 230 with Z275 coating. Material visible after assembly of wall panel shall be finished to match aluminum panels.
- .5 Sub-girts: of 1.2mm minimum base metal thickness, structural quality steel to [ASTM A653](#), with Z275 zinc coating, profile as indicated to accept liner and exterior sheet with structural attachment to building frame.
- .6 Expansion joints: as recommended by Manufacturers Instructions.
- .7 Sealant: as indicated in Section 07 92 00 - Joint Sealants and as recommended by manufacturer. Colour of exposed sealant to match adjacent panel.
- .8 Insect and rodent screen: linear perforated aluminum screen sized to suit application.
- .9 Insulation adhesive: compatible with insulation type and zinc coated steel sheet, incombustible after curing.
- .10 Screws: stainless steel, head colour same as exterior sheet, dished stainless steel and neoprene.
- .11 Powder actuated fasteners: galvanized, peened ballistic point, plastic cap of same colour as exterior sheet.
- .12 Gaskets: soft pliable arctic grade vinyl, extruded profile.
- .13 Touch-up paint: as recommended by panel manufacturer.
- .14 Isolation coating: bituminous paint epoxy resin solution.

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 composite metal building panel 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 PREPARATION

- .1 Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

3.3 INSTALLATION (SITE ASSEMBLED)

- .1 Install liner sheet and sub-girts to structural wall supports, using self-tapping screws.
 - .1 Interlock and seal side and end joints.
 - .2 Pre-caulk one side of interlocking joint to ensure continuous vapour retarder.
- .2 Install insulation using adhesive to ensure continuous thermal barrier in conjunction with air barrier formed by liner sheet.
- .3 Install exterior finish cladding to internal sub-girts with concealed fasteners.
- .4 Provide notched and formed top closures, sealed to arrest direct weather penetration at vertical profiles for exterior cladding.
 - .1 Ensure continuity of "pressure equalization" of rain screen principle.
- .5 Include alignment bars, brackets, clips, inserts, shims as required to securely and permanently fasten wall system to building structure.

3.4 INSTALLATION (SHOP ASSEMBLED)

- .1 Attach shop assembled wall system to building framing system with inside fasteners.
- .2 Install insulated wall assembly to achieve thermal barrier, air barrier and vapour retarder.
- .3 Install wall cladding over sill flashings, install cap flashings and ensure completed installation is continuously sealed at perimeter.
- .4 Install and seal notched and formed top closures, to arrest direct weather penetration at vertical profiles of exterior cladding.
 - .1 Ensure continuity of "pressure equalization" of rain screen principle.

3.5 CONTROL AND EXPANSION JOINTS

- .1 Construct control joints as indicated.
- .2 Use cover sheets, of brake formed profile, of same material and finish as adjacent material.
- .3 Use mechanical fasteners to secure sheet materials.
- .4 Assemble and secure wall system to structural frame so stresses on sealants are within manufacturers' recommended limits.

3.6 CONSTRUCTION

- .1 Site Tolerances:

- .1 Maintain following installation tolerances:
 - .1 Maximum variation from plane or location shown on approved shop drawings: 10mm/m of length and up to 20mm/100 m maximum.
 - .2 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75 mm.

3.7 SITE QUALITY CONTROL

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation, application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's site services: include manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
- .4 Obtain reports within 3 days of review and submit.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .1 Clean after installation to remove construction and accumulated environmental dirt.
 - .2 Wash down exposed interior and exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths. Wipe interior surfaces clean as part of final clean-up.
 - .3 Remove excess sealant with recommended solvent.
- .2 Final Cleaning: remove surplus materials, rubbish, tools and equipment
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.9 PROTECTION

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

END OF SECTION

Section 07 52 00

Modified Bituminous Membrane Roofing

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 62 00 - Sheet Metal Flashing and Trim
- .2 Section 07 92 00 - Joint Sealants

1.2 DEFINITIONS

- .1 Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life cycle assessment information. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - .1 Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.
 - .2 Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International Inc:
 - .1 [ASTM C726-17](#), Standard Specification for Mineral Fiber Roof Insulation Board
 - .2 [ASTM C728-17a](#), Standard Specification for Perlite Thermal Insulation Board
 - .3 [ASTM C1002-20](#), Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 - .4 [ASTM C1177/C1177M-17](#), Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - .5 [ASTM C1396/C1396M-17](#), Standard Specification for Gypsum Board
 - .6 [ASTM D41/D41M-11\(2016\)](#), Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
 - .7 [ASTM D312/D312M-16a](#), Standard Specification for Asphalt Used in Roofing
 - .8 [ASTM D448-12\(2017\)](#), Standard Classification for Sizes of Aggregate for Road and Bridge Construction
 - .9 [ASTM D2178/D2178M-15a](#), Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
 - .10 [ASTM D6162/D6162M-16](#), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements

- .11 [ASTM D6163/D6163M-16](#), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements
- .12 [ASTM D6164/D6164M-16](#), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
- .13 [ASTM D6222/D6222M-16](#), Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcement
- .14 [ASTM D6223/D6223M-16](#), Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcement
- .15 [ASTM D6509/D6509M-16](#), Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcement
- .16 [ASTM D6622/D6622M-20](#), Standard Guide for Application of Fully Adhered Hot-Applied Reinforced Waterproofing Systems
- .17 [ASTM E96/E96M-16](#), Standard Test Methods for Water Vapor Transmission of Materials
- .18 [ASTM E2707-15](#), Standard Test Method for Determining Fire Penetration of Exterior Wall Assemblies Using a Direct Flame Impingement Exposure
- .19 [ASTM E2886/E2886M-20](#), Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement
- .2 Canadian General Standards Board (CGSB):
 - .1 [CGSB 37-GP-9Ma-83](#), Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing
 - .2 [CGSB 37-GP-56M-80b\(A1985\)](#), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing
 - .3 [CAN/CGSB-51.33-M89](#), Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction
- .3 Canadian Roofing Contractors Association (CRCA):
 - .1 CRCA Roofing Specifications Manual- Current Version
- .4 CSA Group (CSA):
 - .1 [CSA-A123.3-05](#), Asphalt Saturated Organic Roofing Felt (Reaffirmed 2010)
 - .2 [CAN/CSA-A123.4-04](#), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems, Includes Update No. 1 (2006)
 - .3 [CSA A123.21-20](#), Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
 - .4 [CSA A231.1:19/A231.2:19](#), Precast Concrete Paving Slabs/Precast Concrete Pavers, Includes Update No. 1 (2020).
 - .5 [CAN/CSA O80 SERIES-15](#), Wood Preservation, Includes Update No. 1 (2017) and Update No. 2 (2019).
 - .6 [CSA O121-17](#), Douglas Fir Plywood

- .7 [CSA O151-17](#), Canadian Softwood Plywood
- .5 Factory Mutual (FM Global):
 - .1 FM Approvals - Roofing Products
 - .2 FM Approval Standard #4470, Approval Standard for Singly-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied for use in Class 1 and Non-combustible Roof Deck Construction
- .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .7 Underwriters Laboratories' of Canada (ULC):
 - .1 ULC 102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies. ([ULC S102](#))
 - .2 ULC 107, Methods of Fire Tests of Roof Coverings. ([CAN/ULC S107 10](#))
 - .3 ULC 701.1, Standard for Thermal Insulation, Polystyrene, Boards
 - .4 ULC 702.2, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines. ([ULC S702.2-15](#))
 - .5 ULC 704, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced. ([CAN/ULC-S704-11](#))
 - .6 ULC 770, Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams [CAN/ULC-S770-\(15\)](#)
 - .7 [CAN/ULC-S107-10](#), Methods of Fire Tests of Roof Coverings

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting oneweek before beginning waterproofing Work, with DCC Representative in accordance with 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Examine existing waterproofing system, and propose new SBS modified bituminous membrane system compatible with existing system, by the same manufacturer or a manufactured product that is compatible with the existing roofing membrane system and that meet all requirements of this specification 07 52 00 Modified bituminous membrane roofing.

- .2 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide one electronic copy of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements, and indicate VOC content for:
 - .1 Primers.
 - .2 Asphalt.
 - .3 Sealers.
 - .4 Filter fabric.
- .3 Provide shop drawings:
 - .1 Indicate flashing and tapered insulation details.
 - .2 Provide layout for tapered insulation.
- .4 Samples: submit two (2) sample membrane and insulation.
- .5 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .6 Test and Evaluation Reports: submit laboratory test reports certifying compliance of membrane with specification requirements.
- .7 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .8 Manufacturer's field report: in accordance with Section 01 43 00 - Quality Assurance.
- .9 Reports: indicate procedures followed, ambient temperatures and wind velocity during application, and curing.
- .10 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 50% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit list of recycled content products used, including details of required percentages of recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

1.6 QUALITY ASSURANCE

- .1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
 - .2 Provide and maintain dry, off-ground weatherproof storage.
 - .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.
 - .4 Remove only in quantities required for same day use.
 - .5 Place plywood runways over completed Work to enable movement of material and other traffic.
 - .6 Store sealants at +5 degrees C minimum.
 - .7 Store insulation protected from daylight and weather and deleterious materials.
- .3 Packaging Waste Management: remove for reuse by manufacturer of packaging materials, pallets and crates in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
 - .2 Fold up metal banding, flatten and place in designated area for recycling.

1.8 SITE CONDITIONS

- .1 Ambient Conditions
 - .1 Do not install roofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations for mop application.
 - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.
- .3 Fire Protection
 - .1 Fire Extinguishers:
 - .1 Maintain one cartridge operated type or stored pressure rechargeable type with hose and shut-off nozzle,
 - .2 ULC labelled for A, B and C class protection.
 - .3 Size 4.5 kg or as indicated on roof per torch applicator, within 6 m of torch applicator.
 - .2 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.9 WARRANTY

- .1 Extend the 12 month warranty period to 24 months for Work of this Section 07 52 00 - Modified Bituminous Membrane Roofing.

Part 2 Products**2.1 PERFORMANCE CRITERIA**

- .1 Compatibility between components of roofing system is essential. Provide written declaration to DCC Representative stating that materials and components, as assembled in system, meet this requirement.
- .2 Roofing System: to [CSA A123.21](#) for wind uplift resistance.

2.2 DECK COVERING

- .1 Gypsum board sheathing: to [ASTM C1396/C1396M](#) 12.7 mm thick Type X Fire Rated.
 - .1 Recycled content: 75%.
 - .1 Minimum 10 % by weight of recycled material in core of finished product.
 - .2 Minimum 20 % by weight of FGD gypsum and 5 % by weight of recycled material in core.
 - .3 Minimum 50 % by weight of FGD gypsum in core.
 - .2 Ecolabel certified.
 - .3 UL Classified for resistance to external fire sources per ANSI/UL 790 and CAN/ULC-S114.
 - .4 Wind Uplift resistance tested with fastening meets FM 4470 and ANSI/UL 1897 test procedures
- .2 Plywood:
 - .1 To [CSA O151](#) sheathing grade, tongue and groove, 15.9 mm thick.
 - .2 As specified in Section 06 10 53 - Miscellaneous Rough Carpentry.
- .3 Sand: natural silica sand passing 1-18 mm sieve.

2.3 DECK PRIMER

- .1 Primer comprised of elastomeric bitumen, volatile solvents and adhesive enhancing additives as recommended by membrane roofing manufacturer to suit substrate and installation conditions to CGSB 37-GP-9Ma.

2.4 AIR AND VAPOUR RETARDER

- .1 One-ply asphalt laminated membrane to [CAN/CGSB-51.33](#), Type 1, and fire retardant adhesive.
- .2 Base sheet vapour retarder: to [CGSB 37-GP-56M](#), Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, glass reinforcement, weighing 95 g/m².
 - .1 Top and bottom surfaces: sanded/polyethylene.
- .3 Self adhesive air/vapour barrier modified bitumen membrane. Compatible with wall and roof air/vapour retarder membranes as recommended by accepted membrane manufacturers.

2.5 MINERAL FIBRE INSULATION

- .1 To [CAN/ULC-S702.2](#), thickness 150 mm, 1220mm x 2440mm mm maximum size, square edges, unfaced. Tapered shape to provide [1:50].

- .1 Recycled content: 75% .

2.6 POLYISOCYANURATE INSULATION

- .1 Primary Flat and Sloped Insulation: Closed-cell polyisocyanurate foam core laminated to heavy non asphaltic glass fibre reinforced facers to [CAN/ULC-S704](#), Type II, Class 1, Grade 3, facing, flame spread classification: less than 500, thickness 2 layers of 75 mm (sloped and flat) as indicated.

- .1 Recycled content: 50%.

2.7 ADHESIVE

- .1 Manufacturers recommended adhesive for securing overlay board and insulation: asphalt extended vulcanized adhesive, two component unit, consisting of two liquids mixed on site to produce pourable adhesive.
- .2 Roofing Base Sheet Adhesive: Manufacturers recommended adhesive for adhering base sheet to substrate.
- .3 Sheathing Board Adhesive: Manufacturers standard adhesives specifically formulated for installation of sheathing to metal deck.

2.8 BITUMEN

- .1 Asphalt: to [CAN/CSA A123.4](#), Type 1.

2.9 ACCESSORIES

- .1 Perimeter Fire Seal: SBS modified bitumen, minimum 60 gm/m² glass fleece reinforced, self adhering membrane having sanded top face, cut into strips minimum 150 mm wide x nominal 1.5 mm thick.
- .2 Sealers
 - .1 Plastic cement: asphalt.
 - .2 Sealing compound: , rubber asphalt type.
 - .3 Sealants: . 07 92 00 - Joint Sealants.
- .3 Flashing and sheet metal in accordance with section 07 62 00 - Sheet Metal Flashing and Trim.
- .4 Waterproofing Mastic: Black, solvent based mastic containing SBS modified bitumen, fibres and mineral fillers.
- .5 Expansion Joint Waterproofing Membrane: EPDM-based synthetic rubber flexible membrane as recommended by waterproofing system materials manufacturer.
- .6 Cant Strips
 - .1 Cut from pressure-treated wood material, to measure 140 mm on slope.
- .7 Fasteners
 - .1 Covering to steel deck: No. 10 flat head, self tapping, Type A or AB, cadmium plated screws. Recommend FM Approved screw and plate assemblies.

- .2 Insulation to deck: coated insulation fasteners and galvanized plates must meet FM Approval for wind uplift and corrosion resistance, as recommended by insulation manufacturer.
- .8 Torches: Use only torches designed for torching roofing material and acceptable to manufacturer.

2.10 PIPE SUPPORTS

- .1 Roof drain pans, vent stack covers and other roof penetration flashings: pre manufactured, stainless steel construction, purpose made to suit application and location, designed to tie-in to SBS modified membrane roofing systems.
- .2 Premanufactured Pipe Supports: fabricated from 100% recycled content, with 2.7 mm thickness galvanized steel frame, 150 mm wide x 100 mm tall x length to suit installation; including fasteners, bridge components, and angled supports as required for a complete installation and having the following accessories:
 - .1 Pipe and Conduit Support: Galvanized pipe clamp sized to suit gas pipe in accordance with manufacturer's instructions.
 - .2 Multi-Pipe and Conduit Support: Galvanized pipe support system size and number to suit pipes being supported in accordance with manufacturer's instructions.
 - .3 Extendable Height Support: Galvanized steel pipe extensions to suit installation in accordance with manufacturer's instructions.

Part 3 Execution

3.1 QUALITY OF WORK

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual, particularly for fire safety precautions, and to ULC Design No. S704.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 Fit the interface of the walls and roof assemblies with durable rigid material sheet metal providing connection point for continuity of air barrier.
- .4 Make assembly, component and material connections in consideration of appropriate design loads, with reversible mechanical attachments.

3.2 EXAMINATION OF ROOF DECKS

- .1 Verification of Conditions:
 - .1 Inspect with DCC Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
- .2 Evaluation and Assessment:
 - .1 Before beginning of work ensure:
 - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

- .2 Curbs have been built.
- .3 Roof drains have been installed at proper elevations relative to finished roof surface.
- .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.3 Do not install roofing materials during rain or snowfall.

.4 Provide fire protection during installation.

3.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Cover walls, walks, sloped roofs and adjacent work where materials hoisted or used.

.2 Maintain in good order warning signs and barriers until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by DCC representative.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 PREPARATION OF STEEL DECK (CHANNEL TYPE)

.1 Install sound absorbing insulation in flutes of acoustical steel roof deck in accordance with deck manufacturer's instructions.

.2 Steel decking to be treated with rust proofing or galvanization.

3.5 DECK SHEATHING

.1 mechanically fasten to steel deck Gypsum Board Sheathing with screws to steel deck's upper rib surfaces, spaced 400 mm on centre each way.

.2 Place with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.

3.6 PRIMING DECK

.1 Apply deck primer to deck roofing substrate at the rate as recommended by manufacturer

.2 Surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.

.3 Cover primed surfaces with roofing membrane within time limits recommended by roofing membrane system manufacturer.

3.7 AIR AND VAPOUR RETARDER (CONCRETE/GYPSUM BOARD/PLYWOOD DECK)

.1 Modified bituminous vapour retarder sheet.

3.8 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

- .1 Insulation: fully adhered, adhesive application:
 - .1 Adhere insulation to laminated vapour barrier using solvent-based adhesive.
 - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .3 Cut end pieces to suit.
 - .4 Apply adhesive in continuous ribbons at 300 mm on centre.
 - .5 Separate membrane and insulation with a drainage layer or slip sheet.
- .2 Insulation: fully adhered, bitumen application:
 - .1 Embed insulation in 1 to 1.5 kg/m² mopping of bitumen.
 - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .3 Cut end pieces to suit.
- .3 Insulation: mechanically fastened application:
 - .1 Mechanically fasten insulation using screws and pressure distribution plates.
 - .2 Fasten insulation as per manufacturer's written recommendations.
 - .3 Number and pattern of screws per board to meet Factory Mutual requirements.
 - .4 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .5 Cut end boards to suit.
- .4 Tapered insulation application:
 - .1 Mop insulation to vapour retarder and top layer of insulation to bottom layer with hot asphalt at rate of 1 kg/m².
 - .2 Install tapered insulation as second insulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.
- .5 Overlay Board: adhesive application:
 - .1 Adhere overlay board to insulation with vulcanized adhesive at the rate of one litre/m².
 - .2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.
 - .3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.
- .6 Installation of Composite Cover Board and Factory Laminated Base Sheet:
 - .1 Adhere base sheet board using adhesive applied in continuous strips spaced as required and based on manufacturer's instructions and the [CSA A123.21](#) Wind Uplift Roof System Analysis Report.
 - .2 Heat seal side laps of the cover board with an industrial hot air welder as recommended by manufacturer.

- .3 Line up end laps of the cover boards (not staggered) and apply primer as per manufacturer's recommendations and allow to "flash off" in preparation for the application of the self-adhesive cover strip membrane.
- .4 Self-adhesive cover strip membrane shall be applied over each primed end lap of the cover board, rolled into place and a hot air welder is required to heat seal the side and end laps.
- .5 Avoid the formation of wrinkles, swellings or fishmouths.
- .7 Base Sheet Application (Torch On):
 - .1 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
 - .2 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
 - .3 Application to be free of blisters, wrinkles and fishmouths.
- .8 Perimeter Fire Seal Application
 - .1 Apply perimeter fire seal to roof perimeter and curb substrates prior to applying base sheet materials. Apply fire seal to vertical joints in parapet or curb sheathing, and at vertical corners.
 - .2 Extend fire seal minimum 50 mm up parapet faces and extend fire seal minimum 75 mm onto adjacent substrates. Ensure air bubbles and fish mouths are removed.
 - .3 Install perimeter fire seal to act as temporary moisture seal until installation of flashing materials.
- .9 Reinforced gusset installation:
 - .1 Install gussets at every angle, and on inside and outside corners.
 - .2 Install self adhesive gussets before installing self adhesive base sheet flashing membranes.
- .10 Base sheet flashing installation:
 - .1 Apply base sheet flashing when primer coat is dry and in accordance with manufacturer's written instructions.
 - .2 Position pre-cut membrane pieces; peel back 100 mm to 150 mm of silicone release paper to hold the membrane in place at the top of the parapet, then gradually peel back remaining silicone release paper, pressing down on the membrane with aluminium applicator to provide good adhesion and to provide smooth transition between up-stand and field surface; smooth entire membrane surface with a roller for full adhesion.
 - .3 Cut off corners at end laps being covered by next roll.
 - .4 Install a reinforcing gusset in all inside and outside corners.
 - .5 Seal overlaps at the end of each workday.
- .11 Cap Sheet Application (Torch):

- .1 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
- .2 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.
- .3 Avoid overheating. Take care to avoid excessive bitumen bleed out at joints during installation.
- .4 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
- .5 Application to be free of blisters, fishmouths and wrinkles.
- .6 Do membrane application in accordance with manufacturer's recommendations.
- .12 Flashings:
 - .1 Complete installation of flashing base sheet stripping before installing membrane cap sheet.
 - .2 torch sheet onto substrate in 1 metre wide strips.
 - .3 Lap flashing base sheet over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
 - .7 Do work in accordance with manufacturer's recommendations.
- .13 Roof penetrations:
 - .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.9 CANTS

- .1 Install wood cants over rigid insulation.
- .2 Apply hot bitumen to receiving surface and embed cant firmly by hand.
 - .1 Fasten wood cants to wood insulation stops.
- .3 Angle cut cants to fit tightly on back and bottom where roof to wall angle varies from 90 degrees.

3.10 SITE QUALITY CONTROL

- .1 Inspections:
 - .1 Inspection and testing of roofing application will be carried out by testing laboratory designated by Contractor.

- .2 Costs of tests will be paid by Contractor.
- .2 Testing:
 - .1 Manufacturers' Field Services:
 - .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
 - .2 Manufacturer's field services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
 - .4 Obtain reports within three days of review and submit.

3.11 CLEANING

- .1 Remove bituminous markings from finished surfaces.
- .2 Consult manufacturer of surfaces for cleaning advice and complying with their documented instructions in areas where finished surfaces are soiled caused by work of this section.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Place materials defined as hazardous or toxic in designated containers.
 - .2 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
 - .3 Ensure emptied containers are sealed and stored safely.
 - .4 Divert unused aggregate materials from landfill to local facility for reuse as reviewed by DCC Representative.
 - .5 Unused coating and paint material must be disposed of at official hazardous material collections site as reviewed by DCC Representative.
 - .6 Do not dispose of unused adhesive, sealant and asphalt materials into sewer system, streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
 - .7 Dispose of unused adhesive material at official hazardous material collections site approved by DCC Representative.

- .8 Dispose of unused sealant material at official hazardous material collections site approved by DCC Representative.
- .9 Dispose of unused asphalt material at official hazardous material collections site approved by DCC Representative.
- .10 Divert unused gypsum materials from landfill to recycling facility as reviewed by DCC Representative.

END OF SECTION

Section 07 62 00 Sheet Metal Flashing and Trim

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants

1.2 DEFINITIONS

- .1 Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life cycle assessment information. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - .1 Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.
 - .2 Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

1.3 REFERENCE STANDARDS

- .1 The Aluminum Association Inc. (AAI):
 - .1 AA Aluminum Design Manual 2020 Part VIII Guidelines for Aluminum Sheet Metal Work in Building Construction
 - .2 AAI DAF45- 2003, Designation System for Aluminum Finishes
- .2 Fenestration and Glazing Industry association (FGIA) Formerly AAMA:
 - .1 AAMA 611- 20, Voluntary Specifications for Anodized Architectural Aluminum
 - .2 AAMA 621- 02, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Substrates
 - .3 AAMA 2603- 20, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
 - .4 AAMA 2604- 20 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - .5 AAMA 2605- 20 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .3 American National Standards Institute (ANSI):
 - .1 ANSI/SPRI/FM 4435/ES-1- 2017, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems 2011
- .4 American Society for Testing and Materials International (ASTM):

- .1 [ASTM A167- 99\(2009\)](#), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip (Withdrawn 2014)
- .2 [ASTM A240/A240M- 20a](#), Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .3 [ASTM A606/A606M- 18](#), Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
- .4 [ASTM A653/A653M- 20](#), Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 [ASTM A755/A755M- 18](#) Standard Specification for Steel Sheet, Metallic coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
- .6 [ASTM A 792/A 792M- 10\(2015\)](#), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .7 [ASTM B32- 20](#), Standard Specification for Solder Metal
- .8 [ASTM B209- 14](#) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- .9 [ASTM B 370- 12\(2019\)](#), Standard Specification for Copper Sheet and Strip for Building Construction
- .10 [ASTM D 523- 14\(2018\)](#), Standard Test Method for Specular Gloss
- .11 [ASTM D822/D822M-13\(2018\)](#), Standard Practice for Filtered Open Flame Carbon Arc Exposures of Paint and Related Coatings
- .12 [ASTM D1970/D1970M- 20](#) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- .13 [ASTM D4586/D4586M- 07\(2018\)](#), Standard Specification for Asphalt Roof Cement, Asbestos-Free
- .14 [ASTM D4587- 11\(2019\)e1](#) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
- .15 [ASTM F1667- 18a](#) Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .5 Canadian General Standards Board (CGSB):
 - .1 [CAN/CGSB-37.29- M89](#), Rubber-Asphalt Sealing Compound
 - .2 [CAN/CGSB-51.32- M77](#), Sheathing, Membrane, Breather Type
- .6 Canadian Roofing Contractors Association (CRCA):
 - .1 Roofing Specifications Manual Current Edition
- .7 Canadian Sheet Steel Building Institute (CSSBI):

- .1 CSSBI S8- 2018 Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
- .2 CSSBI B17- 2002 Barrier Series Prefinished Steel Sheet: Product Performance & Applications.
- .3 CSSBI Sheet Steel Facts #12 2003 Fastener Guide for Sheet Steel Building Products.
- .8 CSA Group (CSA):
 - .1 [CSA A123.3- 05\(2015\)](#), Asphalt Saturated Organic Roofing Felt
 - .2 [CSA A440 17](#), North American Fenestration Standard/Specification for windows, doors, and skylights, Includes Errata (2018).
 - .3 [CSA B111-1974\(R2003\)](#), Wire Nails, Spikes and Staples
 - .4 [CSA A123.22- 08\(2013\)](#) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
- .9 FM Global:
 - .1 Property Loss Prevention Data Sheets 1-49 Perimeter Flashing
- .10 Green Seal Environmental Standards:
 - .1 Standard GS-03-97, Anti-Corrosive Paints
 - .2 Standard GS-11-15 Paints, Coatings, Stains, and Sealers
 - .3 Standard GS-36-15, Adhesives for Commercial Use
- .11 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS)
- .12 Sheet Metal and Air Conditioning Contractors Association of North America (SMACNA):
 - .1 Architectural Sheet Metal Manual (2012)
 - .2 Residential Sheet Metal Guidelines (2001)
- .13 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule #1113- 16, Architectural Coatings
 - .2 SCAQMD Rule #1168- 17, Adhesives and Sealants

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting
 - .1 Include sheet metal flashing and trim on agenda of pre-installation meetings of affected sections.

1.5 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 including product specifications and technical data sheets for sheet metal flashing fasteners and accessory

materials. Include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit one electronic copy WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit shop drawings for all sheet metal fabrications.
 - .2 Indicate sheet thickness, flashing dimensions and fastenings. Include anchorage, expansion joints and other provisions for thermal movement.
 - .3 Submit manufacturer's catalogue cut sheets for manufactured items.
- .4 Samples:
 - .1 Submit 50 x 50 mm samples of each type of sheet metal material, finishes and colour.
- .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 50 % 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.

1.6 QUALITY ASSURANCE

- .1 Installer: Engage an experienced installer having documented experience who has completed projects similar in material, design, and extent to that indicated for this Project and with a record of successful in service performance.
- .2 Construct and install roof metal flashings in accordance with CRCA Manual details and in accordance with the CRCA Manual. If requirements conflict, this specification takes precedence over the manual.
- .3 Mock-ups
 - .1 Include flashings in mock-ups as specified for work of other affected sections.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.
- .3 Waste Management and Disposal:

- .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.8 WARRANTY

- .1 The same warranty provisions apply to flashings associated with roofing as to the roofing.
- .2 Provide Warranty for sheet metal flashing and trim to include in maintenance manuals as specified in Section 01 91 13 General commissioning requirements

Part 2 Products

2.1 SUSTAINABILITY CHARACTERISTICS

2.2 BASE SHEET METAL MATERIALS

- .1 Provide sheet metal in base metal thickness specified. Where no thickness specified, provide base sheet metal in thickness recommended in SMACNA Architectural Sheet Metal Manual for type of item being fabricated, but not less than the thickness required by the authority having jurisdiction.
- .2 Zinc coated galvanized steel sheet: 0.35mm thickness, commercial quality to [ASTM A653/A653M](#), with Z275 designation zinc coating, and as follows:
 - .1 Class: F2S-Finished two sides.
 - .2 Thickness: minimum 0.45 mm base metal thickness.
 - .3 Factory Finish: silicone modified polyester
- .3 Aluminum-zinc alloy coated steel sheet: to [ASTM A792/A792M](#), commercial quality, grade 37 with AZ180 coating, as follows:
 - .1 Surface: regular spangle
 - .2 Finish: pre-finished as indicated below
 - .3 Thickness: minimum 1.20 mm
- .4 Stainless steel sheet: to [ASTM A240/A240M](#), Type 304 with No. 4 finish.

2.3 FABRICATION

- .1 Fabricate sheet metal building flashings and trim in accordance with the recommendations of SMACNA's Architectural Sheet Metal Manual that apply to the design, dimensions, metal, and other characteristics as required.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI Aluminum Sheet Metal Work in Building Construction.
- .3 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .4 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .5 Make flashings of prefinished metal for all cap flashings, for all flashings adjacent to roofing at roof edges and area dividers and where exposed to view from ground. Make flashings for other locations, of plain galvanized metal as follows:
- .6 Use 0.45 mm metal core thickness except where otherwise indicated.

- .7 Use 0.62 mm metal core thickness wherever a flat length exceeding 305 mm wide occurs.
- .8 Use 0.80 mm metal core thickness for concealed fastening strips.
- .9 S Lock all straight run joints.
- .10 Make joints allow for thermal movement, space S Lock joints at 2440 mm maximum centers.
- .11 Form non-expansion but movable joints in metal to accommodate elastomeric sealant in accordance with SMACNA standards.
- .12 Make flashings so that joints can be lapped 100 mm or more for building into masonry and concrete.
- .13 Strengthen free edges of metal flashings by folding to form a 13 mm hem.
- .14 Make flashings to curbs, walls and parapets a minimum of 200 mm high, where possible.
- .15 Provide flashing sleeves and collars for all pipes and conduit extending through the roof where curb mounted roof penetrations are not required. Sleeves shall be soldered to a piece of sheet metal extending at least 150 mm onto the surrounding roof.
- .16 Make joints for corners and intersections with standing seams except where exposed of pre finished metal when seams shall be flat locked.
- .17 All bends machine made; form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .18 Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, non corrosive metal recommended by sheet metal manufacturer, and as follows:
 - .19 Size as recommended by SMACNA manual or sheet metal manufacturer for application but not less than thickness of metal being secured.
 - .20 Back paint metal flashings in contact with dissimilar metals or materials with bituminous paint that would result in electrolytic action or corrosion.

2.4 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of 0.6 mm thick galvanized and prefinished.

2.5 PANS

- .1 Form pans to receive roofing plastic from 1.2mm galvanized and prefinished steel metal sheet metal with minimum 75 mm upstand above finished roof and 100mm continuous flanges with no open corners.
 - .1 Solder joints.
 - .2 Make pans minimum 50 mm wider than member passing through roof membrane.

2.6 REGLETS AND CAP FLASHINGS

- .1 Form metal cap flashing of 0.6 mm thick sheet metal to be built-in for base flashings as detailed in accordance with CRCA FL series details, FL.

- .1 Provide slotted fixing holes and steel/plastic washer fasteners.
- .2 Cover face and ends with plastic tape.

2.7 FINISHES

- .1 Prefinished Steel Sheet
 - .1 Prefinished steel sheet with coating system consisting of base metal pre-treatment, primer, silicone modified polyester or polyester topcoat meeting requirements of CSSBI S8.
 - .1 Finished colour finished on both sides.
 - .2 Matchcolour to existing.
 - .3 Specular gloss: 75 units +/- 5 gloss units in accordance with [ASTM D523](#).
 - .4 Exposed coating thickness: dry film coating system thickness not minimum 22 micrometres.
 - .2 Prefinished steel with factory applied two-coat polyvinylidene fluoride resin on specified steel sheet substrate conforming to [ASTM A755](#) and AAMA 621-02:
 - .1 Finished colour finished on both sides.
 - .2 Match colour with existing.
 - .3 Specular gloss: 25 units +/- in accordance with [ASTM D523](#).
 - .4 Exposed coating thickness: dry film coating system thickness minimum 22 micrometres.
- .2 Prefinished Aluminum Sheet
 - .1 Finish: factory applied polyvinylidene fluoride (PVDF) coating to AAMA 621 as follows:
 - .1 Finished two sides.
 - .2 Match colour existing.
 - .3 Specular gloss: 75 units +/- 5 units.
 - .4 Coating system thickness: minimum 25 micrometres dry film thickness.

2.8 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Roofing Cement: to [ASTM D4586](#), asphalt based, asbestos free.
- .3 Pourable sealer: proprietary two-part polyurethane pourable sealer designed for sealing penetration pockets.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.
- .4 Loose laid underlay for metal flashing: dry sheathing to [CAN/CGSB-51.32](#).
- .5 Self-adhesive membrane underlay and tie-in membrane for metal flashings: To [CSA A123.22](#) or [ASTM D1970](#), minimum 1 mm thickness.

- .6 Sealants: Use in accordance with Section 07 92 00 - Joint Sealants, in colour to match flashing finish colour.
 - .1 Mastix Sealant: [CAN/CGSB 37.29](#) polyisobutylene; non hardening, non skinning, non drying, non migrating sealant.
 - .2 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00 - Joint Sealants.
- .7 Cleats and hook strips: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness 0.6 mm or same as sheet metal being secured.
 - .1 Provide continuous hook strip at outside of parapets.
- .8 Nails: of same material as sheet metal to [ASTM F1667](#), ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .9 Screws: of same material as sheet metal, TO [ASTM F1667](#) Suitable for substrate and material being fastened, galvanized head, neoprene washer.
- .10 Solder: to [ASTM B32](#), alloy composition Sn 96.
- .11 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .12 Touch-up paint: as recommended by prefinished material manufacturer.
 - .1 Maximum VOC limit 50g/L SCAQMD Rule 1113.
- .13 Metal Accessories: Provide non-corrosive sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work. Accessories shall match or be compatible with material being installed; size and thickness as require.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking and fastener disengagement.
- .2 Install metal flashings on all surfaces such as roof cant edges, sleepers, parapets and cap type, wall junctions, roof dividers, curbs, roof control joints, through roof penetrations and the like, and as otherwise required to provide flashing type protection to details. Extend all flashings down and onto the horizontal portion of the roof unless otherwise directed. Install counter and base flashings unless otherwise directed by the Consultant.
- .3 Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects:

- .1 Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.
- .2 Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
- .3 Temperature change (range): 67 degrees Celsius ambient; 100 degrees Celsius material surfaces.
- .4 Provide sheet metal flashing and trim to create a rain screen assembly to the completed air/vapour and roofing membrane termination details.
- .5 Install prefinished metal fascia to complete edge details. Install as separate piece from flashing.
- .6 Coordinate installation of flashing work of this Section with flashing work of other Sections which ties into this work. Coat surfaces of different metals such as aluminum and galvanized steel which are in contact to each other, with bituminous paint to prevent electrolysis.

3.3 INSTALLATION: METAL FLASHING

- .1 Install sheet metal work in accordance with CRCA FL series details, FL.
- .2 Install sheet metal flashing and trim in accordance with performance requirements, manufacturer's installation instructions, and SMACNA's Architectural Sheet Metal Manual.
- .3 Do not install metal flashings over flexible roof flashing until the flexible roof flashing has been inspected and approved by the Roofing Inspector. This includes curbs for roof mounted items.
- .4 Fasten metal base flashing to walls or upstands along top of flashing. Do not secure to cant strip. Form lapped corner joints. Extend rolled edge of base flashing approximately 25 mm on to roof from toe of cant, and rest on top of roof surface.
- .5 Use concealed fastenings except where approved before installation.
- .6 Provide underlay under sheet metal.
 - .1 Secure in place and lap joints 100 mm.
 - .2 Provide self-adhesive membrane to tie into adjacent assemblies.
- .7 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lockforming tight fit over hook strips, as detailed.
- .8 Lock end joints and caulk with sealant.
- .9 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .10 Insert metal flashing into reglets and under cap flashing to form weather tight junction.
- .11 Separate metal from non compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

- .12 Underlayment: Install a slip sheet of red rosin paper and a course of polyethylene underlayment where installing stainless steel or aluminum directly on cementitious or wood substrates.
- .13 Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.
- .14 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .15 Caulk flashing at reglet and cap flashing with sealant.
- .16 Install pans, where shown around items projecting through roof membrane.
- .17 Install drainage items to drain roof in the most efficient manner fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the Item manufacturer.
- .18 Coordinate roof drain flashing installation with roof drainage system installation.
- .19 Provide a smooth flat surface free of indentations, bumps, oil canning, or twists, all edges, bends hard, sharp and true to line for all exposed and pre finished flashings.
- .20 Install fasteners in slots or oversize holes to allow expansion and contraction of flashings where flashing installed with mechanical fasteners..
- .21 Provide isolation coating or impervious self-adhesive membrane to separate aluminum items from concrete and masonry.

3.4 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment on completion and verification of performance of installation.
- .2 Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- .3 Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Performance.
- .4 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Section 07 84 00 Firestopping

Part 1 General

1.1 SUMMARY

- .1 This Section specifies fire stop and smoke seal systems and 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. 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 and smoke seal work for the entire Project including selection, installation and inspection of all required fire stops.

1.2 RELATED REQUIREMENTS

- .1 Section 02 81 00 - Hazardous Materials

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 Compartment: spaces within a building that are enclosed by exterior walls or separated from other parts of the building by enclosing Fire Separations having a Fire-Resistance Rating.
- .3 Fire-Resistance Rating: time in minutes or hours that a material or assembly of materials will withstand the passage of flame and transmission of heat when exposed to fire, meeting the requirements of [CAN/ULC-S101](#) or as determined by formal testing of material or assembly of materials, meeting requirements of [CAN/ULC-S115](#), or an interpretation of information derived from formal testing in accordance with requirements of the Building Code and acceptable to the Authority Having Jurisdiction (AHJ).
- .4 Fire Separation: assembly that acts as a barrier against the spread of fire, smoke and noxious gases resulting from combustion as defined by the Building Code and includes the following assemblies having a Fire-Resistance Rating requiring Fire Stopping as follows:
 - .1 Penetration-Type Fire Stop systems located within loadbearing walls and partitions.
 - .2 Penetration-Type Fire Stop systems located within non-loadbearing walls and partitions.
 - .3 Penetration-Type located within floor assemblies.
 - .4 Building Perimeter-Type located between floor assemblies and exterior wall and roof construction.
 - .5 Construction Joint-Type and other assemblies having a Fire-Resistance Rating indicated on Drawings or Schedules.
- .5 Fire Stop: 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.
- .6 Fire Stop System: a specific site 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](#).
 - .1 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.
 - .2 FT-Rating: a fire stop system with an F-Rating for the required time period which can also resist 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.

- .3 FH-Rating: a fire stop system with an F-Rating for the required time period which can also resist the force of a hose stream without developing openings for a prescribed period.
- .4 FTH-Rating: a fire stop system with an FT-Rating for the required time period which also passes the hose stream test for a prescribed period.
- .5 L-Rating: largest test sample leakage rate, determined in accordance with the optional air leakage test in [CAN/ULC-S115](#).
- .7 Multi-penetration: two or more service penetrations through an opening in the fire separation.
- .8 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.
- .9 Single-penetration: single service penetration through an opening in the fire separation.
- .10 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 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 [ASTM A1008/A1008M](#)- 13Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable
 - .2 [ASTM C719](#)- 14, Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
 - .3 [ASTM C920](#)- 14, Standard Specification for Elastomeric Joint Sealants
 - .4 [ASTM E84](#)- 21, Standard Test Method for Surface Burning Characteristics of Building Materials
 - .5 [ASTM E119](#)- 20, Standard Test Methods for Fire Tests of Building Construction and Materials
 - .6 [ASTM E136](#)- 19A, Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 degrees
 - .7 [ASTM E595](#)- 15, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
 - .8 [ASTM E814](#)- 13a, Standard Test Method for Fire Tests of Penetration Firestop Systems
 - .9 [ASTM E1966](#) 15, Standard Test Method for Fire Resistive Joint Systems
 - .10 [ASTM E2032](#)- 09, Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E 119.
 - .11 [ASTM E2174](#)- 20A, Standard Practice for On-Site Inspection of Installed Firestops.

- .12 [ASTM E2393- 20A](#), Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
- .2 Firestop Contractors International Association (FCIA):
 - .1 FCIA Firestop Manual of Practice, 6th Edition 2015
- .3 Factory Mutual Approvals (FM):
 - .1 FM 4990- 2009, Approval Standard for Fire stopping
 - .2 FM 4991- 2013, Approval Standard for Firestop Contractors
- .4 International Accreditation Service (IAS):
 - .1 IAS AC291- 19, 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 Fire Protection Agency (NFPA):
 - .1 [NFPA 251- 2006](#), Standard Methods of Tests of Fire Endurance of Building Construction and Materials
- .7 National Research Council Canada (NRC):
 - .1 National Building Code of Canada (NBC) 2015
 - .2 Best Practice Guide on Fire Stops and Fire Blocks and Their Impact on Sound Transmission 2007
- .8 ULC Standards (ULC):
 - .1 [CAN/ULC-S101- 14](#), Standard Method of Fire Endurance Tests of Building Construction and Materials
 - .2 [CAN/ULC-S102- 10](#), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .3 [CAN/ULC-S114- 05](#), Standard Method of Test for Determination of Non-Combustibility in Building Materials
 - .4 [CAN/ULC-S115- 11](#), Standard Method of Fire Tests of Firestop Systems
- .9 Underwriters Laboratories Inc. (UL):
 - .1 [UL 1479- 2015](#), Fire Tests of Penetration Firestops
 - .2 UL Qualified Firestop Contractor Program

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:

- .1 Hold pre-installation meeting oneweek before beginning Work of this Section, with Contractor, Subcontractor DCC Representative in accordance with Section 01 31 19 - Project Meetingsto:
 - .1 Verify Project requirements.
 - .2 Review sustainable requirements.
 - .3 Review installation and substrate conditions.
 - .4 Discuss coordination with other Subcontractors.
 - .5 Review system design listings, manufacturer's installation instructions and warranty requirements.
 - .6 Review quantity and location of mock-ups.
- .2 Hold 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 trade.
- .2 Sequencing:
 - .1 Proceed with installation only when submittals have been reviewed by DCC Representative.
 - .2 Install fire stops located in floor assemblies before interior partition erections.
 - .3 Metal deck bonding: Unless otherwise noted 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 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Qualification Statement:
 - .1 Submit contractor qualification statements and certificates demonstrating compliance with the qualification requirements of this Section, as described in

PART 1 - QUALITY ASSURANCE, within Tenworking days after award of contract and before starting Work.

- .3 Product Data:
 - .1 Submit manufacturer's product data for each type of fire stopping and smoke seal. 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 manufacturer certification certifying 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 E595](#).
 - .3 Submit one copy of WHMIS Safety Data Sheets (SDS) for each individual component.
 - .4 Submit a comprehensive list of all products and components included in submittal.
- .4 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. Insert title in front and spine of binder.

- .2 Table of Contents at front of each binder.
- .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
- .5 System Design Listings:
 - .1 Submit design listings for each listed fire stop system and each application identified in accordance with [CAN/ULC-S115](#)
 - .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.
- .5 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and QUALITY ASSURANCE in Part 1.
- .6 Samples: Submit to DCC Representative a minimum one week before beginning site work:
 - .1 Submit two 300 x 300-mm samples of each system showing actual fire stop materials proposed for Project including anchors/fasteners and damming materials.
 - .2 Submit two samples of each type of label proposed for the identification of fire stops.
- .7 Quality Assurance Submittals: Submit the following in accordance with Section 01 45 00 - Quality Control:
 - .1 Test reports in accordance with [CAN/ULC-S101](#), [CAN/ULC-S102](#), and [CAN/ULC-S115](#).
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .2 Document from Engineer of Record showing compliance of alternative fire stopping solution with [CAN/ULC-S115](#) and the EJ guidelines provided by the National Research Council, Best Practice Guide on Fire Stops and Fire Blocks and Their Impact on Sound Transmission.
 - .3 Certificates: Submit 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 Manufacturer's Site Reports: Submit manufacturer's reports within three days of review, verifying compliance of Work, as described in SITE QUALITY CONTROL in Part 3 of this Section.
- .8 Engineering Judgments(EJ):
 - .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 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 which EJ is based on.
 - .6 EJ issuer name and contact information.
 - .7 Date of issue of EJ with authorization signature of issuer.
 - .5 EJ shall only be issued by fire stop manufacturer's qualified technical personnel or in collaboration 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.
 - .6 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 EJ is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g., [ASTM E2032](#)) may also be used as further support data.
 - .7 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.
 - .8 EJ shall be limited to the specific conditions and configurations for which it was created and should be based upon reasonable performance expectations for the recommended fire stop system under those conditions.

- .9 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.
 - .1 Manufacturer letter stating their opinion, with supporting justification, that the EJ will perform as a fire stop system when subjected to the appropriate standard fire test method for the required fire rating duration.
- .10 Once the EJ has been reviewed, submit to the DCC representative for final approval.
- .9 Closeout Submittals:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Operation and Maintenance Data: Submit maintenance data for incorporation into manual, including:
 - .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 EJs, and
 - .4 matrix schedule listing all system design listings and EJs with a description of their penetration or joint type.
 - .5 Certifications:
 - .1 Provide proof of training for each worker that performed installation on the Project.
 - .2 Provide proof of company installing fire stopping and smoke seals is a Member in Good Standing with FCIA.
 - .3 Certification of company as a ULC Qualified FM 4991 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).
- .11 Record Documentation:
 - .1 Maintain a daily log of all activities on site during the course of construction. Submit a copy of all daily logs after completion of fire stopping work.
 - .2 As-built Drawings:
 - .1 Submit a marked-up set of Drawings to provide referencing system identifying the location of each fire stop.
 - .2 Identify each penetration type fire stop with their penetration identification number.

- .3 Provide detailed Drawings of system design listings for each type of fire stop (i.e., through-penetration, membrane penetration, blank opening, construction joint, building perimeter).
- .4 Fire Stop Schedules:
 - .1 Submit complete fire stop schedules for floors, walls and ceilings.
 - .2 Indicate all penetration fire stops and joint fire stops through each reference wall, floor and ceiling in the schedules.
 - .3 Cross-reference firestop schedules with as-built drawings and indicate design listing numbers associated to each penetration fire stop and joint fire stop.

1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: Use materials and methods of determining required thickness of application that have the full acceptance of AHJ and that are tested in accordance with [CAN/ULC-S115](#), and form a part of a ULC or cUL listed system, Engineered Judgement or Equivalent Fire Resistance Rated Assembly.
- .2 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).
- .3 Qualifications:
 - .1 Contractor specializing in selection and installation of fire stops approved by manufacturer. Submit a list of five successfully completed projects of similar scale and type.
 - .2 The installers are recognized as a Member in Good Standing with the Firestop Contractors International Association (FCIA). Submit proof of current membership.
 - .3 Training: Workers, including site supervisor, to complete:
 - .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 certificate.
 - .2 FM 4991
 - .5 Third-Party Inspection Firm: IAS AC291 inspection agency with inspectors who have passed the ULC Firestop Exam or FM Firestop Exam.
- .4 Mock-ups:
 - .1 Construct mock-up of fire stop systems in accordance with Section 01 45 00 - Quality Control.

- .2 Before beginning construction, provide mock-up of each proposed listed fire stop system for review by DCC Representative. Mock-up shall include work by other trades to demonstrate the required finish work, such as steel stud/gypsum board trade framing out multi-penetration openings.
- .3 Install proposed identification labels for each penetration.
- .4 Locations for mock-ups as directed by the DCC Representative.
- .5 After mock-up completion and adequate curing time for materials, provide a minimum of 48hours notification to DCC Representative to conduct review.
- .6 Manufacturer's representatives shall be present during review of mock-ups.
- .7 Correct mock-up deficiencies as directed by DCC Representative. Mock-up may not remain as part of finished work.
- .8 DCC Representative may perform destructive tests to each mock-up to ensure the system meets or exceeds the approved system design listing.
- .5 Manufacturer Site Visits:
 - .1 Conducted after delivery and storage of products, and when preparatory Work is complete, but before installation begins.
 - .2 During progress of work at 25 % and 75 % completion.
 - .3 Conducted again upon completion of Work and after final cleaning is complete.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 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 in a well-ventilated, dry indoor location and in accordance with manufacturer's instructions.
 - .2 Coordinate delivery of materials with scheduled installation dates to allow minimum storage time on site.
 - .3 Comply with recommended procedures, precautions and measures described in WHMIS Safety Data Sheets (SDS).
- .3 Waste Management and Disposal:
 - .1 Perform in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.9 AMBIENT CONDITIONS

- .1 Ambient Conditions:

- .1 Install fire stops and smoke seals 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 48hours before and 72hours after installation.
- .2 Ventilate fire stops and smoke seals in accordance with manufacturers' instructions by natural means or, where this is inadequate or not available, use forced air circulation.

1.10 WARRANTY

- .1 Extend 12 month warranty period to 24months for Work of this Section.
- .2 Manufacturers shall warrant work of this Section against defects and deficiencies in the product material for a period of 24months. Promptly correct any defects or deficiencies which become apparent within warranty period at no expense.
- .3 Contractor warrants workmanship on materials and installation for a period of 24months. 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 authorization from DCC representative.
- .2 Provide a listed system from an alternative where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stopping application to avoid providing an Engineering Judgment.

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 Fire stop and smoke seal systems 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 the NBC.
- .2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with the NBC, ULC Standards, and AHJ, and as follows:
 - .1 Non-rated fire separations: Provide L-Rated smoke protection fire stop system for application on both sides of separation.
 - .2 Provide through-penetration fire stop and joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of penetrated assembly, such as:
 - .1 Fire-resistance rated loadbearing walls, including partitions, with fire protection rated openings.
 - .2 Fire-resistance rated non-loadbearing walls, including partitions with fire protection rated openings.
 - .3 Fire-resistance rated floor assemblies.

- .3 "F" Rated Systems: Provide through-penetration fire stop systems with F-ratings indicated, as determined by [CAN/ULC-S115](#) or [ASTM E814](#), and equal to or exceeding the fire-resistance rating of the penetrations created during construction.
- .4 "T" Rated Systems: Where fire stop systems protect penetrating items from potential contact with adjacent materials, provide through-penetration fire stop systems with T-ratings and F-ratings indicated, as determined by [CAN/ULC-S115](#) or [ASTM E814](#), for the following conditions:
 - .1 Penetrations located outside wall cavities.
 - .2 Penetrations located outside fire resistive shaft enclosures.
 - .3 Penetrations located in a construction containing fire protection rated openings.
 - .4 Penetrating items larger than a 100-mm-diameter nominal pipe or 100 cm² in overall cross-sectional area.
- .5 Fire stopping and Smoke Seal Systems Exposed to View: Provide products that after curing do not deteriorate when exposed to view, traffic, moisture, and physical damage both during and after construction, and as follows:
 - .1 Provide moisture resistant through-penetration fire stop systems for piping penetrations for plumbing and wet pipe sprinkler systems.
 - .2 Provide fire stopping and smoke seal systems capable of supporting anticipated floor loads either by installing floor plates or by other means for floor penetrations with annular spaces exceeding 100 mm in width and exposed to possible loading and traffic.
 - .3 Provide fire stopping and smoke seal systems not requiring removal of insulation for penetrations involving insulated piping.
 - .4 Provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 50 for fire stopping, smoke seal, and joint systems exposed to view.
 - .5 Architectural considerations: When fire stop system is exposed to view, consider architectural finish, potential traffic, and exposure to moisture and heat.
- .6 Fire Resistance of Joint Systems: Assembly ratings and movement capabilities shall be as indicated with assembly ratings equal to or exceeding the fire-resistance rating of constructions in which joints are located.
- .3 Dynamic Joints: Where required, design fire stop and smoke seal systems to accommodate a defined amount of movement in structural elements, construction joints and mechanical piping caused by expansion or contraction. Systems should also accommodate movement and sound and vibration control in mechanical installations.
- .4 Insulated Pipes and Ducts: Design and test listed fire stop system with the actual insulation materials penetrating the fire separation, as indicated on the system design listing.
- .5 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.

- .6 Environment Considerations: Select materials taking into consideration the environment in which they will be used during and after curing, as well as the intended use of the space. Confirm compatibility of the proposed materials/products with fire stop manufacturer for the following situations:
 - .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 Compatibility: Under conditions of service and application, provide fire stopping and smoke seal systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating the systems, as demonstrated by fire stopping and smoke seal system manufacturer based on testing and site experience, and as follows:
 - .1 Asbestos-free materials and systems capable of maintaining an 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 Service penetration assemblies and fire stop components: Certified by testing laboratory to [CAN/ULC-S115](#).
 - .3 Provide elastomeric seal or non-shrink foam cement mortar for fire and smoke stop systems at openings intended for re-entry, such as cables. Do not use cementitious or rigid seal at such locations.
 - .4 Provide elastomeric protection for fire and smoke stop systems at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control. Do not use a cementitious or rigid seal at such locations. Exemption for fire dampers.
 - .5 Provide elastomeric seal for fire and smoke seals behind and around mechanical and electrical boxes within wall, floor, and ceiling assemblies.

2.4 FILL MATERIALS

- .1 General:
 - .1 Provide fire stopping and smoke seal systems containing the types of fill materials indicated in SCHEDULE in Part 3 of this Section by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
 - .2 Fire stopping and smoke seal systems shall be tested in accordance with [CAN/ULC-S115](#) and be comprised of asbestos free materials and systems capable of maintaining an effective barrier against flame, smoke and gases. Fire stopping and smoke seal systems not to exceed opening sizes for which they are intended for the ratings as indicated on Drawings.
- .2 Cast-in-Place Fire Stopping and Smoke Seal Devices: Factory assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with

- an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- .3 Latex Sealants: Single component latex formulations that after curing do not re-emulsify during exposure to moisture.
 - .4 Fire Stopping and Smoke Seal Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrating item.
 - .5 Cable Penetration Devices:
 - .1 Pre-manufactured intumescent blocks
 - .2 Pre-manufactured sleeves, consisting of an adjustable core
 - .3 Pre-manufactured cable management system, consisting of a system of intumescent inserts and adjustable cores
 - .6 Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.
 - .7 Intumescent Putties: Non-hardening dielectric, water resistant putties containing no solvents, inorganic fibres, or silicone compounds.
 - .8 Intumescent Spray Foam: Expanding spray-in-place intumescent foam sealant.
 - .9 Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.
 - .10 Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.
 - .11 Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing [ASTM E136](#), with flame-spread and smoke-developed ratings of zero per [ASTM E84](#).
 - .12 Solvent-Release-Curing Intumescent Sealant: Solvent-release-curing, single-component, synthetic-polymer-based sealant of grade indicated below:
 - .1 Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces. Non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/gunnable sealant, unless indicated fire stop system limits use non-sag grade.
 - .13 Mortars: Pre-packaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
 - .14 Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass fibre cloth cases filled with a combination of mineral fibre, water insoluble expansion agents and fire-retardant additives.
 - .15 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in-place to produce a flexible, non-shrinking foam.
 - .16 Silicone Sealants: Moisture curing, single component, silicone based, neutral curing elastomeric sealants of grade indicated below:

- .1 Grade for Horizontal Surfaces: Pourable (self-levelling) formulation for openings in floors and other horizontal surfaces.
- .2 Grade for Vertical Surfaces: Non-sag formulation for openings in vertical and other surfaces.
- .17 Ceramic-Fibre and Mastic Coating: Ceramic fibres in bulk form formulated for use with mastic coating, and ceramic fibre manufacturer's mastic coating.
- .18 Ceramic-Fibre Sealant: Single-component formulation of ceramic fibres and inorganic binders.

2.5 MIXING

- .1 For those products requiring mixing before application, comply with fire stopping and smoke seal system manufacturer's instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.6 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

- .1 Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer that comply with [ASTM C920](#) requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.
- .2 Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.
 - .1 Additional Movement Capability: When tested for adhesion and cohesion under maximum cyclic movement per [ASTM C719](#), provide sealant with the capability to withstand the changes in joint width existing at the time of installation, and remain in compliance with other requirements of [ASTM C920](#).
- .3 Multicomponent, Non-sag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.
 - .1 Additional Movement Capability: When tested for adhesion and cohesion under maximum cyclic movement per [ASTM C719](#), provide sealant with the capability to withstand the change in joint width existing at the time of installation, and remain in compliance with other requirements of [ASTM C920](#).
- .4 Single-Component, Non-sag, Urethane Sealant: Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.

2.7 FIRE STOP IDENTIFICATION

- .1 Identification Labels and Markings: Permanent 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 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 Indicate on label that fill material around the penetration is a fire stop system and shall not be disturbed except by authorized personnel.
- .3 Fire Separation (Barrier) Markings:
 - .1 Provide identification for all vertical fire separations.
 - .2 Identification markings: adhesivewith lettering at least 75mm in height with a minimum 10 -mm stroke in contrasting colour.
 - .3 Incorporate assembly's fire-resistance rating and the following suggested wording, "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS", or other accepted wording.
- .4 For occupied areas with exposed ceilings: Use 50-mm red dot adhesive stickers.

2.8 ACCESSORIES

- .1 Provide components for each fire stopping and smoke seal system needed to install fill materials. Use only components specified by fire stopping and smoke seal system manufacturer and approved by the qualified testing and inspecting agency for fire stopping and smoke seal systems indicated on Drawings.
- .2 Primers: To manufacturer's recommendation for specific material, substrate, and end use.
- .3 Water (if applicable): Potable, clean and free from harmful amounts of deleterious substances.
- .4 Metal Fire Stop: Commercial galvanized steel, to [ASTM A1008/A1008M](#), zinc coating 260 g/m², minimum metal core thickness 0.912 mm.
- .5 Steel Deck Moulded Flute Inserts: One-piece moulded mineral fibre flute inserts, sized for steel deck profiles, for placement at top of fire-rated wall assemblies
- .6 Packing/Damming Materials, Supports and Anchoring Devices: To manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to AHJ.
- .7 Fire Stop Insulation: Pre-formed, semi-rigid, non-combustible mineral wool, pre-cut in 1220-mm lengths to required depth and width.

- .8 Junction Box/Outlet Sealing Putty: Intumescent putty, pre-formed in pads.
- .9 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

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that conditions of substrates previously installed 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. Remove all temporary lines and markings to meet the approved system design listings.
- .4 Verify that proposed fire stop system consists of components that are compatible with each other, with substrates forming the openings, and with items, if any, penetrating the fire stop under conditions of application and service, as demonstrated by the fire stop manufacturer based on testing and site experience.
- .5 Pipe and Duct Insulation: Confirm that 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 fire stopped areas are accessible for proper application and that 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 before commencing any installations.
- .9 Proceed only once defected surfaces or conditions have been corrected.
- .10 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
 - .2 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 Prime surfaces as required.
- .7 Ensure multi-penetration openings have been framed and boarded out around annular openings, as indicated in the system design listing before prepping the opening.

3.3 INSTALLATION

- .1 Install fire stop and smoke seal 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 seal systems
- .4 Seal holes or voids 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.

3.4 INSTALLATION - 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 Tool non-sag fire stop materials immediately after their application and before the time skinning begins. Form smooth, uniform beads of configuration indicated or required to

- .1 provide required fire-resistance rating,
- .2 eliminate air pockets, and
- .3 ensure contact and adhesion with sides of joint.
- .4 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 INSTALLATION - THROUGH PENETRATION JOINT SEALANTS

- .1 Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position required to achieve fire ratings of designated through-penetration fire stop systems.
- .2 Install fill materials for through-penetration fire stop systems by techniques recommended by the manufacturer to produce the following results:
 - .1 Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - .2 Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - .3 For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- .3 Remove combustible forming materials and other accessories not indicated as permanent components of fire stop systems.

3.6 IDENTIFICATION

- .1 General:
 - .1 Clean substrate before applying identification.
 - .2 Determine final location of identification 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 fire stopped wall/floor service penetration. 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 before requesting substantial performance.
- .3 Fire Separations (Barriers):
 - .1 Position identification at least 4500mm from end of each wall and at intervals not exceeding 9000mm along wall/floor joint fire stops.

- .2 Install markings within ceiling spaces, 600mm below horizontal fire separation or roof structure unless otherwise indicated on Drawings.
- .3 Review location of identification with DCC Representative for occupied areas with exposed ceilings before proceeding.

3.7 REPAIRS AND MODIFICATIONS

- .1 Identify damaged or re-entered seals requiring repair or modification.
- .2 Remove loose or damaged materials. If adding penetrating items, remove sufficient material to insert new elements and to avoid damaging the balance of the seal.
- .3 Ensure sealed surfaces 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.

3.8 SITE QUALITY CONTROL

- .1 Inspections: Notify DCC Representative when ready for inspection and before concealing or enclosing fire stop materials and service penetration assemblies.
- .2 Manufacturer's Field Services:
 - .1 Mock-ups: Manufacturer to provide confirmation that the fire stop system installed meets or exceeds the system design listing requirements for each mock-up application.
 - .2 Obtain report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Site Reports as described in SUBMITTALS in Part 1 of this Section.
 - .3 Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 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 before closing off any concealed areas. Perform inspections and destructive testing in compliance with [ASTM E2174](#) and [ASTM E2393](#).
- .2 DCC Representative to conduct random inspections and direct exploratory review (i.e., destructive testing) during the course of construction and before closing off any concealed areas. Perform inspections and destructive testing in compliance with [ASTM E2174](#) and [ASTM E2393](#).
 - .1 Include a minimum of 2% of each 900-m² area 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 DCC Representative. 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 representatives 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 DCC Representative will conduct the substantial performance review in the presence of the fire stop Contractor and the manufacturer's representative.

3.10 CLEANING

- .1 Perform cleaning in accordance with Section 01 74 11 - Cleaning.
- .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
- .4 Remove temporary dams after initial set of fire stop and smoke seal materials.

3.11 SCHEDULE

- .1 Provide fire stop and L-Rated smoke-resistant fire stop systems at locations shown on Drawings and schedules.
- .2 Design and provide through-penetration fire stopping and smoke seals as follows:
 - .1 Systems with no penetrating items, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 silicone sealant
 - .3 intumescent putty
 - .4 intumescent foam blocks or boards
 - .5 intumescent spray foam
 - .2 Systems for metallic pipes, conduit, or tubing, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 silicone sealant
 - .3 intumescent putty
 - .4 intumescent foam blocks or boards
 - .5 intumescent spray foam
 - .3 Systems for non-metallic pipe, conduit, or tubing, select one or more of the following fill materials:

- .1 latex sealant
- .2 silicone sealant
- .3 intumescent putty
- .4 intumescent foam blocks or boards
- .5 intumescent spray foam
- .4 Re-enterable and cable managed systems for electrical, and data and communications cables:
 - .1 prefabricated fire stop sleeve cp653 (hilti)
 - .2 preformed intumescent blocks cfs-bl (hilti)
 - .3 preformed intumescent blocks (roxtec)
 - .4 prefabricated cable pathways (ez-path)
- .5 Systems for electrical, and data and communications cables, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 silicone sealant
 - .3 intumescent putty
 - .4 silicone foam
 - .5 prefabricated fire stop sleeve cp 653 (hilti)
 - .6 preformed intumescent blocks cfs-bl (hilti)
 - .7 preformed intumescent blocks (roxtec)
 - .8 prefabricated cable pathways (ez-path)
 - .9 intumescent foam blocks or boards
 - .10 intumescent spray foam
- .6 Systems for cable trays, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 intumescent putty
 - .3 silicone foam
 - .4 pillows/bags
 - .5 intumescent foam blocks or boards
- .7 Systems for insulated pipes, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 intumescent putty
 - .3 silicone foam
 - .4 intumescent wrap strips

- .5 intumescent foam blocks or boards
- .6 intumescent spray foam
- .8 Systems for miscellaneous electrical penetrations, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 intumescent putty
 - .3 intumescent foam blocks or boards
 - .4 intumescent spray foam
- .9 Systems for miscellaneous mechanical penetrations, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 intumescent foam blocks or boards
 - .3 intumescent spray foam
- .10 Systems for groupings of penetrations, select one or more of the following fill materials:
 - .1 latex sealant
 - .2 intumescent wrap strips
 - .3 fire stopping and smoke seal device
 - .4 intumescent composite sheet
 - .5 intumescent foam blocks or boards
 - .6 intumescent spray foam
- .3 Design and provide joint fire stopping and smoke seals as follows for:
 - .1 Floor-to-Floor, Fire-Resistive Joint System: Provide materials to meet the following criteria:
 - .1 assembly rating: as indicated
 - .2 nominal joint width: as indicated
 - .3 movement capabilities: compression and extension
 - .2 Floor-to-Wall, Fire-Resistive Joint System: Provide materials to meet the following criteria:
 - .1 assembly rating: as indicated
 - .2 nominal joint width: as indicated
 - .3 movement capabilities: to be confirmed, compression, extension, or horizontal shear
 - .3 Head-of-Wall, Fire-Resistive Joint System: Provide materials to meet the following criteria:
 - .1 assembly rating: as indicated

- .2 nominal joint width: as indicated
- .3 movement capabilities: compression and extension
- .4 Wall-to-Wall, Fire-Resistive Joint System: Provide materials to meet the following criteria:
 - .1 assembly rating: as indicated
 - .2 nominal joint width: as indicated
 - .3 movement capabilities: compression and extension
- .4 Design and provide perimeter fire containment fire stopping and smoke seals as follows for:
 - .1 Perimeter Fire Containment System: Provide materials to meet the following criteria:
 - .1 integrity rating: as indicated
 - .2 insulation rating: as indicated
 - .3 linear opening width: as indicated

END OF SECTION

Section 07 92 00 Joint Sealants

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 84 00 - Fire Stopping

1.2 DEFINITIONS

- .1 Environmental Product Declaration (EPD): Submit an Industry-wide EPD for each metal product outlined in the specification. Provide EPD with at least a cradle to gate scope, identifying the following impact categories (minimum):
 - .1 Global Warming Potential (GWP): Submit GWP information in the form of kgCO₂eq.
 - .2 Ozone Depletion Potential (ODP): Submit ODP information in the form of kgCFC-11 eq.
 - .3 Acidification Potential (AP): Submit AP information in the form of kgSO₂eq.
 - .4 Eutrophication Potential (EP): Submit EP information in the form of kgN eq.
 - .5 Smog Formation Potential (SFP): Submit SFP information in the form of kgO₃eq. Also referred to as Photochemical ozone creation potential (POCP).

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 [ASTM C834-17](#), Standard Specification for Latex Sealants
 - .2 [ASTM C919-19](#), Standard Practice for Use of Sealants in Acoustical Applications
 - .3 [ASTM C920-18](#), Standard Specification for Elastomeric Joint Sealants
 - .4 [ASTM C1193-16](#), Standard Guide for Use of Joint Sealants
 - .5 [ASTM C1330-18](#), Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants
 - .6 [ASTM C1481-12](#), Standard Guide for Use of Joint Sealants with Exterior Insulation and Finish Systems (EIFS)
 - .7 [ASTM D1056-20](#), Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
 - .8 [ASTM D2240-15e1](#), Standard Test Methods for Rubber Property, Durometer Hardness
 - .9 [ASTM D2628-91](#), Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
- .2 Canadian General Standards Board (CGSB) 1330:
 - .1 [CAN/CGSB-19.24-M90](#), Multi-component, Chemical Curing Sealing Compound
- .3 Department of Justice Canada (Jus):

- .1 Canadian Environmental Protection Act, 1999 (2018) (CEPA)
- .4 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
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
 - .2 Sealant, Waterproofing, and Restoration Institute (SWRI): Sealants: The Professionals' Guide 2013
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards:
 - .1 SCAQMD Rule 1168-A2017, Adhesives and Sealants Applications
- .7 Transport Canada (TC):
 - .1 Transportation of Dangerous Goods Act, 1992 (2019 amended.) (TDGA)
- .8 ULC Standards/ UL Canada (ULC):
 - .1 CAN/ULC 115-2018, Standard Method of Fire Tests of Firestop Systems

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product data for each type of primer, backer rod, and sealants and include product characteristics, performance criteria, available colours, compatibility warnings, compliance standards and limitations.
 - .2 Manufacturer's product to describe:
 - .3 Submit one electronic copy of WHMIS SDS.
- .3 Samples:
 - .1 Submit two samples of each type of joint sealant material and colour.
 - .2 Submit two cured samples of exposed sealants of each colour to match adjacent material.
- .4 Certificates: When requested by DCC Representative, submit manufacturer's product certificates indicating proposed sealant is appropriate for each application on this Project.
- .5 Manufacturer's Instructions:
 - .1 Submit instructions for each type of product.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer: Obtain each type of joint sealant from a single manufacturer.
 - .2 Documented experience in Work of similar size and complexity.
- .2 Compatibility: Ensure sealants are compatible with adjacent materials and are approved by manufacture for use with adjacent materials.
- .3 Mock-Ups:
 - .1 Construct mock up in accordance with Section 01 45 00 - Quality Control.
 - .2 Before performing sealant work do sample applications of each type of sealant forreview.
 - .3 Site locations for sample applications shall be designated by DCC Representative.
 - .4 Construct joint sealant mock-ups in assemblies of other Sections with joint sealants, which are referenced in this Section.
- .4 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to Health Canada.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, with manufacturer's label.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in a ventilated dry indoor locationand in accordance with manufacturer's recommendations.
 - .2 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
 - .3 Do not dispose of unused sealant material into sewer system, streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
 - .4 Divert unused joint sealing material from landfill to official hazardous material collections site approved by DCC Representative.

1.8 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.

1.9 WARRANTY

- .1 Manufacturer's warranty: Provide manufacturer's standard warranty documentation.
- .2 Warrant that sealant work will not leak, crack, crumble, melt, shrink, run, lose adhesion or stain adjacent surfaces in accordance with General Conditions, except for five years.
- .3 Installer's Warranty: Provide an installation warranty, installer agrees to repair or replace joint sealants that do not comply with requirements of this Section for two years from Substantial Performance.

Part 2 Products

2.1 SUSTAINABILITY CHARACTERISTICS

- .1 When low toxicity sealants 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.
- .2 VOC emissions limits shall be as follows:
 - .1 Sealant Primers:
 - .1 for non-porous surfaces: 250g/L
 - .2 for porous surfaces: 775g/L
 - .3 for modified bituminous membranes: 500g/L
 - .4 for marine deck: 760g/L
 - .5 for other conditions: 420g/L
 - .2 Sealants:
 - .1 architectural: 250g/L
 - .2 marine deck: 760g/L
 - .3 non-membrane roof: 300g/L
 - .4 roadway: 250g/L
 - .5 single-ply roof membrane: 450g/L
 - .6 other conditions: 420g/L

2.2 PERFORMANCE REQUIREMENTS

- .1 Each sealant system shall meet the following requirements for warranty period:
 - .1 Waterproof, flexible, and compatible with substrate under applicable service conditions.
 - .2 Provide a weather-tight seal that does not allow moisture penetration.
 - .3 Shall not de-bond, crack, or craze.
 - .4 Shall not leak.

2.3 SEALANT MATERIALS

- .1 In air handling units and supply air system, use sealants without strong odours, without toxic chemicals, and are mould-resistant. When low toxicity sealants 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.

- .2 Provide primers in accordance with manufacturer recommendation.

2.4 SEALANT MATERIAL DESIGNATIONS

- .1 Type S-1: Acrylic Latex One Part, Shore A Hardness 20,
- .2 Type S-2: Silicone Sealant; mould and mildew resistant.
 - .1 To [CAN/CGSB-19.13](#); type S; grade NS; class 50; use NT, G, and A.
 - .2 To [CAN/CGSB-19.13](#); type S; grade NS; class 25; use NT, G, and A.
- .3 Type S-3: Silicone Sealant; general construction and air-seal sealant.
 - .1 To [ASTM C920](#): type S; grade NS; class 25; use NT, M, G, A, O.
- .4 Type S-4: Silicone Sealant; structural glazing.
 - .1 To [CAN/CGSB-19.13](#): type S; grade NS; class 25; use NT, A, G, O.
- .5 Type S-5: Acoustical Sealant; interior, non-skimming, non-hardening, simple component synthetic rubber sealant, to [ASTM C919](#).
- .6 Type S-6: Multi-component polyurethane sealant; chemical curing, exterior wall sealant.
 - .1 To [CAN/CGSB-19.24](#): type M; grade NS; class 50; use T, NT, M, A, O.
- .7 Type S-7: One-component polyurethane sealant; non-sag, for general construction.
 - .1 To [CAN/CGSB-19.24](#): type S; grade NS; class 25; use NT, M, A, O.
- .8 Type S-8: Horizontal joint sealant; two component, self-levelling.
 - .1 To [CAN/CGSB-19.13](#): type M; grade P; class 25; use T, M, O.
- .9 Type S-9: One part moisture curing, low modulus polyurethane sealant for sealing joints in level and slightly slope surfaces conforming to [CAN/CGSB-19.24](#), type S, grade P, class 50, use T, M, A,O, MC-1-25-B-N.
- .10 Type S-10: Control joint sealant: two-component, epoxy-urethane, self-levelling, load bearing saw cut or preformed control joints.
- .11 Type S-11 Control Joint Sealant: Two component, polyurea based, load bearing, self levelling sealant.
- .12 Type S-12 Control Joint Sealant: Two component, semi-rigid epoxy, load bearing, self levelling sealant.
- .13 Type S-13: One-component polyurethane sealant; medium-modulus, non-sag, low-VOC, UV stable, to [CAN/CGSB-19.24](#).
- .14 Type S-14: Polysulfide two part:
 - .1 Self-levelling to [CAN/CGSB-19.24](#), Type 1, Class B.
 - .2 Non-sag: to [CAN/CGSB-19.24](#), Type 2, Class B.
- .15 Type S-15: Polysulfide one part:
 - .1 Self-levelling: to GRADE P, Class 35. Use MC-1-40-B-N.

.2 Non-sag: Grade NS, Class 35use M, A.

2.5 SEALANT SELECTION

- .1 Where no specific type of sealant is scheduled, provide one of the sealants indicated in this Section appropriate for its application and consistent with manufacturer's recommendations and the recommendations of SWRI, Sealants: The Professionals' Guide.
- .2 Make sealant selections consistent with manufacturer's recommendations.
- .3 Use acrylic sealant Type S-1 only on the interior and only in situations where little or no movement can occur.
- .4 Use mould & mildew resistant silicone sealant Type S-2 for nonmoving joints in washrooms and kitchens. Do not use on floors.
- .5 Use silicone general construction sealant Type S-3 or Type S-6 and S-7 for all joints, interior and exterior, where no other specific sealant type specified.
- .6 Use structural glazing silicone Type S-4 for sealing glass, interior and exterior.
- .7 Use acoustical sealant Type S-5 and air seal sealant Type S-3 only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.
- .8 Use multi component sealant type S-6, primed penetration element surfaces other than concrete, for mechanical and electrical service penetrations in concrete foundation walls.
- .9 Use multi component sealant Type S-8 for horizontal joint sealant of plaza, floors and decks, exterior areas only, subject to pedestrian and vehicular traffic.
- .10 Use polyurethane, semi-self levelling sealant Type S-9 for in expansion joints in sidewalks, plazas, floors and other pedestrian and vehicular horizontal surfaces with slopes up to 6%.
- .11 Use control joint sealant S-10 as filler for interior, horizontal saw cut or preformed control joints where joints are subject to load bearing conditions.
- .12 Use control joint sealant S-10 as filler for interior only, horizontal saw cut or preformed control joints where joints are subject to load bearing conditions.
- .13 Use control joint sealant S-11 as filler for interior, horizontal saw cut or preformed control joints, where joints are subject to low temperatures (freezer floors) and where joints require nosing support.
- .14 Use control joint sealant S-12 as filler for interior, horizontal saw cut or preformed control joints where joints are subject to thermal shock conditions, traffic loops, and where a high bond strength is required.
- .15 Use sealant S-13 for sealing exterior holes and penetrations around pipes and other services passing through concrete foundations and requiring greater movement capability.

2.6 ACCESSORIES

- .1 Preformed compressible and non-compressible back-up materials that are non-staining, compatible with joint substrate, sealants, primers, and other joint fillers, and are approved

for applications indicated by sealant manufacturer based on site experience and laboratory testing:

- .1 Rod Type Sealant Backings:
 - .1 [ASTM C1330](#), Type C (closed cell material with a surface skin), Type O (open cell material) or Type B (bi cellular material with a surface skin).
 - .2 Provide any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.
 - .3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - .4 Non adhering to sealant, to maintain two sided adhesion across joint.
- .2 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.
 - .3 Elastomeric Tubing Joint Fillers: Neoprene, butyl, EPDM, or silicone tubing complying with [ASTM D1056](#), non absorbent to water and gas, capable of remaining resilient at temperatures down to 15 deg C. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth and otherwise contribute to optimum sealant performance.
- .4 Bond Breaker Tape:
 - .1 Polyethylene bond breaker tape or other tape recommended by sealant manufacturer which will not bond to sealant.
- .2 Preformed Sealants:
 - .1 Preformed Silicone Sealant System: Manufacturer's standard system consisting of pre-cured low modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral curing silicone sealant for bonding extrusions to substrates.
 - .2 Preformed Hollow Neoprene Gasket: Manufacturer's standard preformed polychloroprene elastomeric joint seal of the open cell compression type complying with [ASTM D2628](#) and with requirements for size, profile and cross sectional design.
- .3 Bond Breaker: Pressure-sensitive plastic tape that will not bond to sealants.
- .4 Joint Cleaner: Provide a non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's recommendations
- .5 Primer: Provide in accordance with sealant manufacturer's recommendations.
- .6 Masking Tape: Non-absorbent type, non-staining, compatible with joint sealant and joint substrates.

2.7 COLOURS

- .1 Sealant Colours: Match colour of adjacent materials where visible, as selected by DCC Representative, from manufacturer's standard colour range.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for joint sealants installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate.
 - .2 Verify joint surfaces are dry and frost free.
 - .3 Verify substrates are without contaminants capable of interfering with sealant adhesion. Remove contaminants where occurring.
 - .4 Examine joint sizes and conditions to establish acceptable depth to width ratio for installation of backup materials and application of sealants.
 - .5 Verify joint widths are within the limits recommended by joint sealant manufacturer for applications indicated.
 - .6 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .7 Proceed with installation only after unacceptable conditions have been remedied.

3.2 SURFACE PREPARATION

- .1 Clean bonding joint surfaces of harmful contaminants including dust, rust, oil grease, and other matter which may impair adhesion.
- .2 Do not apply sealants to joint substrates treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .3 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

- .1 Mask adjacent surfaces prior to priming and sealing where necessary to prevent staining.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately applying sealant, except when manufacturer's instructions explicitly state priming is not required.
- .3 Prime all porous material (e.g. wood, masonry, concrete, ceramic or paver tile, etc).

3.4 BACKUP MATERIAL

- .1 Provide backer rod as specified, to limit depth of sealant and to act as bond breaker at back of joint.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.
- .3 Apply paper masking tape to back of joint to act as bond break where depth of joint does not permit the use of backer rod.

- .4 Ensure that no joints are formed which are bonded on adjacent sides where there is any possibility of movement.

3.5 MIXING

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

3.6 APPLICATION

- .1 Sealant: Application: Apply sealants to recommendations of [ASTM C1193](#), [ASTM C1481](#), and in accordance with manufacturer's instructions, and as follows:
 - .1 Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature range.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
 - .3 For joints where movement is possible, apply backer rod to achieve a joint depth of one half the joint width but not less than 9 mm; for joints larger than 25 mm use a depth of 13 mm
 - .4 Apply sealant in a continuous beads.
 - .5 Apply sealant using gun with proper size nozzle.
 - .6 Fill voids and joints solid.
 - .7 Form sealant surface with a smooth full bead, without from ridges, wrinkles, sags, air pockets, embedded impurities.
 - .8 Tool exposed surfaces before skinning begins to give slightly concave shape.
 - .9 Ensure bead is solid, filling entire space between sides and bedding material, exerting sufficient pressure to obtain maximum bond, by allowing sealant to bulge out in advance of nozzle.
 - .10 Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature range.
 - .11 Seal at all locations where dissimilar material meet.
- .2 Sealant Curing:
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until after curing has completed.

3.7 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Clean adjacent surfaces immediately of excess primers and sealants.
 - .2 Remove excess and droppings, using recommended cleaners as work progresses.
 - .3 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: Perform in accordance with Section 01 74 11 - Cleaning upon completion.

- .3 Waste Management: Perform in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Do not dispose of unused sealant materials into sewer system, streams, lakes, onto ground, or other location where it might pose a health or environmental hazard.
 - .2 Divert unused sealants from landfill to a hazardous material collection site.
 - .3 Place materials defined as hazardous or toxic in designated containers.
 - .4 Dispose of hazardous materials in accordance with the CEPA, TDGA, regional and municipal regulations.

3.8 PROTECTION

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

3.9 SCHEDULE

- .1 Use acrylic sealant Type S-1 only on the interior and only where little or no movement can occur.
- .2 Use mould and mildew-resistant silicone sealant Type S-2 for non-moving joints in washrooms and kitchens. Do not use on floors.
- .3 Use silicone general construction sealant Type S-3 or Type S-6 and S-7 for all joints, interior and exterior, where no other specific sealant type is specified.
- .4 Use structural glazing silicone Type S-4 for sealing structural glass and sealing butt-to-glazing joints, interior and exterior.
- .5 Use acoustical sealant Type S-5 only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.
- .6 Use multicomponent sealant type S-6, primed penetration element surfaces other than concrete, for mechanical and electrical service penetrations in concrete foundation walls.
- .7 Use multicomponent sealant type S-6, at perimeters of exterior openings where frames meet exterior facade of building (e.g., brick, block, precast masonry).
- .8 Use multicomponent sealant Type S-8 for horizontal joint sealant of plaza, floors and decks, exterior areas only, subject to pedestrian and vehicular traffic.
- .9 Use sealant Type S-8 for exterior joints in horizontal wearing surfaces.
- .10 Use polyurethane, semi-self-levelling sealant Type S-9 for in expansion joints in sidewalks, plazas, floors and other pedestrian and vehicular horizontal surfaces with slopes up to 6%.
- .11 Use control joint sealant S-10 as filler for interior, horizontal saw cut or preformed control joints where joints are subject to load bearing conditions.
- .12 Use control joint sealant S-11 as filler for interior, horizontal saw cut or preformed control joints, where joints are subject to low temperatures (freezer room floors) and where joints require nosing support.

- .13 Use control joint sealant S-12 as filler for interior, horizontal saw cut, or preformed control joints where joints are subject to thermal shock conditions, traffic loops, and where a high bond strength is required.
- .14 Use sealant S-13 for exterior holes and penetrations around pipes and other services passing through concrete foundations and requiring greater movement capability.
- .15 Use sealant S-16 in pavement wherever fuel oils may be present
- .16 In addition, provide joint sealants at the following conditions:
- .17 Seal perimeters of hollow metal door frames on both sides.
- .18 Seal control joints in gypsum board , except where prefabricated control joints are specified.
- .19 Seal junctures between interior partitions with exterior walls.
- .20 Seal window and door frames around the inside perimeter, so that an airtight seal is obtained , as indicated on Drawings.
- .21 Seal joints in floors and walls and around service and mechanical and electrical fixture penetrations.
- .22 Perimeter of bath fixtures (e.g., sinks, tubs, urinals, water closets, basins, vanities).
- .23 Expansion and control joints in exterior surfaces of poured-in-place concrete walls.
- .24 Expansion and control joints in exterior surfaces of precast architectural wall panels.
- .25 Movement, control and expansion joints in exterior surfaces of unit masonry walls.
- .26 Coping joints and coping-to facade joints.
- .27 Cornice and wash (or horizontal surface joints).
- .28 Seal interior perimeters of exterior openings as detailed on Drawings.
- .29 Control and expansion joints on the interior of exterior cast-in place concrete walls.
- .30 Expansion and control joints on the interior of exterior precast, architectural wall panels.
- .31 Joints of underside of precast beams or planks.
- .32 Movement, control and expansion joints on the interior of exterior surfaces of unit masonry walls.
- .33 Interior control and expansion joints in floor surfaces.
- .34 Perimeters of interior frames , as detailed.
- .35 Movement, control and expansion joints in exterior surfaces of unit masonry walls.
- .36 Joints at tops of non-load bearing masonry walls at the underside of poured concrete.
- .37 Exposed interior control joints in gypsum board.
- .38 Seal at all locations where dissimilar material meet.
- .39 Refer to Section 07 84 00 - Fire Stopping for additional requirements.

END OF SECTION

Section 23 05 00 Common Work Results for HVAC

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

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

- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to 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.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 DCC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 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 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.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section Section 01 78 00 - Closeout Submittals.
- .2 Supply one set of special tools required to service equipment as recommended by manufacturers.

Part 2 Products - Not Used

Part 3 Execution

3.1 PAINTING, REPAIRS AND RESTORATION

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

3.2 SYSTEM CLEANING

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

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Management System and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

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

3.5 DEMONSTRATION

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

3.6 PROTECTION

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

END OF SECTION

Section 23 05 13

Common Motor Requirements for HVAC Equipment

Part 1 General

1.1 SUMMARY

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

1.2 RELATED REQUIREMENTS

- .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 70 12 - Safety Requirements.
- .5 Section 01 74 11 - Cleaning.
- .6 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7 Section 01 78 00 - Closeout Submittals.

1.3 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 [ASHRAE 90.1-19](#), Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI approved; IES co-sponsored)
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

- .1 Submittals in accordance with Section Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria and limitations.

- .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 333 00 - Submittal Procedures.
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Management System.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEEA, TDGA, and applicable Provincial/Territorial Regulations..
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 70 12 - Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management.

Part 2 Products

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local electric company standards and to [ASHRAE 90.1](#).

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified. Motors to be suitable for variable speed operation, where required.
- .2 Motors under 373 W: 12 HP speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.
- .3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 575 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

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

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 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.

2.5 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 diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.3 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

Section 23 05 15

Common Installation Requirements for HVAC Pipework

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 07 84 00 - Fire Stopping
- .5 Section 23 05 00 - Common Work Results for Mechanical.
- .6 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCE STANDARDS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 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.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products - Not Used

Part 3 Execution

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspections, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.4 DRAINS

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

3.5 AIR VENTS

- .1 Install automatic air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible. Glycol drainage piping shall not terminate at a floor drain.
- .4 Install manual air vents rated for glycol service, at high points in glycol systems.

3.6 DIELECTRIC COUPLINGS

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

3.7 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .6 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

- .7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .8 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .9 Group piping wherever possible and as indicated.
- .10 Ream pipes, remove scale and other foreign material before assembly.
- .11 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .12 Provide for thermal expansion as indicated.
- .13 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use ball valves at branch take-offs for isolating purposes except where specified.
 - .7 Install ball valves for glycol service.
 - .8 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

3.8 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for fire stopping.
 - .2 Maintain the fire-resistance rating integrity of the fire separation.

- .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
- .4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
 - .1 Chrome or nickel plated brass or type 302 stainless steel..
- .3 Sizes: outside diameter to cover opening or sleeve.
 - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .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 firestopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise DCC Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of Division 23.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of DCC Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. DCC Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by DCC Representative.

3.12 CLEANING

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

END OF SECTION

Section 23 05 23.01 Valves - Bronze

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 78 00 - Closeout Procedures.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 [ANSI/ASME B1.20.1-2013\(R2018\)](#), Pipe Threads, General Purpose (Inch).
 - .2 [ANSI/ASME B16.18-2018](#), Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International (ASTM)
 - .1 [ASTM A276-17](#), Standard Specification for Stainless Steel Bars and Shapes.
 - .2 [ASTM B62-17](#), Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 [ASTM B283-20](#), Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 [ASTM B505/B505M-18](#), Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS-SP-25-2018, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2019, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-2010, 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.
- .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.

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:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 [ANSI/ASME B1.20.1](#)
 - .2 Copper tube systems: to [ANSI/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 or lockshield handles as indicated..
- .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed or union bonnet.
 - .2 Operator: handwheel.
- .7 NPS 2 1/2 and over, flanged:
 - .1 Rising stem: to ANSI/MSS SP-80, Class 125, 860 kPA, bronze body, screw-in bonnet, solid wedge disc.
- .8 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
- .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 disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to [ASTM B505](#)
 - .3 Operator: handheld or lockshield handles as indicated..
- .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to [ASTM B505](#)
 - .3 Operator: handwheel or lockshield handles as indicated..
- .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 disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
 - .3 Operator: handwheel or lockshield handles as indicated..
- .6 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
- .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 no. 6 composition 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 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
- .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 [ANSI B1.20.1](#) and with hex. shoulders
 - .4 Disc and seat: renewable rotating disc.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.
 - .2 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
- .8 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to [ASTM B62](#)
 - .2 Pressure rating:
 - .1 Class 150, 1034 kPa steam.
 - .2 Class 600, 4136 kPa WOG.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders, solder ends to ANSI..
 - .4 Full bore, two piece body, blow-out proof.

- .5 Stem: tamperproof ball drive.
- .6 Stem packing nut: external to body.
- .7 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
- .8 Stem seal: TFE with external packing nut.
- .9 Operator: removable lever handle. Stem extensions required for insulated systems.
- .2 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.

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 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Section 23 05 29

Hangers and Supports for HVAC Piping and Equipment

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 05 12 23 - Structural Steel for Buildings
- .3 Section 05 50 00 - Metal Fabrications
- .4 Section 23 05 48 - Vibration Control for HVAC Piping and Equipment

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 [ASME B31.1-2020](#), Power Piping.
- .2 ASTM International (ASTM)
 - .1 [ASTM A125-1996\(2018\)](#), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 [ASTM A307-21](#), Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 [ASTM A563-15](#), Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Canadian Standards Association(CSA International)
 - .1 [CSA G40.20-13/G40.21-13\(R2018\)](#), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 [CAN/CSA G164-18](#), Hot-Dip Galvanizing of Irregularly Shaped Articles.
 - .3 [CAN/CSA W59-18](#), Welded Steel Construction.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 [MSS SP58-2018](#), Pipe Hangers and Supports - Materials, Design and Manufacture.
- .5 Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing 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 and 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.
- .2 Performance Requirements:
 - .1 Design supports, platforms, catwalks, hangers, to withstand events as specified in Section 23 05 48 - Vibration Control for HVAC Piping and Equipment.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
 - .3 Quality assurance submittals: submit the 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 DCC Representative will make available 1 copy of systems supplier's installation instructions.
 - .4 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Packaging Waste Management: remove for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with [MSS SP58](#), [ANSI B31.1](#) and

- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Ensure steel hangers in contact with copper piping are copper piping are copper plated..
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip..
 - .1 Rod: 9mm UL listed, 13 mm FM approved for sprinkler systems..
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, [MSS-SP58](#).
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, M.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.
- .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 to MSS SP-58.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies
 - .2 Steel brackets.
 - .3 Sway braces for seismic restraint systems: to Section 23 05 48 - Vibration Control for HVAC Piping and Equipment.
- .6 Hanger rods: threaded rod material to [MSS SP58](#):
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to [MSS SP58](#):
 - .1 Attachments for steel piping: carbon steel black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.

- .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP-58 clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-58.
- .10 U-bolts: carbon steel to MSS SP-58 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-58.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: black carbon steel to [MSS SP58](#), type 42.
- .2 Copper pipe: carbon steel copper plated to [MSS SP58](#), type 42
- .3 Bolts: to [ASTM A307](#)
- .4 Nuts: to [ASTM A563](#)

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP58, galvanized sheet carbon steel. Length designed for maximum 3 m span
- .2 Insulated hot piping:
 - .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-58.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to [ASTM A125](#), 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.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps and as indicated.
- .3 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.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Support from structural members. Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 HANGER SPACING

- .1 Plumbing piping: to most stringent requirements of National Plumbing Code of Canada, Provincial Code or authority having jurisdiction..
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .4 Within 300 mm of each elbow.
 - .1

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m

5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

.5 Pipework greater than NPS 12: to [MSS SP69](#)

3.4 HANGER INSTALLATION

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

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

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

END OF SECTION

Section 23 05 48

Vibration and Seismic Controls for HVAC

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Vibration isolation materials and components, seismic control measures and their installation.
- .2 Related Requirements
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 61 00 - Common Product Requirements.
 - .3 Section 01 74 11 - Cleaning.
 - .4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS)
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .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.
 - .1 DCC Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm 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 Cadmium plate for outdoor 100% relative humidity installations.
- .4 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 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

- .3 Type M3 - stable open spring: 6 mm 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 6 mm 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.
- .6 Performance: as indicated.

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.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.
- .6 Performance: as indicated.

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.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to 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 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to DCC Representative within 3 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.
 - .2 Provide DCC Representative with notice 24 hours in advance of commencement of tests.
 - .3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
 - .4 Submit complete report of test results including sound curves.

3.4 CLEANING

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

END OF SECTION

Section 23 05 93

Testing, Adjusting and Balancing for HVAC

Part 1 General

1.1 SUMMARY

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

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to DCC Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, 7th Edition (2016).
 - .2 National Environmental Balancing Bureau (NEBB) Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2015, 8th Edition.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

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

1.4 EXCEPTIONS

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

1.5 COORDINATION

- .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 confirm in writing to DCC Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to DCC Representative in writing proposed procedures which vary from standard.
- .3 During construction, coordinate 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 22 and 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 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, and caulking.
- .3 Pressure, leakage, other tests specified elsewhere Division 23.
- .4 Provisions for TAB installed and operational.

- .5 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Isolating and balancing valves installed, open.
 - .3 Calibrated balancing valves installed, at factory settings.
 - .4 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 Hydronic systems: plus or minus 5%.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to DCC Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to DCC Representative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit, prior to commencement of TAB:
 - .1 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 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.

- .2 Submit 6 copies of TAB Report to DCC Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

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

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 COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by DCC Representative.

1.19 AIR SYSTEMS

- .1 Standard: TAB to be most stringent of this section or TAB standards of AABC or NEBB.
- .2 Do TAB of systems, equipment, components, controls specified in Divisions 22 and 23.
- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified by AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 HYDRONIC SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, or ASHRAE.

- .2 Do TAB of systems, equipment, components, controls specified Division 23.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by standards of AABC or NEBB.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: flow rate, pressure drop (or loss), pipe size.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of all calibrated balancing valves, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.

1.21 OTHER SYSTEMS

- .1 Plumbing Systems:
 - .1 Flush valves: adjust to suit project pressure conditions.
 - .2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.
 - .3 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.
- .2 Refrigeration systems forming part of HVAC systems.
- .3 Wet pipe sprinkler in accordance with authority having jurisdiction and ANSI/NFPA 13-2002.

1.22 OTHER TAB REQUIREMENTS

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

1.23 POST OCCUPANCY TAB

- .1 Measure DBT, WBT, air velocity, air flow patterns, NC levels in occupied areas as designated by the DCC Representative.
- .2 Participate in systems checks twice during warranty period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of warranty period.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

2023-02-17

Section 23 05 93
Testing, Adjusting and Balancing for HVAC

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END OF SECTION

Section 23 05 94 Pressure Testing of Ducted Air Systems

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 SMACNA 016-2012, HVAC Air Duct Leakage Test Manual, 2nd edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 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.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety 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 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3% 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.
- .4 Test instruments: calibrated and certificate of calibration deposited with DCC Representative no more than 28 days before start of tests.
- .5 Re-calibrated every six months thereafter.

2.2 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components such as VAV boxes, duct heating leakage: 10%.

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 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:

- .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2%.
 - .2 VAV box and duct on downstream side of VAV box: leakage 2%.
 - .3 Large low pressure duct systems up to 500 Pa: leakage 2%.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 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 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services.
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.

- .4 Obtain reports, within 3 days of review, and submit, immediately, to DCC Representative.
- .2 Performance Verification:
 - .1 DCC Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved by DCC Representative to undertake TAB on this project.

3.6 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Section 23 07 13 Thermal Insulation for Ducting

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings
- .2 ASTM International (ASTM):
 - .1 [ASTM B209M-07](#), Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
 - .2 [ASTM C335-05ae1](#), Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation
 - .3 [ASTM C411-05](#), Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
 - .4 [ASTM C449/C449M-07](#), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .5 [ASTM C547-07](#), Standard Specification for Mineral Fiber Pipe Insulation
 - .6 [ASTM C553-02](#), Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
 - .7 [ASTM C612-04](#), Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - .8 [ASTM C795-03](#), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
 - .9 [ASTM C921-03a](#), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
- .3 Canadian General Standards Board (CGSB):
 - .1 [CGSB 51-GP-52Ma-89](#), Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005):
- .5 ULC Standards (ULC):
 - .1 [CAN/ULC-S102-03](#), Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

- .2 [CAN/ULC-S701-05](#), Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
- .3 CAN/ULC-S702.1997, Thermal Insulation for Mineral Fibre for Buildings.
- .4 CAN/ULC S702.2-03, Thermal Insulation for Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

1.3 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 provided the mechanical service is not visible from floor level.
 - .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.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 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.

1.5 MANUFACTURER'S 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.

1.6 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least documented years successful experience in this size and type of project.

1.7 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.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste Management and Disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Mangement and Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 To [CAN/ULC-S102](#):
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with [ASTM C335](#)
- .3 TIAC Code C-1: Rigid mineral fibre board to [ASTM C612](#), with or without factory applied vapour retarder jacket to [CGSB 51-GP-52 Ma](#) (as scheduled in PART 3 of this Section)
- .4 TIAC Code C-2: Mineral fibre blanket to [ASTM C553](#) faced with or without factory applied vapour retarder jacket to [CGSB 51-GP-52 Ma](#) (as scheduled in PART 3 of this section)
 - .1 Mineral fibre: to [ASTM C553](#)
 - .2 Jacket: to [CGSB 51-GP-52 Ma](#)
 - .3 Maximum "k" factor: to [ASTM C553](#)

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to [ASTM C921](#)
- .2 Lagging adhesive: compatible with insulation.
- .3 Aluminum:
 - .1 To [ASTM B209](#) with and without moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed.
 - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to [ASTM C449](#)
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to [ASTM C921](#).

- .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, plain, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .11 Fasteners: 4 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PREINSTALLATION REQUIREMENTS

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

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: at 300 mm oc in horizontal and vertical directions, minimum two rows each side.
- .7 Blank off sections of louvres to be insulated with 100 mm thick insulation sandwiched between 2 galvanized sheets of metal.

3.3 DUCTWORK INSULATION SCHEDULE

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

TIAC Code	Vapour Retarder	Thickness (mm)	
Rectangular cold and dual temperature supply air ducts	[C-1]	[yes]	[25]

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Round cold and dual temperature supply air ducts	[C-2]	[yes]	[25]
Supply and return exposed in space being served	[C-1]	[yes]	none (unless indicated on drawing)
Fresh air ducts	[C-1]	[yes]	[50]
Mixing plenums or space being served	[C-1]	[yes]	[50]
Exhaust duct to 3000 mm from discharge location between dampers and louvres	[C-1]	[no]	[50]
Acoustically lined ducts	[none]		

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct

.1 Finishes: conform to following table:

.1

	TIAC CodeRectangular	TIAC CodeRound
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.4 PLENUMS AND PLENUM BOXES

.1 Plenums and plenum boxes to be insulated as if considered in the system they service.

END OF SECTION

Section 23 07 19 HVAC Piping Insulation

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 07 92 00 - Joint Sealants
- .3 Section 23 05 15 - HVAC Piping
- .4 Section 23 05 29 - Hangers and Supports
- .5 Section 23 21 13.01 - Hydronic Systems: Copper
- .6 Section 23 21 13.01 - Hydronic Systems: Steel

1.3 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ASHRAE Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard)
- .2 ASTM International (ASTM):
 - .1 [ASTM B209M-14](#), Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric
 - .2 [ASTM C195-07\(2019\)](#), Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .3 [ASTM C335-17](#), Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation
 - .4 [ASTM C411-19](#), Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
 - .5 [ASTM C449/C449M-07\(2019\)](#), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .6 [ASTM C533-2017](#), Calcium Silicate Block and Pipe Thermal Insulation
 - .7 [ASTM C547-2019](#), Mineral Fiber Pipe Insulation
 - .8 [ASTM C795-08\(2018\)](#), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
 - .9 [ASTM C921-10\(2015\)](#), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

- .3 Manufacturer's Trade Associations:
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004)
- .4 ULC Standards (ULC):
 - .1 [CAN/ULC-S102-18](#), Surface Burning Characteristics of Building Materials and Assemblies
 - .2 [CAN/ULC-S702-1:2014-AMD1](#), Thermal Insulation, Mineral Fibre, for Buildings
 - .3 [CAN/ULC-S702.2-15](#), Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines

1.4 DEFINITIONS

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

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 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.

1.6 QUALITY ASSURANCE

- .1 Qualifications:

.1 Contractor: company specializing in performing the work of this section, with documented years of experience of projects of a similar nature and value as this tender. Proof to be verified after contract award.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 70 12 - Safety Requirements.

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.

.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.

.3 Waste Management and Disposal:

.1 Place excess or unused insulation and insulation accessory materials in designated containers.

.2 Dispose of unused adhesive material at official hazardous material collections site approved by DCC Representative.

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°C mean temperature when tested in accordance with [ASTM C335](#).

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to [ASTM C547](#).

.2 Maximum "k" factor: to [CAN/ULC-S702](#).

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

- .1 Mineral fibre: to [ASTM C547](#).
- .2 Jacket: to [CGSB 51-GP-52 Ma](#).
- .3 Maximum "k" factor: to [ASTM C547](#).
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to [ASTM C547](#).
 - .2 Jacket: to [CGSB 51-GP-52 Ma](#).
 - .3 Maximum "k" factor: to [ASTM C547](#).
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: to ASTM C534 with vapour retarder jacket.
 - .2 Jacket: to [CGSB 51-GP-52 Ma](#).
 - .3 Maximum "k" factor: ASTM C534.
 - .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 C533](#).
 - .2 Maximum "k" factor: to ASTM C533.
 - .3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

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

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

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

2.7 JACKETS

- .1 Polyvinyl Chloride (PVC): (exposed areas).

- .1 One-piece moulded type and sheet to [CAN/CGSB-51.53](#) with pre-formed shapes as required.
- .2 Colours: to match adjacent finish paint by DCC Representative.
- .3 Minimum service temperatures: -20°C.
- .4 Maximum service temperature: 65°C.
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Thickness: 0.38 mm.
- .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.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENT

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

3.2 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.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment..
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.4 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.

3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Insulation securements: SS wire.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements: Tape at 300 mm oc.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2.
 - .1 Insulation securements: SS bands.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

.1

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run Out	to 1	1 1/4 - 2	2 1/2 - 4	5 - 6	8 & over

Hot Water Heating	60 - 94	[A-1]	25	38	38	38	38	38
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.8 Finishes:

- .1 Exposed indoors: [PVC] jacket.
- .2 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .3 Outdoors: water-proof aluminum jacket.
- .4 Finish attachments: SS screws bands, at 150 mm on centre. Seals: wing closed.
- .5 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.6 CLEANING

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

END OF SECTION

Section 23 11 23 Facility Natural Gas Piping

Part 1 General

1.1 SUMMARY

- .1 Section Includes: materials and installation for piping, valves and fittings for gas fired equipment.
- .2 Sustainable requirements for construction and verification.

1.2 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 45 00 - Quality Control
- .3 Section 01 74 11 - Cleaning
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .5 Section 01 78 00 - Closeout Submittals
- .6 Section 23 05 05 - Installation of Pipework
- .7 Section 23 08 16 - Cleaning and Start-up of Mechanical Piping Systems

1.3 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings
 - .2 [ASME B16.18-2001\(R2005\)](#), Cast Copper Alloy Solder Joint Pressure Fittings
 - .3 [ASME B16.22-2001\(R2005\)](#), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - .4 [ASME B18.2.1-1996\(R2005\)](#), Square and Hex Bolts and Screws Inch Series
- .2 ASTM International (ASTM):
 - .1 [ASTM A47/A47M-99\(2018\)e1](#), Standard Specification for Ferritic Malleable Iron Castings
 - .2 [ASTM A53/A53M-20](#), Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
 - .3 [ASTM B75M-20](#), Standard Specification for Seamless Copper Tube Metric
 - .4 [ASTM B837-19](#), Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems
- .3 CSA Group (CSA):
 - .1 [CSA W47.1:19](#), Certification of Companies for Fusion Welding of Steel
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CSA B149.1 HB-05, Natural Gas and Propane Installation Code Handbook.

- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Indicate on manufacturers catalogue literature following: valves.
 - .3 Submit WHMIS SDS in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's for adhesive and solvents during application and curing.
- .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.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to [ASTM A53/A53M](#), Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS2 1/2 and over, plain end.
- .2 Copper tube: to [ASTM B837](#)

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.

- .2 Welded fittings: to [CSA W47.1](#)
- .3 Flange gaskets: non-metallic flat.
- .4 Brazing: to [ASTM B837](#).

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to [ASME B16.5](#)
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to [ASTM A47/A47M](#)
 - .5 Bolts and nuts: to [ASME B18.2.1](#)
 - .6 Nipples: schedule 40, to [ASTM A53/A53M](#)
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to [ASME B16.18](#)
 - .2 Wrought copper fittings: to [ASME B16.22](#)

2.4 VALVES

- .1 Provincial Code approved, lubricated plug ball type.

2.5 FLEXIBLE CONNECTIONS

- .1 Provincial Code approved, minimum length 1m.

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 PIPING

- .1 Install in accordance with Section 23 05 05 - Installation of Pipework, [CAN/CSA B149.1](#) and [CAN/CSA B149.2](#), supplemented as specified.
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by DCC Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FLEXIBLE CONNECTIONS

- .1 Install flexible connections at each portable (movable) appliance.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Test system in accordance with [CAN/CSA B149.1](#) and [CAN/CSA B149.2](#) and requirements of authorities having jurisdiction.
- .2 Test performance of components.

3.6 ADJUSTING

- .1 Purging: purge after pressure test in accordance with [CAN/CSA B149.1](#) and [CAN/CSA B149.2](#).
- .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.

3.7 CLEANING

- .1 Cleaning: in accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems [CAN/CSA B149.1](#) and [CAN/CSA B149.2](#), supplemented as specified.
- .2 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.
- .3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Section 23 21 13.01 Hydronic Systems: Copper

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 23 05 00 - Common Work Results for HVAC
- .3 Section 23 05 15 - Common Installation Requirements for HVAC Pipework
- .4 Section 23 07 19 - HVAC Piping Insulation
- .5 Section 23 05 23.01 - Valves - Bronze
- .6 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- .7 Section 23 21 16 - Hydronic Specialties
- .8 Section 23 21 13.02 - Hydronic Systems: Steel

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS):
 - .1 [ANSI/AWS A5.8/A5.8M-19](#), AMD1 Specification Filler Metals for Brazing and Braze Welding
- .2 American Society of Mechanical Engineers (ASME):
 - .1 [ANSI/ASME B16.4-16](#), Gray-Iron Threaded Fittings Classes 125 and 250
 - .2 [ANSI/ASME B16.15-18](#), Cast Copper Alloy Threaded Fittings Classes 125 and 250
 - .3 [ANSI B16.18-18](#), Cast Copper Alloy, Solder Joint Pressure Fittings
 - .4 [ANSI/ASME B16.22-18](#), Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings
- .3 ASTM International (ASTM):
 - .1 [ASTM B32-20](#), Standard Specification for Solder Metal
 - .2 [ASTM B61-15](#), Standard Specification for Steam or Valve Bronze Castings
 - .3 [ASTM B62-17](#), Standard Specification for Composition Bronze or Ounce Metal Castings
 - .4 [ASTM B88M-20](#), Standard Specification for Seamless Copper Water Tube Metric
 - .5 [ASTM E202-18](#), 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 SP67-2017](#), Butterfly Valves
- .2 MSS SP-70-2011, Gray Iron Gate Valves, Flanged and Threaded Ends
- .3 [MSS SP71-2018](#), Grey Iron Swing Check Valves, Flanged and Threaded Ends
- .4 [MSS SP80-2019](#), 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 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.
- .3 Shop Drawings:
 - .1 Indicate on manufacturers catalogue literature the following: valves, components and accessories.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
 - .1 Include special servicing requirements.

1.5 EXTRA STOCK MATERIALS

- .1 Supply spare parts as follows:
 - .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
 - .2 Discs: 1 minimum for every ten valves each size. Minimum one.
 - .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
 - .4 Valve handles: 2 minimum of each size.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 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 in dry location 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.

Part 2 Products

2.1 TUBING

- .1 Type K 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 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 Globe valves: application: throttling, 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.
 - .4 Drain valves: gate, Class [125] , non-rising stem, solid wedge disc, as specified Section [23 05 23.01 - Valves - Bronze].
 - .5 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

- .6 Circuit Balance Valves (CBV)
 - .1 General:
 - .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports connected to differential pressure.
 - .2 Accuracy:
 - .1 Readout to be within plus or minus 2% of actual flow at design flow rate.
 - .3 Pressure die-cast dezincification resistant copper alloy construction, 1.7 MPa, 121C, screwed ends, EPDM "O" ring seal, screw-in bonnet.
 - .1 Flow control: at least four (4) full turns of handwheel with digital handwheel and tamperproof concealed mechanical memory.
 - .4 Insulation:
 - .1 Use prefabricated shipping packaging of 5.3 R polyurethane as insulation.
 - .5 Drain connection:
 - .1 NPS 3/4 valved and capped, suitable for hose socket.
 - .6 Acceptable manufacturers: Armstrong CBV, Tour & Anderson STA, Victaulic.

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 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

3.3 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

- .3 Install globe valves for balancing and in by-pass around control valves as indicated.
- .4 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .5 Install ball valves for glycol service.

3.4 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Install in accordance with manufacturer's written instructions.

3.5 FLUSHING AND CLEANING FILLING OF SYSTEM

- .1 Flush and clean in presence of DCC Representative.

3.6 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment/glycol as specified.

3.7 FIELD 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 propylene 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.
 - .2 Refer to Section 01 45 00 - Quality Management System for applicable procedures.

3.8 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.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work area clean at end of each day.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.10 PROTECTION

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

END OF SECTION

Section 23 21 13.02 Hydronic Systems: Steel

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 23 05 00 - Common Work Results for HVAC
- .3 Section 23 05 15 - Common Installation Requirements for HVAC Pipework
- .4 Section 23 05 23.01 - Valves - Bronze
- .5 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- .6 Section 23 21 16 - Hydronic Specialties
- .7 Section 23 21 13.01 - Hydronic Systems: Copper

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - .1 [ANSI/AWWA C111/A21.11-17](#), Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- .2 American Society of Mechanical Engineers (ASME):
 - .1 [ASME B16.1-20](#), Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - .2 [ASME B16.3-16](#), Malleable Iron Threaded Fittings: Classes 150 and 300
 - .3 [ASME B16.5-20](#), Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
 - .4 [ASME B16.9-18](#), Factory-Made Wrought Buttwelding Fittings
 - .5 [ASME B18.2.1-12](#), Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series)
- .3 ASTM International (ASTM):
 - .1 [ASTM A47/A47M-99\(2018\)e1](#), Standard Specification for Ferritic Malleable Iron Castings
 - .2 [ASTM A53/A53M-20](#), Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
 - .3 [ASTM A536-84\(2019\)e1](#), Standard Specification for Ductile Iron Castings
 - .4 [ASTM B61-15](#), Standard Specification for Steam or Valve Bronze Castings
 - .5 [ASTM B62-17](#), Standard Specification for Composition Bronze or Ounce Metal Castings
 - .6 [ASTM E202-18](#), Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols

- .4 CSA Group (CSA):
 - .1 [CSA B242-05\(R2021\)](#), Groove and Shoulder Type Mechanical Pipe Couplings
 - .2 [CSA W48-18](#), Filler Metals and Allied Materials for Metal Arc Welding
 - .3 [CSA W47.1-19](#), Certification of Companies for Fusion Welding of Steel
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS):
 - .1 [MSS-SP-67-2017](#), Butterfly Valves
 - .2 [MSS-SP-70-2011](#), Grey Iron Gate Valves, Flanged and Threaded Ends
 - .3 [MSS-SP-71-2018](#), Grey Iron Swing Check Valves Flanged and Threaded Ends
 - .4 [MSS-SP-80-2019](#), Bronze Gate, Globe, Angle and Check Valves
 - .5 [MSS-SP-85-2011](#), Grey Iron Globe and Angle Valves, Flanged and Threaded Ends

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 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.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Components and accessories.
- .4 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:
 - .1 Special servicing requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
 - .1 Include special servicing requirements.

1.5 EXTRA STOCK MATERIALS

- .1 Supply spare parts as follows:
 - .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
 - .2 Discs: 1 minimum for every ten valves, each size. Minimum one.
 - .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
 - .4 Valve handles: 2 minimum of each size.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 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 in dry location 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.

1.7 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 70 12 - Safety Requirements.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to [ASTM A53/A53M](#), Grade B, as follows:
 - .1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape.
- .2 NPS 2-1/2 and over: welding fittings and flanges to [CSA W48](#).
- .3 Roll grooved: rigid coupling to [CSA B242](#)
- .4 Flanges: weld neck to , [ANSI/AWWA C111/ A21.11](#).
- .5 Orifice flanges: slip-on raised face, 2100 kPa.
- .6 Flange gaskets: to [ANSI/AWWA C111/ A21.11](#).
- .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.

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](#)
- .4 Unions: malleable iron, to [ASTM A47/A47M](#) and [ASME B16.3](#).

- .5 Fittings for roll grooved piping: malleable iron to [ASTM A47/A47M](#).

2.4 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2-1/2 and larger: flanged ends.
- .2 Gate valves: to MSS-SP-80 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 Globe valves: to MSS-SP [85] 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.
- .4 Drain valves: Gate, Class [125], non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .5 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Provide complete with valve extensions on insulated piping systems.
- .6 Circuit Balancing Valves (CBV):
 - .1 General:
 - .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports for connected to differential pressure meter.
 - .2 Accuracy:
 - .1 Readout to be within plus or minus 2% of actual flow at design flow rate.
 - .3 Pressure die-cast dezincification resistant copper alloy construction, 1.7 MPa, 121C screwed ends, EPDM "O" ring seal, screw-in bonnet.
 - .1 Flow control: at least four (4) full turns on handwheel with digital handwheel and tamperproof concealed mechanical memory.
 - .4 Insulation:
 - .1 Use prefabricated shipping packaging of 5.4 R polyurethane as insulation.
 - .5 Drain connection:
 - .1 NPS 3/4 valved and capped, suitable for hose socket.
 - .2 Incorporate into valve body or provided as separate item.

.6 Acceptable manufacturers: Armstrong CBV, Tour & Anderson STA, Victaulic.

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

3.2 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install gate valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves as indicated.
- .4 Provide swing check valves in horizontal lines on discharge of pumps and as indicated.
- .5 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Mechanical Equipment Rooms.
- .6 Coordinate ball valve extension length with pipe insulation thickness.
- .7 Install ball valves for glycol service on pipes NPS 2 and down.

3.3 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Install in accordance with manufacturer's written instructions.

3.4 TESTING

- .1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.

3.5 BALANCING

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.7 PROTECTION

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

END OF SECTION

Section 23 23 00 Refrigerant Piping

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 21 07 20 - Thermal Insulation for Piping
- .3 Section 23 05 00 - Common Work Results for Mechanical
- .4 Section 23 05 05 - Installation of Pipework
- .5 Section 23 05 17 - Pipe Welding
- .6 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- .7 Section 23 73 11 - Air Handling Units - Packaged
- .8 Section 23 81 23 - Computer Room Air Conditioning

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 [ASME B16.22-18](#), Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings
 - .2 [ASME B16.24-16](#), Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500
 - .3 [ASME B16.26-18](#), Cast Copper Alloy Fittings for Flared Copper Tubes
 - .4 [ASME B31.5-16](#), Refrigeration Piping and Heat Transfer Components
- .2 ASTM International (ASTM):
 - .1 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength
 - .2 [ASTM B280-18](#), Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- .3 CSA Group (CSA):
 - .1 [CSA B52-18](#), B52 Package, Mechanical Refrigeration Code
- .4 Environment Canada (EC):
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems

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 refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Verify project requirements.
- .2 Review installation conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to [ASTM B280](#), type ACR.
 - .2 Annealed copper: to [ASTM B280](#), with minimum wall thickness as per [CSA B52](#) and [ASME B31.5](#)

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121°C.
- .2 Brazed:
 - .1 Fittings: wrought copper to [ASME B16.22](#)
 - .2 Joints: silver solder, 45% Ag-15% Cu-5% or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .3 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 A307](#), heavy series
- .4 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.
- .3 All valves to have CRN, registration number.
- .4 Acceptable manufacturers: Sporlan, Alco, Muller.

2.5 SIGHT GLASS

- .1 Provide moisture indicating double sight glass upstream from expansion valve.

Part 3 Execution

3.1 GENERAL

- .1 Install in accordance with CSA B52, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems and ASME B31.5.
- .2 Connect to equipment with isolating valves and flanges.
- .3 Provide space for servicing, disassembly and removal of equipment and components all as recommended by manufacturer.
- .4 Protect all openings in piping against entry of foreign material.

3.2 INSTALLATION AND TESTING

- .1 Installation shall be performed by certified refrigeration mechanics/technicians registered in Province of Ontario.
- .2 Provide copy of technicians' Provincial Certificate Number and technicians' Provincial ODS Awareness Card Number to DCC Representative prior to starting work.
- .3 Refrigeration Contractor shall provide to the Condenser/Evaporator Manufacturer a detailed piping schematic prior to shop drawing acceptance. Schematic to indicate: length and run of refrigerant piping connecting outdoor condensing units and cooling coils, all bends and changes in elevation in piping, line sizes, and size and manufacturer of thermal expansion valve, pump down solenoid and moisture indicating double sight glass. Condenser/Evaporator Manufacturer to verify refrigerant piping line sizes, prior to final shop drawing submission. Install double risers where instructed by Condenser/Evaporator Manufacturer.
- .4 Upon reviewing Refrigerant Contractor's piping schematic Condenser/Evaporator Manufacturer to determine whether further refrigerant change is required. Change only with amount of refrigerant as recommended by Condenser/Evaporator Manufacturer and follow Condenser/Evaporator Manufacturer's changing instructions.

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 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings..
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m³/s at minimum load. Connect upstream of traps on large riser.

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 2 MPa and 1 MPa on high and low sides respectively
- .3 Test Procedure:
 - .1 The testing media shall be dry nitrogen. The Contractor shall perform the leak test before insulating, evacuating and charging, in the presence of the DCC Representative.
 - .2 Charge the system to pressures listed above and allow it to remain under pressure for 24 hours. Maximum pressure drop shall be 34.5 kPa in 24 hours, at constant ambient temperature. For every 5.5°C drop in ambient temperature, from start of test, the maximum pressure drop may increase by 20.7 kPa.
 - .3 Isolate the compressor from the leak test by firmly closing the suction and discharge valves.
 - .4 Do not attempt to repair any leak while the system is pressurized. If any leaks are found, relieve the test pressure and perform repairs. Repeat test to ensure all leaks have been repaired.
- .4 DCC Representative shall witness all tests.

3.6 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.

- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 hours.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 hours.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to DCC Representative.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to DCC Representative.
- .9 Upon completion, a draft copy of the **Garrison Toronto Refrigeration & Air Conditioning Service Log** is to be submitted to DCC Representative for review. Upon acceptance, a signed copy is to be submitted to DCC Representative for distribution.

3.7 CLEANING

- .1 Perform cleaning operations in accordance with manufacturer's recommendations.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Section 23 31 13.01 Metal Ducts - Low Pressure to 500 PA

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 07 84 00 - Fire Stopping
- .3 Section 07 92 00 - Joint Sealants
- .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 32 48 - Sound Attenuation
- .7 Section 23 33 00 - Air Duct Accessories
- .8 Section 23 33 14 - Dampers - Balancing
- .9 Section 23 33 15 - Dampers - Operating
- .10 Section 23 33 16 - Dampers - Fire and Smoke
- .11 Section 23 33 46 - Flexible Ducts
- .12 Section 23 36 00 - Air Terminal Units
- .13 Section 23 37 13 - Diffusers, Registers and Grilles
- .14 Section 23 37 20 - Louvres, Intakes and Vents
- .15 Section 23 38 13 - Commercial Kitchen Hoods

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International (ASTM)
 - .1 [ASTM A480/A480M-18](#), Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 [ASTM A635/A635M-15](#), Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 [ASTM A653/A653M-18](#), Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).

- .5 National Fire Protection Association (NFPA)
 - .1 [NFPA 90A-18](#), Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 [NFPA 90B-18](#), Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 [NFPA 96-17](#), Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:
 - .1

Maximum Pressure Pa	SMACNA Seal Class
500	[C]
250	[C]
125	[C]

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.
 - .3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.
 - .1 Acceptable manufacturers: Duro Dyne, Foster, Bakor.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
 - .1 Acceptable manufacturers: Duro-Dyne, Bakor, Foster..

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual..

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius or short radius with single thickness turning vanes. Centreline radius: 1.5 times width of duct, where possible.
- .3 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct, where possible..
 - .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.
- .4 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .5 Offsets:
 - .1 Full radiused elbows as required or as indicated..

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Firestopping material and installation must not distort duct.
- .3 Coordinate with installer of fireproofing.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to [ASTM A653/A653M](#), Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .3 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

- .1 Acceptable material: Ductmate Canada Ltd., Mez Industries, Ward Industries (for proprietary joints).

2.8 KITCHEN EXHAUST SYSTEMS

- .1 Construct in accordance with [NFPA 96](#)
- .2 Material: black steel 3003-H-14.
- .3 Thickness: in accordance with NFPA 96.
- .4 Fabrication: to NFPA 96.
- .5 Reinforcement: to ASHRAE and SMACNA..
- .6 Joints: continuous liquid-tight inert gas welded.
- .7 Cleanouts: to NFPA 96 and as indicated.

2.9 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.
- .2 Hanger configuration: to ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)	
up to 750	25 x 25 x 3	6	undefined
751 to 1050	40 x 40 x 3	6	
1051 to 1500	40 x 40 x 3	10	
1501 to 2100	50 x 50 x 3	10	
2101 to 2400	50 x 50 x 5	10	
2401 and over	50 x 50 x 6	10	

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .1 Acceptable manufacturers: Myatt, Grinnell, Erico.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Acceptable manufacturers: Grinnell, Myatt, Erico.
 - .3 For steel beams: manufactured beam clamps:
 - .1 Acceptable manufacturers: Grinnell, Myatt, Erico.

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with ASHRAE, SMACNA and as indicated..

- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with ASHRAE and SMACNA..
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with as follows:

.1

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
 - .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Weld joints of bottom and side sheets.
 - .2 Seal other joints with waterproof mastic.
- .3 Slope horizontal branch ductwork down towards equipment served.
 - .1 Slope header ducts down toward risers.

3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.

- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.
- .8 Test to be witnessed by DCC Representative. Provide 21 days notice prior to testing.

END OF SECTION

Section 23 32 48 Acoustical Air Plenums

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.
- .3 Section 23 73 11 - Air Handling Units - Packaged.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 [ASTM A653/A653M-18](#), Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 [ASTM C423-17](#), Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 [ASTM E90-09\(R2016\)](#), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .4 [ASTM E477-13e1](#), Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition
 - .2 SMACNA 016-2012, HVAC Air Duct Leakage Test Manual, 2nd edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide separate shop drawings for each piece of attenuation equipment complete with product data.

1.4 PERFORMANCE RATING DATA

- .1 Provide performance rating data, certified by professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:
 - .1 Silencer: insertion loss, pressure drop at design conditions.
 - .2 Acoustic plenums: transmission loss and acoustical absorption.
 - .3 Acoustical performance measurements in accordance with ASTM E477, ASTM E90 and ASTM C423, except where specified otherwise.

Part 2 Products

2.1 SILENCERS WIT ACOUSTIC MEDIA (MEDIUM VELOCITY)

- .1 Outer casings of silencers shall be fabricated from not less than 20 ga. galvanized steel in accordance with ASHRAE Guide or SMACNA recommended construction for high pressure ductwork. Seams shall be lock-formed and mastic pressure ductwork. Center body tail sections shall be fabricated from not less than 22 ga. galvanized perforated steel.
- .2 Silencers shall not leak air or fail structurally when subjected to a differential air pressure of 8 inches of water gauge inside to outside of the casing.
- .3 Filler material shall be inorganic material or glass fibre packed under at least 15% compression. Materials shall be inert, vermin and moisture proof.
- .4 Combustion rating of the filler material shall be not less than the following when tested in accordance with ASTM E84, NFPA Standard 90A or UL No. 723:
 - .1 Flame spread rating: 15
 - .2 Smoke development rating: 5
- .5 Acoustical testing shall conform to ASTM E477 standard method of testing duct liner material and manufactured silencers for acoustical and air flow performance. Tests shall be run both with and without air flowing through the silencer at not less than three different airflow rates. All ratings shall be based on test data from a nationally known, qualified, independent laboratory. Test methods shall eliminate effects due to end reflection, vibration, flanking transmission, and standing waves in the reverberant room. Airflow and pressure loss measurements shall be made in accordance with applicable portions of ASME, AMCA, and ADC airflow tests.
- .6 The Dynamic Insertion Loss in dB for silencers shall not be less than that shown on the schedule on Drawing No. H-W5-7709-413.
- .7 Performance as indicated.
- .8 Acceptable manufacturer: Vibro Acoustics, Vibron, VAW, EH Price.

2.2 ABSORPTION AND INSULATING MEDIA

- .1 Acoustic quality, glass fibre, bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of CFFM for duct lining.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.
- .3 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .4 Suspension: to manufacturer's instructions.

DRDC HVAC Compliance Upgrade

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Project No: TT210006-BE21207056

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Acoustical Air Plenums

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END OF SECTION

Section 23 33 00 Air Duct Accessories

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa..

1.2 REFERENCE STANDARDS

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

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 air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
- .3 Instructions: submit manufacturer's installation instructions.
- .4 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Verify project requirements.
- .2 Review installation conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards CSA B228.1.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 0.66 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Doors to be full swing or removable door..
 - .6 Acceptable manufacturers: Mifab, SMS, Acudor.

2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated
- .2 Acceptable manufacturers: Duro Dyne, Dynair, AeroDyne.

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.
- .5 Acceptable manufacturers: Duro Dyne, Metalaire, Titus.

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.
- .3 Acceptable manufacturers: Duro Dyne, NovaFlex, Imperial Mfg. Group.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors:
 - .1 Size:
 - .1 600 x 600 mm for person size entry.
 - .2 300 x 300 mm for servicing entry.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 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 air handling 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.
 - .3 And as indicated.
- .4 Turning Vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated

END OF SECTION

Section 23 33 14 Dampers - Balancing

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Where applicable, submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.3 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.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 300 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon or bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.
- .6 Acceptable manufacturers:
 - .1 Nailor.
 - .2 EH Price.
 - .3 Titus.

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: pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Acceptable manufacturers:
 - .1 Nailor.
 - .2 EH Price.
 - .3 Titus.

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 on all branch ducts and where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
- .3 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .4 Dampers: vibration free.
- .5 Ensure damper operators are observable and accessible.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Tests to demonstrate that system is functioning as specified.

3.4 CLEANING

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

END OF SECTION

Section 23 33 15 Dampers - Operating

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 [ASTM A653/A653M-18](#), Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Where applicable, Material Safety Data Sheets (SDS).

1.3 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. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate the following:
 - .1 Performance data.
- .2 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 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed unless otherwise specified.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .4 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 250 Pa differential across damper.
- .5 Operator: by Division 25.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with R factor of 5.0.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0.
- .7 Acceptable manufacturers:
 - .1 Belimo.
 - .2 Tamco.
 - .3 Ventex.
 - .4 Ruskin.

2.2 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, multi leaf, steel construction spring-assisted with nylon bearings, install where indicated.
- .2 Acceptable manufacturers:
 - .1 Nailor.
 - .2 EH Price.
 - .3 Titus.
 - .4 Ruskin.

2.3 RELIEF DAMPERS

- .1 Automatic multi-leaf double V-type dampers with ball bearing centre pivoted and counter-weights set to open at 25 Pa static pressure, 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 where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

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

END OF SECTION

Section 23 33 16 Dampers - Fire and Smoke

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .2 National Fire Protection Association (NFPA)
 - .1 [NFPA 90A-18](#), Standard for the Installation of Air Conditioning and Ventilating Systems.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 [CAN/ULC-S112-10](#), Standard Test Method of Fire Test of Fire Damper Assemblies.
 - .2 [CAN/ULC-S112.2-07](#), Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
 - .3 [ULC-S505-2004](#), Standard for Fusible Links for Fire Protection Service.

1.3 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. Include product characteristics, performance criteria, and limitations.
 - .1 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.
 - .6 Breakaway joint design.
 - .3 Indicate the following:
 - .1 Fire dampers.

- .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.
 - .6 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Certificates: submit certificates by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement to have blades out of airstream, listed and bear label of ULC, and meet requirements of CFFM and ANSI/NFPA 90A. Fire damper assemblies fire tested in accordance with CAN/ULC-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; 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 or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damper HVAC and in manufacturer's instructions for fire dampers shall be followed.
- .11 All dampers to be functionally tested after installation. Provide tag near access verifying test.
- .12 Acceptable manufacturers: Ruskin, Nailor, E.H. Price, Greenheck, Alumavent.

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 [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.
 - .1 100% of damper operation shall be verified and witnessed by DCC Representative. Fusible link removal and replacement are to be witnessed, as well as full range movement of the damper.
 - .2 Tags are to be placed on the fire damper access door after verification and are to be signed off by DCC Representative. The tag should provide additional space to document subsequent periodic testing.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

Firestopping to be completed by Division 7 and in strict accordance with the fire damper manufacturer's installation instructions.

- .5 Co-ordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install heavy gauge angles and break-away joints of approved design on each side of fire separation.

3.3 CLEANING

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

END OF SECTION

Section 23 33 46 Flexible Ducts

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 National Fire Protection Association (NFPA)
 - .1 [NFPA 90A-18](#), Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 [NFPA 90B-18](#), Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
- .4 Underwriters' Laboratories (UL)
 - .1 [UL 181-2013](#), Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 [CAN/ULC-S110-13](#), Standard Methods of Tests for Air Ducts.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 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.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 Acceptable manufacturers: Omni Duct Systems, Anco Products Inc., Superior Air Ducts.

2.2 NON-METALLIC - UNINSULATED

- .1 Non-collapsible, coated mineral-based fabric type mechanically bonded to, and helically supported by, external steel wire.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.3 NON-METALLIC - INSULATED

- .1 Non-collapsible, coated mineral base fabric type mechanically bonded to, and helically supported by, external steel wire with factory-applied, flexible mineral fibre thermal insulation with vapour barrier reinforced mylar/neoprene laminate jacket.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Thermal loss/gain: 1.31 W/m². degrees C mean.

Part 3 Execution

3.1 DUCT INSTALLATION

- .1 Install in accordance with: [CAN/ULC-S110](#).
- .2 Install in accordance with manufacturer's instructions.
- .3 Install in accordance with SMACNA.
- .4 Support in accordance with SMACNA.
- .5 Maximum fully stretched length: 1.5 m
- .6 Provide rigid duct elbow between all flexible ducts and diffusers.
- .7 Limit flex duct use to connections between branch ductwork and diffusers or terminal units.

END OF SECTION

Section 23 37 13 Diffusers, Registers and Grilles

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 08 90 00 - Louvres and Vents
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- .4 Section 23 31 14 - Metal Ducts - Low Pressure to 500Pa

1.2 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 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. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
- .2 Samples:
 - .1 Samples are required for following:

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.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
 - .1 Plaster frames where set into plaster or gypsum board.
 - .2 Concealed fasteners.
- .3 Colour: white.

2.2 SUPPLY GRILLES AND REGISTERS

- .1 General: steel, size as indicated, opposed blade dampers.
- .2 Adjustable louvres, 20 mm spacing.
- .3 Acceptable manufacturers: E.H. Price, Nailor, Titus.

2.3 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: steel, size as indicated, opposed blade dampers.
- .2 Types: as indicated.
- .3 Acceptable manufacturers: E.H. Price, Nailor, Titus.

2.4 DIFFUSERS

- .1 Steel, 600 mm x 600 mm square with adjustable cones, neck size as indicated.
- .2 Steel: 345 and 457 mm round with adjustable cones, neck size as indicated.
- .3 Steel louvred face supply registers with blades fixed at 45 degree, size as indicated.
- .4 Acceptable manufacturers: E.H. Price, Nailor, Titus.

2.5 DOOR GRILLES

- .1 By Section 08 90 00 - Louvres and Vents.

2.6 FIRE-RATED DOOR GRILLES

- .1 By Section 08 90 00 - Louvres and Vents.

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 instructions.
- .2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible, color to match.

3.3 CLEANING

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

3.4 BALANCING

- .1 Balance in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

END OF SECTION

Section 23 37 20 Louvres, Intakes and Vents

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.
- .3 Section 23 33 15 - Dampers Operating.

1.2 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 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. Include product characteristics, performance criteria, and limitations.
 - .1 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

- .1 Factory manufactured galvanized steel hinged at curb line.
 - .1 Complete with integral birdscreen of 2.7 mm diameter ss wire.
 - .2 Backdraft damper.
 - .3 Maximum throat velocity 3.3 m/s.
 - .4 Shape: as indicated.
- .2 Birdscreens:
 - .1 Complete with integral birdscreen of 2.7 mm diameter ss wire. Use [12] mm mesh on exhaust [19] mm mesh on intake.
- .3 Dampers: in accordance with Section 23 33 15 - Dampers Operating.
- .4 Roof curbs: 305 mm high, of same manufacturer and built to suit model specified.
- .5 Acceptable manufacturers: Greenheck, Cook, Penn.

2.2 GOOSENECK HOODS

- .1 Thickness: to ASHRAE and SMACNA.
- .2 Fabrication: to ASHRAE and SMACNA.
- .3 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint considered class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter ss wire. Use [12] mm mesh on exhaust [19] mm mesh on intake.
- .6 Horizontal motorized damper.
- .7 Dampers: in accordance with Section 23 33 15 - Dampers Operating.
- .8 Roof curbs: built to suit gooseneck hood.

2.3 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: drainable blade stormproof pattern, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: prime coated with anodized colour finish. Colour: to DCC Representative's approval.
- .9 Acceptable Material: Aiolite, Ruskin, Ventex.
- .10 Provide AMCA certified ratings for pressure drop, free area and water penetration.
- .11 Free area velocity and pressure drop beginning point of water penetration per AMCA Standard 511: 375 m/min and 57 Pa.
- .12 Provide extended sill, 14 GA aluminum.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

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

END OF SECTION

Section 23 44 00 HVAC Cleaning Devices

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 23 36 00 - Air Terminal Units
- .3 Section 23 72 00 - Air-to-Air Energy Recovery Equipment.
- .4 Section 23 73 11 - Air Handling Units - Packaged.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 ASHRAE 52.2-2017, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI Approved).
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .3 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
- .3 Underwriters' Laboratories of Canada:
 - .1 ULC S111-07, Standard Method of Fire Tests for Air Filter Units.
- .4 National Fire Protection Association (NFPA):
 - .1 ANSI/NFPA (Fire) 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2017 Edition.

1.3 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. Include product characteristics, performance criteria, and limitations.
 - .1 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) 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.

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by DCC Representative, supply 1 complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50°C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

- .1 Holding frames: permanent "T" section or channel section construction of galvanized steel or extruded aluminum, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

- .4 Access and servicing: through doors/panels on each side and/or from face of filter bank.

2.3 COTTON PANEL FILTERS

- .1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.
- .2 Holding frame: side access, by air handling unit manufacturer.
- .3 Performance:
 - .1 Average atmospheric dust spot efficiency 30% to ASHRAE 52.2.
 - .2 Average synthetic dust weight arrestance 90% to ASHRAE 52.2.
- .4 Fire rated: to ULC-S111.
- .5 Nominal thickness: 100 mm.
- .6 Acceptable manufacturers:
 - .1 Flanders.
 - .2 AAF.
 - .3 Farr.

2.4 CARTRIDGE TYPE FILTERS, 80-85% EFFICIENCY

- .1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.
- .2 Holding frame: side access, by air handling unit manufacturer.
- .3 Media support: welded wire grid.
- .4 Performance: average atmospheric dust spot efficiency 80-85% to ASHRAE 52.2
- .5 Fire rated: to ULC-S111.
- .6 Acceptable manufacturers:
 - .1 Flanders.
 - .2 AAF.
 - .3 Farr.

2.5 FILTER GAUGES - DIAL TYPE

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure 0 to 250 Pa.

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 GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 REPLACEMENT MEDIA

- .1 Replace all media with new upon acceptance.
- .2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.4 FILTER GAUGES

- .1 Install type across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.5 CLEANING

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

END OF SECTION

Section 23 63 14 Condensing Units - Air Cooled

Part 1 General

1.1 SECTION INCLUDES

- .1 Condensing unit package.
- .2 Charge of refrigerant and oil.
- .3 Controls and control connections.
- .4 Refrigerant piping connections.
- .5 Motor starters.
- .6 Electrical power connections.

1.2 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-In-Place Concrete
- .2 Section 23 05 13 - Motors
- .3 Section 23 05 48 - Vibration Isolation: Placement of Vibration Isolators
- .4 Section 23 23 00 - Refrigerant Piping and Specialties
- .5 Section 23 54 00 - Forced Air Furnaces
- .6 Section 23 73 23 - Air Handling Units
- .7 Section 23 82 00 - Terminals Heat Transfer Units: Fan-Coil Units
- .8 Section 23 82 16 - Air Coils
- .9 Section 23 09 93 - Sequence of Operation
- .10 Section 26 05 83 - Equipment Wiring: Electrical characteristics and wiring connections

1.3 REFERENCE STANDARDS

- .1 STD 210/240: 2017 Performance rating of unitary air-conditioning and air source heat pump equipment.
- .2 STD 365(I-P): 2009 Commercial and industrial unitary air conditioning condensing units.
- .3 STD 15: 2019 Safety standard for refrigeration systems and designation and classification of refrigerants (ANSI Approved).
- .4 STD 23.1: 2019 Methods for performance testing positive displacement refrigerant compressors and condensing units that operate at subcritical pressures of the refrigerant (ANSI Approved).
- .5 STD 90.1(SI): 2019 Energy standard for buildings except low-rise residential buildings (ANSI approved; IES co-sponsored).
- .6 STD 90.1(I-P): 2019 Energy standard for buildings except low rise residential buildings (ANSI approved, IES co-sponsored).

- .7 NEMA 250-2020 Enclosures for electrical equipment (1,000 Volts maximum).
- .8 CSA (Canadian Standards Association).
- .9 UL (Underwriters Laboratories Inc.).
- .10 UL 207-2009 Standard for Refrigerant Containing Components and Accessories, Nonelectrical (8th Edition).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Indicate components, assembly, dimensions, weights and loadings, required clearances and location and size of field connections. Include schematics layouts showing condensing units, cooling coils, refrigerant piping and accessories required for complete system.
- .3 Informational Submittals:
 - .1 Design Data: indicate pipe and equipment sizing.
 - .2 Installation Data: manufacturer's special installation requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: include start-up instructions, maintenance instructions, parts lists, controls and accessories.
- .3 Warranty Documentation: 1. Compressors: Manufacturer's standard.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals .
- .2 Extra Stock Materials: provide two (2) of complete change of lubricating oil.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section Section 01 61 00 - Common Product Requirements.
- .2 Comply with manufacturer's installation instructions for rigging, unloading and transporting units.
- .3 Protect units on site from physical damage. Protect coils.

1.8 WARRANTY

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Provide a five (5) year warranty to include coverage for refrigerant compressors.

Part 2 Products

2.1 MANUFACTURERS

- .1 Manufacturers:
 - .1 York/Johnson Controls.

- .2 Engineered Air.
- .3 Trane.
- .4 McQuay.

2.2 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Provide a five (5) year warranty to include coverage for refrigerant compressors.

2.3 MANUFACTURED UNITS

- .1 Units: self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, wind deflector.
- .2 Construction and Ratings: to AHRI 210/240.
- .3 Testing: to ASHRAE 23.1.
- .4 Performance Ratings: Energy Efficiency Rating(EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE/IES 90.1 (SI).

2.4 CASING

- .1 House components in welded steel frame with steel panels with weather resistant, baked enamel finish.
- .2 Mount starters, disconnects and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.
- .3 Provide removable access doors or panels with quick fasteners and piano hinges.

2.5 CONDENSING UNITS

- .1 Base Rail:
 - .1 Unit shall have base rails on a minimum of 4 sides.
 - .2 Base rail mounted lifting lugs shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
 - .3 Base rail shall be a minimum of 15 gauge thickness.
- .2 Top panel:
 - .1 Shall be a multi piece top panel.
- .3 Electrical Connections:
 - .1 All unit power wiring shall enter unit cabinet at a single, factory prepared, and knockout location.
 - .2 Through-the-base capability.
 - .1 Standard unit shall have a through-the-base electrical location(s) using a raised, embossed portion of the unit base-pan.
 - .2 Optional, factory approved, watertight connection method must be used for through-the-base electrical connections.

.3 No base-pan penetration, other than those authorized by the manufacturer, is permitted.

.4 Units shall meet the wind load requirements in accordance with NBCC 2015.

.5 Units are certified with wind resistance ratings of 186 MPH as certified by independent structural engineers.

2.6 FANS AND MOTORS

.1 Vertical discharge driven propeller type condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing.

.2 Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or three phase, with permanent lubricated ball bearings and built in overhead protection. Refer to Section 23 05 13.

.3 Horizontal discharge, double width, double inlet centrifugal type condenser fans, equipped with roller or ball bearings with grease fittings extruded to outside of casing, V-belt drive with belt guard.

.4 Motors as indicated, in compliance with Section 23 05 13.

2.7 COMPRESSORS

.1 Compressor: Hermetically Sealed Swing Type.

.2 Mounting: statically and dynamically balance rotating parts and mount on rubber in shear vibration isolators. Refer to Section 23 05 48.

.3 Lubrication System: centrifugal oil pump with oil charging valve, oil level sight glass and magnetic plug or strainer.

.4 Motor, constant speed, suction gas cooled with electronic sensor and winding over temperature protection, designed for across the line starting. Provide with starter

.5 Capacity Reduction Equipment: suction valve unloaders, with lifting mechanism operated by electrically actuated solenoid valve, with unloaded compressor start, controlled from room thermostat. Hot gas bypass.

.6 Sump Oil Heater: evaporates refrigerant returning to sump during shut down. Energize heater thermostatically.

2.8 SPECIAL FEATURE OPTIONS AND ACCESSORIES

.1 Phase Monitor:

.1 Shall provide protection against phase reversal, phase loss, and phase unbalance.

.2 Switch shall automatically shut off unit control circuit if any of the above conditions is detected.

.3 Shall have visual LED indication of operational status.

.2 Coil Guard:

.1 Shall contain all materials necessary to field install a coil guard.

.2 Shall provide protection for the fins and tubes on the entire exposed surfaces of the outdoor coil.

- .3 Unit-Mounted, Non-Fused Disconnect Switch:
 - .1 Switch shall be factory installed, internally mounted.
 - .2 National Electric Code (NEC) and UL approved nonfused switch shall provide unit power shutoff.
 - .3 Shall be accessible from outside the unit.
 - .4 Shall provide local shutdown and lockout capability.
- .4 Low Ambient Kit:
 - .1 Shall contain an integrated low ambient controller to regulate condenser head pressure at low ambient temperatures by varying the amount of airflow through the condenser.
 - .2 Shall allow units to operate in cooling mode down to -18° C outdoor ambient.
 - .3 Shall be required when mechanical cooling is required at temperatures below -4° C.

2.9 PERFORMANCE

- .1 Follow on schedule of drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Complete structural, mechanical and electrical connections to manufacturer's installation instructions.
- .3 Provide for connection to electrical service. Refer to Section 26 05 83.
- .4 Install units on vibration isolation. Refer to Section 23 05 48.
- .5 Install units on concrete base as indicated. Refer to Section 03 30 00.
- .6 Provide connection to refrigeration piping system and evaporators. Refer to Section 23 23 00. Comply with ASHRAE 15.
- .7 Provide charge of refrigerant and oil.

3.2 DEMONSTRATION AND TRAINING

- .1 Section 01 78 00 - Demonstrating installed work.
- .2 Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.
- .3 Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.
- .4 Shut down system if initial start up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.
- .5 Provide cooling season startup and winter season shutdown for first year of operation.
- .6 Inspect and test for refrigerant leaks every 8 weeks during first year of operation.

3.3 START-UP AND PERFORMANCE VERIFICATION

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements: report forms and schematics.
- .3 Manufacturer to certify installation.
- .4 Manufacturer to be present during start-up and certify performance.
- .5 Manufacturer to provide verbal and written instructions to operating personnel.
- .6 Submit written report to DCC Representative.
- .7 Complete Garrison Toronto Halocarbon Management System - New Equipment Form. Form will be available from DCC Representative. Complete one form for each system.
- .8 Complete Garrison Toronto Halocarbon Management System Service Log as part of the initial charge. Form will be available from DCC Representative. Complete on form for each system.
- .9 Perform leak test on each system. Attach the copy to unit with a second copy to be turned over to DCC Representative.

END OF SECTION

Section 23 73 23 Indoor Air Handling Unit

Part 1 General

1.1 SECTION INCLUDES

- .1 Heating coils.
- .2 Mixing boxes.
- .3 Combination filter/mixing boxes.
- .4 Filter sections.
- .5 Face and bypass dampers.
- .6 Multi-zone dampers.
- .7 Cooling coils.

1.2 RELATED REQUIREMENTS

- .1 Section 22 10 00 - Plumbing Piping: Equipment Drains
- .2 Section 23 05 13 - Motors
- .3 Section 23 05 16 - Piping Expansion Compensation
- .4 Section 23 07 13 - Duct Insulation
- .5 Section 23 31 00 - Duct Work
- .6 Section 23 33 00 - Duct Work Accessories: Flexible Duct Connections
- .7 Section 23 34 13 - Axial Fans
- .8 Section 23 34 16 - Centrifugal Fans
- .9 Section 23 40 00 - Air Cleaning Devices
- .10 Section 23 82 16 - Air Coils
- .11 Section 26 05 83 - Equipment Wiring: Electrical Characteristics and Wiring Connections.

1.3 DEFINITIONS

- .1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.

1.4 REFERENCE STANDARDS

- .1 STD 9:2015 Load Ratings and Fatigue Life for Ball Bearings.
- .2 STD 11:2014 Load Ratings and Fatigue Life for Roller Bearings.
- .3 STD 410:2001 Forced-circulation air-cooling and air-heating coils.
- .4 STD 430(I-P):2014 Performance Rating of Central Station Air-Handling Unit Supply Fans.
- .5 STD 610(I-P):2014 Performance Rating of Central System Humidifiers for Residential Applications.

- .6 STD 210-16 ANSI/AMCA 210-16/ASHRAE Standard 51-16 Laboratory Methods for Sound Testing of Fans.
- .7 STD 300-14 ANSI/AMCA Standard 300-14 Reverberant Room Method for Sound Testing of Fans.
- .8 STD 301-14 ANSI/AMCA Standard 301-14 Methods for Calculating Fan Sound Ratings From Laboratory Test Data.
- .9 STD 500-D-18 ANSI/AMCA Standard 500-D-18 Laboratory Methods of Testing Dampers for Rating.
- .10 STD 500-L-12 ANSI/AMCA Standard 500-L-12 Laboratory methods of testing louvers for rating.
- .11 STD 99-16 ANSI/AMCA Standard 99-16 Standards Handbook.
- .12 UL 900-2015 - Standard for Air Filter Units (8th Edition).
- .13 UL 1996-2009-Electric Duct Heaters (4th Edition).
- .14 HVAC duct construction standards - metal and flexible.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
 - .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
 - .3 Provide fan curves with specified operating point clearly plotted.
 - .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
 - .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .3 Shop Drawings:
 - .1 Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- .4 Samples:
 - .1 Submit two (2) of each type of replacement filter media with frame.
- .5 Installation Data: manufacturer's special installation requirements.

1.6 CLOSEOUT SUBMITTALS

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

- .2 Operation and Maintenance Data: include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section Section 01 78 00 - Closeout Submittals.
- .2 Extra Stock Materials: provide one(1) set for each unit of fan belts.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section Section 01 61 00 - Common Product Requirements.
- .2 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- .3 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish.

1.9 SITE CONDITIONS

- .1 Ambient Conditions: do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

Part 2 Products

2.1 MANUFACTURERS

- .1 York/Johnson Controls.
- .2 Engineered Air.
- .3 Trane.
- .4 McQuay.

2.2 GENERAL DESCRIPTION

- .1 Configuration: fabricate with fan and coil section plus accessories, including:
 - .1 Heating coil.
 - .2 Mixing box section.
 - .3 Combination filter/mixing box section.
 - .4 Filter section.
 - .5 Cooling coil section.
- .2 Performance:
 - .1 Air Flow: 5664 L/s at 374 Pa external static pressure.
 - .2 Motor: 10 hp, 575 volt, three-phase, 60 Hz.

2.3 BASE RAIL

- .1 Unit(s) shall be provided with structural base rail under the full perimeter of the unit, formed from mill galvanized steel.

- .2 Structural steel shall be installed providing clearance for proper external trapping of drain pans and steam condensate.
- .3 Unit(s) shall be provided with base rail and lifting lug system that does not require additional support for rigging. Include base rail lifting lugs at unit corner.

2.4 CASING

- .1 Construction: fabricate on channel base and drain pan of welded steel coated externally with manufacturer's standard paint finish with perforated inside casing. Assemble sections with gaskets and bolts.
 - .1 Outside Casing:
 - .1 Galvanized Steel: STD Ga. G-90.
 - .2 Inside Casing:
 - .1 Galvanized Steel: STD Ga. G-90.
 - .3 Floor Plate:
 - .1 Galvanized Steel: STD Ga. G-90.
- .2 Casing construction shall not rely on the casing panels for structural integrity.
- .3 Casing panels shall be 50 mm double-wall construction with thermal break. Thermal break shall be between interior and exterior liner of the panel assembly, and between the panel and casing framework.
- .4 Provide casing with minimum thermal resistance (R-value) of 2.3 m²K/W. Exposed insulation is not acceptable.
- .5 Casing panel insulation shall be injected polyurethane foam. Foam insulation shall be manufactured by EcoMate®. Rigid foam board panels shall not be used.
- .6 Casing panels with perforated interior liners (perforated panels) shall be provided where indicated on the drawings and/or schedule. Perforated panels shall be a hybrid combination of 25 mm fiberboard and 25 mm injected polyurethane foam. Foam insulation shall be manufactured by EcoMate®. Rigid foam board panels shall not be used. Minimum perforated panel thermal resistance (R-Value) shall be RSI 1.93 m²K/W.
- .7 All exterior and interior casing panels (roof, wall, floor, access door) shall be made of galvanized steel.
- .8 Panel assembly shall meet UL standard 1995 for fire safety. Panel insulation shall comply with the requirements of NFPA 90A.
- .9 Insulation system provided shall be resistant to mold growth in accordance with a standardized test method such as UL 181 or ASTM C 1338.
- .10 Encapsulate insulation with sheet metal so that air does not contact insulation. Solid lined double-walled panels insulated with injected foam shall be hermetically sealed at each corner and around their entire perimeter to eliminate airflow through the panel and to eliminate microbial growth potential within the casing wall.
- .11 Unit shall conform to ASHRAE Standard 111 Class 6 for casing leakage no more than 1% of design airflow at 1.25 times design static pressure.

- .12 Provide wall panels and access doors that deflect no more than $L/240$ when subjected to 1.5 times design static pressure. 'L' is the panel-span length and ' $L/240$ ' is the deflection at panel midpoint.
- .13 Provide floors and roofs that deflect no more than $L/240$ when subjected to a 136 kg static load at mid-span. 'L' is the panel-span length and ' $L/240$ ' is the deflection at panel midpoint.
- .14 Condensation shall not form anywhere on unit exterior at 12 deg C supply air and 27 deg C DB / 23 deg C WB exterior ambient. Manufacturer shall supply an external condensation performance line, plotted on the psychrometric chart, based on actual test data. Plot will show the exterior conditions at which unit will sweat given the design supply air temperature. Manufacturer shall clearly indicate whether the design conditions will or will not result in external condensation forming anywhere on the unit exterior. If the unit will sweat, indicate where sweating will occur. Unit exterior includes the base, base rail, roof, corners, doors, door frames, and under the cooling coil drain pan."

2.5 ACCESS DOORS

- .1 Provide double wall access door(s) that meet requirements for the AHU casing.
- .2 Provide industrial-style stainless steel hinges that permit 180 degrees of door swing.
- .3 Provide latches with roller cam mechanisms that ensure a tight seal. Rotating knife-edge or "paw" latches are not acceptable.
- .4 Provide each door with a single handle linked to multiple latching points or a separate handle for each latching point. Doors serving access segments shall have an interior latch handle.
- .5 Provide access doors with a locking hasp to accommodate a lockout device.
- .6 Provide double-pane viewing windows. Windows shall be a non-condensing type consisting of a desiccant dehumidification layer. Minimum dimension shall be 8 mm x 200 mm.

2.6 FANS

- .1 Type: Forward curved, single width, single inlet, centrifugal type fan.
- .2 Belt-Drive Fans:
 - .1 Belt-driven fans shall be statically and dynamically balanced by the manufacturer as a complete fan assembly including: fan wheel, motor, drive, belts and isolators.
 - .2 Fan motor shall be provided on an adjustable base to allow adjustable and consistent belt tension. Fan and motor shall be mounted on a welded structural steel fan isolation base.
 - .3 Fans shall be provided with polished steel shafts with first critical shaft speed at least 125% of the maximum operating speed for the fan pressure class. Shaft shall have an anti-corrosion coating.
 - .4 Fan wheels shall be keyed to the fan shaft to prevent slipping.
 - .5 Fan shall be provided with an OSHA-approved belt guard to deter incidental contact with rotating sheaves and belts.

- .3 Bearings: self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with aluminum tube and grease fitting rigidly attached to casing.
 - .1 Unit fans shall be provided with bearings complying with ANSI/AFBMA 9 for fatigue life ratings and with an average life L10 of at least 200,000 hours, as scheduled.
 - .2 Forward curved fans smaller than 18" shall be provided with permanently lubricated bearings. For other fans, manufacturer shall provide re-greaseable bearings with hydraulic grease fittings and lube lines extended to the motor side of the fan or to the exterior of the unit primary access side.
 - .3 Fans shall be provided drives selected with a 1.5 service factor. Sheaves shall be machined from a close grain cast iron and statically balanced by the manufacturer.
 - .4 Fixed pitch sheaves shall be provided on both the fan and motor. Fans with motors rated at 15 HP or less may be field balanced using variable pitch sheaves. Fixed pitch sheaves shall be provided when final balance is complete. Air balancer shall select and provide final set of sheaves.
 - .5 For Belt-driven fans with 10 HP motors or greater shall be provided with multiple belt drives. Belts shall be V-type, precision molded, raw edge construction, anti-static, oil- and heat-resistant.
 - .6 Bearings shall be offered either with sealed bearings permanent lubrication or with serviceable bearings to facilitate periodic relubrication. Bearings requiring relubrication shall offer grease lines extended from the bearing to an accessible location on the fan-support bracket on the drive side of the fan.
- .4 Mounting: locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors. Provide built-in inertibase of welded steel with bottom sheet and reinforcing grid for concrete ballast. Mount base on vibration isolators, refer to Section 23 05 48.
- .5 Mounting: locate motor, drive and belt guard on integral casing framework on exterior casing. Provide ventilated weather cover of galvanized steel completely enclosing motor and drive with tachometer opening. Mount casing on vibration isolators. Refer to Section 23 05 48.
- .6 Unit shall be provided with fans as shown on equipment schedule and drawings.
- .7 The fan section shall be provided with an access door on the drive side of the fan.
- .8 Fans shall be provided with the following safety accessories:
 - .1 Fan inlet screens in the inlets of fan housing.
 - .2 Fan cage on discharge of fan housing.
- .9 Mount the fan and motor assembly on a common adjustable base. This common base shall attach to vibration isolators, which mount to structural support channels. These channels shall span the AHU floor and mount directly to the AHU frame. Manufacturers not complying with this requirement must submit detailed structural and weight data to a

licensed structural engineer for review and stamped certification. The mechanical engineer shall review these engineers' final reports prior to submittal approval.

- .10 Fan-Motor Disconnects:
 - .1 Manufacturer shall provide UL or ETL listed fan-motor disconnects and associated components, as scheduled and shown on drawings. Disconnects shall comply with applicable provisions of the National Electric Code.
 - .2 Fused or non-fused fan-motor disconnects shall be provided in NEMA 1, NEMA 3R, NEMA 4, NEMA 12 enclosures, as scheduled or as shown on drawings.
 - .3 Disconnects shall be mounted on the primary access side of the associated fan segment. Whereas, unit main disconnect shall be mounted on the primary access side of supply fan section.
 - .4 Disconnect shall be suitable for use as an OSHA lockout/tagout disconnect when applied in accordance with part IV, Department of Labor OSHA 29 CFR Part 1910, Control of Hazardous Energy Source (lockout/tagout): final rule.
 - .5 Disconnect handles shall be lockable in the "off" position with up to three padlocks. Switch mechanism shall be directly lockable in the "off" position via padlock when door is open.
 - .6 Disconnects shall be provided with integral ground lug.:
 - .1 Provide two (2) #14 ground wires on 16A to 100A disconnects.
 - .2 Provide one (1) #6-250 ground wire on 200A to 400A disconnects.
 - .7 Auxiliary contacts shall be provided as scheduled.
- .11 Fan-Motor Variable Frequency Drives (VFDS):
 - .1 Manufacturer shall provide UL or ETL listed VFDs and associated components, as scheduled and shown on drawings. VFDs shall comply with applicable provisions of the National Electric Code.
 - .2 VFDs shall be mounted in a dedicated NEMA 1 compartment located on the primary access side of its associated fan section and wire VFD to motor, unless otherwise indicated on drawings.
 - .3 After unit installation, VFD shall be started and programmed by a factory trained and employed service technician. Refer to Section 3.05.
 - .4 Unit(s) shall be provided with following VFD disconnect and bypass optional:
 - .1 Non-Fused, Fused main disconnect.
 - .2 2 contactor VFD bypass with VFD service input switch and Non-Fused, Fused main disconnect.
 - .5 Unit(s) shall be provided with harmonic distortion feedback protection:
 - .1 Equivalent 5% impedance input line reactor.
 - .2 Integral RFI/EMI filtering to meet EMC EN61800-3 for First Environment.
- .12 Unit(s) shall be provided with a user interface consisting of following features:
 - .1 30 Character multi-lingual alphanumeric display.

- .2 Parameter set-up and operating data.
- .3 Display data shall include:
 - .1 output frequency (Hz)
 - .2 speed (RPM)
 - .3 motor current
 - .4 calculated % motor torque
 - .5 calculated motor power (kW)
 - .6 DC bus voltage
 - .7 output voltage
 - .8 heat sink temperature
 - .9 elapsed time meter (re-settable)
 - .10 kWh (re-settable)
 - .11 input / output terminal monitor
 - .12 PID actual value (feedback) & error
 - .13 fault text
 - .14 warning text
 - .15 scalable process variable display
- .13 VFD shall be provided with the following protection circuits:
 - .1 over current
 - .2 ground fault
 - .3 over voltage
 - .4 under voltage
 - .5 over temperature
 - .6 input power loss of phase
 - .7 loss of reference/feedback
 - .8 adjustable current limit regulator
- .14 VFD shall be UL 508C approved for electronic motor overload (12t).
- .15 VFD shall be provided with features for high input transient protection and surge suppression, such as:
 - .1 4 MOVs ahead of diode bridge.
 - .2 120 Joule rated 1600V diode module.
 - .3 Compliant with UL 1449 / ANSI 61.4.
- .16 VFD shall be provided with the following communication features:
 - .1 Two programmable analog inputs

- .2 Six programmable digital inputs
- .3 Two programmable analog output
- .4 Three programmable digital relay outputs
- .5 Modbus RTU Communications protocol
- .6 Adjustable filters on analog inputs and outputs
- .7 Input speed signals, including 4-20 mA and 0-10 VDC
- .8 Accel/Decel contacts floating point control
- .9 Auto restart customer selectable and adjustable
- .10 Start/Stop options shall include application of input power, and application of reference signal (PID sleep/wake-up).
- .11 Integrated control interface for Siemens FLN, Johnson N2, Modbus RTU, BACnet MS/TP or LONWorks over RS-485.
- .17 VFD shall consist of the following functions:
 - .1 Pre-magnetization on start
 - .2 DC braking/hold at stop
 - .3 Ramp or coast to stop
 - .4 Seven preset speeds
 - .5 Three critical frequency lockout bands
 - .6 Start function shall include ramp, flying start, automatic torque boost, and automatic torque boost with flying start.
- .18 Factory Installed Electrical Accessories:
 - .1 In addition to motor power terminals, unit(s) shall be provided with an independent power terminal for convenience receptacles and lights.
 - .2 All switches shall be provided as shown on drawings.
 - .3 Unit[s] shall be provided with LED (light emitting diode) lights in segments as scheduled or shown on drawings.
 - .4 On supply fan segment 120V convenience receptacle shall be provided.
- .19 Provide vibration isolation, as scheduled.
- .20 Provide horizontal thrust restraints between AHU casing and fan housings with end discharge as required.
- .21 Flexible Connection: separate fan and coil sections, refer to Section 23 33 00.
- .22 Supply Fan Performance:
 - .1 Air Flow: as per the schedule.

2.7 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- .1 Electrical Characteristics:

- .1 575 volts, three-phase, 60 Hz.
- .2 Refer to Section 26 05 83.
- .2 Motor: TEFC.
- .3 Wiring Terminations: provide terminal lugs to match branch circuit conductor quantities, sizes and materials indicated.

2.8 COILS

- .1 Water Coils: Steel Connection material, Corrugated Fin type, Copper Tube Material with a Minimum wall thickness of 0.016 inches, section casing to be galvanized steel.
- .2 DX Coils: R-410a Flugid type, copper connection material, aluminum fin material and corrugated type with copper tube material. Casing is galvanized steel, drain pan to be 304 stainless steel.
- .3 Water cooling coil.

2.9 FILTERS

- .1 Filter Box: section with filter guides, access doors from both sides, for side loading.
- .2 Pre-filter, Depth 2", Pleated 30% (MERV 8) Aluminum Frames.
- .3 Primary filter, Depth 12" Rigid, 90-95% Eff (MERV 14) Aluminum Frames.

2.10 DAMPERS

- .1 Return and Outside Air Dampers to be galvanized with parallel blade orientation.
- .2 Dampers provided shall be tested in accordance with AMCA 500.
- .3 Factory-installed dampers shall be provided, as shown on drawings.
- .4 Dampers shall have airfoil blades, extruded vinyl edge seals, and flexible metal compressible jamb seals.
- .5 Dampers shall have a maximum leakage rate of 20.34 l/s/m² at 250 Pa w.g., and shall comply with ASHRAE 90.1.
- .6 Damper blades shall be parallel acting unless otherwise indicated.
- .7 Damper blades shall be galvanized steel or aluminum, as scheduled.

2.11 LIGHTS AND OUTLETS

- .1 Lights:
 - .1 Factory shall provide vapor resistant, marine type LED lighting fixture located in segments and quantity as indicated on the drawings.
 - .2 Factory shall wire all light fixtures to a common 120v switch located on the supply fan segment.
- .2 Outlets:
 - .1 Factory shall provide a 15A GFI duplex outlet mounted in a weatherproof enclosure in segments and quantity as indicated on the drawings.

2.12 PRIMARY DRAIN PANS

- .1 Unit(s) shall be provided with a drain pans under each cooling coil and humidifier.
- .2 Provide drain pan under the complete width and length of cooling coil and humidifier sections. Drain pan shall be full width, and extend a minimum of 150mm downstream of cooling coil.
- .3 Drain pans for cooling coils and humidifiers shall meet the requirements of ASHRAE 62.
- .4 Drain connection shall be made of same material as drain pan. Dissimilar metals shall not be used to mitigate risk of galvanic corrosion. Drain connection shall be welded to the drain pan.
- .5 Drain pan shall be double wall with an insulation RSI-value of 2.3 m²K/W per 25 mm.
- .6 Drain pan shall allow visual inspection and physical cleaning on 100% of the pan surface without removal of the coil or humidifier.
- .7 Provide a minimum of 25 mm clearance between the drain pan and any coil casing, coil support or any other obstruction.
- .8 Provide drain pan that allows the design rate of condensate drainage regardless of fan status.
- .9 Provide drain pan that allows the design rate of condensate drainage regardless of fan status.
- .10 Provide drain pan sloped in at least two planes by at least 1 % toward a single drain. Locate drain connection at the lowest point of the pan. Pan shall have no horizontal surfaces.

Part 3 Execution

3.1 INSTALLATION

- .1 Air Handling Unit to go into the Mechanical Room in pieces and will be assembled internally. Wall opening size to be coordinated with other trades for proper guidance.
- .2 Install to manufacturer's written instructions.
- .3 Install to AHRI 430/431.
- .4 Assembly high pressure units by bolting sections together. Isolate fan section with flexible duct connections.
- .5 Install assembled unit on vibration isolators. Refer to Section 23 05 48.

3.2 FIELD QUALITY CONTROL

- .1 AHU shall be stored as per manufacturer's written recommendations.
- .2 AHUs shall be stored indoors in a warm, clean, dry place where unit(s) will be protected from weather, construction traffic, dirt, dust, water and moisture. If unit(s) to be stored for more than 6 months, manufacturer's instruction for long-term storage shall be followed.
- .3 Rig and lift units shall be according to manufacturer's instructions.

3.3 AHU INSPECTION

- .1 Hire manufacturer's factory-trained and factory-employed service technician to perform an inspection of unit and installation prior to startup. Technician shall inspect and verify the following as a minimum:

- .1 Damage of any kind.
- .2 Level installation of unit.
- .3 Proper reassembly and sealing of unit segments at shipping splits.
- .4 Tight seal around perimeter of unit at the roof curb.
- .5 Installation of shipped-loose parts, including filters, air hoods, bird screens and mist eliminators.
- .6 Completion and tightness of electrical, ductwork and piping.
- .7 Tight seals around wiring, conduit and piping penetrations through AHU casing.
- .8 Supply of electricity from the building's permanent source.
- .9 Integrity of condensate trap for positive or negative pressure operation.
- .10 Condensate traps charged with water.
- .11 Removal of shipping bolts and shipping restraints.
- .12 Tightness and full motion range of damper linkages operate manually.
- .13 Complete installation of control system including end devices and wiring.
- .14 Cleanliness of AHU interior and connecting ductwork.
- .15 Proper service and access clearances.
- .16 Proper installation of filters.
- .17 Filter gauge set to zero.
- .2 Resolve any non-compliant items prior to unit start-up.

3.4 INSPECTION AND ADJUSTMENT: AHU FAN ASSEMBLY

- .1 Hire the manufacturer's factory-trained and factory-employed service technician perform an inspection of the AHU fan assembly subsequent to general AHU inspection and prior to startup. Technician shall inspect and verify the following as a minimum:
 - .1 Fan isolation base and thrust restraint alignment.
 - .2 Tight set screws on pulleys, bearings and fan.
 - .3 Tight fan bearing bolts.
 - .4 Tight fan and motor sheaves.
 - .5 Tight motor base and mounting bolts.
 - .6 Blower wheel tight and aligned to fan shaft.
 - .7 Sheave alignment and belt tension.
 - .8 Fan discharge alignment with discharge opening.
 - .9 Fan bearing lubrication.
 - .10 Free rotation of moving components rotate manually.
- .2 Manufacturer shall dynamically balance fan/motor/base assembly.

- .1 Balance constant volume fan assemblies at design RPM.
 - .2 Balance variable volume fan assemblies from 10% to 100% of design RPM.
 - .3 Take filter-in measurements in the horizontal and vertical axes on the drive and opposite-drive sides of fan shafts.
 - .4 Constant speed fan vibration limits: filter-in measurements shall not exceed 4 mils.
 - .5 Variable speed fan vibration limits: filter -in measurements shall not exceed 7 mils.
- .3 Manufacturer shall hi-pot test wiring intended to carry voltages greater than 30VAC.

3.5 STARTUP SERVICE AND OWNER TRAINING

- .1 Manufacturer's factory-trained and factory-employed service technician shall startup AHUs. Technician shall perform the following steps as a minimum:
 - .1 Energize the unit disconnect switch.
 - .2 Verify correct voltage, phases and cycles.
 - .3 Energize fan motor briefly ("bump") and verify correct direction of rotation.
 - .4 Re-check damper operation; verify that unit cannot and will not operate with all dampers in the closed position.
 - .5 Energize fan motors and verify that motor FLA is within manufacturer's tolerance of nameplate FLA for each phase.
- .2 Provide a minimum of 4 hours of training for owner's personnel by manufacturer's factory-trained and factory-employed service technician. Training shall include AHU controls, motor starter, VFD, and AHU.
- .3 Training shall include startup and shutdown procedures as well as regular operation and maintenance requirements.
- .4 If AHU is provided with a factory-mounted variable frequency drive (VFD), hire the VFD manufacturer's factory-trained and factory-employed service technician to inspect, test, adjust, program and start the VFD. Ensure that critical resonant frequencies are programmed as 'skip frequencies' in the VFD controller.
- .5 Submit a startup report summarizing any problems found and remedies performed.

3.6 CLEANING

- .1 Clean unit interior prior to operating. Remove tools, debris, dust and dirt.
- .2 Clean exterior prior to transfer to owner.

3.7 DOCUMENTATION

- .1 Provide Installation Instruction Manual, & Startup checklist in the supply fan section of each unit.
- .2

Provide six copies of Spare Parts Manual for owner's project system manual.

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

2023-02-17

Section 23 73 23
Indoor Air Handling Unit

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END OF SECTION

Section 23 74 00 Packaged Roof Top Unit

Part 1 General

1.1 GENERAL

- .1 Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic, suction gas cooled direct drive compressor(s) for cooling duty and gas combustion or nickel chromium elements for heating duty.
- .2 Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start up.
- .3 Unit shall be installed in accordance with the manufacturer's instructions.
- .4 Unit must be selected and installed in compliance with local, state, and federal codes.
- .5 Unit shall use environmentally sound, R-410A refrigerant.

1.2 RELATED REQUIREMENTS

- .1 Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems
- .2 Section 23 74 00 - Packaged Outdoor HVAC Equipment

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data shall include dimensions, weights, capacities, certifications, component performance, electrical characteristics, casing construction details, wiring interconnections, gauges and finishes of materials.
- .3 Provide all technical information relevant to the product being provided, including but not limited to all the information shown in the schedules of this specification. It is the responsibility of the supplier to highlight any variances that his equipment has with the requirements of this specification whether or not pre-approval has been obtained. Provide the information in the same measurement units as indicated elsewhere in this specification.
- .4 Provide specific fans curves, with operating points clearly plotted.
- .5 Provide filter information, including initial APD, final APD, dust spot efficiency final dust holding capacity, filter media description, filter frame details, and filter removal details.
- .6 Submit sound power levels for both packaged roof top unit inlet, outlet and radiated at rated capacity. If unit exceeds sound power levels at scheduled conditions, manufacturer must provide sound attenuators and meet specified BHP.
- .7 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .8 Submit manufacturer's recommended installation instructions.
- .9 Omission of any of the above information will cause shop drawings to be immediately returned without review.

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 packaged roof top equipment for incorporation into manual.
- .3 Include performance data as noted in equipment schedules.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 1 spare set of filters.
- .3 Provide 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.
- .4 Spare filters: in addition to filters installed immediately prior to acceptance by Owner's Representative, supply 1 complete set of filters for each filter unit or filter bank.
- .5 Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 QUALITY ASSURANCE

- .1 Unit meets ASHRAE 90.1 minimum efficiency requirements.
- .2 Unit shall be rated in accordance with AHRI Standards 210/240 or 340/360.
- .3 Unit shall be designed to conform to ASHRAE 15.
- .4 Unit shall be CSA tested and certified in accordance with ANSI Z21.47-2016/CSA 2.3-2016 and CSA C22.2 No. 60335-2-40.
- .5 Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- .6 Unit casing shall be capable of withstanding 750- hour salt spray exposure per ASTM B117 (scribed specimen).
- .7 Roof curb shall be designed to conform to NRCA Standards.
- .8 The Unit shall be subjected to a completely automated run test on the assembly line data for each unit will be stored at the factory, and must be available upon request.
- .9 Unit shall be constructed to prevent intrusion of snow into the control box.
- .10 Unit shall be designed in accordance with CSA C.22.2 NO.60335-2-40, including tested to withstand rain.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Unit shall be stored and handled per manufacturer's recommendations.
- .2 Overhead crane can be used to place the units on a roof using rigging holes built into the unit base rails without any additions to the unit.
- .3 Unit shall only be stored or positioned in the upright position.

1.8 OPERATING CHARACTERISTICS

- .1 Unit shall be capable of starting and running at 115 degrees Fahrenheit (52 degrees Celsius) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at $\pm 10\%$ voltage.
- .2 Compressor with standard controls shall be capable of operation down to 45°F (7°C), ambient outdoor temperatures. Intermittent cooling shall be operational down 0° F (-17°C). Low ambient kit is necessary if mechanically cooling at ambient temperatures below 40°F (4°C).
- .3 Unit shall only be stored or positioned in the upright position.

1.9 ELECTRICAL REQUIREMENTS

- .1 Main power supply voltage, phase and frequency must match those required by the manufacturer.

1.10 UNIT CABINET

- .1 Unit cabinet shall be constructed of G60 and G90 galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 1000 hour salt spray test per ASTM-B117 standards.
- .2 Unit cabinet exterior paint shall be: film thickness, (dry) 3.0 MILS minimum, gloss (per ASTM D523, 60°F / 16°C): 80+/- 5, Hardness: H- 2H Pencil hardness.
- .3 Unit cabinet shall have electric utility entry locations marked from the factory with a dimple for accuracy of field drilling. Entry locations shall be available for entry through the side of the unit or from the unit underside. Cabinet doors shall be hinged with toolless access for servicing and maintenance.
- .4 Unit cabinet shall have gas utility entry holes in the side of the unit and in the unit underside. Entry holes shall not require field setup and shall be capped from the factory to prevent water intrusion when not in use.
- .5 Condensate pan and connections:
 - .1 Shall be a multidirectional internally sloped condensate drain pan made of a non-corrosive material.
 - .2 Shall comply with ASHRAE Standard 62.
 - .3 Shall use a 1" NPT female drain connection through the side of the drain pan. Connection shall be made per manufacturer's recommendations.
 - .4 Shall include intentional "overflow notch" and water containment path to guide flow of water where desired in the event of a drain pan overflow.
- .6 Base Rail:
 - .1 Unit shall have base rails on all 4 sides.
 - .2 Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
 - .3 Holes shall be provided in the base rail for moving the unit by fork truck.
 - .4 Base rail shall be a minimum of 15 gauge thickness.
- .7 Electrical Connections:

- .1 All unit power wiring shall enter unit cabinet through a field drilled hole located by a factory provided dimple.
- .2 Through- the- base capability.
 - .1 Standard unit shall have a through-the- base electrical location(s) using a raised, embossed portion of the unit base-pan.
 - .2 No base-pan penetration, other than those authorized by the manufacturer, is permitted.
- .8 Top Panel:
 - .1 Shall be a multi-piece top panel.

1.11 GAS HEAT

- .1 General:
 - .1 Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
 - .2 Shall incorporate a direct- spark ignition system and redundant main gas valve.
 - .3 Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
 - .4 Burners shall be of the in- shot type constructed of aluminum- coated steel.
 - .5 Burners shall incorporate orifices for rated heat output up to 2000 ft. (610m) elevation. Additional accessory kits may be required for applications above 2000 ft. (610m) elevation, depending on local gas supply conditions.
 - .6 Each heat exchanger tube shall contain multiple dimples for increased heating effectiveness.
- .2 The gas furnace shall be controlled by an integrated gas controller (IGC) microprocessor.
 - .1 IGC board shall notify users of fault using an LED (light- emitting diode).
 - .2 Unit shall be equipped with anti- cycle protection with one cycle on the unit flame rollout switch, 3 short cycles on the high temperature limit switch, one cycle on the auxiliary limit switch, and one cycle on indoor blower fault detection. Fault indication shall be made using an LED.
- .3 Stainless Steel Heat Exchanger construction:
 - .1 The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20- gauge type 409 stainless steel.
 - .2 Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
- .4 Induced draft combustion motor and blower:
 - .1 Shall be a direct- drive, single inlet, forward- curved centrifugal type.
 - .2 Shall be made from steel with a corrosion- resistant finish.
 - .3 Shall have permanently lubricated sealed bearings.
 - .4 Shall have inherent thermal overload protection with automatic reset feature.

- .5 Modulating Gas Heat:
 - .1 Shall modulate flow of gas through to furnace to allow for incremental change of heating capacity, with capability of adjusting by as little as 1%.
 - .2 Shall have a turndown ratio of 2.85 to 1.
 - .3 Heat exchangers shall be of stainless steel construction.

1.12 COILS

- .1 Evaporator Coils, Aluminum Fin Copper Tube:
 - .1 Standard evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
 - .2 Shall be leak tested to 150 psig, pressure tested to 250 psig, and burst qualified to CSA C22.2 No. 60335-2-40.th edition burst test at 1775 psig.
 - .3 Assembled unit shall be pressure tested to 450 psig.
- .2 Condenser Coils, All Aluminum Microchannel:
 - .1 Condenser coils shall have all aluminum microchannel design consisting of aluminum multiport flat tube design and aluminum fin. Coils shall be a furnace brazed design and contain epoxy lined shrink wrap on all aluminum to copper connections.
 - .2 Microchannel condenser coils shall be leak tested to 150 psig, pressure tested by supplier to 600 psig, and burst qualified to CSA C22.2 No. 60335-2-40.
 - .3 Assembled unit shall be pressure tested to 450 psig.

1.13 REFRIGERANT CIRCUITS

- .1 Speed and Variable Air Volume 4 Speed Intelli airflow options shall have 2 independent refrigerant circuits with 4 stages of cooling.
- .2 Refrigerant circuit shall include the following control, safety, and maintenance features:
 - .1 Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range.
 - .2 Refrigerant filter drier - Solid core design.
 - .3 Liquid line filter drier/strainer.
 - .4 Discharge line high pressure switch.
 - .5 Suction line freezestat.
 - .6 Low pressure / loss-of-charge switch.
 - .7 Accessible service gauge connections on both suction and liquid line.
- .3 Compressors:
 - .1 Unit shall use fully hermetic scroll compressors for each independent refrigeration circuit.
 - .2 Four stage models that are 15, 17.5, or 20 tons shall use a two speed compressor on circuit one and a fixed speed compressor on circuit two.

- .3 Compressor motors shall be cooled by refrigerant gas passing through motor windings.
- .4 Compressors shall be internally protected from high discharge temperature conditions.
- .5 Compressors shall be protected from an over- temperature and over- amperage conditions by an internal, motor overload device.
- .6 Compressor shall be factory mounted on rubber grommets.
- .7 Crankcase heaters shall be installed in the factory as needed on tandem compressor sets.

1.14 FILTER SECTION

- .1 Filter access is specified in the unit cabinet section of this specification.
- .2 100 mm (4") MERV 13 filters shall be furnished and be accessible through a hinged access door, sealed airtight. Units filter track shall be designed to accommodate 4" filters. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating air by-pass of the coil.

1.15 EVAPORATOR FAN AND MOTOR

- .1 Evaporator Fan Motor:
 - .1 Shall have permanently lubricated ball bearings.
 - .2 Shall have inherent automatic- reset thermal overload protection.
 - .3 The job site selected brake horsepower shall be required to not exceed the motor's nameplate horsepower rating plus the service factor.
- .2 Evaporator Fan:
 - .1 Fan shall be a belt drive assembly with an adjustable pitch motor pulley.
 - .2 Blower bearings shall have an L10 life of 100,000 hrs.
 - .3 Shall use sealed, permanently lubricated ball-bearing type.
 - .4 Shall use dual blower design consisting of two balanced blower fans on a single shaft.
 - .5 Blower fan shall be double- inlet type with forward- curved blades.
 - .6 Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

1.16 CONDENSER FANS AND MOTORS

- .1 Condenser fan motors:
 - .1 Shall be a totally enclosed motor and internally protected against overload conditions and staged independently.
 - .2 Shall use permanently lubricated ball-bearings and shall be dynamically balanced.
 - .3 Shall have inherent thermal overload protection with an automatic reset feature.

- .4 Shall use a shaft- down design.
- .2 Condenser Fans:
 - .1 Shall be a direct- driven propeller type fan discharging air vertically. Fan shall be dynamically balanced for smooth operation.

1.17 SPECIAL FEATURES OPTIONS AND ACCESSORIES

- .1 Phase Monitor:
 - .1 Shall provide protection against reversal, phase loss and phase unbalance.
 - .2 Switch shall automatically shut off unit control circuit if any of the above conditions is detected.
 - .3 Shall have visual LED indication of operational status.
- .2 Low Leak Economizer:
 - .1 Integrated, tie-bar driven parallel modulating blade design type capable of simultaneous economizer and compressor operation.
 - .2 Damper blades shall be galvanized steel with tie-bar metal linkages. Plastic or composite blades on intake or return shall not be acceptable.
 - .3 Damper blades shall be class 1A dampers.
 - .4 Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below set points.
 - .5 Shall be equipped with tie-bar driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
 - .6 Economizer shall comply with, and be certified to, the AMCA 511 standard.
 - .7 Standard leak rate shall be equipped with dampers not to exceed 15.3 l/s / m² (3 cfm/ft²) leakage at 250 Pa (1") wg pressure differential.
 - .8 Economizer controller shall be the Johnson Controls SE Economizer Controller.
 - .1 On- board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is not operating properly, meets the requirements for California Title 24, IECC 2015, and ASHRAE 90.1.
 - .2 Display alarms if the following occur:
 - .1 Economizer is economizing when conditions do not support.
 - .2 Economizer is not economizing when conditions do support.
 - .3 Damper Stuck.
 - .4 Excess Outdoor Air.
 - .5 Failed Sensor Automatic sensor detection.
 - .3 Capabilities for use with multiple-speed indoor fan systems.
 - .4 Utilize digital sensors: Dry bulb and Enthalpy.
 - .5 UL, CSA, and ICES-003 recognized and FCC compliant to CFR47.

- .9 Shall be capable of introducing up to 100% outdoor air.
- .10 Shall be equipped with a barometric relief damper capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1 requirements. Barometric relief can be replaced by optional power exhaust.
- .11 Shall be designed to close damper(s) during loss- of- power situations with spring return built into motor.
- .12 Dry bulb outdoor air temperature sensor shall be provided as standard. Single or dual enthalpy sensing is available as a factory or field installed sensing option. Outdoor air sensor set point shall be adjustable and shall range from 40° to 80°F / 4° to 27°C. Additional sensor options shall be available as accessories.
- .13 The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
- .14 The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
- .15 Dampers shall be completely closed when the unit is in the unoccupied mode.
- .16 Economizer controller shall accept a 2-10 Vdc CO2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
- .17 Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.
- .3 Variable Frequency Drive (VFD). Available on multi-speed (IntelliSpeed) and VAV indoor fan motor options:
 - .1 Shall be installed inside the unit cabinet, mounted, wired and tested.
 - .2 Shall contain Electromagnetic Interference (EMI) frequency protection.
 - .3 Insulated Gate Bi- Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform.
 - .4 Built in LED display and controls. Does not require additional kit or options.
 - .5 RS485 capability standard.
 - .6 Electronic thermal overload protection.
 - .7 All printed circuit boards shall be conformal coated.

1.18 UNIT CONTROLS

- .1 Unit Controls, the Unit Control Board shall include the following:
 - .1 Self-contained low-voltage control circuit protected by a circuit breaker on the 24-volt transformer side.
 - .2 Lockout circuit to provide reset capability at the space thermostat should any of the following standard safety devices trip and shut off compressor.
 - .1 Loss-of-charge/Low-pressure switch.
 - .2 High-pressure switch.

- .3 Freeze-protection thermostat (evaporator coil).
- .3 Automatically-resetting compressor over temperature and over current protection.
- .4 Low voltage terminal strip for easy hook-up to a thermostat.
- .5 Microprocessor On-board diagnostics and fault code display by a LED indicator.
- .6 Independent monitoring of each refrigerant safety switch.
- .7 Retention of last 5 fault codes in non-volatile memory.
- .8 Anti-short cycle protection.
- .9 Low voltage protection.
- .10 Cooling operation down to 0°.

1.19 UNIT MOUNTED, NON-FUSED DISCONNECT SWITCH

- .1 Switch shall be factory installed, internally mounted.
- .2 National Electric Code (NEC) and UL approved non-fused switch shall provide unit power shutoff.
- .3 Shall be accessible from outside the unit.
- .4 Shall provide local shutdown and lockout capability.

1.20 NON-POWERED CONVENIENCE OUTLET

- .1 Outlet shall be powered from a separate 115/1120 V power source.
- .2 A transformer shall not be included.
- .3 Outlet shall be factory installed and internally mounted with easily accessible 115- v female receptacle.
- .4 Outlet shall include 15 amp GFI receptacles with independent fuse protection.
- .5 Outlet shall be accessible from outside the unit.

Part 2 Products

2.1 MANUFACTURERS

- .1 Trane.
- .2 Johnson Controls.
- .3 Lennox.

2.2 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Products Requiring Electrical Connection: listed and classified by CSA as suitable for the purpose specified and indicated.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 71 00: verify existing conditions before starting work.

- .2 Verify that roof is ready to receive work and opening dimensions are as illustrated by the manufacturer.
- .3 Verify that proper power supply is available.

3.2 INSTALLATION

- .1 Install as per manufacturer's written instructions.
- .2 Mount units on factory built roof mounting curb and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof structure with anchor bolts. Install roof mounting curb level.
- .3 Remove roof decking only as required for curb. Install ducts to termination at top of roof passage of ducts; do not cut out decking under entire roof curb.
- .4 Connect gas piping to burner, full size of gas train inlet, with union and shutoff valve with sufficient clearance for burner removal and service.
- .5 Locate remote panels where indicated.
- .6 Install condensate drain, minimum connection size, with trap and direct to nearest roof.

3.3 OPERATOR HANDS-ON TRAINING

- .1 As a minimum, hands-on training for operations personnel will include:
 - .1 Discussing, demonstrating, and performing standard operating procedures and round checks.
 - .2 Discussion and performing the preventative maintenance activities.
 - .3 Discussing and performing the performing start-up and shutdown procedures.
 - .4 Performing the required equipment exercise procedures.
 - .5 Performing routing disassembly and assembly of equipment if applicable.
 - .6 Identifying and reviewing safety items and performing safety procedures, if feasible.

3.4 MAINTENANCE HANDS-ON TRAINING

- .1 Hands-on training for maintenance and repair personnel will include:
 - .1 Locating and identifying equipment components.
 - .2 Reviewing the equipment function and theory of operation.
 - .3 Reviewing normal repair procedures.
 - .4 Performing routine start-up and shutdown procedures.
 - .5 Reviewing and performing the safety procedures.
 - .6 Reviewing and using equipment manufacturer's manuals in the hands-on training.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:

- .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, verify compliance of work with Contract.
- .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 at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Upon completion of work, after cleaning is carried out.
- .2 Obtain reports within 3 days of review and submit immediately to DCC Representative.
- .3 Verify accessibility, serviceability, of components including motorized damagers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
- .4 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.
- .5 Performance Verification:
 - .1 Rooftop Air Handling Units:
 - .1 Set zone mixing dampers for full cooling, except that were diversity factor forms part design set that 50% of zone dampers to full heating.
 - .2 Set outside air and return air dampers for minimum outside air.
 - .3 Check for smooth, vibration less correction rotation of supply fan impeller.
 - .4 Measure supply fan capacity.
 - .5 Adjust impeller speed as necessary and repeat measurement of fan capacity.
 - .6 Measure pressure drop each component of air handling unit.
 - .7 Set outside air and return air dampers for the 20% of outside air required by design and repeat measurements of fan capacity.
 - .8 Reduce difference between fan capacity at minimum and maximum outside air less than 5%.
 - .9 Set face and bypass dampers to full bypass and repeat measurement of fan capacity.
 - .10 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5%.
 - .11 OAD: verify for proper stroking, interlock with RAD.
 - .12 Measure DBT, WBT of SA, RA, EA.
 - .13 Measure air cooled condenser discharge DBT.

- .14 Measure flow rates (Minimum and maximum) of SA, RA, EA, relief air.
- .15 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
- .16 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.
- .17 Simulate maximum heating load and:
 - .1 Verify temperature rise across heat exchanger.
 - .2 Perform flue gas analysis. Adjust for peak efficiency.
 - .3 Verify combustion air flow to heat exchanger.
 - .4 Simulate minimum heating load and repeat measurements.
- .18 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
- .19 Verify operating control strategies, including:
 - .1 Heat exchanger operating and high limit.
 - .2 Early morning warm-up cycle.
 - .3 Freeze protection.
 - .4 Economizer cycle operation, temperature of change-over.
 - .5 Alarms.
 - .6 Voltage drop across thermostat wiring.
 - .7 Operation of remote panel including pilot lights, failure modes.
- .20 Set zone mixing dampers for full heating and repeat measurements.
- .21 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.
- .22 Adjust impeller speed as necessary and repeat measurement of return fan capacity.
- .23 Check capacity of heating unit.
- .24 Measure DX refrigeration system performance as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .25 Refer to other sections of these specifications for PV procedures for other components.

END OF SECTION

Section 23 81 23 Computer Room Air Conditioning

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 -Submittal Procedures
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .3 Section 01 78 00 - Closeout Submittals

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1-92, Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices
Used in General Ventilation for Removing Particulate Matter.
- .2 ASTM International (ASTM):
 - .1 [ASTM C547-19](#), Specification for Mineral Fiber Pipe Insulation
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters For Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.15-M91, High Efficiency, Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
- .4 CSA Group (CSA)
 - .1 [CSA B52-18](#), Mechanical Refrigeration Code
 - .2 [CSA C656-14](#), Performance Standard for Split-System and Single-Package Central Air Conditioners and Heat Pumps
- .5 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate major components and accessories including sound power levels of units.
- .3 Type of refrigerant used.

1.4 CLOSEOUT SUBMITTALS

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 19 - Waste Management And Disposal.

1.6 WARRANTY

- .1 For refrigeration compressors, the 12 months warranty period prescribed in subsection GC 3.13 of DCL 250 - Standard Construction Contract Documents - General Conditions is extended to 5 years.

Part 2 Products

2.1 GENERAL

- .1 Integrated package: to CAN/CSA-C656.
- .2 System type:
 - .1 Air flow arrangement: horizontal.
 - .2 Cooling: direct expansion.
 - .3 Condensing: air cooled.

2.2 DESCRIPTION

- .1 Cooling and dehumidifying capacity, with fan heat extracted: based on computer room environment of 22 degrees C dry bulb and 50% R.H. (plus or minus 1 degree C and 5% R.H.), with minimum supply air temperature of 14 degrees C and minimum control dead-band of 3% R.H. separating humidification and dehumidification capable to operate at low ambient temperature of - 40 deg.C .
- .2 Unit capacity: as per schedule on drawings.
- .3 The air conditioning system shall be a packaged air cooled split system with variable compressor speed inverter technology. The outdoor unit shall be pre-charge with R-410A refrigerant. The system shall consist of a wall mounted evaporator section with wired controller and a horizontal discharge, single phase power, matching outdoor condensing unit.

2.3 OUTDOOR UNIT

- .1 The outdoor unit shall be compatible with the indoor unit.
- .2 The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all functions necessary for operation and it shall be completely factory assembled.
- .3 This unit shall be capable of operating at -40 degrees C ambient temperature without additional low ambient controls.
- .4 The outdoor unit shall have the ability to operate with the tubing length between the indoor and the outdoor units with sufficient oil return and without additional requirement for field supplied line segments, or refrigerant pipe traps.

- .5 The unit shall be test run at the factory prior to being supplied.
- .6 The casing shall be constructed from galvanized steel plate and finished with rust protector such as acrylic paint Munsell 3Y7.8/1.1 or equal.
- .7 The fan grille shall be of ABS plastic or similarly suitable material.
- .8 The unit shall be furnished with an AC fan as per the manufacturer's recommendations to match the capacity of the indoor unit.
- .9 The fan blades shall be of aerodynamic design for quiet operation.
- .10 The fan motor bearings shall be permanently lubricated.
- .11 The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front.
- .12 The L-shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build-up.
- .13 The coil shall be protected with an integral metal guard.
- .14 Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be controlled by a microprocessor-controlled step motor.

2.4 COMPRESSOR

- .1 The compressor shall be a Hermetic rotary compressor with a Variable Compressor Speed Inverter Technology.
- .2 The compressor shall be driven by inverter circuit to control compressor speed.
- .3 The compressor speed shall match the room load.
- .4 The outdoor unit shall have high pressure safety switch and overcurrent protective device.

2.5 ELECTRICAL

- .1 Both the outdoor and indoor units shall be 208V, 1 phase, 60 Hz.
- .2 The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
- .3 The control signal between the indoor and the outdoor units shall be pulse signal 24 volts DC.
- .4 The unit shall have pulse amplitude modulation circuit which shall enable the unit to use 98% of input power supply.

2.6 INDOOR UNIT

- .1 The indoor unit shall be factory assembled, wired and tested.
- .2 All factory wiring and internal piping, control circuit board and fan motor shall be contained within the unit. The indoor unit shall pull room air at the top and dispel conditioned air at the bottom.
- .3 The unit in conjunction with the remote wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch.

- .4 Refrigerant piping for the indoor unit shall be charged with helium gas before shipment from the factory.
- .5 Return air shall be filtered by means of an easily removable and washable filter.
- .6 The casing shall be ABS plastic and have a munsell 3.4Y7.7/0.8 finish or equal.
- .7 Multi-directional drain and refrigerant piping offering four direction for refrigerant piping and two directions for draining shall be standard.
- .8 The unit casing shall have a side plate with holes for suspending bolts which shall secure the unit suspending firmly from the hidden ceiling.
- .9 The evaporator fan shall produce a horizontal air jet as directed by the discharge louvres.
- .10 The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- .11 Manual adjustable louvers shall be provided to laterally change the direction of airflow.
- .12 A motorized valve shall close the outlet port when operation is stopped, and shall also automatically direct air flow in a vertical direction for uniform air distribution.
- .13 The fan shall consist of Low, Mid and High speeds.
- .14 The evaporator coil shall be of nonferrous construction with aluminum strake pre-coated fins on copper tubing. All tube joints shall be brazed with phosphor copper or silver alloy.
- .15 The coils shall be pressure tested at the factory.
- .16 A condensate pan and drain shall be provided under the coil.
- .17 Condensate pump, thermally protected, 15 W, 60 Hz, fully potted, self priming with suction lift to 1.2 m, with gravity inlet, assembled inline reservoir complete with lid and sensor cable, float, and stainless steel filter, inlet hose and vinyl breather and discharger tubes.

2.7 CONTROLS

- .1 The system shall have a wired controller to perform input functions necessary to operate the system.
- .2 The wire controller shall have multi-language large DOT liquid crystal display and a weekly timer with multiple pattern settings per day.
- .3 The controller shall consist of the following:
 - .1 On-Off switch.
 - .2 Cool/Dry fan selector.
 - .3 Thermostat setting.
 - .4 Timer mode.
 - .5 High/Low fan speed.
 - .6 Auto vane selector.
 - .7 Check mode switch.
 - .8 Test Run.

- .4 The controller shall have a built-in temperature sensor. It shall also consist of two microprocessors interconnected by a single non-polar two-wire cable.
- .5 Controls field wiring shall run direct from the indoor unit to the controller with no splices, and manufacturer shall provide 2 conductor non-polar 22 AWG stranded wire for connection to remote controller.
- .6 The system shall have self-diagnostics with codes for indoor and outdoor unit displayed on wired remote panel.
- .7 Controller shall display operating conditions such as pipe temperatures, compressor operating conditions, LEV opening pulses, sub-cooling and discharge super heat.
- .8 The microprocessor within the wall mounted remote controller shall provide automatic cooling, display setpoint and the room temperature.
- .9 Control system shall control the continued operation of the air sweep louvers as well as provide On/Off switching.
- .10 The microprocessor located in the indoor unit shall have the capability to monitor return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit, and shall have BACnet interface for connection to the BAS in accordance with Div.25.
- .11 The control voltage from the controller to the indoor unit shall be 12 volts, DC.
- .12 The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC.
- .13 The system shall be capable of automatic restart when power is restored after power interruption.

2.8 ACCEPTABLE MANUFACTURERS

- .1 Mitsubishi, Lennox, Samsung , York/Johnson Controls , Fujitsu.

2.9 REFRIGERANT PIPING, VALVES, FITTINGS AND ACCESSORIES WITHIN UNIT

- .1 To CSA B52.
- .2 Include for each refrigerant circuit:
 - .1 Thermal expansion valve, external equalizing type.
 - .2 Combination filter-dryer.
 - .3 Solenoid valves.
 - .4 Liquid sight glass with moisture indicator.
 - .5 Refrigerant line insulation: flexible elastomeric unicellar to ASTM C 547, 12 mm minimum thickness and as per local Code requirements.
 - .6 Refrigerant Charge:
 - .1 Holding charge of refrigerant applied at factory.

2.10 SEQUENCES OF OPERATIONS

- .1 Refer to the Flow Diagrams and Controls drawings for schematics and sequences of operations.

2.11 ENVIRONMENTAL CONTROLS

- .1 Solid state electronic control system.
- .2 Wall mounted control to include following:
 - .1 Manual operation and adjustment:
 - .1 On-Off air conditioning system control.
 - .2 Room temperature set point, indicator and sensitivity adjustment controller.
 - .3 Room humidity set point, indicator and sensitivity adjustment controller.
 - .4 Alarm silencing switch for each alarm point.
 - .5 Compressor lead-lag selection switch.
 - .6 Alarm circuits test switch.
 - .2 Operational: Visual and Audible Alarm:
 - .1 Loss of air flow.
 - .2 Loss of liquid flow.
 - .3 High room temperature.
 - .4 Low room temperature.
 - .5 High humidity.
 - .6 Low humidity.
 - .7 High head pressure.
 - .3 Operational: Visual Display:
 - .1 Cooling each stage.
 - .2 Reheat stage 1 and 2.
 - .3 Humidification.
 - .4 Dehumidification.
 - .5 Change filter.

2.12 REFRIGERANT CHARGE

- .1 Charge refrigerant system at factory, seal and test.

Part 3 Execution

3.1 GENERAL

- .1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

3.2 EQUIPMENT PREPARATION

- .1 Provide services of manufacturer's site engineer to set and adjust equipment for operation as specified.

3.3 START-UP AND PERFORMANCE VERIFICATION

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements: report form and schematics.
- .3 Manufacturer to certify installation.
- .4 Complete Garrison Toronto Halocarbon Management System - New Equipment Form. Form will be available from DCC Representative. Complete one form for each system.
- .5 Complete Garrison Toronto Halocarbon Management System Service Log as part of the initial charge. Form will be available from DCC Representative. Complete one form for each system.
- .6 Perform leak test on each system. Attach the copy to unit with a second copy to be turned over to DCC Representative.

3.4 OPERATOR HANDS-ON TRAINING

- .1 As a minimum, hands-on training for operations personnel will include:
 - .1 Discussing, demonstrating, and performing standard operating procedures and round checks.
 - .2 Discussion and performing the preventative maintenance activities.
 - .3 Discussing and performing the performing start-up and shutdown procedures.
 - .4 Performing the required equipment exercise procedures.
 - .5 Performing routing disassembly and assembly of equipment if applicable.
 - .6 Identifying and reviewing safety items and performing safety procedures, if feasible.

3.5 MAINTENANCE HANDS-ON TRAINING

- .1 Hands-on training for maintenance and repair personnel will include:
 - .1 Locating and identifying equipment components.
 - .2 Reviewing the equipment function and theory of operation.
 - .3 Reviewing normal repair procedures.
 - .4 Performing routine start-up and shutdown procedures.
 - .5 Reviewing and performing the safety procedures.
 - .6 Reviewing and using equipment manufacturer's manuals in the hands-on training.

END OF SECTION

Section 25 01 11

EMCS: Start-Up, Verification and Commissioning

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 25 05 01 - EMCS: General Requirements

1.2 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:
 - .1 Controller automatically and correctly operated in stand-alone mode.
 - .2 Failure was not due to failure of any specified EMCS equipment.
 - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

- .1 Confirm with DCC Representative that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to DCC Representative.
 - .1 Include measurements, final settings and certified test results.

- .2 Bear signature of commissioning technician and supervisor
- .3 Report format to be approved by DCC Representative before commissioning is started.
- .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to DCC Representative in accordance with Section 01 78 00 - Closeout Submittals.
- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of DCC Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.
- .2 Carry out commissioning in presence of DCC Representative.
- .3 Inform, and obtain approval from, DCC Representative in writing at least 14 days before commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of DCC Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by DCC Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2months before tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Commissioning Manager.
- .3 Commission integrated systems using procedures prescribed by Commissioning Manager.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of site tests of equipment just before installation.
 - .2 Testing may be on site or at Contractor's premises as approved by DCC Representative.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .2 DP switches used for dirty filter indication and fan status.
 - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0and 500Pa, to hold steady at any setting and with direct output to milli-amp metre at source.

- .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
- .8 Transmitters above 0.5 % error will be rejected.
- .9 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate site hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.
 - .11 Blow out flow measuring and static pressure stations with high pressure air at 700kPa.
 - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and DCC Representative. This document will be used in final startup testing.
 - .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system and provide:
 - .1 2 technical personnel capable of re-calibrating site hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 DCC Representative's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.

- .6 Commissioning to be supervised by qualified supervisory personnel and DCC Representative.
- .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
- .8 Operate systems as long as necessary to commission entire project.
- .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Before beginning of 30day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
 - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
 - .6 Correct defects when they occur and before resuming tests.
- .5 Commissioning Managerto verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Commissioning Manager and DCC Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Commissioning Manager and DCC Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

DRDC HVAC Compliance Upgrade

**1133 Sheppard Ave. W,
Toronto, ON M3M 3B9**

Project No: TT210006-BE21207056

2023-02-17

Section 25 01 11
EMCS: Start-Up, Verification and Commissioning

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END OF SECTION

Section 25 01 12 EMCS: Training

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 25 05 01 - EMCS: General Requirements

1.2 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to DCC Representative 30 days before anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 DCC Representative reserves right to approve instructors.

1.5 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.6 TIME FOR TRAINING

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.

- .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

- .1 Two (2) day program to begin before 30 day test period at time mutually agreeable to Contractor, DCC Representative and Commissioning Manager.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

1.9 ADDITIONAL TRAINING

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

- .1 DCC Representative to monitor training program and may modify schedule and content.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 25 05 01

EMCS: General Requirements

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 25 05 54 - EMCS: Identification

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE 260.1-2004, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 135-2016, BACnet--A Data Communication Protocol for Building Automation and Control Networks.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-00(R2011), Canadian Metric Practice Guide.
- .5 Consumer Technology Association (CTA).
 - .1 CTA-709.1-D-2014, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act, 2012 (S.C. 2012, c. 19, s. 52)
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act(TDGA), 1992, c. 34.

1.3 ABBREVIATIONS AND ACRONYMS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level
 - .2 AI - Analog Input

- .3 AIT - Agreement on International Trade
- .4 AO - Analog Output
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Centre.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.

- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.4 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
 - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to [ANSI/IEEE 260.1](#).
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.5 SYSTEM DESCRIPTION

- .1 Refer to control schematics for system architecture.
- .2 EMCS is to have the capability to remove monitored, but will not be connected via Base Communications as part of this project.
- .3 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 Data communications equipment necessary to effect EMCS data transmission system.
 - .4 Field control devices.
 - .5 Acceptance tests, technical support during commissioning, full documentation.
 - .6 Wiring interface coordination of equipment supplied by others.
 - .7 Miscellaneous work as specified in these sections and as indicated.
- .4 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by DCC Representative before installation.
 - .3 Location of controllers as reviewed by DCC Representative before installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with [CAN/CSA Z234.1](#).
- .5 Language Operating Requirements:
 - .1 Provide English operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
 - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
 - .5 Include, in English:
 - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions

and not related to system modifications, additions, or logic re-
refinements).

- .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in English.
- .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers within 10 days after award of contract.
 - .2 Complete control schematics with corresponding sequences of operation.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by DCC Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
 - .6 Permits and fees: in accordance with general conditions of contract.
 - .7 Submit certificate of acceptance from authority having jurisdiction to DCC Representative.

1.7 QUALITY ASSURANCE

- .1 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

Part 2 Products

2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to CTA 709.1, ASHRAE STD 135.

2.2 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

END OF SECTION

Section 25 05 54 EMCS: Identification

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 25 05 01 - EMCS: General Requirements

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 [CSA C22.1-18](#), The Canadian Electrical Code, Part I 9th Edition), Safety Standard for Electrical Installations (24th Edition)

1.3 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
- .2 Submit to DCC Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

- .1 Identify by 3 mm thick melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: as required.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain or plastic tie.
- .2 Sizes: 50 mm x 100mm mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by DCC Representative.
- .3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS".

2.5 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to [CSA C22.1](#). Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with DCC Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times

END OF SECTION

Section 25 08 20 EMCS: Warranty and Maintenance

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 25 05 01 - EMCS: General Requirements

1.2 REFERENCE STANDARDS

- .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations
- .2 CSA Group (CSA):
 - .1 [CSA Z204-94\(R1999\)](#), Guidelines for Managing Indoor Air Quality in Office Buildings

1.3 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to DCC Representative.
- .3 Submit detailed inspection reports to DCC Representative.
- .4 Submit dated, maintenance task lists to DCC Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Maintain records and logs of each maintenance task on site.

- .2 Organize cumulative records for each major component and for entire EMCS chronologically.
- .3 Submit records to DCC Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to DCC Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.5 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish DCC Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 48 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of DCC Representative.

1.6 SERVICE CONTRACTS

- .1 Provide in-depth technical expertise and assistance to DCC Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
 - .1 Annual verification of site points for operation and calibration.
 - .2 4 visits per year.
 - .3 4 responses to emergency calls during day, per year.
 - .4 Complete inventory of installed system.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to DCC Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check and Calibrate each site input/output device in accordance with [CSA Z204](#).
 - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with DCC Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.

- .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
- .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
- .5 Provide mechanical adjustments, and necessary maintenance on printers.
- .6 Run system software diagnostics as required.
- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Section 25 10 01 EMCS: Local Area Network (LAN)

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 25 05 01 - EMCS - General Requirements

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 [CSA T530-99\(R2004\)](#), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications)
 - .2 [CSA T568.1-4-05\(R2010\)](#), Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 4 - Recognition of Category 6 and 850 nm Laser-Optimized 50/125 um Multimode Optical Fiber Cabling.
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements:
 - .1 IEEE 802.3-2018, IEEE Standard for Ethernet.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA):
 - .1 TIA/EIA 568 SET, Commercial Building Telecommunications Cabling Standard Set, 2009.
 - .2 TIA 569, Commercial Building Standard for Telecommunications Pathways and Spaces, 2012.
- .4 Treasury Board Information Technology Standard (TBITS):
 - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

1.4 SYSTEM DESCRIPTION

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with [CSA T529.1-4](#), [CSA T530](#), TIA 569 and TBITS 6.9.
 - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
 - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
 - .1 EMCS-LAN.

- .2 Modems.
- .3 Network interface cards.
- .4 Network management hardware and software.
- .5 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
 - .1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
 - .2 EMCS-LAN to: BACnet,.
 - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
 - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
 - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
 - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
 - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
 - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
 - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
 - .1 Network medium: shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 25 10 02

EMCS: Operator Work Station (OWS)

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Hardware and software requirements for an Operator Work Station (OWS) in a Building Energy Monitoring and Control System (EMCS), including primary, secondary, portable and remote OWS's.

1.2 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 25 05 01 - EMCS: General Requirements
- .3 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- .2 Portable OWS: used as remote dial-up OWS with same capabilities as primary OWS including graphic display.
- .3 Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

1.4 OWS SYSTEM DESCRIPTION

- .1 Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.
- .2 Primary OWS to include:
 - .1 Report printer.
 - .2 Colour graphics printer.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.6 ENVIRONMENTAL CONDITIONS

- .1 OWS to operate in conditions of 10°C to 32°C and 20% to 90% non-condensing RH.

Part 2 Products

2.1 OWS HARDWARE

- .1 PC system to include:
 - .1 Processor: Pentium IV micro-processor, operating at minimum clock speed of 2 Gigahertz, capable of supporting software necessary to perform functions specified in this section. System backplane bus (100 Megahertz) to support PCI and ISA boards.

- .2 Internal clock.
 - .1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year / month / day / hour / minute / second.
 - .2 Rechargeable batteries: to provide minimum 48 hours clock operation in event of power failure.
 - .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.
- .2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.
- .3 Include UPS to provide 5 minutes minimum operation of PC, CRT and communication and peripheral devices; applies to fixed (non portable) OWSs and peripherals.

2.2 OWS PC COMPONENTS

- .1 Primary OWS: IBMPC compatible with following as minimum:
 - .1 IDE Disk drive controller to support 4 drives.
 - .1 1-160 GB hard disk drive, 12 ms.
 - .2 1-16X DVD-RW drive.
 - .2 4 GB RAM minimum.
 - .3 Enhanced 101 key keyboard.
 - .4 PS2 mouse.
 - .5 Monitor: 19". Flat panel display TFT.
 - .6 Integrated HD graphics.
 - .7 2 Parallel Ports to support printers.
 - .8 4 USB 2.0 ports and 2 USB 2.0 ports.
 - .9 PCI Ethernet LAN Adapter to connect to local Ethernet LAN network.
 - .10 200 W minimum power supply.

2.3 PRINTERS

- .1 Report printer: Include following features:
 - .1 Laser printer.
 - .2 Accommodate 8.5 X 11" and 8.5 X 14" paper.
 - .3 Minimum 1200 by 1200 dpi resolution.
 - .4 Minimum 16 MB RAM, expandable to minimum 72 MB RAM.
 - .5 Minimum 18 pages per minute print speed.

2.4 OPERATING SYSTEM (OS) OR EXECUTIVE

- .1 OS to support complement of hardware terminals and software programs specified.
- .2 OS to be true multitasking operating environment.

- .1 MS DOS or PC DOS based software platforms not permitted.
- .3 OWS software to operate in "Windows" based operating environment: Windows 2000, XP or Unix "X" Windows based system.

2.5 OWS CONTROL SOFTWARE

- .1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.
- .2 Time Synchronization Module.
 - .1 System to provide Time Synchronization of real-time clocks in controllers.
 - .2 System to perform this feature on regular scheduled basis and on operator request.
- .3 User Display Interface Module.
 - .1 OWS software to support " Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.
 - .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of site change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.
- .4 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:
 - .1 Operator Log-in from user interface device.
 - .2 Communication messages: errors, failures and recovery.
 - .3 Event notifications and alarms by category.
 - .4 Record of operator initiated commands.
- .5 General Event Log:
 - .1 Hold minimum of 4 months information and be readily accessible to operator.
 - .2 Able to be archived as necessary to prevent loss of information.
- .6 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:
 - .1 Automatic logging of digital alarms and change of status messages.

- .2 Automatic logging of analog alarms.
- .3 System changes: alarm limits, set-points, alarm lockouts.
- .4 Display specific point values, states as selected.
- .5 Provide reports as requested and on scheduled basis when required.
- .6 Display graphics as requested, and on alarm receptions (user's option).
- .7 Display list of points within system.
- .8 Display list of systems within building.
- .9 Direct output of information to selected peripheral device.
- .10 On-line changes:
 - .1 Alarm limits.
 - .2 Setpoints.
 - .3 Deadbands.
 - .4 Control and change of state changes.
 - .5 Time, day, month, year.
 - .6 Control loop configuration changes for controller-based CDLs.
 - .7 Control loop tuning changes.
 - .8 Schedule changes.
 - .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
- .11 According to assigned user privileges (password definition) following functions are to be supported:
 - .1 Permit operator to terminate automatic (logic based) control and set value of site point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
 - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
- .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.
- .7 Dial-up host Module for off site OWSs.
 - .1 Operators at dial-up OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.
 - .2 Operator to be able to access remote buildings by selection of facility by its logical name. Dial-up module to maintain user-definable cross-reference of buildings and associated telephone numbers without manual dialing.

- .3 Local OWS may serve as dial-up host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via dial-up transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.
- .8 Message Handling Module - and Error Messages: to provide message handling for following conditions:
 - .1 Message and alarm buffering to prevent loss of information.
 - .2 Error detection correction and retransmission to guarantee data integrity.
 - .3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.
- .9 Access Control Module.
 - .1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:
 - .1 Guest: no password data access and display only.
 - .2 Operator Level: full operational commands including automatic override.
 - .3 Technician: data base modifications.
 - .4 Programmer: data base generation.
 - .5 Highest Level: system administration - password assignment addition, modification.
 - .2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.
- .10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.
 - .1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 6 month capacity.
 - .2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO, set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 hours basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.

- .3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.
- .4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.
- .5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.
- .11 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level. Refer also to Section 25 30 01 - EMCS: Building Controllers.
 - .1 Reports to include time, day, month, year, report title, operator's initials.
 - .2 Software to provide capability to:
 - .1 Generate and format reports for graphical and numerical display from real time and stored data.
 - .2 Print and store reports as selected by operator.
 - .3 Select and assign points used in such reports.
 - .4 Sort output by area, system, as minimum.
 - .3 Periodic/automatic report:
 - .1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.
 - .2 Reports to include:
 - .1 Power demand and duty cycle summary: see application program for same.
 - .2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.
 - .3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.

- .4 Summary of run time alarms: include point name, run time to date, alarm limit.
- .5 Summary of start/stop schedules: include start/stop times and days, point name.
- .6 Motor status summary.
- .4 Report types:
 - .1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
 - .2 Points in accessible from this OWS (total connected for this location), multiple "areas".
 - .3 Area (points and systems in Area).
 - .4 Area, system (points in system).
 - .5 System (points by system type).
 - .6 System point (points by system and point object type).
 - .7 Area point (points by system and point object type).
 - .8 Point (points by point object type).
 - .5 Summary report: printout or display of point objet data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
 - .6 Include preformatted reports as listed in Event/Alarm Module.
- .12 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.
 - .1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlaid with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.
 - .2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.
 - .3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.

- .4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:
 - .1 Modify portion of graphic picture/schematic background.
 - .2 Delete graphic picture.
 - .3 Call up and cancel display of graphic picture.
 - .4 Define symbols.
 - .5 Position and size symbols.
 - .6 Define background screens.
 - .7 Define connecting lines, curves.
 - .8 Locate, orient, size descriptive text.
 - .9 Define, display colours of elements.
 - .10 Establish co-relation between symbols or text and associated system points or other graphic displays.
- .5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.
- .6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.
- .7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress. If interface is unable to display several different types of display at same time, provide at minimum 2OWS's.
- .8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by DCC Representative. In addition provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and, flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. DCC Representative to provide CAD floor layouts. Provide display of TCU-VAV's in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal value, and heating signal value. Organize table by rooms and floor groupings.
- .9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click" to activate selected graphic.

- .10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain English language.
- .13 Event/Alarm Module: displays in window alarms as received and stored in General Event Log.
 - .1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.
 - .2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.
 - .3 Alarm reports.
 - .1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
 - .2 Analog alarm limit summary: include point name, alarm limits, deviation limits.
 - .3 Summary of alarm messages: include associated point name, alarm description.
 - .4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
 - .5 EMCS to notify operator of occurrence of alarms originating at site device within following time periods of detection:
 - .1 Critical - 5 seconds.
 - .2 Cautionary - 10 seconds.
 - .3 Maintenance - 10 seconds.
 - .6 Display alarm messages in English.
 - .7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.
 - .8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgement of one alarm as acknowledgement of other alarms.

- .9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:
 - .1 Controller not responding - where possible delineate between controller and communication line failure.
 - .2 Controller responding - return to normal.
 - .3 Controller communications bad - high error rate or loss of communication.
 - .4 Controller communications normal - return to normal.
- .10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.
- .14 Archiving and Restoration Module.
 - .1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.
 - .2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.
 - .3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.
- .15 CDL Generator and Modifier Module.
 - .1 CDL Generator module to permit generation and modification of CDLs.
 - .2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.
 - .3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs Module to include graphic tools required to generate and create new object code for downloading to building controllers.
 - .4 Module to permit testing of code before downloading to building controllers.

2.6 ADDITIONAL UTILITY SOFTWARE

- .1 Supply and install on primary OWS, following CAD software products by Autodesk Inc. and include:
 - .1 AutoCAD LT latest version.
 - .2 Include special drivers, fonts, to ensure complete and proper functioning of software packages specified. Deliver system complete with full set of User Manuals.

- .3 Enter soft copy submissions, including "Record" drawings specified in Section 01 33 00 - Submittal Procedures in OWS.
- .4 Enter soft copy of Architectural, Electrical, Mechanical systems plans and "Record" drawings in OWS. Plans and drawings to be provided by DCC Representative.

Part 3 Execution

3.1 INSTALLATION REQUIREMENTS

- .1 Provide necessary power as required from local 120 V emergency power branch circuit panels for OWS's and peripheral equipment.
 - .1 Install tamper locks on breakers of circuit panels.
 - .2 Refer to UPS requirements stated under OWS Hardware in PART 2.

END OF SECTION

Section 25 30 02 EMCS: Field Control Devices

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning
- .3 Section 25 05 01 - EMCS: General Requirements
- .4 Section 25 05 54 - EMCS: Identification
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems

1.2 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/IEEE C57.13-2016, Standard Requirements for Instrument Transformers.
- .2 ASTM International (ASTM):
 - .1 [ASTM B148-18](#), Standard Specification for Aluminum-Bronze Sand Castings
- .3 National Electrical Manufacturer's Association (NEMA):
 - .1 NEMA 250-2018, Enclosures for Electrical Equipment (1000 Volts Maximum)
- .4 Air Movement and Control Association, Inc. (AMCA):
 - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating
- .5 CSA Group (CSA):
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion-resistant.

- .3 Operating conditions: 0 - 32°C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200°C and over.
 - .2 RTD's: 100 or 1000 ohm at 0°C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm °C.
 - .3 Sensing element: hermetically sealed.
 - .4 Stem and tip construction: copper or type 304 stainless steel.
 - .5 Time constant response: less than 3 seconds to temperature change of 10°C.
 - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100, 150 mm as indicated.
- .2 Room temperature sensors and display wall modules.
 - .1 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum, brushed stainless steel finish, with guard as indicated.
 - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2°C.

2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0°C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01°C per volt change.

- .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .4 Input and output short circuit and open circuit protection.
- .5 Output variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.
- .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.
- .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
- .8 Integral zero and span adjustments.
- .9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50°C.
- .10 Long term output drift: not to exceed 0.25% of full scale/ 6 months.
- .11 Transmitter ranges: select narrowest range to suit application.

2.4 CONTROL VALVES

- .1 Body: globe style.
 - .1 Flow characteristic as indicated on control valve schedule: linear, equal percentage, quick-opening.
 - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .3 Normally open, normally closed, as indicated.
 - .4 Two or three port, as indicated port, as indicated.
 - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity
 - .6 Packing easily replaceable.
 - .7 Stem, stainless steel.
 - .8 Plug and seat, bronze.
 - .9 Disc, replaceable, material to suit application.
 - .10 NPS 2 and under:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to bear ANSI mark
 - .3 Rangeability 50:1 minimum.
 - .11 NPS 2½ and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark
 - .3 Rangeability 100:1 minimum.

2.5 ELECTRONIC / ELECTRIC VALVE ACTUATORS

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.

- .2 Control signal: 0-10V DC or 4-20 mA DC.
- .3 Positioning time: to suit application.
- .4 Fail to normal position as indicated.
- .5 Scale or dial indication of actual control valve position.
- .6 Size actuator to meet requirements and performance of control valve specifications.
- .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
- .8 Minimum shut-off pressure: refer to control valve schedule.

2.6 PANELS

- .1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required.
- .3 Panels to be lockable with same key.

2.7 WIRING

- .1 For wiring under 70 volts use FT4 rated wiring. All wiring to be in conduit.
- .2 Wiring must be continuous without joints.
- .3 Sizes:
 - .1 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in [NEMA I](#) enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Electrical:
 - .1 Complete installation in accordance with Section 25 90 01 - EMCS: Site Requirements.

- .2 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .3 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
- .4 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.5 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Section 25 90 01

EMCS: Site Requirements, Applications and Systems Sequences of Operation

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Division 01 - General Requirements

1.2 SEQUENCING

- .1 Perimeter Radiation:
 - .1 On a drop in space temperature below the space temperature setpoint, control valve(s) associated with perimeter radiation heat shall open.
 - .2 On a rise in space temperature below the space temperature setpoint, control valve(s) associated with perimeter radiation heat shall close.
 - .3 EMCS shall monitor temperature and alarm if space temperature exceeds setpoint.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Section 26 05 00 Common Work Results for Electrical

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN3 C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .2 CSA C22.1-18, Canadian Electrical Code, Part I, (24th Edition), Safety Standard for Electrical Installations.
 - .3 CSA C22.3 No. 1-15, Overhead Systems.
 - .4 CSA C22.3 No. 7-15, Underground Systems.
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (MSDS).

1.3 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Language operating requirements: provide identification nameplates and labels for control items in English.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review single line electrical diagrams. Place approved single line electrical diagram under plexiglass and locate as indicated.
 - .1 Electrical distribution system in main electrical room.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by the Contractor.
 - .2 Submit electronic PDF copies of drawings and product data to the DCC Representative.
 - .3 If changes are required, notify the DCC Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide equipment and material certified to CSA standards.
 - .2 Where CSA certified equipment and material is not available, notify the DCC Representative before delivery to site. Obtain special CSA certification for the equipment or material at no cost to the Owner.
 - .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.
- .5 Manufacturer's Field Reports: submit to the DCC Representative manufacturer's written report, within 7 days of review, verifying compliance of Work as described in PART 3 - FIELD QUALITY CONTROL.
- .6 Submit all reports and forms in the Commissioning Section.

1.5 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 Electrician license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings:
 - .1 In accordance with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Charts.
 - .2 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 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.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide the DCC Representative with schedule within 2 weeks after award of Contract.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

1.8 SYSTEM STARTUP

- .1 Instruct the 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 with aspects of its care and operation.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be certified to CSA standards. Where CSA certified material and equipment are not available, notify the DCC Representative before delivery to site. Obtain special CSA certification for the equipment or material at no cost to the Owner.
- .3 Factory assemble control panels and component assemblies.
- .4 CSA Type 1A enclosures complete with sprinkler-proof hoods are to be provided on surface mounted distribution panels, switchboards, dry-type transformers and motor control centres. Conduits entering or leaving these enclosures are to be installed using rain-tight EMT connectors complete with sealing rings.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of DCC Representative.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core, mechanically attached with self-tapping screws. De-energize equipment when installing nameplates.
 - .2 Sizes as follows:
 - .1

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters

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

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by DCC Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.6 WIRING IDENTIFICATION

- .1 Identify branch circuit wiring with permanent indelible numbered markings at both ends of conductors and all junction boxes, switches and receptacles. Identify phase conductors of feeders with coloured plastic tape at both ends of conductors.
- .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.

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Colour code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, at 3 m intervals, and at all junction/pull boxes.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour. Fire alarm conduit and junction box covers - red.

	Prime	Auxiliary	
up to 250V	Yellow		undefined
up to 600V	Yellow	Green	undefined
up to 5kV	Yellow	Blue	undefined

up to 25kV	Yellow	Red	undefined
Telephone	Blue		undefined
Other Comms. Systems	Blue		undefined
Fire Alarm	Red		
Emergency Voice	Red	Blue	
Other Security Systems	Red	Yellow	

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish to Munsell 9G7 1.5/2.6.
 - .2 Exterior finish shall conform to IEEE C57.12.28, except that salt spray test acceptance criteria shall be a minimum of 1500 hours.
 - .3 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

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 and No. 7 except where specified otherwise.
- .3 Provide a separate neutral conductor for every single phase circuit. Shared neutrals are not permitted.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .4 Where an electrical circuit is installed on a roof, use armoured cable, liquid tight conduit, or aluminum conduit. Do not use PVC conduit. Mount the circuit on recycled rubber UV resistant blocks with 12 gauge galvanized steel channels. Treated wood is not acceptable.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 600 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm. Verify against millwork drawings.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.

3.6 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

- .1 Power distribution system including phasing, voltage, grounding and load balancing.
- .2 Circuits originating from branch distribution panels.
- .3 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 600 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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .6 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified wood.
 - .8 Low-emitting materials.

3.7 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.

3.8 FIRE STOPPING

- .1 Firestopping of openings through which conduits, cables and cable trays pass shall be done under Section 07 84 00. Intumescent fire brick system shall be used for cable trays where they pass through rated or non-rated partitions, walls, ceiling and floor assemblies. Firestop the entire opening to maintain the integrity of the penetrated assembly. Firestop after cables are installed.

3.9 CUTTING AND PATCHING

- .1 Cutting and patching and associated costs including core drilling slabs for Divisions 26 and 27 shall be the responsibility of Divisions 26 and 27 respectively. Confirm the locations of all holes with the General Contractor prior to starting work.
- .2 When core drilling hollow core slabs, verify exact location with floor manufacturer and DCC Representative before drilling.

3.10 CABLE SPLICES

- .1 Splices are not permitted in new feeder cables supplying panelboards, transformers, or motor control centres.
- .2 Splices are not permitted in new branch circuit cables supplying equipment such as motors, pumps, air handling units, chillers, fans, etc.
- .3 Where it is necessary to splice new conductors to existing conductors, get approval from the DCC Representative before proceeding. Compression sleeves and shrink tubing are to be used. Split bolt connectors or twist-on pressure type connectors are not acceptable.

3.11 COMMISSIONING

- .1 Commissioning to be done in accordance with the Commissioning Plan.

END OF SECTION

Section 26 05 20

Wire and Box Connectors (0-1000 v)

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No. 18.3-12, Conduit, Tubing and Cable Fittings.
 - .2 CSA C22.2 No. 65-18, Wire Connectors.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2 No. 65, with current carrying parts of copper or copper alloy sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No. 65, with current carrying parts of copper or copper alloy sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, as required to: CAN/CSA-C22.2 No. 18.3.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install twist-on pressure type wire connectors in accordance with the manufacturer's recommendations.

END OF SECTION

Section 26 05 21 Wires and Cables (0-1000 V)

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 26 05 44 - Installation of Cables in Trenches and in Ducts.

1.2 REFERENCE STANDARDS

- .1 CSA C22.2 No. 0.3-09(R2014), Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-17, Type TECK 90 Cable.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 CONDUIT CABLES - BUILDING WIRE

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90.

2.2 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: low-acid-gas-emitting FT4 rated polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1500 mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.

- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 CONTROL CABLES

- .1 Type LVT (low voltage thermostat wire): soft annealed copper conductors, sized as indicated, with PVC insulation with voltage rating of 30 V, and outer PVC jacket with FT4 rating, colour - brown.
- .2 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with polyethylene insulation and overall covering of PVC jacket with FT4 rating.
- .3 600 V type: stranded annealed copper conductors, sizes as indicated with XLPE insulation and overall jacket of PVC with FT4 rating.

2.4 VOLTAGE DROP

- .1 For all 15 Amp, 120 Volt branch circuits, the following table shall apply. Length includes vertical drops.

0 - 25 m	#12 AWG	
26 m - 38 m	#10 AWG	undefined
39 m - 56 m	#8 AWG	undefined
57 m - 99 m	#6 AWG	
100 m - 152 m	#4 AWG	

- .2 For all 15 Amp, 347 Volt branch circuits, the following table shall apply, length includes vertical drops.

0 - 69 m	#12 AWG
70 m - 114 m	#10 AWG
115 m - 177 m	#8 AWG

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts and Section 26 05 34 - Conduits.
 - .2 In cabletroughs in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.

- .3 In underground ducts in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.
- .4 In surface and lighting fixture raceways in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.
- .5 In wireways and auxiliary gutters in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.

3.2 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
- .2 Lay cable in cabletroughs in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0-1000 V.

3.3 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

END OF SECTION

Section 26 05 22

Connectors and Terminations

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements

1.2 REFERENCE STANDARDS

- .1 IEEE 386-2016; IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 LOAD BREAK ELBOW CONNECTOR

- .1 Ratings: 200 A continuous, 25 kV Class.
- .2 BIL and full wave crest: 125 kV.
- .3 Switching: 10 operations at 200 A rms at 26.3 kV.
- .4 Fault closure: 10,000 A symmetrical at 26.3 kV for 0.17 sec.
- .5 Stainless steel reinforced pulling eye.
- .6 Peroxide-cured EPDM insulation.
- .7 Conductor contact, copper crimp type.
- .8 Complete with capacitive test point for determining circuit condition when used with a high impedance voltage sensing device.
- .9 Elbow connector housing, moulded EPDM compound, integral moulded jacket seal.
- .10 Acceptable material: Cooper, Elastimold, Hubbell.

2.2 LOAD BREAK BUSHING INSERT

- .1 Rating: 200 A continuous, 25 kV Class.
- .2 BIL and full wave crest: 125 kV.
- .3 Switching: 10 operations at 200 Arms at 26.3 kV.
- .4 Fault closure: 10,000 A rms symmetrical at 26.3 kV after 10 switching operations for 0.17 s.
- .5 Peroxide-cured EPDM rubber insulation.
- .6 Connector replaceable contact, copper.

- .7 Load break bushing insert and load break elbow are to be supplied by the same manufacturer.

2.3 CABLE SEALING KIT

- .1 Cold shrink tube to seal cable at point of entry to load break elbow. Alternative - premoulded cable jacket seal.
- .2 Provides waterproof seal over exposed semi-conductive portion of cable, end of elbow boot and cable jacket.
- .3 Rubber mastic sealing strips to seal around concentric neutral wires.

2.4 OUTDOOR CABLE TERMINATOR

- .1 Single piece moulded rubber 4 skirt termination for use on jacketed concentric neutral 25 / 28 kV cable.
- .2 25 kV class, 16 kV phase to ground.
- .3 150 kV BIL.
- .4 65 kV AC withstand, 1 minute dry.
- .5 21.5 kV corona extinction.
- .6 Stem connector.
- .7 Mounting bracket.

Part 3 Execution

3.1 INSTALLATION

- .1 Install terminations in accordance with manufacturer's instructions.
- .2 Bond and ground as required.
- .3 Terminate cables with elbow connectors or cable terminators as indicated and where necessary to complete the primary distribution system.
- .4 Install sealing kit at all cable entry points to load break elbows.

END OF SECTION

Section 26 05 28 Grounding - Secondary

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements

1.2 REFERENCE STANDARDS

- .1 Institute of Electrical and Electronics Engineers (IEEE)
 - .1 IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA Group (CSA)
 - .1 CSA C22.2 No. 0.4-17, Bonding of Electrical Equipment.
 - .2 CSA C22.2 No. 41-13(R2017), Grounding and Bonding Equipment.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
- .3 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .4 Insulated grounding conductors: green, type. RW90 XLPE.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .6 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 connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or approved compression connectors.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install three ground electrodes, at 2 m spacing, outside the Electrical Room. Loop #3/0 AWG copper conductor, with green insulation, around the ground rods and tie the conductor to the service entrance ground bus in the Electrical Room.
- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Install separate ground conductor to outdoor lighting standards.
- .11 Connect building structural steel and metal siding to ground by welding copper to steel.
- .12 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .13 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.2 ELECTRODES

- .1 Install rod electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.
- .3 Use size 3/0 AWG copper conductors for connections to electrodes.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of 600 Y/347 V and 208 Y/120 V systems.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment including, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, distribution panels, outdoor lighting.

3.5 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the DCC Representative.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Section 26 05 29

Hangers and Supports for Electrical Systems

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 26 05 20 - Wire and Box Connectors - 0-1000V.
- .3 Section 26 05 44 - Installation of Cables in Trenches and in Ducts.

1.2 REFERENCE STANDARDS

- .1 CSA C22.2 No. 0.3-09(R2014), Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-17, Type TECK 90 Cable.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 CONDUIT CABLES - BUILDING WIRE

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU 90.

2.2 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 NO. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: low-acid-gas-emitting FT4 rated polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1500 mm centres.

- .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 CONTROL CABLES

- .1 Type LVT (low voltage thermostat wire): soft annealed copper conductors, sized as indicated, with PVC insulation with voltage rating of 30V, and outer PVC jacket with FT4 rating, colour - brown.
- .2 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with polyethylene insulation and overall covering of PVC jacket with FT4 rating.
- .3 600V type: stranded annealed copper conductors, sizes as indicated with XLPE insulation and overall jacket of PVC with FT4 rating.

2.4 VOLTAGE DROP

- .1 For all 15 Amp, 120 Volt branch circuits, the following table shall apply. Length includes vertical drops.

0 - 25m	#12 AWG
26m - 38m	#10 AWG
39m - 56m	#8 AWG
57m - 99m	#6 AWG
100m - 152m	#4 AWG

- .2 For all 15 Amp, 347 Volt branch circuits, the following table shall apply, length includes vertical drops.

0 - 69m	#12 AWG
70m - 114m	#10AWG
115m - 177m	#8 AWG

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts and Section 26 05 34 - Conduits.
 - .2 In cabletroughs in accordance with Section 26 05 44 - Installation of Cables in Trenches and Ducts.

- .3 In underground ducts in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.
- .4 In surface and lighting fixture raceways in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.
- .5 In wireways and auxiliary gutters in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.

3.2 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Lay cable in cabletroughs in accordance with Section 26 05 44 - Installation of Cables in Trenches and in Ducts.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0-1000V.

3.3 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduits.
- .2 Ground control cable shield.

END OF SECTION

Section 26 05 31

Splitters, Junction, Pull Boxes and Cabinets

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 26 05 00 - Common Work Results for Electrical

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - for Electrical.
- .2 Install size 2 identification labels indicating system name and voltage and phase.

END OF SECTION

Section 26 05 32

Outlet Boxes, Conduit Boxes and Fittings

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, (24th Edition), Safety Standard for Electrical Installations.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management And Disposal.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with [CSA C22.1](#)
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes shall not be used to group telecommunications and power systems. Provide separate boxes and conduit systems for telecommunications and power systems.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

- .1 Concrete tight adjustable electro-galvanized sheet steel or cast iron floor boxes with adjustable finishing rings to suit floor finish with brass or brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex or single receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

- .1 Cast malleable iron or copper-free aluminum device boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles. Standard depth boxes or deep boxes as required.

2.7 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

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.

END OF SECTION

Section 26 05 34

Conduits, Conduit Fastenings and Conduit Fittings

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA C22.2 No. 18.1-13(R2018), Metallic Outlet Boxes.
 - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2017), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-06(R2016), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-15, Non-Metallic Mechanical Protection Tubing and Fittings.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to [CSA C22.2 No. 45](#), hot dipped galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to [CSA C22.2 No. 83](#), with couplings.
- .3 Rigid pvc conduit: to [CSA C22.2 No. 211.2](#)
- .4 Flexible metal conduit: to [CSA C22.2 No. 56](#), liquid-tight flexible metal.
- .5 FRE conduit.
- .6 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.
- .5 Power-activated fasteners and drop-in anchors shall not be used for tension loads.

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 CONDUIT COLOUR

- .1 Fire alarm conduit: red identification marking at 3 m intervals.
- .2 Communications conduit: blue identification marking at 3 m intervals.

2.6 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use rigid hot-dipped galvanized steel threaded conduit where specified. Use rigid galvanized steel conduit in wet or damp locations or within 2.4 m of the floor if mechanical injury is possible. Use rigid galvanized steel conduit in hazardous locations.
- .4 Use epoxy coated conduit in corrosive areas.
- .5 The use of electrical metallic tubing (EMT) is generally acceptable. EMT may not be cast in concrete, used in wet or damp locations, or in locations where it will be subject to mechanical injury.
- .6 Use EMT for all branch and systems wiring unless otherwise noted. Systems wiring includes, but is not limited to, low voltage lighting control, security, communications, fire alarm, exit signs, emergency lighting and mechanical EMCS systems. Panel feeders to be the type indicated on drawings.
- .7 Use rigid pvc conduit or FRE conduit for direct burial underground; use pvc type DB2 for concrete encasement.
- .8 Use flexible metal conduit for connection to motors in dry areas.
- .9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .10 Use explosion proof flexible connection for connection to explosion proof motors.
- .11 Install conduit sealing fittings in hazardous locations. Fill with compound.
- .12 Minimum conduit size for lighting and power circuits: 21mm.
- .13 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

- .14 Use a pipe bender to bend steel conduit up to 21 mm in diameter. Use a hydraulic bender, or factory bends, for conduit larger than 21 mm in diameter.
- .15 Field threads on rigid conduit must conform to Table 40 in the CEC.
- .16 Install fish cord in empty conduits.
- .17 Run 2-27 mm spare conduits up to ceiling space from each flush mounted electrical panel. Terminate these conduits in two 152 x 152 x 102 mm junction boxes in ceiling space. Label these junction boxes with word "SPARE" on the cover plates.
- .18 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .19 Dry conduits out before installing wire.
- .20 Provide a green insulated ground conductor in all conduits and EMT containing circuits of 50 V and higher. Minimum size: #12 AWG.
- .21 Use maximum length of 3.0 m of flexible metal conduit or armoured cable for connection to surface or recessed lighting fixtures. Do not use flexible metal conduit or armoured cable for branch circuit wiring.
- .22 Install in each conduit run sufficient number of pull boxes or fittings located such that there shall be not more than a total of four (4) 90° bends nor more than 30 m length between pull points. Install junction box, pull box and raceway fittings such that they will be accessible after construction.
- .23 Coordinate the installation of conduit with other electrical and mechanical services.
- .24 Do not run conduits in or through ground floor slab unless specifically indicated.
- .25 Provide raceway expansion joints for exposed or concealed raceways with necessary bonding jumper at building expansion joints and where necessary to compensate for building expansion or contraction.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.

- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run PVC or FRE conduits 27 mm and larger below slab and encased in 75 mm concrete envelope.
Provide 50 mm of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Solvent weld all PVC joints.
- .3 After the conduits have been installed and backfilled a mandrel shall be passed through the conduit in the presence of the Owner's Representative. If the mandrel fails to pass through the conduit being tested, the conduit shall be considered defective. Defective conduits must be exposed and the defect corrected. After the conduit(s) are repaired, repeat the mandrel test in that section of the conduit.
- .4 The outside diameter of the test mandrel shall be 80% of the inside diameter of the conduit.
The length of the mandrel will vary depending upon the manufacturer and mandrel type.

END OF SECTION

Section 26 27 26 Wiring Devices

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No. 42-2010(R2015), General Use Receptacles, Attachment Plugs, and Similar Devices.
 - .2 CSA C22.2 No. 42.1-13(R2017), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No. 55-15, Special Use Switches.
 - .4 CSA C22.2 No. 111-18, General-Use Snap Switches (Trinational standard, with UL 20 and NMX-J-005-ANCE).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal

Part 2 Products

2.1 SWITCHES

- .1 15 A, 120 V, single pole, three-way and four-way switches to: CSA-C22.2 No. 111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Brown toggle.
- .3 Toggle operated fully rated for tungsten filament and LED lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.

- .5 Acceptable manufacturers: Leviton, Hubbell, Cooper, Pass & Seymour.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: [CSA C22.2 No.42](#) with following features:
 - .1 Black urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Black urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Weather resistant receptacles with nylon housing and corrosion resistant metal components. To be used with in-use protective covers.
- .4 Other receptacles with ampacity and voltage as indicated.
- .5 Receptacles of one manufacturer throughout project.
- .6 Acceptable manufacturers: Leviton, Hubbell, Cooper, Pass & Seymour.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: [CSA C22.2 No.42](#) .1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .5 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet boxes.
- .6 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .7 NEMA 3R rated cast aluminum weatherproof while-in-use protective cover plates, complete with gaskets for weather resistant duplex receptacles at block heater locations.
- .8 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:

- .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section [26 05 00 - Common Work Results for Electrical] or as indicated.
- .2 Receptacles:
- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section [26 05 00 - Common Work Results for Electrical] or as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover plates:
- .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.

END OF SECTION

Section 26 28 13.01 Fuses - Low Voltage

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 248, Low Voltage Fuses Complete Set.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit fuse performance data characteristics for each fuse type and size above 100 A. Performance data to include: average melting time-current characteristics.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.

1.6 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Three spare fuses of each type and size installed above 600 A.
- .3 Six spare fuses of each type and size installed up to and including 600 A.

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 L fuses.
 - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

- .2 Type L2, fast acting.
- .2 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.
- .3 Class R -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its peak let-through values not to exceed limits of UL 198E-1982, table 10.2.
 - .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.
- .4 Class -C fuses (formerly HRCII- C)

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 Class R rejection clips for HRCI-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

END OF SECTION

Section 26 28 23

Disconnect Switches - Fused and Non-Fused

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 26 05 00 - Common Work Results for Electrical
- .3 Section 26 28 13.01 - Fuses - Low Voltage

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA C22.2 No. 4-16, Enclosed and Dead-Front Switches.
 - .2 [CSA C22.2 No.39-13](#)(R2017, Fuseholder Assemblies).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible and non-fusible, horsepower rated disconnect switch in CSA Enclosure, type as indicated, to CAN/CSA C22.2 No. 4, switch size as indicated.
- .2 Provision for padlocking in on-off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, 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 indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.
- .8 Fiberglass disconnect switches shall be used for outdoor (weatherproof) applications. Fiberglass disconnect switches shall have a minimum 3R rating. The switches shall be manufactured from hot compression moulded fiberglass reinforced polyester with additives to reduce the effects of UV degradation and be complete with polyurethane door gasket and integral mounting feet.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Section 28 31 00.01 Multiplex Fire Alarm System

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524-14, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525-2016, Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
 - .3 CAN/ULC-S526-2016, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
 - .4 CAN/ULC-S527-11-AMD-1(2014), Standard for Control Units for Fire Alarm Systems, Including Accessories.
 - .5 CAN/ULC-S528-2014, Manual Stations for Fire Alarm Systems, Including Accessories.
 - .6 CAN/ULC-S529-2016, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S530-91(R1999), Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .8 CAN/ULC-S531-14, Standard for Smoke Alarms.
 - .9 CAN/ULC-S536-13, Inspection and Testing of Fire Alarm Systems.
 - .10 CAN/ULC-S537-04, Standard for the Verification of Fire Alarm Systems.

1.3 SYSTEM DESCRIPTION

- .1 Fully supervised, microprocessor-based, addressable fire alarm system, utilizing digital techniques for data control and digital multiplexing techniques for data transmission.
- .2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to fire department.
- .3 Zoned, single stage.
- .4 Modular in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.
- .6 System to include:

- .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
- .2 Power supplies.
- .3 Initiating/input circuits.
- .4 Output circuits.
- .5 Auxiliary circuits.
- .6 Wiring.
- .7 Addressable manual and automatic initiating devices.
- .8 Audible and visual signalling devices.
- .9 End-of-line resistors
- .10 Local annunciator.
- .11 Event log memory chip.
- .12 Static graphic.
- .13 Isolation modules.
- .7 Fire alarm system shall be Secutron to allow compatibility with the Base fire alarm monitoring system.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- .1 System:
 - .1 To Canadian Forces Fire Marshal approval.
- .2 System components: listed by ULC and comply with applicable provisions of National Building Code, local/Provincial Building Code, and meet requirements of local authority having jurisdiction.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
 - .1 Detail assembly and internal wiring diagrams for control units.
 - .2 Overall system riser identifying control equipment, initiating zones, signaling circuits; identifying terminations, terminal numbers, conductors and raceways.
 - .3 Details for devices.
 - .4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.
 - .5 Step-by-step operating sequence, cross referenced to logic flow diagram.
 - .6 Details of system power requirements for both standby load and alarm load.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.9 MAINTENANCE

- .1 Provide one year's free maintenance with two inspections by manufacturer during the year.
- .2 Inspection tests to conform to ULC S536. Submit inspection report to DCC Representative.
- .3 Provide all assistance to allow DND personnel to fully program the system.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to ULC-S524.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.
- .7 Thermal detectors: to CAN/ULC-S530.
- .8 Smoke detectors: to CAN/ULC-S529.
- .9 Smoke alarms: to CAN/ULC-S531.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY

- .1 Actuation of any alarm initiating device to:
 - .1 Cause electronic latch to lock-in alarm state at central control unit.
 - .2 Indicate zone of alarm at central control unit.

- .3 Cause audible signalling devices to sound continuously throughout building and at central control unit.
- .4 Transmit signal to fire department.
- .2 Acknowledging alarm: indicated at central control unit.
- .3 Possible to silence separate horn signal circuits by "alarm silence" switch at control unit after 60 second period of operation Visual signals to remain functional while audible signals are silenced.
- .4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .5 Actuation of supervisory devices to:
 - .1 Cause electronic latch to lock-in supervisory state at central control unit.
 - .2 Indicate respective supervisory zone at central control unit.
 - .3 Cause audible signal at central control unit to sound.
 - .4 Activate common supervisory sequence.
 - .5 Transmit supervisory signal to central station.
- .6 Resetting or supervisory device not to return system indications/functions back to normal until control unit has been reset.
- .7 Trouble on system to:
 - .1 Indicate circuit in trouble at central control unit.
 - .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.
- .8 Trouble on system: suppressed during course of alarm.
- .9 Trouble condition on any circuit in system not to initiate alarm conditions.
- .10 Horns: temporal pattern.

2.3 INITIATING/INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit with return wires in a separate conduit..
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".
- .6 No circuit shall be loaded to more than 80% of its maximum capacity.

- .7 Where supervisory dry contact devices are monitored in the same physical location, an addressable interface device may be used. The wiring from the contact to the interface device shall be Class A wired. Each supervisory device to have its own zone.

2.4 ALARM OUTPUT CIRCUITS

- .1 Alarm output circuit: connected to signals, wired in class A configuration to central control unit with return wires in a separate conduit.
 - .1 Signal circuits' operation to follow system programming; capable of continuous operation of strobe lights and horns. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.
 - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.
 - .3 No circuit shall be loaded to more than 80% of its maximum capacity with the strobes set at maximum intensity.
 - .4 Strobe lights are to continue to flash even if audible signals are silenced.

2.5 AUXILIARY CIRCUITS

- .1 Auxiliary contacts for control functions.
- .2 Actual status indication (positive feedback) from controlled device.
- .3 Alarm and or supervisory trouble on system to cause operation of programmed auxiliary output circuits.
- .4 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .5 Auxiliary circuits: rated at 2 A, 24 Vdc or 120 Vac, fuse-protected.

2.6 WIRING

- .1 Wiring shall be CSA Type FAS solid copper conductors with coded PVC insulation and an overall red PVC jacket in accordance with the Canadian Electrical Code - 300 volts, 105 deg. C.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements or as required to correct line losses.
- .3 To signal circuits: 14 AWG minimum, and in accordance with manufacturer's requirements or as required to correct line losses. Signal circuits shall be sized to allow all strobes to operate at 110 candelas.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements or as required to correct line losses.
- .5 A Class "A" conduit system is to be provided. Two conduits (i.e. one "in" and one "out") are to be provided for each fire alarm device. The conduits are to be physically separated where possible.
- .6 The horns and the strobes are to be wired on separate circuits so that the strobes can operate if the horns have been silenced.
- .7 Adjacent horn/strobes are to be wired to alternating circuits. A minimum of two signal circuits per floor are to be provided for horn/strobes.

2.7 MANUAL ALARM STATIONS

- .1 Addressable manual pull station.
 - .1 Pull lever, surface wall mounted type, single action, single stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.

2.8 AUTOMATIC ALARM INITIATING DEVICES

- .1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute.
 - .1 Electronics to communicate detector's status to addressable module/transponder.
 - .2 Detector address to be set on detector base in field.
- .2 Addressable smoke detector.
 - .1 Ionization type.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector base in field.

2.9 AUDIBLE/VISUAL SIGNAL DEVICES

- .1 Horns: electronic horn rated 91 dBA peak for surface or semi-flush mounting, 24 V dc.
- .2 Polarized for installation on supervised signal circuits.
- .3 Strobe with lens; lettering "fire/feu".
- .4 Horn/strobe unit suitable for surface or semi-flush mounting as required.
- .5 Strobe to have a minimum of 4 field selectable intensity settings of 15/75, 30/75, 75 and 110 candela. Intensity shall be set at 110 candela.
- .6 Red housing.
- .7 Synchronization module.
- .8 Horn shall have field selectable tones and a High/Low dBA output setting.

2.10 ISOLATOR MODULE

- .1 Automatic switch to open when line voltage drops below 4 volts.
- .2 Provide fault isolation modules on alarm initiating loops as required to meet the requirements of CAN/ULC-S524, Section 4.2.10.
- .3 Fault isolation modules shall be provided at the beginning and the end of each loop. Provide one isolation module for each 25 devices on a loop.

2.11 ACCEPTABLE MANUFACTURERS

- .1 Secutron, Simplex, Chubb, Honeywell.

2.12 AS-BUILT RISER DIAGRAM

- .1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

Part 3 Execution

3.1 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install central control unit and connect to ac power supply.
- .3 Install manual alarm stations and connect to alarm circuit wiring.
- .4 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.
- .5 Connect alarm circuits to main control panel.
- .6 Install horns and visual signal devices and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Install end-of-line devices as required.
- .9 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .10 Splices are not permitted.
- .11 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .12 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .13 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes. Wiring shall be permanently labelled at each end of every conductor.
- .14 No circuit is to be loaded to more than 80% of its maximum capacity.

3.2 LABELLING OF DEVICES

- .1 All intelligent and/or addressable devices such as pull stations and monitoring modules shall have their label fixed on their front cover.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537
- .2 Fire alarm system:
 - .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, sprinkler system transmit alarm to control panel and actuate general alarm.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
 - .4 Addressable circuits system style DCLA:

- .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .3 Provide final PROM program re-burn for system incorporating program changes made during construction.

3.4 DEMONSTRATION AND TRAINING

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

3.5 INSPECTION

- .1 The manufacturer to make an inspection of all equipment, including those components necessary for the direct operation of the system such as manual stations, detectors and controls. The inspection to comprise an examination of such equipment for the following:
 - .1 That the type of equipment installed is that designated by this specification.
 - .2 That the wiring type, installation and connections to all equipment components show that the installer undertook to have observed all applicable codes and standards.
 - .3 That equipment supplied by the manufacturer was installed in accordance with the manufacturer's recommendation and that all devices have been operated or tested to verify their operation.
 - .4 That the supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the governmental regulations, if any, concerning the supervisory wiring, have been met to the satisfaction of the DCC/CFFM Representatives.
- .2 The manufacturer to supply to the electrical contractor reasonable amounts of technical assistance with respect to any changes necessary to conform to this specification. During the period of inspection by manufacturer, the electrical contractor to make available to the manufacturer, electricians as designated by the manufacturer.
- .3 To assist the electrical contractor in preparing his bid, the manufacturer to indicate the number of hours necessary to complete this inspection prior to closing of tenders.
- .4 On completion of the inspection and when all of the above conditions have been complied with, the manufacturer is to issue to the DCC Representative.
 - .1 A copy of the Inspecting Technician's report showing location of each device and certifying the test results of each device.
 - .2 A certificate of verification confirming that the inspection has been completed in accordance with CAN/ULC-S537 and showing the conditions upon which such inspection and certification have been rendered.

- .3 The representative of the manufacturer shall provide evidence of technical training on the type of electronic equipment specified herein and shall have at least five (5) years experience with early warning fire detection and control systems.
- .4 Final test and acceptance of the system shall be witnessed by the DCC Representative, a representative of the CFFM, the Contractor, the Manufacturer.
- .5 Service technicians and replacement components for the system specified shall be available within 24 hours from an authorized service representative of the manufacturer who is able to provide evidence of the technical training and authorization by the manufacturer.
- .5 All costs involved in this inspection, both from the manufacturer and the electrical contractor work, to be included in the tender price.

3.6 CLEANING

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

3.7 WARRANTY

- .1 Provide a written guarantee, signed and issued in the name of Her Majesty the Queen in Right of Canada, stating that the fire alarm system is guaranteed against defects in material, workmanship and performance for a period of one (1) year from the date of the Final Certificate of Completion.

END OF SECTION

Defence Construction Canada

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC COMPLIANCE UPGRADES

Defence Research and Development Canada
Toronto – 1133 Sheppard Avenue West, Toronto,
Ontario


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DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES –
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DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES – DEFENCE RESEARCH AND DEVELOPMENT
CANADA TORONTO, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO

Table ES-1 Summary of Designated Substances and Hazardous Materials

Hazardous Material or Designated Substance	Description of Homogenous Material	Concentration	Location	Estimated Quantity	Notes
Asbestos	Drywall joint compound	2% Chrysotile	Rooms 1100, 1205A, 1516, 1542, 1700, 2020c, 2102, 2205, 2213i and 2232	350 m ²	Non-Friable
Asbestos	Pipe fitting insulation	55% Chrysotile	Rooms 1100, 2102 and 2219	50 observed	Friable
Asbestos	Pipe straight insulation (antisweat)	55% Chrysotile	Room 2102	2 m	Friable
Asbestos	Duct parging cement	55% Chrysotile	Room 2219	30 m ²	Friable
Asbestos	Cement board	8% Chrysotile	Room 2102	40 m ²	Non-Friable
Asbestos	Vibration sleeve	Assumed asbestos	Room 2219	5 m ²	Non-Friable

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES – DEFENCE RESEARCH AND DEVELOPMENT
CANADA TORONTO, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO

Asbestos	Drywall joint compound	2% Chrysotile	Rooms 1100, 1205A, 1516, 1542, 1700, 2020c, 2102, 2205, 2213i and 2232	350 m ²	Non-Friable
Asbestos	(12" x 12") beige vinyl floor tiles	1% Chrysotile	Room 1516	10 m ²	Non-Friable
Potential asbestos-containing materials	Various building materials ⁽¹⁾	N/A	Throughout the building	N/A	N/A
Lead	Yellow pipe paint	602 µg/g	Roof	N/A	N/A
Mercury	White wall paint	16.1 µg/g	Rooms 2205 and 2232 (1970 Addition)	N/A	N/A
Mercury	Thermostat	N/A	Room 1542	One	N/A
Mercury	Fluorescent light tubes	N/A	Throughout the study areas	N/A	N/A
Arsenic	Grey wall paint	12.5 µg/g	Room 1542	N/A	N/A
Silica	Various building materials ⁽²⁾	N/A	Throughout the study areas	N/A	N/A
ODSs	Portable cooler, two chest freezers	N/A	Room 1700	N/A	N/A
ODSs	HVAC units (RTU-7, RTU-8, RTU-9 and RTU-10) and two condensers	N/A	Roof	Seven	N/A

NOTES:

- (1) Potential asbestos-containing materials observed in the subject building included mastic and caulking around roof components and building penetrations.
- (2) Materials observed in the subject building which should be considered to contain silica included concrete, drywall, block walls, joint compound, duct parging cement and pipe insulation.

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ACRONYMS AND ABBREVIATIONS

ACM	Asbestos-Containing Material
Arcadis	Arcadis Canada Inc.
CLC	Canada Labour Code
CAF	Canadian Armed Forces
COHSR	Canada Occupational Health and Safety Regulations
DCC	Defence Construction Canada
DND	Department of National Defence
DSHMS	Designated Substances and Hazardous Materials Survey
HWH	Hot Water Heating
MOL	Ministry of Labour
OEL	Occupational Exposure Limit
OHSA	Occupational Health and Safety Act
OSHA	United States Occupational Health and Safety Administration
PCBs	Polychlorinated Biphenyls
PLM	Polarized Light Microscopy
POL	Paints, Oils and Lubricants
TEM	Transmission Electron Microscopy
UFFI	Urea Formaldehyde Foam Insulation
USEPA	United States Environmental Protection Agency

1 INTRODUCTION

Arcadis Canada Inc. (Arcadis) was retained by Defence Construction Canada (DCC) on behalf of the Department of National Defence (DND) to conduct a Designated Substances and Hazardous Materials Survey in designated areas of the Defence Research and Development Canada Toronto (DRDC) building located at 1133 Sheppard Avenue West, Toronto, Ontario.

The objective of the project was to provide a designated substances and hazardous materials survey for the areas affected by the proposed renovations in the building as required by Ontario's Occupational Health and Safety Act.

1.1 Scope of Work

The scope of work for the designated substances and hazardous materials survey was based on the DCC Statement of Work (SOW) dated November 18, 2022, and the Arcadis proposal to DCC dated January 16, 2023, and included the following tasks:

1. Perform a designated substance and hazardous materials (DSHM) survey in designated areas of the Defence Research and Development Canada Building to determine the presence, accessibility, friability, quantity and condition of asbestos- containing materials and all other designated substances and hazardous materials);
2. Submit a site-specific Health and Safety Plan (HASP) prior to commencing field work on the project, and a detailed schedule.
3. Review all information provided by DCC.
4. Collect bulk samples of materials for asbestos analysis and paint chip samples for analysis of arsenic, lead, mercury and PCBs, and paint chip samples.
5. Submit samples to accredited laboratories for analysis.
6. Prepare and submit draft and final reports in the format outlined in the SOW, incorporating sampling and test results from applicable historical reports.

Mr. Paul Smith of Arcadis visited the site on February 15 and 16, 2023 to conduct the designated substances and hazardous materials survey. The areas investigated included Rooms 1100, 1205A, 1516, 1542, 1700, 2020c, 2102, 2205, 2219, 2213i and 2232, as well as the roof of Building 201B. The roof-top HVAC units (RTU-7, RTU-8, RTU-9 and RTU-10) were in operation at the time of the site inspections. As a result, they were not opened for inspection.

1.2 Building Summary Information

The DRDC building is designated as Building 201, which is comprised of two separate buildings (201A, constructed in 1952) and 201B (constructed in 1975). It is a two-storey structure with a basement and a gross floor area of 20,440 m², concrete structure, flat roof and fixed windows.

Exterior finishes of the building consisted of metal siding. Interior finishes include vinyl floor tiles and concrete flooring; drywall, metal, wood and concrete block walls; and drywall and metal ceilings. The roof

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is asphaltic and was sampled (and found to be non-asbestos-containing) by Wood Environment & Infrastructure Solutions (Wood) in 2018.

1.3 Summary of Past Designated Substances Survey Reporting

As part of this assessment, Arcadis review the following reports:

- Arcadis Canada Inc. report titled *Designated Substances and Hazardous Materials Survey – Defence Construction and Research Development Canada*, dated March 2020,
- Wood report titled *Asbestos-Containing Building Materials Management Survey, Roofing Materials Survey, DRDC Building 201A/B*, dated May 30, 2018
- Pinchin Ltd. Report titled *Hazardous Building Materials Assessment, DRDC Building 201A/B*, dated February 15, 2017 in preparing this report.

Any pertinent sample results from these reports were added to the Bulk Sample table in Appendix C.

2 METHODOLOGY

All designated study areas were surveyed.

2.1 Asbestos

Bulk sampling was performed in accordance with the requirements of O. Reg. 278/05 as follows:

- the minimum number of bulk samples to be collected from an area of homogeneous material is set out in Table 1 of the regulation (Table 3.1 is reproduced below).
- if analysis establishes that a bulk material sample contains 0.5 per cent or more asbestos by dry weight:
 - (a) it is not necessary to analyze other bulk material samples taken from the same area of homogeneous material; and
 - (b) the entire area of homogeneous material from which the bulk materials sample was taken is deemed to be asbestos-containing material.

Table 3.1 Bulk Material Samples (From O.Reg. 278/05)

Item	Type of Material	Size of Area of Homogeneous Material	Minimum Number of Bulk Material Samples to be Collected
1	Surfacing material, including without limitation material that is applied to surfaces by spraying, by trowelling or otherwise, such as acoustical plaster on ceilings and fireproofing materials on structural members	Less than 90 square metres	3
		90 or more square metres, but less than 450 square metres	5
		450 or more square metres	7
2	Thermal insulation, except as described in Item 3	Any size	3
3	Thermal insulation patch	Less than 2 linear metres or 0.5 square metres	1
4	Other material	Any size	3

These Ontario Regulation 278/05 minimum bulk sample number requirements are consistent with the bulk sampling requirements specified in the DND/CF Asbestos Management Directive.

In practice, application of the Table 3.1 requirements means that the specified minimum number of negative (i.e., less than 0.5% asbestos) bulk sample analysis results will be required in order to classify a material

as non-asbestos. Area of homogeneous material means an area in a building constructed at the same time. Homogeneous material is defined as material that is uniform in colour and texture.

Analysis of bulk samples was performed following EPA Method 600/R-93/116 in conformity with the requirements specified in O. Reg. 278/05. A “stop positive” protocol was utilized whereby one positive (more than 0.5%) sample result from a homogeneous area can be considered evidence that all suspect material in that homogeneous area contains asbestos without analysing the remaining samples.

The “*Asbestos Condition Assessment and Response Chart*” in the DND/CF Asbestos Management Directive was used in identifying required response actions. A copy of the Chart is provided in Appendix E.

2.2 Lead

Samples of select representative paint applications collected during the course of the site inspections were forwarded to ALS Environmental Inc. for analysis of lead content.

The locations of paint applications which were similar in appearance to the paints sampled were noted as well as the condition of paint applications on site.

2.3 Mercury

The presence of equipment which may contain mercury, such as fluorescent light tubes, thermometers, gauges, etc. observed during the course of the site inspections was recorded.

Paint samples, discussed above in Section 3.2, were also analyzed for mercury.

2.4 Silica

The presence of silica-containing materials observed during the course of the site inspections was documented. Silica is known to be a constituent of brick, concrete, cement, etc. Sampling and laboratory analysis are not required to make this determination.

2.5 Other Designated Substances and Hazardous Materials

Any products or materials observed which could contain any of the other designated substances noted in section 2.5 above, and which are present in a form that could present an exposure hazard, were noted. Paint samples were collected for analysis of arsenic and chromium.

2.6 Polychlorinated Biphenyls (PCBs)

Fluorescent lights were inspected during the course of our survey to determine whether they were the T12 type and may therefore contain PCB ballasts.

Transformers were investigated to determine whether they were the “dry” type which do not contain PCB dielectric fluids, or the “wet” type which can contain PCBs.

Paint and caulking samples were collected for analysis of PCBs.

2.7 Urea Formaldehyde Foam Insulation (UFFI)

Investigations for the potential presence of UFFI entailed inspections of exterior and interior openings (i.e., “nozzle holes”) made for installation of insulation and limited visual observation of the wall cavity and insulating materials at select, representative locations.

2.8 Ozone-Depleting Substances and Other Halocarbons (ODS’)

The presence of Ozone Depleting Substances (ODSs) and other Halocarbons was reviewed within the building and recorded.

2.9 Biological Hazards

The presence of “suspect” mould observed during the course of the site inspections was documented. “Suspect” mould is typically a coloured, textured substance or discolouration or staining on a building material surface which, based on our experience, may be mould growth. The adjective “suspect” is used where the presence of mould has not been confirmed by laboratory analysis.

Inspections for mould were limited to visual observations of readily accessible surfaces and did not include intrusive inspections of wall cavities.

The presence of any animal droppings observed was also noted where present.

3 DISCUSSIONS AND SUMMARY OF RESULTS

3.1 Asbestos

The locations of accessible asbestos-containing materials and the sample locations are shown on the floor plans provided in Appendix A. The laboratory report is provided in Appendix B, and results of the bulk sample analyses for asbestos content are provided in Appendix C.

Photographs of confirmed asbestos-containing materials are presented in Appendix F. A room-by-room summary of construction materials, sample locations, sample analysis results, asbestos-containing material condition, access and friability is provided in Appendix D. A room-by-room summary of the location, quantity and recommended action for asbestos-containing materials identified in the subject building is presented in Table 3.1. A summary of building materials sampled and found not to contain asbestos is presented in Table 3.2.

Potential asbestos-containing materials are materials which could contain asbestos, but which were not sampled as such sampling could cause significant damage. Potential asbestos-containing materials observed at this site include materials inside the air handling unit in Room 2219 and the roof-top HVAC units.

Other potential asbestos-containing materials may also be present. A list of possible asbestos-containing materials in buildings from the Ministry of Labour “Sample List of Suspect Asbestos-Containing Materials” is provided in Appendix H.

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Table 3.1 Summary of Quantities of Asbestos-Containing Material and Recommended Action – DRDC

Location	Asbestos-Containing Material	Asbestos-Type and %	Substrate	Approximate Quantity	Friability	Condition	Accessibility	Potential Release of Fibers	Action
Room 1100	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 1205A	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 1516	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 1542	Drywall joint compound	2% Chrysotile	Drywall	150 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 1700	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 2020c	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 2102	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 2205	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 2213i	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 2232	Drywall joint compound	2% Chrysotile	Drywall	25 m ²	Non-Friable	Good	A	Low	Level 6 – No action required

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Location	Asbestos-Containing Material	Asbestos-Type and %	Substrate	Approximate Quantity	Friability	Condition	Accessibility	Potential Release of Fibers	Action
Room 1100	Pipe fitting insulation	55% Chrysotile	Pipe	8	Friable	Good	A	Low	Level 6 – No action required
Room 2102	Pipe fitting insulation in pipe chase	55% Chrysotile	Pipe	6	Friable	Good	A	Low	Level 6 – No action required
Room 2219	Pipe fitting insulation	55% Chrysotile	Pipe	35	Friable	Good	A	Low	Level 6 – No action required
Room 2102	Pipe straight insulation in pipe chase	55% Chrysotile	Pipe	2 m	Friable	Good	A	Low	Level 6 – No action required
Room 2219	Duct parging cement	55% Chrysotile	Pipe	30 m ²	Friable	Good	A	Low	Level 6 – No action required
Room 2219	Vibration sleeve	Assumed asbestos	Air handling unit	5 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 2102	Cement board in pipe chase, assumed to be present behind wall panels	8% chrysotile	Wall	40 m ²	Non-Friable	Good	A	Low	Level 6 – No action required
Room 1100	(12" x 12") vinyl floor tiles	2% chrysotile	Concrete	15 m ²	Non-Friable	Good	A	Low	Level 6 – No action required

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Location	Asbestos-Containing Material	Asbestos-Type and %	Substrate	Approximate Quantity	Friability	Condition	Accessibility	Potential Release of Fibers	Action
Room 1516	(12" x 12") vinyl floor tiles	1% chrysotile	Concrete	15 m ²	Non-Friable	Good	A	Low	Level 6 – No action required

NOTES:

(1) For non-friable materials, if the removal is done using non-powered, hand-held tools, the work is classified as Type 1. If the removal is done using power tools that are attached to dust-collecting devices equipped with HEPA filters, the work is classified as Type 2. If the power tools do not have HEPA filtered dust collecting devices, the work is classified as Type 3.

Accessibility

A – Areas of the building within reach (from floor level) of all building users.

B – Frequently entered maintenance areas within reach of maintenance staff, without the need for a ladder.

C – Areas of the building above 3 metres where use of a ladder is required to reach the ACM.

D – Areas of the building which require the removal of a building component, incl. lay-in ceilings, and access panels into solid ceilings.

E – Areas of the building behind inaccessible solid ceiling systems, walls or mechanical equipment, etc., where demolition of ceiling, wall or equipment, etc. is required to access the ACM.

Table 3.2 Summary of Materials Sampled and Confirmed to be Non-Asbestos-Containing – DRDC

Sample ID	Material	Substrate	Sample Location
1-A, 1-B, 1-C	White caulking around electrical wires at air handling units-caulking	Electrical wires	Roof
1-B, 1-C	White caulking around electrical wires at condensers-tar	Electrical wires	Roof
2-A, 2-B, 2-C	Block filler wall paint	Concrete block	Room 1700
3-A, 3-B, 3-C, 4-A, 4-B, 4-C, 5, 7	Concrete block mortar	Concrete block	Rooms 1205A, 1700, 2219 and 2232
6-A, 6-B, 6-C, 8-A, 8-B, 8-C	Brown duct seal	Metal ducts	Rooms 2020c and 2232
9-A, 9-B, 9-C	Fibreboard behind wood panel	Unknown	Room 2102
10-A, 10-B, 10-C, 12	(12" x 12") vinyl floor tiles (coloured specks) and underlying mastic	Concrete	Rooms 2020c, 2102 and 2205
11-A, 11-B, 11-C	(12" x 12") vinyl floor tiles (beige streaks) and underlying mastic	Concrete	Room 2232
13-A, 13-B, 13-C	(24" x 24") vinyl floor tiles (grey) and underlying mastic	Concrete	Room 2213i
14	Fireproofing	Metal deck	Room 2213i
15-A, 15-B, 15-C	Brown caulking around electrical wires at condensers	Electrical wires	Roof
2A, 2B and 2C	SE corner of roof of 201B	Roofing materials	Roof ⁽¹⁾
3A, 3B and 3C	Roof of 201B	Roofing materials	Roof ⁽¹⁾
4A, 4B and 4C	Roof of 201B	White flashing caulking	Roof ⁽¹⁾

NOTE:

(1) Sample result obtained from the Wood Environment & Infrastructure report titled "Asbestos-Containing Building Materials Management Survey, Roofing Materials Survey, DRDC Building 201A/B, dated May 30, 2018.

Based on visual observations, and results of laboratory analyses of samples collected by Arcadis, asbestos-containing materials (ACM) found to be present in the study areas included the following:

- Drywall joint compound in Rooms 1100, 1205A, 1516, 1542, 1700, 2020c, 2102, 2205, 2213i and 2232;
- Pipe fitting insulation in Rooms 1100, 2102 and 2219;

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- Pipe straight insulation in Room 2102;
- Duct parging cement in Room 2219;
- Cement board in the pipe chase in Room 2102 and assumed to be behind the wall panels;
- Duct vibration sleeve in Room 2219; and
- (12" x 12") vinyl floor tiles in Rooms 1100 and 1516.

Cement board, vinyl floor tiles and the vibration sleeve are non-friable materials. The removal, alteration and/or disturbance of these non-friable asbestos-containing materials can be performed as a Type 1 operation as specified in O. Reg. 278/05 if the material is wetted and the work is done only using non-powered, hand-held tools. If the removal, alteration and/or disturbance work is done using power tools that are attached to dust-collecting devices equipped with HEPA filters, then the work is classified as Type 2. If the power tools do not have HEPA filtered dust collecting devices, then the work is Type 3.

Drywall joint compound is a non-friable or semi-friable material. The removal of less than one square metre of drywall in which the joint compound is asbestos-containing can be performed as a Type 1 operation as specified in O. Reg. 278/05. The removal of one square metre or more of drywall in which the joint compound is asbestos-containing can be performed as a Type 2 operation as specified in O. Reg. 278/05.

Thermal pipe insulation and the duct parging material are friable materials. The removal, alteration and/or disturbance of less than 1 m² of friable asbestos-containing materials is classified as a Type 2 enclosure operation as specified in O.Reg. 278/05. The removal, alteration and/or disturbance of more than 1 m² of friable asbestos-containing materials is classified as a Type 3 operation.

Asbestos may be present in materials which were not sampled during the course of the designated substances survey carried out by Arcadis, including, but not limited to, materials inside the air handling unit in Room 2219 and the roof-top HVAC units. Asbestos may also be present in locations that are presently inaccessible (e.g., behind solid ceilings and walls). Vermiculite was not observed at any of the test locations in Rooms 1205A, 1700, 2219 and 2232.

3.2 Lead

Samples of representative paint were collected by Arcadis during the course of the survey. The samples were submitted to ALS for analysis of lead (as well as mercury, arsenic and PCBs). The results of analysis are presented in Table 3.3 and photographs of paint applications are presented in Appendix D. A summary of rooms with similar surface coatings is presented in Table 3.4. The laboratory reports are provided in Appendix B.

Lead was detected at a level above 90 µg/g (Surface Coating Materials Regulations SOR/2016-193 criterion value) in one of the seven paint samples analyzed.

Paint applications were observed to be generally in good condition.

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Table 3.3 Surface Coating – Sampling Summary – DRDC

Sample ID	Sample Location	Sample Description	Substrate Material	Condition	Analytical Results (µg/g)			
					Arsenic (10 µg/g)	Lead (90 µg/g)	Mercury (10 µg/g)	PCBs (50 µg/g)
P-1	Roof	Yellow pipe paint	Pipe	Fair to Good	1.0	602	<0.121	N/A ⁽²⁾
P-2	Room 1700	White wall paint	Drywall	Good	<1.0	<5.0	2.82	N/A ⁽²⁾
P-3	Room 2219	Grey floor paint	Concrete	Good	2.0	6.2	0.198	<0.30
P-4	Room 1205A	White wall paint	Drywall	Good	<1.0	<5.0	<0.123	<0.38
P-5	Room 2232	White wall paint	Drywall	Good	<1.0	<5.0	16.1	<0.30
P-6	Room 2213i	White wall paint	Drywall	Good	<1.0	<5.0	<0.121	<0.30
P-7	Room 1542	Grey wall paint	Drywall	Good	12.5 ⁽¹⁾	<5.0	0.174	<0.41

NOTES:

< = Less than.

N/A = Not analyzed.

Bolded areas indicate contaminants above regulated levels. Use Caution. Follow MOL Guideline for Lead, wet surfaces down before disturbing them.

(1) No current regulated amounts for arsenic.

(2) Insufficient sample size to reach the laboratory limit of detection.

Table 3.4 Summary of Rooms with Similar Surface Coatings – DRDC

Sample ID	Paint Description	Rooms with Similar Surface Coating/Paint Colour
P-1	Yellow paint on gas line	Roof
P-2	White wall paint on drywall wall	Rooms 1100, 1516, 1700, 2020c and 2102
P-3	Grey floor paint on concrete	Room 2219
P-4	White paint on drywall wall	Rooms 1205A, 2205, 2132, 2213i and 2232
P-5	White paint on drywall wall	Rooms 1205A, 2205, 2132, 2213i and 2232
P-6	White paint on drywall wall	Rooms 1205A, 2205, 2132, 2213i and 2232
P-7	Grey paint on drywall wall	Room 1542

3.3 Mercury

During the course of the site inspections, fluorescent lights were observed in the study areas. Mercury should be assumed to be present as a gas in all fluorescent light tubes. A mercury-containing thermostat was observed in Room 1542. It will likely be unaffected by the renovations.

Proper procedures for removing and handling mercury-containing fluorescent light tubes, if required, typically involve:

- ensuring that electrical power to light fixtures has been disconnected and locked out;
- taking all necessary precautions to ensure that fluorescent lamp tubes are removed in a manner that prevents breakage; and
- transporting fluorescent lamp tubes to a licensed processing location for separation and recovery of mercury.

Samples of paint collected during the survey were analyzed for mercury. The results of analysis are presented in Table 4.3. Mercury was detected at a level above 10 µg/g (Surface Coating Materials Regulations SOR/2016/193 criterion value) in one of the seven paint sample analyzed.

3.4 Silica

Materials observed in the subject building which should be considered to contain silica included concrete, drywall, block walls, joint compound, duct parging cement on the air handling unit in Room 2219 and pipe fitting insulation.

3.5 Other Designated Substances and Hazardous Materials

No other designated substances (vinyl chloride, acrylonitrile, benzene, isocyanates, ethylene oxide and coke oven emissions) were observed to be present in the subject building, and none would be expected to be encountered in any building materials in a form that would represent an exposure concern.

Samples of paint collected during the survey were analyzed for arsenic. The results of analysis are presented in Table 3.3.

Arsenic was detected at an amount above the level of 10 µg/g in one of the seven paint samples analyzed.

3.6 Polychlorinated Biphenyls (PCBs)

Light ballasts, such as those associated with the type of fluorescent lights (T8s) observed throughout the building, are usually an electronic-type which do not contain PCBs, however, this would be confirmed by an electrician at the time of dismantling of the lights. An air-cooled transformer was observed in Room 2219. Air-cooled transformers typically do not contain PCBs.

PCBs were detected at a level below the criterion level of 50 µg/g in all five paint samples analyzed and are therefore not considered to contain PCBs.

3.7 Urea Formaldehyde Foam Insulation (UFFI)

UFFI was not observed during the course of the inspections.

3.8 Ozone-Depleting Substances and Other Halocarbons (ODS')

During the course of the site inspections, equipment potentially containing Ozone-Depleting Substances and other Halocarbons included the following:

- Four roof-top HVAC units (RTU-7, RTU-8, RTU-9 and RTU-10) and two roof-top condensers;
- A portable cooler in Room 1700; and
- Two chest freezers in Room 1700.

3.9 Biological Hazards

During the course of the site inspections, no suspect mould growth was observed.

4 CONCLUSIONS AND RECOMMENDATIONS

We recommend the following on the basis of the findings of the designated substances and hazardous materials survey outlined in this report.

4.1 Ongoing Management

1. Ensure that all asbestos-containing materials identified in the study areas of the DRDC building are managed in place in accordance with the Department of National Defence Asbestos Management Directive, March 2007.
2. If any potential asbestos-containing materials that have not been tested for asbestos may be affected by maintenance or other work activities, they should be tested prior to their disturbance or assumed to contain asbestos and handled accordingly.
3. If work activities may cause exposure to metallic elements in paint, develop an exposure control plan, write safe work procedures and implement controls in accordance with MOL *Guideline – Lead on Construction Projects*.
4. If silica-containing materials will be affected by sanding, drilling, chipping, grinding, cutting, sawing, sweeping or blasting, the measures and procedures outlined in the Ontario Ministry of Labour *Guideline, Silica on Construction Projects*, April 2011, should be followed.

4.2 Construction Projects

1. If construction work extends to areas outside of the planned areas of repair, additional destructive sampling investigation and sampling may be required to access hidden areas (ie. – behind walls or above solid ceilings) in order to determine if asbestos-containing materials or other designated substances or hazardous materials are present.
2. If asbestos-containing materials will be affected by any construction and/or demolition work, they must be removed/handled in accordance with work practices and procedures specified in Ontario Regulation 278/05 and the DND Asbestos Management Directive. Requirements for air sampling for asbestos fibres during and upon completion of asbestos abatement operations are prescribed in the Canada Occupational Health and Safety Regulations made under the Canada Labour Code.
3. If lead-containing materials will be disturbed during the course of construction work, the measures and procedures outlined in The Ministry of Labour Guideline, Lead on Construction Projects, dated April 2011, should be followed. For building materials that are to be disposed at a landfill, all lead-based paints and associated substrate (concrete, plaster, wood, etc.) must undergo Toxicity Characteristic Leachate Properties (TCLP) testing to determine disposal procedures. The acceptable level for non-regulated disposal of lead-containing paint is less than 5 mg/L as determined through analytical TCLP. The disposal of lead-containing paint is regulated under the Federal *Transportation of Dangerous Goods Act* and by the Ontario Ministry of Environment and Climate Change.

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4. If silica-containing materials will be disturbed during the course of construction work, the measures and procedures outlined in The Ministry of Labour *Guideline, Silica on Construction Projects*, April 2011, should be followed.
5. Prior to undertaking renovation activities that involve fluorescent lights (may not be affected), ensure that a licensed electrician inspects ballasts to determine whether or not any light ballasts may contain PCBs. Guidance in identification of PCB ballasts is provided in the Environment Canada publication titled "Identification of Lamp Ballasts Containing PCBs. Report EPS 2/CC/2 (revised)", August 1991.
6. Workers involved in the demolition of any mould-impacted materials encountered during any renovation or demolition activities should wear appropriate protective clothing and equipment and follow decontamination practices as outlined in the Canadian Construction Association Standard Construction Document CCA-82 2004 – *Mould Guidelines for the Canadian Construction Industry*, and the Mould Abatement Guidelines. Environmental Abatement Council of Canada. Edition 3. 2015.

5 LIMITATIONS AND SERVICE CONSTRAINTS

The opinions, conclusions and recommendations presented in this report are limited to the information obtained during the performance of the specific scope of service identified in the report. To the extent that Arcadis relied upon any information prepared by other parties not under direct contract to Arcadis, no representation as to the accuracy or completeness of such information is made. This report is an instrument of professional service and the services described in the report were performed in accordance with generally accepted standards and level of skill and care ordinarily exercised by members of the profession working under similar conditions including comparable budgetary and schedule constraints. No warranty, guarantee or certification express or implied, is intended or given with respect to Arcadis' services, opinions, conclusions or recommendations.

Arcadis' observations, the results of any testing and Arcadis' opinions, conclusions and recommendations apply solely to conditions existing at the specific times when and specific locations where Arcadis' investigative work was performed. Arcadis affirms that data gathered and presented in this report was collected in an appropriate manner in accordance with generally accepted methods and practices. Arcadis cannot be responsible for decisions made by our client solely on the basis of economic factors. Observation and testing activities such as those conducted by Arcadis are inherently limited and do not represent a conclusive or complete characterization. Arcadis analyzed only the substances, conditions and locations described in the report at the time indicated. Conditions in other parts of the project site, building or area may vary from conditions at the specific locations where observations were made and where testing was performed by Arcadis. Additionally, other building material hazards which were not identified by Arcadis, may also be present in un-accessed areas and in walls, ceilings, cavities, and floors.

This report is expressly for the sole and exclusive use of Defence Construction Canada (DCC) and Department of National Defence (DND) for whom this report was originally prepared and for the particular purpose outlined in the report. Reuse of this report or any portion thereof for other than its intended purpose, or if modified, or if used by third parties, shall be at the user's sole risk. This report must be presented in its entirety.

6 REFERENCES

Relevant documents referenced for this project included:

- The DCC Statement of Work dated November 18, 2022;
- Arcadis proposal to DCC dated January 16, 2023;
- Department of National Defence (DND) Asbestos Management Directive, March 2007;
- Arcadis report titled *Designated Substances and Hazardous Materials Survey – Defence Construction and Research Development Canada, dated March 2020*;
- Wood Environment & Infrastructure Solutions report titled *Asbestos-Containing Building Materials Management Survey, Roofing Materials Survey, DRDC Building 201A/B* , dated May 30, 2018; and
- Pinchin Ltd. Report titled *Hazardous Building Materials Assessment, DRDC Building 201A/B, dated February 15, 2017*.

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APPENDIX A

Floor Plans

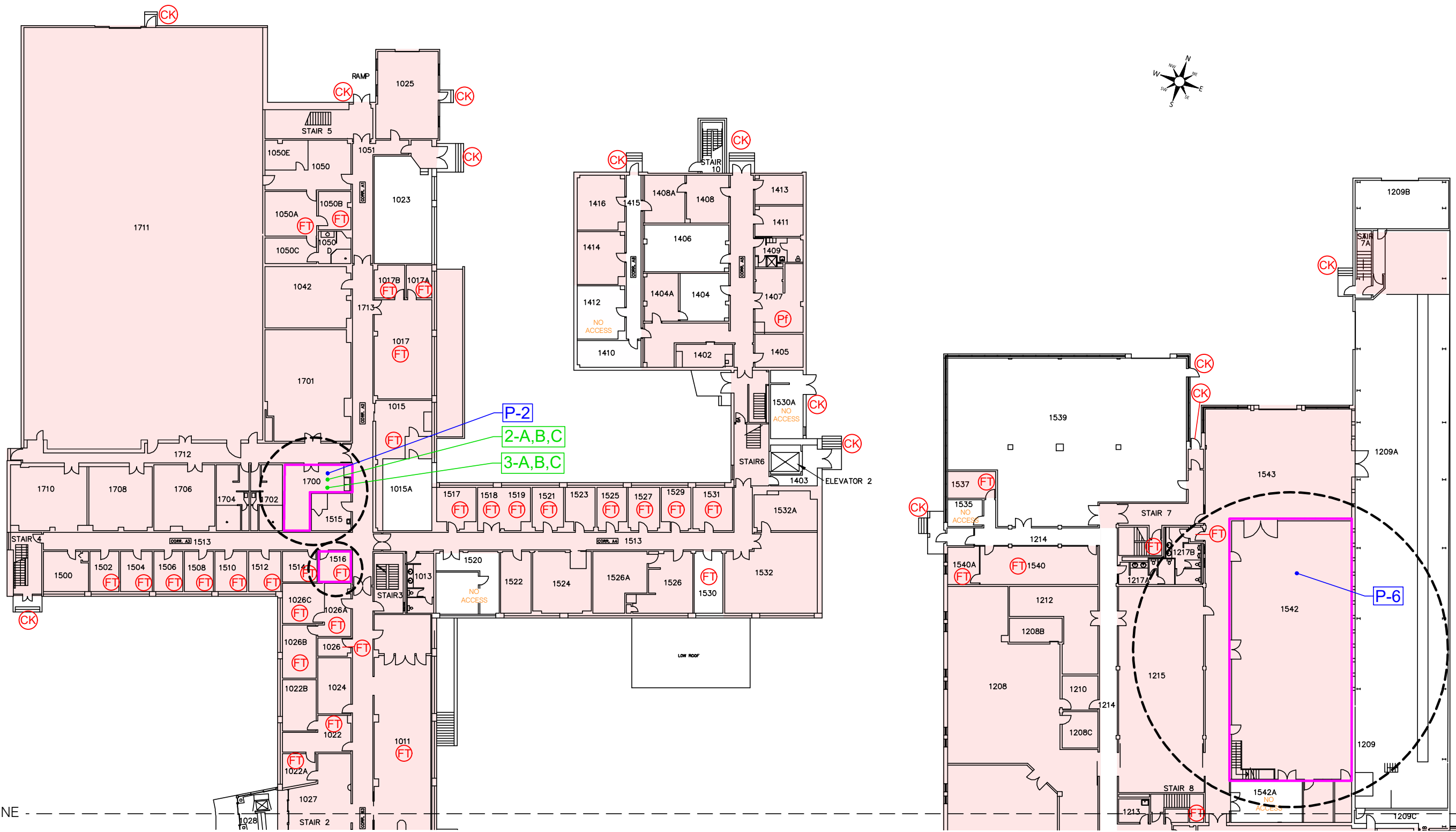


FIG. 1A

--- MATCH LINE ---

FIG. 1B

NOTE

The locations of asbestos-containing materials found within the designated study areas are noted on the floor plan. Asbestos-containing materials identified in locations outside of the designated study areas are also included for reference.

LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023
- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- THROUGHOUT FUNCTIONAL SPACE
- FT ASBESTOS-CONTAINING FLOOR TILES
- PF ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB ASBESTOS-CONTAINING CEMENT BOARD
- CK ASBESTOS CAULKING

Title: DRDC - BLDG 201A/B, 1st FLOOR, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO	
Project: DESIGNATED SUBSTANCES AND HAZARDOUS MATERIAL SURVEY	
Client: DEFENCE CONSTRUCTION CANADA	
Date: April 2023	FIGURE 1A

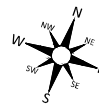
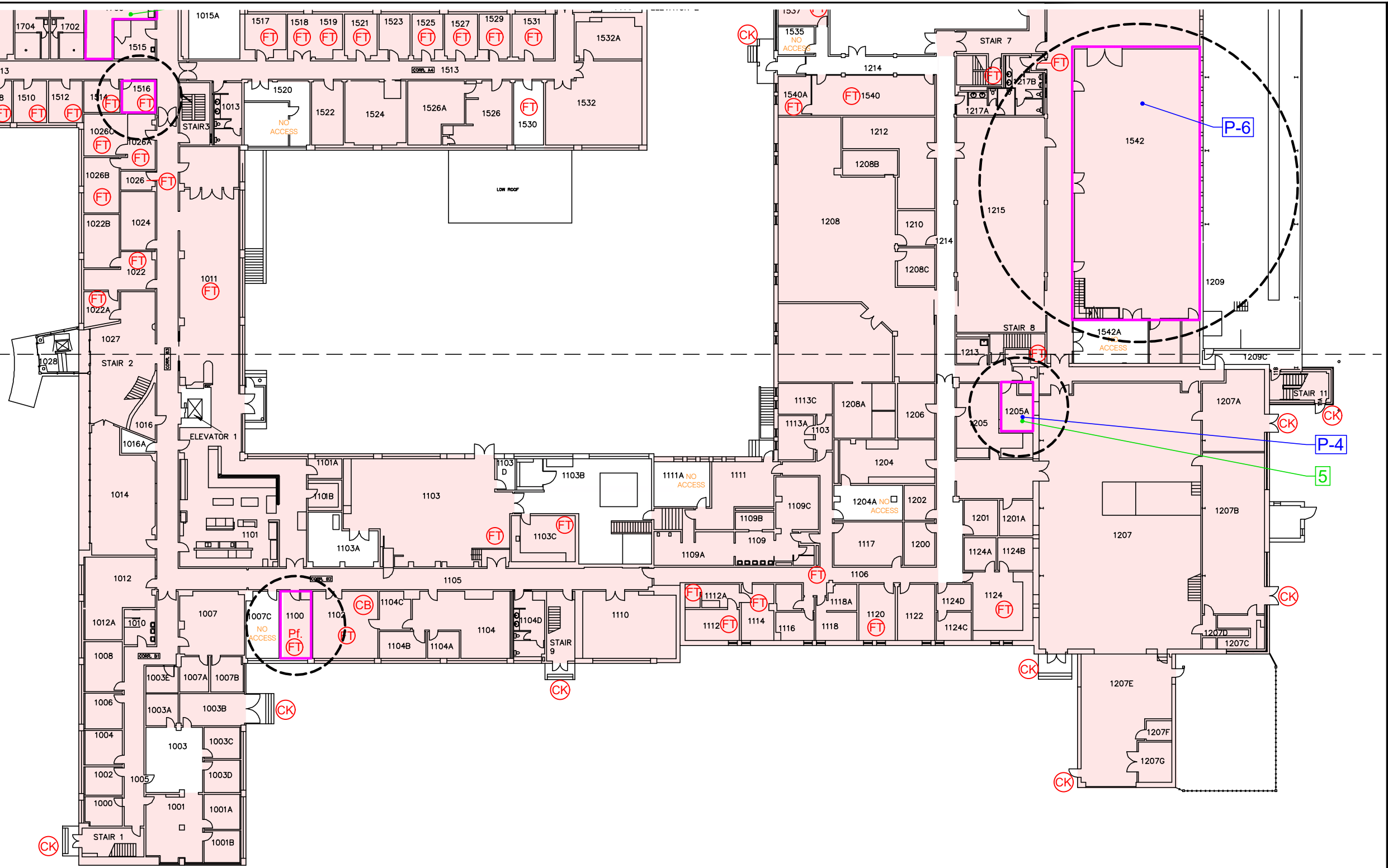


FIG. 1A

MATCH LINE

FIG. 1B



NOTE

The locations of asbestos-containing materials found within the designated study areas are noted on the floor plan. Asbestos-containing materials identified in locations outside of the designated study areas are also included for reference.

LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023
- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- THROUGHOUT FUNCTIONAL SPACE
- FT ASBESTOS-CONTAINING FLOOR TILES
- Pf ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB ASBESTOS-CONTAINING CEMENT BOARD
- CK ASBESTOS CAULKING

Title: **DRDC - BLDG 201A/B, 1st FLOOR, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO**

Project: **DESIGNATED SUBSTANCES AND HAZARDOUS MATERIAL SURVEYS**

Client: **DEFENCE CONSTRUCTION CANADA**

Date: April 2023



FIGURE 1B

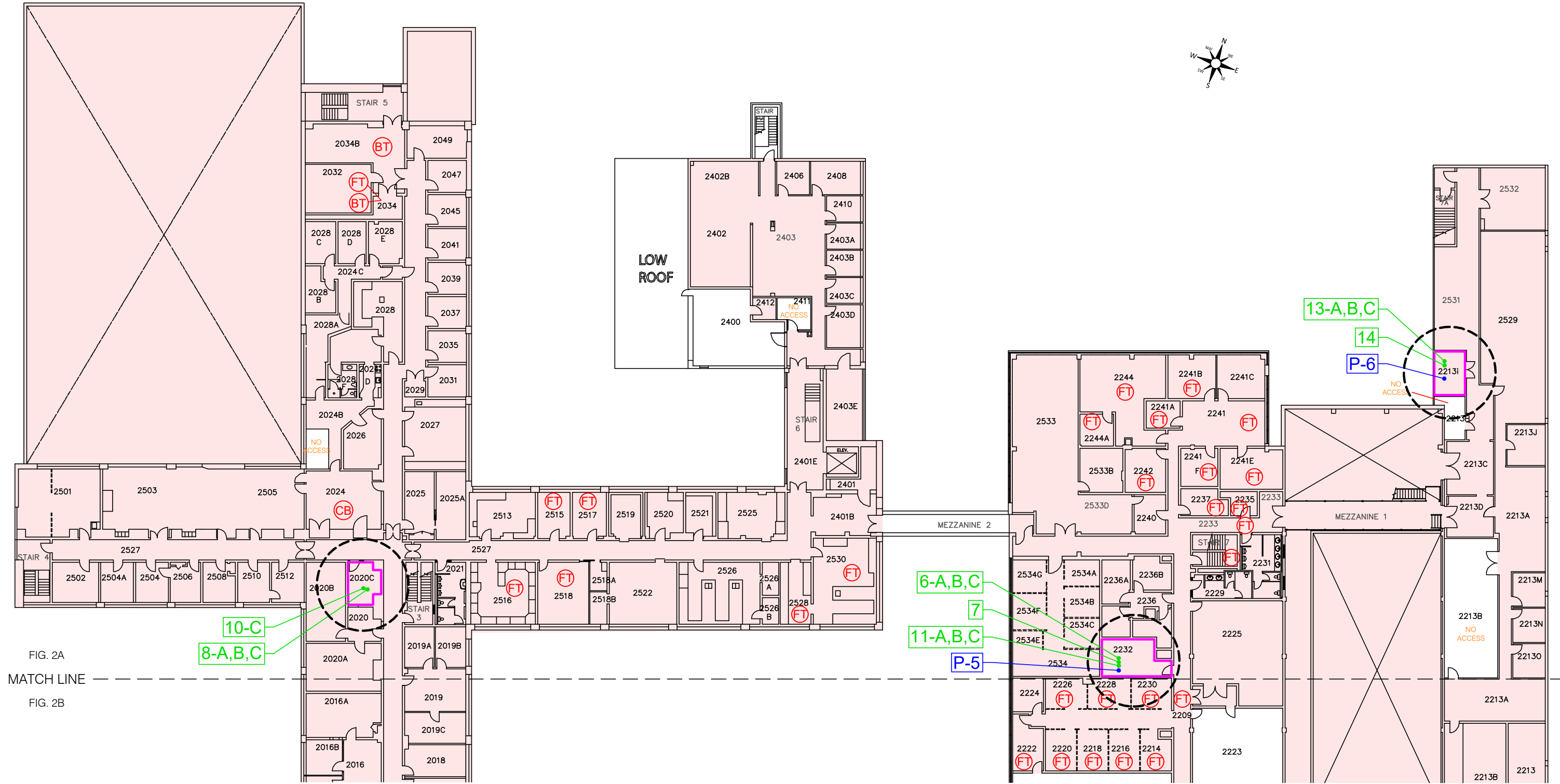
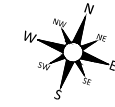


FIG. 2A
MATCH LINE
FIG. 2B

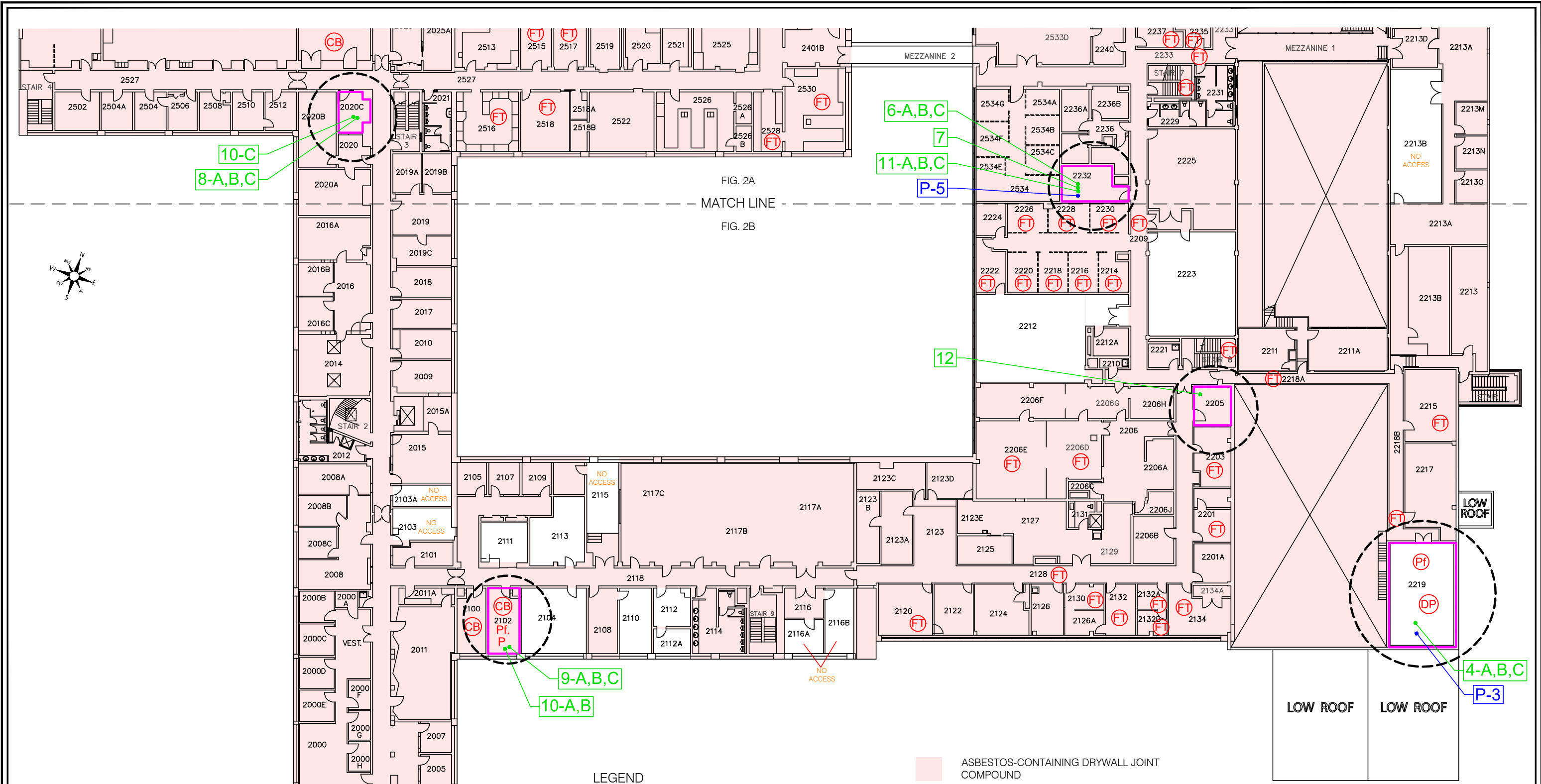
LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023
- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- THROUGHOUT FUNCTIONAL SPACE
- FT ASBESTOS-CONTAINING FLOOR TILES
- Pf ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB ASBESTOS-CONTAINING CEMENT BOARD

NOTE

The locations of asbestos-containing materials found within the designated study areas are noted on the floor plan. Asbestos-containing materials identified in locations outside of the designated study areas are also included for reference.

Title: DRDC - BLDG 201A/B, 2nd FLOOR, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO	
Project: DESIGNATED SUBSTANCES AND HAZARDOUS MATERIAL SURVEYS	
Client: DEFENCE CONSTRUCTION CANADA	
Date: April 2023	FIGURE 2A



NOTE
 The locations of asbestos-containing materials found within the designated study areas are noted on the floor plan. Asbestos-containing materials identified in locations outside of the designated study areas are also included for reference.

LEGEND

- 4 FUNCTIONAL SPACE
- 10-C BULK SAMPLE LOCATION
- P-6 PAINT CHIP SAMPLE LOCATION
- AREA INSPECTED IN MARCH 2023

- ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND
- THROUGHOUT FUNCTIONAL SPACE
- FT ASBESTOS-CONTAINING FLOOR TILES
- Pf ASBESTOS-CONTAINING PIPE FITTING INSULATION
- CB ASBESTOS-CONTAINING CEMENT BOARD
- DP ASBESTOS DUCT PARGING CEMENT
- P ASBESTOS PIPE STRAIGHT INSULATION

Title: **DRDC - BLDG 201A/B, 2nd FLOOR, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO**
 Project: **DESIGNATED SUBSTANCES AND HAZARDOUS MATERIAL SURVEYS**

Client: **DEFENCE CONSTRUCTION CANADA**

Date: April 2023
FIGURE 2B

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES –
DEFENCE RESEARCH AND DEVELOPMENT CANADA TORONTO, 1133 SHEPPARD AVENUE WEST,
TORONTO, ONTARIO

APPENDIX B

Laboratory Reports



CERTIFICATE OF ANALYSIS

Work Order : **WT2304374**
Client : **Arcadis Canada Inc.**
Contact : Paul Smith
Address : 1050 Morrison Drive Suite 201
 Ottawa ON Canada K2H 1L1
Telephone : 613 721 0555
Project : ----
PO : ----
C-O-C number : ----
Sampler : CLIENT
Site : ----
Quote number : Q89695 - Metals and PCBs in Paint and Building Materials
No. of samples received : 7
No. of samples analysed : 7

Page : 1 of 4
Laboratory : Waterloo - Environmental
Account Manager : Emily Smith
Address : 60 Northland Road, Unit 1
 Waterloo ON Canada N2V 2B8
Telephone : +1 519 886 6910
Date Samples Received : 22-Feb-2023 16:10
Date Analysis Commenced : 27-Feb-2023
Issue Date : 01-Mar-2023 16:32

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Greg Pokocky	Supervisor - Inorganic	Metals, Waterloo, Ontario
Jon Fisher	Department Manager - Inorganics	Metals, Waterloo, Ontario
Yan Zhang	Lab Analyst	Organics, Edmonton, Alberta



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
mg/kg	milligrams per kilogram
mg/kg wwt	milligrams per kilogram wet weight

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Workorder Comments

Insufficient sample to complete PCB testing on sample P-1 Yellow Pipe Paint-Roof

Sample -002: Insufficient sample to complete PCB testing.

Qualifiers

<i>Qualifier</i>	<i>Description</i>
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLIS	Detection Limit Adjusted due to insufficient sample.



Analytical Results

Sub-Matrix: Paint Chips

Client sample ID

(Matrix: Soil/Solid)

					P-1 YELLOW PIPE PAINT-ROOF	P-2 ROOM 1700 WHITE WALL PAINT	P-3 ROOM 2219 GREY FLOOR PAINT	P-4 ROOM 1205A WHITE WALL PAINT	P-5 ROOM 2232 WHITE WALL PAINT
Client sampling date / time					15-Feb-2023	15-Feb-2023	15-Feb-2023	15-Feb-2023	16-Feb-2023
Analyte	CAS Number	Method	LOR	Unit	WT2304374-001	WT2304374-002	WT2304374-003	WT2304374-004	WT2304374-005
					Result	Result	Result	Result	Result
Metals									
Arsenic	7440-38-2	E494	1.0	mg/kg	1.3	<1.0	2.0	<1.0	<1.0
Lead	7439-92-1	E494.Pb	5.0	mg/kg	602	<5.0	6.2	<5.0	<5.0
Mercury, total	7439-97-6	E518	0.050	mg/kg	<0.121	2.82	0.198	<0.123	16.1 ^{DLHC}
Polychlorinated Biphenyls									
Aroclor 1016	12674-11-2	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1221	11104-28-2	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1232	11141-16-5	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1242	53469-21-9	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1248	12672-29-6	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1254	11097-69-1	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1260	11096-82-5	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1262	37324-23-5	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Aroclor 1268	11100-14-4	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Polychlorinated biphenyls [PCBs], total	----	E685-H.A	0.30	mg/kg wwt	----	----	<0.30	<0.38 ^{DLIS}	<0.30
Polychlorinated Biphenyls Surrogates									
Decachlorobiphenyl	2051-24-3	E685-H.A	1.0	%	----	----	105	108	109

Please refer to the General Comments section for an explanation of any qualifiers detected.



Analytical Results

Sub-Matrix: Paint Chips

Client sample ID

(Matrix: Soil/Solid)

					P-6 ROOM 2213B WHITE WALL PAINT	P-7 ROOM 1542 GREY WALL PAINT	----	----	----
					16-Feb-2023	16-Feb-2023	----	----	----
Analyte	CAS Number	Method	LOR	Unit	WT2304374-006	WT2304374-007	-----	-----	-----
					Result	Result	---	---	---
Metals									
Arsenic	7440-38-2	E494	1.0	mg/kg	<1.0	12.5	---	---	---
Lead	7439-92-1	E494.Pb	5.0	mg/kg	<5.0	<5.0	---	---	---
Mercury, total	7439-97-6	E518	0.050	mg/kg	<0.121	0.174	---	---	---
Polychlorinated Biphenyls									
Aroclor 1016	12674-11-2	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1221	11104-28-2	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1232	11141-16-5	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1242	53469-21-9	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1248	12672-29-6	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1254	11097-69-1	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1260	11096-82-5	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1262	37324-23-5	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Aroclor 1268	11100-14-4	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Polychlorinated biphenyls [PCBs], total	----	E685-H.A	0.30	mg/kg wwt	<0.30	<0.41 ^{DLIS}	---	---	---
Polychlorinated Biphenyls Surrogates									
Decachlorobiphenyl	2051-24-3	E685-H.A	1.0	%	109	117	---	---	---

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

<p>Work Order : WT2304374</p> <p>Client : Arcadis Canada Inc.</p> <p>Contact : Paul Smith</p> <p>Address : 1050 Morrison Drive Suite 201 Ottawa ON Canada K2H 1L1</p> <p>Telephone : 613 721 0555</p> <p>Project : ----</p> <p>PO : ----</p> <p>C-O-C number : ----</p> <p>Sampler : CLIENT</p> <p>Site : ----</p> <p>Quote number : Q89695 - Metals and PCBs in Paint and Building Materials</p> <p>No. of samples received : 7</p> <p>No. of samples analysed : 7</p>	<p>Page : 1 of 8</p> <p>Laboratory : Waterloo - Environmental</p> <p>Account Manager : Emily Smith</p> <p>Address : 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8</p> <p>Telephone : +1 519 886 6910</p> <p>Date Samples Received : 22-Feb-2023 16:10</p> <p>Issue Date : 01-Mar-2023 16:32</p>
--	---

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

- Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO: Data Quality Objective.
- LOR: Limit of Reporting (detection limit).
- RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Lead in Paint by CRC ICPMS											
Compliant container P-5 ROOM 2232 WHITE WALL PAINT	E494.Pb	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	11 days	✓	
Metals : Lead in Paint by CRC ICPMS											
Compliant container P-6 ROOM 2213B WHITE WALL PAINT	E494.Pb	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	11 days	✓	
Metals : Lead in Paint by CRC ICPMS											
Compliant container P-7 ROOM 1542 GREY WALL PAINT	E494.Pb	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	11 days	✓	
Metals : Lead in Paint by CRC ICPMS											
Compliant container P-1 YELLOW PIPE PAINT-ROOF	E494.Pb	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✓	
Metals : Lead in Paint by CRC ICPMS											
Compliant container P-2 ROOM 1700 WHITE WALL PAINT	E494.Pb	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✓	
Metals : Lead in Paint by CRC ICPMS											
Compliant container P-3 ROOM 2219 GREY FLOOR PAINT	E494.Pb	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✓	
Metals : Lead in Paint by CRC ICPMS											
Compliant container P-4 ROOM 1205A WHITE WALL PAINT	E494.Pb	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✓	



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Metals (As,Cr) in Paint Chips by CRC ICPMS											
Compliant container P-5 ROOM 2232 WHITE WALL PAINT	E494	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	11 days	✔	
Metals : Metals (As,Cr) in Paint Chips by CRC ICPMS											
Compliant container P-6 ROOM 2213B WHITE WALL PAINT	E494	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	11 days	✔	
Metals : Metals (As,Cr) in Paint Chips by CRC ICPMS											
Compliant container P-7 ROOM 1542 GREY WALL PAINT	E494	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	11 days	✔	
Metals : Metals (As,Cr) in Paint Chips by CRC ICPMS											
Compliant container P-1 YELLOW PIPE PAINT-ROOF	E494	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✔	
Metals : Metals (As,Cr) in Paint Chips by CRC ICPMS											
Compliant container P-2 ROOM 1700 WHITE WALL PAINT	E494	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✔	
Metals : Metals (As,Cr) in Paint Chips by CRC ICPMS											
Compliant container P-3 ROOM 2219 GREY FLOOR PAINT	E494	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✔	
Metals : Metals (As,Cr) in Paint Chips by CRC ICPMS											
Compliant container P-4 ROOM 1205A WHITE WALL PAINT	E494	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	180 days	12 days	✔	
Metals : Total Mercury in Paint Chips by CVAAS											
Compliant container P-5 ROOM 2232 WHITE WALL PAINT	E518	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	28 days	11 days	✔	
Metals : Total Mercury in Paint Chips by CVAAS											
Compliant container P-6 ROOM 2213B WHITE WALL PAINT	E518	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	28 days	11 days	✔	



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Total Mercury in Paint Chips by CVAAS											
Compliant container P-7 ROOM 1542 GREY WALL PAINT	E518	16-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	28 days	11 days	✔	
Metals : Total Mercury in Paint Chips by CVAAS											
Compliant container P-1 YELLOW PIPE PAINT-ROOF	E518	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	28 days	12 days	✔	
Metals : Total Mercury in Paint Chips by CVAAS											
Compliant container P-2 ROOM 1700 WHITE WALL PAINT	E518	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	28 days	12 days	✔	
Metals : Total Mercury in Paint Chips by CVAAS											
Compliant container P-3 ROOM 2219 GREY FLOOR PAINT	E518	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	28 days	12 days	✔	
Metals : Total Mercury in Paint Chips by CVAAS											
Compliant container P-4 ROOM 1205A WHITE WALL PAINT	E518	15-Feb-2023	27-Feb-2023	----	----		27-Feb-2023	28 days	12 days	✔	
Polychlorinated Biphenyls : PCB Aroclors by GC-ECD											
Compliant container P-3 ROOM 2219 GREY FLOOR PAINT	E685-H.A	15-Feb-2023	28-Feb-2023	----	----		28-Feb-2023	0 days	0 days	✔	
Polychlorinated Biphenyls : PCB Aroclors by GC-ECD											
Compliant container P-4 ROOM 1205A WHITE WALL PAINT	E685-H.A	15-Feb-2023	28-Feb-2023	----	----		28-Feb-2023	0 days	0 days	✔	
Polychlorinated Biphenyls : PCB Aroclors by GC-ECD											
Compliant container P-5 ROOM 2232 WHITE WALL PAINT	E685-H.A	16-Feb-2023	28-Feb-2023	----	----		28-Feb-2023	0 days	0 days	✔	
Polychlorinated Biphenyls : PCB Aroclors by GC-ECD											
Compliant container P-6 ROOM 2213B WHITE WALL PAINT	E685-H.A	16-Feb-2023	28-Feb-2023	----	----		28-Feb-2023	0 days	0 days	✔	



Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Polychlorinated Biphenyls : PCB Aroclors by GC-ECD										
Compliant container P-7 ROOM 1542 GREY WALL PAINT	E685-H.A	16-Feb-2023	28-Feb-2023	----	----		28-Feb-2023	0 days	0 days	✔

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✘ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP)							
Lead in Paint by CRC ICPMS	E494.Pb	846458	1	9	11.1	5.0	✔
Metals (As,Cr) in Paint Chips by CRC ICPMS	E494	846459	1	7	14.2	5.0	✔
PCB Aroclors by GC-ECD	E685-H.A	847647	0	5	0.0	5.0	✘
Total Mercury in Paint Chips by CVAAS	E518	846460	1	7	14.2	5.0	✔
Laboratory Control Samples (LCS)							
Lead in Paint by CRC ICPMS	E494.Pb	846458	2	9	22.2	10.0	✔
Metals (As,Cr) in Paint Chips by CRC ICPMS	E494	846459	2	7	28.5	10.0	✔
PCB Aroclors by GC-ECD	E685-H.A	847647	1	5	20.0	5.0	✔
Total Mercury in Paint Chips by CVAAS	E518	846460	2	7	28.5	10.0	✔
Method Blanks (MB)							
Lead in Paint by CRC ICPMS	E494.Pb	846458	1	9	11.1	5.0	✔
Metals (As,Cr) in Paint Chips by CRC ICPMS	E494	846459	1	7	14.2	5.0	✔
PCB Aroclors by GC-ECD	E685-H.A	847647	1	5	20.0	5.0	✔
Total Mercury in Paint Chips by CVAAS	E518	846460	1	7	14.2	5.0	✔



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Metals (As,Cr) in Paint Chips by CRC ICPMS	E494 Waterloo - Environmental	Soil/Solid	EPA 200.2/6020B (mod)	Paint samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.
Lead in Paint by CRC ICPMS	E494.Pb Waterloo - Environmental	Soil/Solid	EPA 200.2/6020B (mod)	This analysis is carried out using procedures adapted from EPA Method 200.2. The sample is manually homogenized and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020B).
Total Mercury in Paint Chips by CVAAS	E518 Waterloo - Environmental	Soil/Solid	SW846 7470A	Samples are homogenized, then sieved through a 2 mm sieve and digested with HNO ₃ and HCl, followed by CVAAS analysis.
PCB Aroclors by GC-ECD	E685-H.A Edmonton - Environmental	Soil/Solid	EPA 8082A (mod)	PCB Aroclors are extracted from paint, tar, or other solids using hexane/acetone, then analyzed by GC-ECD. Samples are reported in sample wet weight units.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Digestion for Metals and Mercury in Paint Chips	EP494 Waterloo - Environmental	Soil/Solid	EPA 200.2 (mod)	This analysis is carried out using procedures adapted from EPA Method 200.2. The sample is manually homogenized and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids.
PCB Aroclors Extraction (High Level)	EP685-H Edmonton - Environmental	Soil/Solid	EPA 3570/3550C (mod)	Samples are subsampled and PCBs are extracted with solvents using a mechanical shaking extractor. Water is added to the extract and the resulting hexane extract undergoes one or more of the following clean-up procedures (if required): florisil clean-up, silica gel clean-up, sulphur clean-up and/or sulphuric acid clean-up.

QUALITY CONTROL REPORT

<p>Work Order : WT2304374</p> <p>Client : Arcadis Canada Inc.</p> <p>Contact : Paul Smith</p> <p>Address : 1050 Morrison Drive Suite 201 Ottawa ON Canada K2H 1L1</p> <p>Telephone :</p> <p>Project : ----</p> <p>PO : ----</p> <p>C-O-C number : ----</p> <p>Sampler : CLIENT 613 721 0555</p> <p>Site : ----</p> <p>Quote number : Q89695 - Metals and PCBs in Paint and Building Materials</p> <p>No. of samples received : 7</p> <p>No. of samples analysed : 7</p>	<p>Page : 1 of 4</p> <p>Laboratory : Waterloo - Environmental</p> <p>Account Manager : Emily Smith</p> <p>Address : 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8</p> <p>Telephone : +1 519 886 6910</p> <p>Date Samples Received : 22-Feb-2023 16:10</p> <p>Date Analysis Commenced : 27-Feb-2023</p> <p>Issue Date : 01-Mar-2023 16:33</p>
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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Greg Pokocky	Supervisor - Inorganic	Waterloo Metals, Waterloo, Ontario
Jon Fisher	Department Manager - Inorganics	Waterloo Metals, Waterloo, Ontario
Yan Zhang	Lab Analyst	Edmonton Organics, Edmonton, Alberta



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

- Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO = Data Quality Objective.
- LOR = Limit of Reporting (detection limit).
- RPD = Relative Percent Difference
- # = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 846458)											
WT2304374-002	P-2 ROOM 1700 WHITE WALL PAINT	Lead	7439-92-1	E494.Pb	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
Metals (QC Lot: 846459)											
WT2304374-002	P-2 ROOM 1700 WHITE WALL PAINT	Arsenic	7440-38-2	E494	1.0	mg/kg	<1.0	<1.0	0	Diff <2x LOR	----
Metals (QC Lot: 846460)											
WT2304374-002	P-2 ROOM 1700 WHITE WALL PAINT	Mercury, total	7439-97-6	E518	0.124	mg/kg	2.82	2.19	25.4%	40%	----



Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 846458)						
Lead	7439-92-1	E494.Pb	5	mg/kg	<5.0	----
Metals (QCLot: 846459)						
Arsenic	7440-38-2	E494	1	mg/kg	<1.0	----
Metals (QCLot: 846460)						
Mercury, total	7439-97-6	E518	0.05	mg/kg	<0.125	----
Polychlorinated Biphenyls (QCLot: 847647)						
Aroclor 1016	12674-11-2	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1221	11104-28-2	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1232	11141-16-5	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1242	53469-21-9	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1248	12672-29-6	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1254	11097-69-1	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1260	11096-82-5	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1262	37324-23-5	E685-H.A	0.3	mg/kg wwt	<0.30	----
Aroclor 1268	11100-14-4	E685-H.A	0.3	mg/kg wwt	<0.30	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				Qualifier
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	
Metals (QCLot: 846458)									
Lead	7439-92-1	E494.Pb	5	mg/kg	50 mg/kg	100	70.0	130	----
Metals (QCLot: 846459)									
Arsenic	7440-38-2	E494	1	mg/kg	100 mg/kg	105	70.0	130	----
Metals (QCLot: 846460)									
Mercury, total	7439-97-6	E518	0.05	mg/kg	0.1 mg/kg	106	70.0	130	----
Polychlorinated Biphenyls (QCLot: 847647)									
Aroclor 1260	11096-82-5	E685-H.A	0.3	mg/kg wwt	0.25 mg/kg wwt	120	65.0	130	----



Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Metals (QCLot: 846458)									
	RM	Lead	7439-92-1	E494.Pb	267 mg/kg	121	70.0	130	----
Metals (QCLot: 846459)									
	RM	Arsenic	7440-38-2	E494	3.73 mg/kg	102	70.0	130	----
Metals (QCLot: 846460)									
	RM	Mercury, total	7439-97-6	E518	0.0585 mg/kg	106	70.0	130	----



www.alsqlab.ca

Canada Toll Free: 1 800 868 9878

Chain of Custody (COC) / Analytical Request Form

COC Number: 17 -

Page 1 of 1
March 14, 2023

Contact and company name below will appear on the final report

Report Format / Distribution

Select Service Level Below - Contact your AIT to confirm all E&P TATs (surcharges may apply)

Company: Accolis Canada

Select Report Format: PDF EXCEL EDD (DIGITAL)

Regular [R] Standard [AT] if received by 3 pm - business days - no surcharges apply

Contact: Paul Smith

Quality Control (QC) Report with Report YES NO

1 Business day [E - 100%]

Phone: 416-953-0456

Compare Results to Criteria on Report - provide details below if box checked

Same Day, Weekend or Statutory holiday [E2 - 200%]

Street: 121 Gerrard St. E. Unit 12

Select Distribution: EMAIL MAIL FAX

Emergency [E3 - 200%]

City/Province: Richmond Hill, ON

Email 1 or Fax Paul Smith @ accolis.com

For tests that can not be performed according to the service level being requested, please indicate the reason below

Postal Code: L4B 3N4

Email 2

Date and Time Required for all E&P TATs: 03/14/23 10:00 AM

Invoice To: Same as Report To

Invoice Distribution

Indicate Filtered (F), Preserved (P) or Filtered

Company: Project Information

Select Invoice Distribution: EMAIL MAIL FAX

Analysis #

ALS Account # / Quote #:

Oil and Gas Required Fields (client use)

Telephone: + 1 519 886 6910

Job #: ALS Account # / Quote #

AFE/Cost Center: PO#

Barcode

PO / AFE: Requestioner: Routing Code:

Major/Minor Code: Location:

Work Order Reference WT2304374

LSID: ALS Lab Work Order # (lab use only):

ALS Contact:

SAMP

ALS Sample # (lab use only)

Sample Identification and/or Coordinates (This description will appear on the report)

NUMBER OF CONTAINERS

P-1 yellow pipe paint - E-pole

Date (dd-mm-yy) 03/15/2023

Time (hhmm) 10:00

P-2 Room 1700 white wall paint

Date (dd-mm-yy) 03/15/2023

Time (hhmm) 10:00

P-3 Room 2219 grey floor

Date (dd-mm-yy) 03/15/2023

Time (hhmm) 10:00

P-4 Room 1205A white wall paint

Date (dd-mm-yy) 03/16/2023

Time (hhmm) 10:00

P-5 Room 2232 white wall paint

Date (dd-mm-yy) 03/16/2023

Time (hhmm) 10:00

P-6 Room 2238 white wall paint

Date (dd-mm-yy) 03/16/2023

Time (hhmm) 10:00

P-7 Room 1542 grey wall paint

Date (dd-mm-yy) 03/16/2023

Time (hhmm) 10:00

Drinking Water (DW) Samples (client use)

Special Instructions: Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Are samples taken from a Regulated DW System? YES NO

Frozen Ice Packs Ice Cubes Custody seal intact Yes No No

Cooling Initiated INITIAL COOLER TEMPERATURES °C 9.5 FINAL COOLER TEMPERATURES °C 10.0

Are samples for human consumption/ use? YES NO

SHIPMENT RELEASE (client use)

INITIAL SHIPMENT RECEPTION (lab use only)

Released by: [Signature] Date: 03/12/2023

Received by: [Signature] Date: 03/14/2023

Received by: [Signature] Date: 03/14/2023

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form. LEGIBLE. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

SSR-842

7/28/2018



EMSL Canada Inc.

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Phone/Fax: (289) 997-4602 / (289) 997-4607
<http://www.EMSL.com> / torontolab@emsl.com

EMSL Canada Order 552302567
Customer ID: 55DCSL97
Customer PO: 30160112
Project ID:

Attn: Paul Smith
ARCADIS Canada Inc.
121 Granton Drive
Unit 12
Richmond Hill, ON L4B 3N4
Proj: DRDC

Phone: (905) 882-5984
Fax: (905) 882-8962
Collected:
Received: 2/21/2023
Analyzed: 2/28/2023

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 1-A **Lab Sample ID:** 552302567-0001

Sample Description: Roof RTU-7/white caulking around electrical

TEST	Analyzed		Non-Asbestos		Asbestos	Comment
	Date	Color	Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	White	0.0%	100%	None Detected	
TEM Grav. Reduction	2/28/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 1-B-Caulking **Lab Sample ID:** 552302567-0002

Sample Description: Roof RTU-9/white caulking around electrical

TEST	Analyzed		Non-Asbestos		Asbestos	Comment
	Date	Color	Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 1-B-Tar **Lab Sample ID:** 552302567-0002A

Sample Description: Roof RTU-9/white caulking around electrical

TEST	Analyzed		Non-Asbestos		Asbestos	Comment
	Date	Color	Fibrous	Non-Fibrous		
PLM	2/27/2023	Black	0.0%	100.0%	None Detected	

Client Sample ID: 1-C-Caulking **Lab Sample ID:** 552302567-0003

Sample Description: Roof RTU-10/white caulking around electrical

TEST	Analyzed		Non-Asbestos		Asbestos	Comment
	Date	Color	Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 1-C-Tar **Lab Sample ID:** 552302567-0003A

Sample Description: Roof RTU-10/white caulking around electrical

TEST	Analyzed		Non-Asbestos		Asbestos	Comment
	Date	Color	Fibrous	Non-Fibrous		
PLM	2/27/2023	Black	0.0%	100.0%	None Detected	

Client Sample ID: 2-A **Lab Sample ID:** 552302567-0004

Sample Description: Room 1700/block filler wall paint

TEST	Analyzed		Non-Asbestos		Asbestos	Comment
	Date	Color	Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 2-B **Lab Sample ID:** 552302567-0005

Sample Description: Room 1700/block filler wall paint

TEST	Analyzed		Non-Asbestos		Asbestos	Comment
	Date	Color	Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	



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EMSL Canada Order 552302567
Customer ID: 55DCSL97
Customer PO: 30160112
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 2-C **Lab Sample ID:** 552302567-0006

Sample Description: Room 1700/block filler wall paint

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 3-A **Lab Sample ID:** 552302567-0007

Sample Description: Room 1700/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 3-B **Lab Sample ID:** 552302567-0008

Sample Description: Room 1700/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 3-C **Lab Sample ID:** 552302567-0009

Sample Description: Room 1700/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 4-A **Lab Sample ID:** 552302567-0010

Sample Description: Room 2219/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	<1% Chrysotile	
400 PLM Pt Ct	2/27/2023	Gray	0.0%	100.0%	<0.25% Chrysotile	

Client Sample ID: 4-B **Lab Sample ID:** 552302567-0011

Sample Description: Room 2219/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	<1% Chrysotile	
400 PLM Pt Ct	2/27/2023	Gray	0.0%	100.0%	<0.25% Chrysotile	

Client Sample ID: 4-C **Lab Sample ID:** 552302567-0012

Sample Description: Room 2219/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	<1% Chrysotile	
400 PLM Pt Ct	2/27/2023	Gray	0.00%	99.75%	0.25% Chrysotile	

Client Sample ID: 5 **Lab Sample ID:** 552302567-0013

Sample Description: Room 1205A/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	None Detected	



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EMSL Canada Order 552302567
Customer ID: 55DCSL97
Customer PO: 30160112
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 6-A **Lab Sample ID:** 552302567-0014

Sample Description: Room 2232/brown duct seal

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	Brown	10.4%	89.6%	None Detected	
TEM Grav. Reduction	2/28/2023	Brown	0.0%	100.0%	None Detected	

Client Sample ID: 6-B **Lab Sample ID:** 552302567-0015

Sample Description: Room 2232/brown duct seal

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Brown	10.0%	90.0%	None Detected	Sample split from 6A

Client Sample ID: 6-C **Lab Sample ID:** 552302567-0016

Sample Description: Room 2232/brown duct seal

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Brown	10.0%	90.0%	None Detected	Sample split from 6A

Client Sample ID: 7 **Lab Sample ID:** 552302567-0017

Sample Description: Room 2232/block wall mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 8-A **Lab Sample ID:** 552302567-0018

Sample Description: Room 2020c/brown duct seal

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	Brown	9.2%	90.8%	None Detected	
TEM Grav. Reduction	2/28/2023	Brown	0.0%	100.0%	None Detected	

Client Sample ID: 8-B **Lab Sample ID:** 552302567-0019

Sample Description: Room 2020c/brown duct seal

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Brown	10.0%	90.0%	None Detected	

Client Sample ID: 8-C **Lab Sample ID:** 552302567-0020

Sample Description: Room 2020c/brown duct seal

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Brown	10.0%	90.0%	None Detected	

Client Sample ID: 9-A **Lab Sample ID:** 552302567-0021

Sample Description: Room 2102/fibreboard behind wood panel

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Brown	80.0%	20.0%	None Detected	



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EMSL Canada Order 552302567
Customer ID: 55DCSL97
Customer PO: 30160112
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 9-B **Lab Sample ID:** 552302567-0022

Sample Description: Room 2102/fibreboard behind wood panel

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Brown	80.0%	20.0%	None Detected	

Client Sample ID: 9-C **Lab Sample ID:** 552302567-0023

Sample Description: Room 2102/fibreboard behind wood panel

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Brown	80.0%	20.0%	None Detected	

Client Sample ID: 10-A-Vinyl Floor Tile **Lab Sample ID:** 552302567-0024

Sample Description: Room 2102/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	White	0.0%	100%	None Detected	
TEM Grav. Reduction	2/28/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 10-A-Mastic **Lab Sample ID:** 552302567-0024A

Sample Description: Room 2102/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/28/2023	Black/Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 10-B-Floor Tile **Lab Sample ID:** 552302567-0025

Sample Description: Room 2102/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 10-B-Mastic **Lab Sample ID:** 552302567-0025A

Sample Description: Room 2102/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Black/Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 10-C-Red Putty **Lab Sample ID:** 552302567-0026

Sample Description: Room 2020c/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Red	0.0%	100.0%	None Detected	

Client Sample ID: 10-C-Floor Tile **Lab Sample ID:** 552302567-0026A

Sample Description: Room 2020c/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	



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EMSL Canada Order 552302567
Customer ID: 55DCSL97
Customer PO: 30160112
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 10-C-Black Mastic **Lab Sample ID:** 552302567-0026B

Sample Description: Room 2020c/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Black	0.0%	100.0%	None Detected	

Client Sample ID: 11-A-Vinyl Floor Tile **Lab Sample ID:** 552302567-0027

Sample Description: Room 2232/(12" x 12") vinyl floor tile-beige streaks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	White	0.0%	100%	None Detected	
TEM Grav. Reduction	2/28/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 11-A-Mastic **Lab Sample ID:** 552302567-0027A

Sample Description: Room 2232/(12" x 12") vinyl floor tile-beige streaks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/28/2023	Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 11-B-Floor Tile **Lab Sample ID:** 552302567-0028

Sample Description: Room 2232/(12" x 12") vinyl floor tile-beige streaks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Beige	0.0%	100.0%	None Detected	

Client Sample ID: 11-B-Mastic **Lab Sample ID:** 552302567-0028A

Sample Description: Room 2232/(12" x 12") vinyl floor tile-beige streaks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 11-C-Floor Tile **Lab Sample ID:** 552302567-0029

Sample Description: Room 2232/(12" x 12") vinyl floor tile-beige streaks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Beige	0.0%	100.0%	None Detected	

Client Sample ID: 11-C-Mastic **Lab Sample ID:** 552302567-0029A

Sample Description: Room 2232/(12" x 12") vinyl floor tile-beige streaks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 12-Vinyl Floor Tile **Lab Sample ID:** 552302567-0030

Sample Description: Room 2205/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	White	0.0%	100%	None Detected	
TEM Grav. Reduction	2/28/2023	White	0.0%	100.0%	None Detected	



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EMSL Canada Order 552302567
Customer ID: 55DCSL97
Customer PO: 30160112
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 12-Mastic **Lab Sample ID:** 552302567-0030A

Sample Description: Room 2205/(12" x 12") vinyl floor tile-coloured specks

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/28/2023	Black/Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 13A **Lab Sample ID:** 552302567-0031

Sample Description: Room 2213i/(2'x2') vinyl floor tile-grey

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	Gray	0.0%	100%	None Detected	
TEM Grav. Reduction	2/28/2023	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 13B-Floor Tile **Lab Sample ID:** 552302567-0032

Sample Description: Room 2213i/(2'x2') vinyl floor tile-grey

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 13B-Mastic/Epoxy **Lab Sample ID:** 552302567-0032A

Sample Description: Room 2213i/(2'x2') vinyl floor tile-grey

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray/Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 13C-Floor Tile **Lab Sample ID:** 552302567-0033

Sample Description: Room 2213i/(2'x2') vinyl floor tile-grey

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	White	0.0%	100.0%	None Detected	

Client Sample ID: 13C-Mastic/Epoxy **Lab Sample ID:** 552302567-0033A

Sample Description: Room 2213i/(2'x2') vinyl floor tile-grey

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray/Yellow	0.0%	100.0%	None Detected	

Client Sample ID: 14 **Lab Sample ID:** 552302567-0034

Sample Description: Room 2213i/fireproofing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	White	90.0%	10.0%	None Detected	

Client Sample ID: 15A **Lab Sample ID:** 552302567-0035

Sample Description: Roof condensers/brown caulking around electrical

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	2/27/2023	Gray/Black	0.0%	100%	None Detected	
TEM Grav. Reduction	2/28/2023	Gray/Black	0.0%	100.0%	None Detected	



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Customer ID: 55DCSL97
Customer PO: 30160112
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 15B

Lab Sample ID: 552302567-0036

Sample Description: Roof condensers/brown caulking around electrical

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 15C

Lab Sample ID: 552302567-0037

Sample Description: Roof condensers/brown caulking around electrical

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	2/27/2023	Gray	0.0%	100.0%	None Detected	

Analyst(s):

Caroline Allen PLM (3)
 Khue Nguyen TEM Grav. Reduction (8)
 Kira Ramphal PLM (34)
 400 PLM Pt Ct (2)
 PLM Grav. Reduction (6)
 Marzan Regaspi PLM Grav. Reduction (2)
 Nickesh Mistry PLM (4)
 400 PLM Pt Ct (1)

Reviewed and approved by:

Matthew Davis or other approved signatory
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This is a summary report; official reports are available on LabConnect or upon request and relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 02/28/2023 12:01:37

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES –
DEFENCE RESEARCH AND DEVELOPMENT CANADA TORONTO, 1133 SHEPPARD AVENUE WEST,
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APPENDIX C

**Summary of Results of Analyses of Bulk Samples for Asbestos
Content – DRDC**

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES – DEFENCE RESEARCH AND DEVELOPMENT
CANADA TORONTO, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO

Table C.1 Summary of Results of Analyses of Bulk Samples for Asbestos Content – DRDC

Sample No.	Sample Location	Sample Description	Asbestos Content
1-A	Roof	white caulking around electrical	None Detected None Detected (TEM)
1-B	Roof	white caulking around electrical-caulking	None Detected
1-B	Roof	white caulking around electrical-tar	None Detected
1-C	Roof	white caulking around electrical-caulking	None Detected
1-C	Roof	white caulking around electrical-tar	None Detected
2-A	Room 1700	block filler wall paint	None Detected
2-B	Room 1700	block filler wall paint	None Detected
2-C	Room 1700	block filler wall paint	None Detected
3-A	Room 1700	block wall mortar	None Detected
3-B	Room 1700	block wall mortar	None Detected
3-C	Room 1700	block wall mortar	None Detected
4-A	Room 2219	block wall mortar	<0.25% Chrysotile (400 Pt Ct)
4-B	Room 2219	block wall mortar	<0.25% Chrysotile (400 Pt Ct)
4-C	Room 2219	block wall mortar	0.25% Chrysotile (400 Pt Ct)
5	Room 1205A	block wall mortar	None Detected
6-A	Room 2232	brown duct seal	None Detected None Detected (TEM)
6-B	Room 2232	brown duct seal	None Detected
6-C	Room 2232	brown duct seal	None Detected
7	Room 2232	block wall mortar	None Detected
8-A	Room 2020c	brown duct seal	None Detected None Detected (TEM)
8-B	Room 2020c	brown duct seal	None Detected
8-C	Room 2020c	brown duct seal	None Detected

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Sample No.	Sample Location	Sample Description	Asbestos Content
9-A	Room 2102	fibreboard behind wood panel	None Detected
9-B	Room 2102	fibreboard behind wood panel	None Detected
9-C	Room 2102	fibreboard behind wood panel	None Detected
10-A	Room 2102	(12" x 12") vinyl floor tile-coloured specks-vinyl portion	None Detected None Detected (TEM)
10-A	Room 2102	(12" x 12") vinyl floor tile-coloured specks-mastic	None Detected
10-B	Room 2102	(12" x 12") vinyl floor tile-coloured specks-vinyl portion	None Detected
10-B	Room 2102	(12" x 12") vinyl floor tile-coloured specks-mastic	None Detected
10-C	Room 2020c	(12" x 12") vinyl floor tile-coloured specks-red putty	None Detected
10-C	Room 2020c	(12" x 12") vinyl floor tile-coloured specks-vinyl portion	None Detected
10-C	Room 2020c	(12" x 12") vinyl floor tile-coloured specks-mastic	None Detected
11-A	Room 2232	(12" x 12") vinyl floor tile-beige streaks-vinyl portion	None Detected None Detected (TEM)
11-A	Room 2232	(12" x 12") vinyl floor tile-beige streaks-mastic	None Detected
11-B	Room 2232	(12" x 12") vinyl floor tile-beige streaks-vinyl portion	None Detected
11-B	Room 2232	(12" x 12") vinyl floor tile-beige streaks-mastic	None Detected
11-C	Room 2232	(12" x 12") vinyl floor tile-beige streaks-vinyl portion-vinyl portion	None Detected
11-C	Room 2232	(12" x 12") vinyl floor tile-beige streaks-mastic	None Detected
12	Room 2205	(12" x 12") vinyl floor tile-coloured specks-vinyl portion	None Detected None Detected (TEM)
12	Room 2205	(12" x 12") vinyl floor tile-coloured specks-mastic	None Detected
13-A	Room 2213i	(24" X 24") vinyl floor tile-grey	None Detected None Detected (TEM)
13-B	Room 2213i	(24" X 24") vinyl floor tile-grey-vinyl portion	None Detected
13-B	Room 2213i	(24" X 24") vinyl floor tile-grey-mastic/epoxy	None Detected
13-C	Room 2213i	(24" X 24") vinyl floor tile-grey-vinyl portion	None Detected
13-C	Room 2213i	(24" X 24") vinyl floor tile-grey-mastic/epoxy	None Detected

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Sample No.	Sample Location	Sample Description	Asbestos Content
14	Room 2213i	fireproofing	None Detected
15-A	Roof condensers	brown caulking around electrical	None Detected None Detected (TEM)
15-B	Roof condensers	brown caulking around electrical	None Detected
15-C	Roof condensers	brown caulking around electrical	None Detected
A1-A	Basement east tunnel	Pipe straight insulation (antisweat) – sweat wrap	65% Chrysotile ⁽¹⁾
A2-A	B114	Pipe fitting insulation	55% Chrysotile ⁽¹⁾
A2-B	Basement west tunnel	Pipe fitting insulation	55% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A2-C	B114	Pipe fitting insulation	55% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A7-C	1517	Drywall joint compound	2% Chrysotile ⁽¹⁾
A7-D	Stairwell 5	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A7-E	2117C	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A7-F	2034	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A7-G	2020	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A30-E	2213C	Sprayed fireproofing on metal ceiling	None Detected ⁽¹⁾
A30-F	2213D	Sprayed fireproofing on metal ceiling	None Detected ⁽¹⁾
A30-G	2213C	Sprayed fireproofing on metal ceiling	None Detected ⁽¹⁾
A45-A	2533	Drywall joint compound	2% Chrysotile ⁽¹⁾
A45-B	2212	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A45-C	2213A	Drywall joint compound	2% Chrysotile ⁽¹⁾

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Sample No.	Sample Location	Sample Description	Asbestos Content
			(Positive stop – not analyzed)
A45-D	Mezzanine 1	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A45-E	2209	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A45-F	2218B	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A45-G	2218B	Drywall joint compound	2% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A49-A	2024	Cement board	8% Chrysotile ⁽¹⁾
A49-B	2100	Cement board	8% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A49-C	2100	Cement board	8% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A52-A	2219	Elbow fitting insulation	55% Chrysotile ⁽¹⁾
A52-B	2219	Elbow fitting insulation	55% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A52-C	B1208	Elbow fitting insulation	55% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A53-A	2219	Duct parging cement	55% Chrysotile ⁽¹⁾
A53-B	2219	Duct parging cement	55% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
A53-C	2219	Duct parging cement	55% Chrysotile ⁽¹⁾ (Positive stop – not analyzed)
2A	SE corner of roof of 201B	Roofing Materials	None Detected ⁽²⁾

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Sample No.	Sample Location	Sample Description	Asbestos Content
2B	SE corner of roof of 201B	Roofing Materials	None Detected ⁽²⁾
2C	SE corner of roof of 201B	Roofing Materials	None Detected ⁽²⁾
3A	Roof of 201B	Roofing Materials	None Detected ⁽²⁾
3B	Roof of 201B	Roofing Materials	None Detected ⁽²⁾
3C	Roof of 201B	Roofing Materials	None Detected ⁽²⁾
4A	Roof of 201B	White flashing caulking	None Detected ⁽²⁾
4B	Roof of 201B	White flashing caulking	None Detected ⁽²⁾
4C	Roof of 201B	White flashing caulking	None Detected ⁽²⁾

NOTES:

(1) Sample result obtained from the Arcadis report titled “*Designated Substances and Hazardous Materials Survey – Defence Research and Development Canada*, dated March 2020.

(2) Sample result obtained from the Wood Environment & Infrastructure report titled “*Asbestos-Containing Building Materials Management Survey, Roofing Materials Survey, DRDC Building 201A/B*, dated May 30, 2018.

Bulk samples were analyzed by Polarized Light Microscopy (PLM) analysis, except where “TEM” is noted, in which case Transmission Electron Microscopy analysis was also performed.

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES –
DEFENCE RESEARCH AND DEVELOPMENT CANADA TORONTO, 1133 SHEPPARD AVENUE WEST,
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APPENDIX D

Room By Room Inventory of Hazardous Materials

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES – DEFENCE RESEARCH AND DEVELOPMENT
CANADA TORONTO, 1133 SHEPPARD AVENUE WEST, TORONTO, ONTARIO

Table D.1 Building 201 A/B - Room by Room Inventory of Hazardous Materials

Floor	Room No.	Component	Material	Description	Comments
First	1100	Floor	(12" x 12") vinyl floor tiles	Olive 2% chrysotile	15 m ²
		Walls	Drywall and wood	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint similar to Sample P-2
		Ceiling	Concrete	Painted white	May contain silica
		Mechanical	Pipe fitting insulation	55% chrysotile	8 fittings, below ceiling
First	1205A	Floor	(12" x 12") vinyl floor tiles	Beige streaks	Non-asbestos
		Walls	Masonry and drywall	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint Sample P-4
		Ceiling	Drywall	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint similar to Sample P-4
First	1516	Floor	(12" x 12") vinyl floor tiles	Beige Contains 1% chrysotile	15 m ²
		Walls	Wood and drywall	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint similar to Sample P-2
		Ceiling	Concrete	Painted black	May contain silica
First	1542	Floor	Concrete	Painted light grey	May contain silica Paint not sampled (not affected)
		Walls	Masonry and drywall	Painted grey Joint compound contains 2% chrysotile	Drywall painted grey may contain silica (150 m ²) Grey paint Sample P-7 (contains 12.5 µg/g arsenic)
		Ceiling	Concrete	Painted grey	May contain silica
		Other	Thermostat		Contains mercury

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES – DEFENCE RESEARCH AND DEVELOPMENT
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Floor	Room No.	Component	Material	Description	Comments
First	1700	Floor	(12" x 12") vinyl floor tiles	Beige streaks	Non-asbestos-containing
		Walls	Masonry	Painted white	May contain silica White paint Sample P-2
		Ceiling	Drywall	Painted white, 2% chrysotile	May contain silica 15 m ² White paint similar to Sample P-2
Second	2020c	Floor	(12" x 12") vinyl floor tiles	Beige, coloured specks	Non-asbestos
		Walls	Drywall and wood	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint similar to Sample P-2
		Ceiling	Concrete	Not painted	May contain silica
Second	2102	Floor	(12" x 12") vinyl floor tiles	Beige, coloured specks	Non-asbestos
		Walls	Wood and drywall	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint similar to Sample P-2
		Ceiling	Concrete	Not painted	May contain silica
		Mechanical	Pipe fitting insulation	55% chrysotile	6 pipe fittings, in pipe chase
		Mechanical	Pipe straight insulation	55% chrysotile	2 m, in pipe chase
		Other	Cement board	8% chrysotile	25 m ² , in pipe chase and assumed to be behind walls
Second	2205	Floor	(12" x 12") vinyl floor tiles	Beige, coloured specks	Non-asbestos
		Walls	Masonry and drywall	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint Sample P-5
		Ceiling	Metal	Not painted	

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Floor	Room No.	Component	Material	Description	Comments
Second	2219	Floor	Concrete	Painted grey	Paint Sample P-3
		Walls	Masonry and metal	Not painted	May contain silica
		Ceiling	Metal	Not painted	
		Mechanical	Pipe fitting insulation	55% chrysotile	35 pipe fittings, below ceiling
		Mechanical	Vibration sleeve	Assumed asbestos	5 m ² , below ceiling
		Mechanical	Duct parging cement	55% chrysotile	25 m ² , below ceiling
Second	2213i	Floor	(2' x 2') vinyl floor tiles	Grey	Non-asbestos
		Walls	Wood and drywall	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint Sample P-6
		Ceiling	Metal with fireproofing	White	Non-asbestos
Second	2232	Floor	(12" x 12") vinyl floor tiles	Beige, coloured streaks	Non-asbestos
		Walls	Masonry and drywall	Painted white Joint compound contains 2% chrysotile	Drywall may contain silica 25 m ² White paint Sample P-5 (contains 16.1 µg/g mercury)
		Ceiling	Metal	Not painted	

NOTES:

Unless specifically stated, building materials such as vinyl flooring, drywall joint compound, ceiling tiles, caulking, etc., do not contain asbestos. Unless specifically stated, paint samples did not contain exceedances for PCBs, lead, arsenic, mercury or PCBs.

DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY – HVAC UPGRADES –
DEFENCE RESEARCH AND DEVELOPMENT CANADA TORONTO, 1133 SHEPPARD AVENUE WEST,
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APPENDIX E

Background Information on Designated Substances and Hazardous Materials

BACKGROUND INFORMATION ON DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS

Canada Labour Code

Requirements related to disclosing the presence of hazardous substances (including designated substances) in federal government buildings are specified in Part II of the Canada Labour Code, sections 125(1)y and 125(1)(z.14), which state that employers shall:

- “ensure that the activities of every person granted access to the workplace do not endanger the health and safety of employees [Section y]; and
- take all reasonable care to ensure that all of the persons granted access to the workplace, other than the employer’s employees, are informed of every known or foreseeable health or safety hazard to which they are likely to be exposed in the workplace [Section z.14].”

Canada Occupational Health and Safety Regulations

The requirement for employers to keep and maintain a record of all hazardous substances that are used, produced, handled or stored for use in the work place and the criteria to employ in carrying out an investigation into potential exposure to a hazardous substance are specified in Part X – Hazardous Substances – of the Canada Occupational Health and Safety Regulations.

Ontario Occupational Health and Safety Act (OHSa)

A decision of the Ontario Superior Court of Justice ⁽¹⁾ confirms that when construction or redevelopment work is undertaken by a company whose primary activity is construction or redevelopment work at the site of a federally-regulated employer, the provincial health and safety laws will apply. The *Ontario Occupational Health and Safety Act* and regulations made thereunder would therefore apply to any construction work undertaken at the subject site.

The *Occupational Health and Safety Act (OHSa)* sets out, in very general terms, the duties of employers and others to protect workers from health and safety hazards on the job. These duties include, but are not limited to:

- taking all reasonable precautions to protect the health and safety of workers [clause 25(2)(h)];
- ensuring that equipment, materials and protective equipment are maintained in good condition [clause 25(1)(b)];
- providing information, instruction and supervision to protect worker health and safety [clause 25(2)(a)]; and
- acquainting a worker or a person in authority over a worker with any hazard in the work and in the handling, storage, use, disposal and transport of any article, device, equipment or a biological, chemical or physical agent [clause 25(2)(d)].

⁽¹⁾ Gowlings OHS Law Report – December 2007.

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In addition, Section 30 of the OHS Act deals with the presence of designated substances on construction projects. Compliance with the OHS Act and its regulations requires action to be taken where there is a designated substance hazard on a construction project.

Section 30 of the OHS Act requires the owner of a project to determine if designated substances are present on a project and, if so, to inform all potential contractors as part of the bidding process. Contractors who receive this information are to pass it onto other contractors and subcontractors who are bidding for work on the project.

Regulation for Construction Projects, O.Reg. 213/91

The Regulation for Construction Projects, O.Reg. 213/91, applies to all construction projects. The following sections of the regulation would apply to situations where there is the potential for workers to be exposed to designated substances:

- | | | |
|------------|-----|--|
| Section 14 | (5) | A competent person shall perform tests and observations necessary for the detection of hazardous conditions on a project. |
| Section 21 | (1) | A worker shall wear such protective clothing and use such personal protective equipment or devices as are necessary to protect the worker against the hazards to which the worker may be exposed. |
| | (2) | A worker's employer shall require the worker to comply with subsection (1). |
| | (3) | A worker required to wear personal protective clothing or use personal protective equipment or devices shall be adequately instructed and trained in the care and use of the clothing, equipment or device before wearing or using it. |
| Section 30 | | Workers who handle or use substances likely to endanger their health shall be provided with washing facilities with clean water, soap and individual towels. |
| Section 46 | (1) | A project shall be adequately ventilated by natural or mechanical means, if a worker may be injured by inhaling a noxious dust or fume. |
| | (2) | If it is not practicable to provide natural or mechanical ventilation in the circumstances described in clause (1)(a), respiratory protective equipment suitable for the hazard shall be provided and be used by the workers. |
| Section 59 | | If the dissemination of dust is a hazard to a worker, the dust shall be adequately controlled or each worker who may be exposed to the hazard shall be provided with adequate personal protective equipment. |

Regulation for Designated Substances (O.Reg. 490/09)

The Designated Substance Regulation (O.Reg. 490/09) specifies occupational exposure limits (OELs) for eleven designated substances in Ontario (asbestos, lead, mercury, silica, vinyl chloride, acrylonitrile, isocyanates, benzene, arsenic, ethylene oxide and coke oven emissions) and requires an assessment and a control program to ensure compliance with these OELs.

Although O.Reg. 490/09 and the OELs do not apply to an employer on a construction project, or to their workers at the project (O.Reg.490/09, Section 14, Exception – Construction), employers still have a responsibility to protect the health of their workers and to comply with the OHSA and other applicable regulations. Section 25(2)(h) of the OHSA requires that employers take "every precaution reasonable in the circumstances for the protection of a worker".

Other regulatory requirements (and guidelines) which apply to control of exposure to designated substances and hazardous materials are referenced in the sections below.

Asbestos

Asbestos has been widely used in buildings, both in friable applications (materials which can be crumbled, pulverized or powdered by hand pressure, when dry) such as pipe and tank insulation, sprayed-on fireproofing and acoustic texture material, and in non-friable manufactured products such as floor tile, gaskets, cement board and so on. The use of asbestos in friable applications was curtailed around the mid-1970s. The use of asbestos in certain non-friable materials continued beyond the mid-1970s. The import, sale or use of asbestos products was banned in Canada, effective December 30, 2018.

Provincial Government Requirements

Control of exposure to asbestos is governed in Ontario by Regulation 278/05 – *Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations*. Disposal of asbestos waste (friable and non-friable materials) is governed by Ontario Regulation 278/05 and by Ontario Regulation 347, Waste Management – General. O.Reg. 278/05 classifies asbestos work operations into three types (Type 1, 2 and 3), and specifies procedures to be followed in conducting asbestos abatement work.

O. Reg. 278/05 prescribes certain requirements for asbestos management in buildings. For on-going asbestos management in buildings, building owners are required to:

- prepare (and keep on the premises) a record (i.e., asbestos survey report) of the locations of all friable and non-friable asbestos-containing materials in a building;
- inspect asbestos-containing materials at reasonable intervals to determine their condition and update the asbestos survey record at least once in each 12-month period, and whenever asbestos-containing material is removed or discovered;

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- give any person who is an occupier⁽²⁾ of the building written notice of any information in the asbestos survey record that relates to the area occupied by the person;
- give contractors written notice of the information in the asbestos survey record if the work to be carried out by contractor may involve asbestos-containing material or may be carried out in close proximity to and may disturb asbestos-containing material;
- advise staff of the information in the asbestos survey record, if work is to be performed in a facility that contains asbestos-containing material;
- provide training for staff based on the responsibilities and duties to be undertaken in relation to asbestos management;
- clean up any fallen asbestos-containing fireproofing or acoustical or thermal insulation (if the material is being disturbed so that exposure to the material is likely to occur);
- repair, seal, remove or permanently enclose asbestos-containing fireproofing as thermal insulation if it is readily apparent that material will continue to fall because of deterioration; and,
- perform work operations which involve disturbance (i.e., cleanup, removal, repair, etc.) of asbestos-containing materials in accordance with the measures and procedures (Type 1, 2 and 3 operations) specified in O. Reg. 278/05.

**Federal Government Requirements – Canada Occupational Health and Safety Regulations-
Hazardous**

The Canada Labour Code Part II – Canada Occupational Health and Safety Regulations, Division II – Hazardous Substances Other Than Hazardous Products prescribes requirements for Asbestos Exposure Management Programs.

Federal Government Requirements – National Joint Council Directive

The National Joint Council Directive, Part XI – Hazardous Substances – 11.6 Asbestos Management – states:

11.6.1 The employer shall comply with federal, provincial, territorial and municipal regulations, statutes and requirements with respect to asbestos-containing materials (ACM) in any government-owned, managed or leased facilities.

11.6.2 An asbestos management program and code of practice meeting the intent of the appropriate standard shall be followed if material containing asbestos may exist in any building or facility.

⁽²⁾ An “occupier” is defined as:

- (a) a person who is in physical possession of premises, or
- (b) a person who has responsibility for and control over the condition of premises or the activities carried on there, or control over persons allowed to enter the premises.

11.6.3 As a minimum requirement, departments and agencies will comply with Public Works and Government Services Canada Policy DP 057 and Code of Practice on Asbestos Management.

DND Asbestos Management Directive

The Department of National Defence (DND) Asbestos Management Directive, March 2007, was developed in order to establish a standard and consistent approach for the management of asbestos-containing materials. The Directive identifies organizational roles and responsibilities, and establishes a comprehensive approach for the identification, management, removal and disposal of asbestos-containing materials within DND buildings and facilities. CFB Trenton considers asbestos-containing materials to be 0.5% or more asbestos, by dry weight, in accordance with O. Reg. 278/05.

Technical Guideline to Asbestos Exposure Management Programs

The purpose of this technical guide is to provide guidance on how amendments to the *Canada Occupational Health and Safety Regulations* under the *Canada Labour Code*, Part, II relate to the management of contracts involving asbestos abatement.

Lead

Lead is a heavy metal that can be found in construction materials such as paints, coatings, mortar, concrete, pipes, solder, packings, sheet metal, caulking, glazed ceramic products and cable splices. Lead has been used historically in exterior and interior paints.

The Surface Coating Materials Regulations (SOR/2016-193) made pursuant to the *Canada Consumer Product Safety Act* states that a surface coating material must not contain more than 90 mg/kg total lead. Health Canada defines a lead-containing surface coating as a paint or similar material that dries to a solid film that contains over 90 mg/kg dry weight of lead.

Information from the United States Occupational Health and Safety Administration (OSHA) suggests that the improper removal of lead paint containing 600 mg/kg lead results in airborne lead concentrations that exceed half of the permissible exposure limit. Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children⁽³⁾.

The National Plumbing Code allowed lead as an acceptable material for pipes until 1975 and in solder until 1986.

The Ontario Ministry of Labour *Guideline, Lead on Construction Projects*, dated April 2011, provides guidance in the measures and procedures that should be followed when handling lead-containing materials during construction projects. In the guideline, lead-containing construction operations are classified into three groups - Type 1 (low risk), Type 2 (medium risk) and Type 3 (high risk) based on presumed airborne concentrations of lead. Any operation that may expose a worker to lead that is not a Type 1, Type 2, or Type 3b operation, is classified as a Type 3a operation. Type 3a operations include, but are not limited to,

⁽³⁾ *Lead-Containing Paints and Coatings: Preventing Exposure in the Construction Industry*. WorkSafe BC, 2011.

for example, welding or high temperature cutting of lead-containing coatings or materials indoors or in a confined space and removal of lead-containing coatings or materials using power tools without an effective dust collection system equipped with a HEPA filter. Type 3b operations include abrasive blasting of lead-containing coatings or materials and removal of lead-containing dust using an air mist extraction system.

Mercury

Mercury has been used in electrical equipment such as alkaline batteries, fluorescent light bulbs (lamps), high intensity discharge (HID) lights (mercury vapour, high pressure sodium and metal halide), “silent switches” and in instruments such as thermometers, manometers and barometers, pressure gauges, float and level switches and flow meters. Mercury-containing lamps, the bulk of which are 1.22 m (four foot) fluorescent lamps contain between 7 and 40 mg of mercury each. Mercury compounds have also been used historically as additives in latex paint to protect the paint from mildew and bacteria during production and storage.

The intentional addition of mercury to Canadian-produced consumer paints for interior use was prohibited in 1991. Mercury may have remained in paints after 1991, however, as a result of impurities in the paint ingredients or cross-contamination due to other manufacturing processes. The Surface Coating Materials Regulations (SOR/2016-193) made pursuant to the Canada *Consumer Product Safety Act* states that a surface coating material must not contain more than 10 mg/kg mercury.

Mercury-containing thermostats and silent light switches are mercury tilt switches which are small tubes with electrical contacts at one end of the tube. A mercury tilt switch is usually present when no switch is visible. Mercury switches often have the word “TOP” stamped on the upper end of the switch, which is visible after removing the cover plate. If mercury switches are to be removed, the entire switch should be removed and placed into a suitable container for storage and disposal.

Waste light tubes generated during renovations or building demolition and waste mercury from equipment must either be recycled or disposed of in accordance with the requirements of Ont. Reg. 347 – *Waste Management, General*.

Waste mercury in amounts less than 5 kg (per month) are exempt from the generator registration requirements prescribed by O.Reg. 347 – *Waste Management – General*. Waste mercury from mercury switches or gauges should, however, be properly collected and shipped to a recycling facility or disposed of as a hazardous waste. Removal of mercury-containing equipment (e.g., switches, gauges, controls, etc.) should be carried out in a manner which prevents spillage and exposure to workers.

The Environment and Climate Change Canada (ECCC) document *Code of Practice for the Environmentally Sound Management of End-Of-Life Lamps Containing Mercury, February 2017* is a voluntary tool developed to complement provincial initiatives, and to promote best practices for managing end-of-life mercury-containing lamps.

Silica

Silica exists in several forms of which crystalline silica is of most concern with respect to potential worker exposures. Quartz is the most abundant type of crystalline silica. Some commonly used construction

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materials containing silica include brick, refractory brick, concrete, concrete block, cement, mortar, rock and stone, sand, fill dirt, topsoil and asphalt containing rock or stone.

The Ontario Ministry of Labour *Guideline, Silica on Construction Projects*, dated April 2011, provides guidance in controlling exposure to silica dust during construction activities. In the guideline, silica-containing construction operations are classified into three groups – Type 1 (low risk), Type 2 (medium risk) and Type 3 (high risk) based on presumed airborne concentrations of respirable crystalline silica in the form of cristobalite, tridymite, quartz and tripoli.

Other Designated Substances

Vinyl chloride vapours may be released from polyvinyl chloride (PVC) products in the event of heating or as a result of decomposition during fire. PVC is used in numerous materials that may be found in building construction, including, for example, piping, conduits, siding, window and door frames, plastics, garden hoses, flooring and wire and cable protection.

Acrylonitrile is used to produce nitrile-butadiene rubber, acrylonitrile-butadiene-styrene (ABS) polymers and styrene-acrylonitrile (SAN) polymers. Products made with ABS resins which may be found in buildings include telephones, bottles, packaging, refrigerator door liners, plastic pipe, building panels and shower stalls. Acrylonitrile can be released into the air by combustion of products containing ABS.

Isocyanates are a class of chemicals used in the manufacture of certain types of plastics, foams, coatings and other products. Isocyanate-based building construction materials may include rigid foam products such as foam-core panels and spray-on insulation and paints, coatings, sealants and adhesives. Isocyanates may be inhaled if they are present in the air in the form of a vapour, a mist or a dust.

Benzene is a clear, highly flammable liquid used mainly in the manufacture of other chemicals. The commercial use of benzene as a solvent has practically been eliminated, however it continues to be used as a solvent and reactant in laboratories.

Arsenic is a heavy metal used historically in pesticides and herbicides. The primary use in building construction materials was its use in the wood preservative chromated copper arsenate (CCA). CCA was used to pressure treat lumber since the 1940s. Pressure-treated wood containing CCA is no longer being produced for use in most residential settings.

Ethylene oxide is a colourless gas at room temperature. It has been used primarily for the manufacture of other chemicals, as a fumigant and fungicide and for sterilization of hospital equipment.

Coke oven emissions are airborne contaminants emitted from coke ovens and are not a potential hazard associated with building construction materials.

Polychlorinated Biphenyls (PCBs)

The management of equipment classified as waste and containing Polychlorinated Biphenyls (PCBs) at concentrations of 50 parts per million (mg/kg) or greater is regulated by *Ontario Regulation 362, Waste Management – PCBs*. Under this regulation, PCB waste is defined as any waste material containing PCBs in concentrations of 50 mg/kg or greater. Any equipment containing PCBs at or greater than this level,

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such as transformers, switchgear, light ballasts and capacitors, which is removed from service due to age, failure or as a result of decommissioning, is considered to constitute a PCB waste. Although current federal legislation (effective 1 July 1980) has prohibited the manufacture and sale of new equipment containing PCBs since that time, continued operation of equipment supplied prior to this date and containing PCBs is still permitted. Handling, storage and disposition of such equipment is, however, tightly regulated and must be managed in accordance with provincial and federal government requirements as soon as it is taken out of service or becomes unserviceable.

In most institutional, commercial facilities and in smaller industrial facilities, the primary source of equipment potentially containing PCBs is fluorescent and H.I.D. light ballasts. Small transformers may also be present. In larger industrial facilities, larger transformers and switch gear containing, or potentially containing, PCBs may also be present.

PCBs were also commonly added to industrial paints from the 1940s to the late 1970s. PCBs were added directly to the paint mixture to act as a fungicide, to increase durability and flexibility, to improve resistance to fires and to increase moisture resistance. The use of PCBs in new products was banned in Canada in the 1970s. PCB amended paints were used in specialty industrial/institutional applications prior to the 1970s including government buildings and equipment such as industrial plants, radar sites, ships as well as non-government rail cars, ships, grain bins, automobiles and appliances. PCB caulking was used in the 1950s and through the 1970s to seal the joints of brick, masonry, stone and metal window frames.

Removal of in-service equipment containing PCBs, such as fluorescent light ballasts, capacitors and transformers, is subject to the requirements of the federal *PCB Regulations* (discussed below).

The *PCB Regulations*, which came into force on 5 September 2008, were made under the *Canadian Environmental Protection Act, 1999* (CEPA 1999) with the objective of addressing the risks posed by the use, storage and release to the environment of PCBs, and to accelerate their destruction. The *PCB Regulations* set different end-of-use deadlines for equipment containing PCBs at various concentration levels.

The Regulations Amending the PCB Regulations and Repealing the Federal Mobile PCB Treatment and Destruction Regulations were published on 23 April 2014, in the Canada Gazette, Part II, and came into force on 1 January 2015. The most notable part of the amendments is the addition of an end-of-use deadline date of 31 December 2025 for specific electrical equipment located at electrical generation, transmission and distribution facilities.

When the PCB materials are classified as waste, jurisdiction falls under the Ontario Ministry of the Environment and Climate Change (MOECC) and O.Reg. 362. All remedial and PCB management work must be carried out under the terms of a Director's Instruction issued by an MOE District Office (for quantities of PCB fluid greater than 50 litres). The PCB waste stream, regardless of quantity, must be registered with the MOE, in accordance with O.Reg. 347, *General – Waste Management*. O.Reg. 362 applies to any equipment containing greater than 1 kg of PCBs.

Urea Formaldehyde Foam Insulation (UFFI)

Urea formaldehyde foam insulation (UFFI) is a polymer manufactured at point-of-use by blending urea formaldehyde resin with a phosphoric acid catalyst and compressed air at a nozzle tip. This nozzle was

used to inject the freshly mixed foam product into enclosed wall cavities. UFFI was introduced in Canada in the 1970s. In response to concerns about the health effects of formaldehyde gas, the installation of UFFI was banned in Canada in 1980.

Ozone-Depleting Substances and Other Halocarbons (ODS')

In Canada, the federal, provincial and territorial governments have legislation in place for the protection of the ozone layer and management of ozone-depleting substances and their halocarbon alternatives. The use and handling of these substances are regulated by the provinces and territories in their respective jurisdictions, and through the *Federal Halocarbon Regulations, 2022* (FHR 2022) for refrigeration, air-conditioning, fire-extinguishing and solvent systems under federal jurisdiction.

The FHR 2022 were established under the authority of the *Canadian Environmental Protection Act, 1999*. The purpose of the FHR 2022 is to reduce and prevent emissions of ozone-depleting substances and of their halocarbon alternatives to the environment from air-conditioning units, refrigeration, fire-extinguishing and solvent systems that are:

- located on federal or aboriginal lands; or
- owned by federal departments, board agencies, Crown corporations, or federal works and undertakings.

Ontario Regulation 347, *General – Waste Management*, has also been amended to provide for more strict control of CFCs. The requirements under the amended regulation apply primarily to the keeping of records for the receipt or recycling of CFC waste.

The FHR 2022 replaced the former Federal Halocarbon Regulations and incorporated new provisions to achieve an orderly transition from CFCs and Halons to alternative substances and technologies, reflecting *Canada's Strategy to Accelerate the Phase-Out of CFC and Halon Uses and to Dispose of the Surplus Stocks*.

Under the FHR 2022, a person who installs, services, leak tests, or charges a refrigeration system or an air conditioning system or does any other work on the system that may result in the release of a halocarbon must do so in accordance with the *Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems*.

Some of the requirements of FHR 2022 include:

- certification is required for all persons testing, repairing, filling or emptying equipment containing ozone-depleting substances and their halocarbon alternatives;
- no person shall store, transport or purchase a halocarbon unless it is in a container designed and manufactured to be refilled and to contain that specific type of halocarbon;
- before dismantling, decommissioning or destruction of any system, a person shall recover all halocarbons contained in the system into a container designed and manufactured to be refilled and to contain that specific type of halocarbon;
- before dismantling, decommissioning or destruction or destroying a system, a person shall affix a notice to the system containing information as required in Column 3, Item 1 of Schedule 2. This

information includes the name and address of the owner of the system; name of the operator of the system, specific location of the system before its dismantling, decommissioning or destruction; description of the system; name of service technician who recovered the halocarbons; certificate number of the service technician (if applicable); name of employer of service technician (if applicable); type and quantity of halocarbon and date recovered; type and charging capacity of the system; and final destination of the system; and

- in the case of dismantling, decommissioning or destruction of any system, the owner shall keep a record of the information contained in the notice as described above.

Biological Hazards

Mould

Moulds are forms of fungi that are found everywhere both indoors and outdoors all year round. Outdoors, moulds live in the soil, on plants and on dead and decaying matter. More than 1000 different kinds of indoor moulds have been found in buildings. Moulds spread and reproduce by making spores, which are all small and light-weight, able to travel through air, capable of resisting dry, adverse environmental conditions, and hence capable of surviving a long time. Moulds need moisture and nutrients to grow and their growth is stimulated by warm, damp and humid conditions.

Control of exposure to mould is required under Section 25(2)(h) of the Ontario *Occupational Health and Safety Act*, which states that employers shall take every precaution reasonable in the circumstances for the protection of workers. Recommended work practices are outlined in the following documents:

- *Mould Guidelines for the Canadian Construction Industry*. Standard Construction Document CCA 82 2004. Canadian Construction Association.
- *Mould Abatement Guidelines*. Environmental Abatement Council of Ontario. Edition 3. 2015.

Animal Droppings

Histoplasmosis is an infectious disease caused by inhaling the spores of a fungus called *Histoplasma capsulatum*. Histoplasmosis primarily affects a person's lungs, and its symptoms vary greatly. Histoplasmosis can appear as a mild, flu-like respiratory illness and has a combination of symptoms, including malaise (a general ill feeling), fever, chest pain, dry or non productive cough, headache, loss of appetite, shortness of breath, joint and muscle pains, chills, and hoarseness. Chronic lung disease due to histoplasmosis resembles tuberculosis and can worsen over months or years.⁴

H capsulatum grows in soils throughout the world. The fungus seems to grow best in soils having a high nitrogen content, especially those enriched with bird manure or bat droppings. The organism can be carried on the wings, feet and beaks of birds and infect soil under roosting sites or manure accumulations inside or outside buildings. Active and inactive roosts of blackbirds have been found heavily contaminated by *H*

⁴ *Histoplasmosis — Protecting Workers at Risk*, Revised Edition, United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH), December 2004.

capsulatum. On the other hand, fresh bird droppings on surfaces such as sidewalks and window sills have not been shown to present a health risk for histoplasmosis because birds themselves do not appear to be infected by *H capsulatum*. Rather, bird manure is primarily a nutrient source for the growth of *H capsulatum* already present in the soil. Unlike birds, bats can become infected with *H capsulatum* and consequently can excrete the organism in their droppings.

In addition to *H capsulatum*, inhalation exposure to *Cryptococcus neoformans* may also be a health risk for workers in environments containing accumulations of bat droppings or bird manure. *C neoformans* is the infectious agent of the fungal disease cryptococcosis. Formerly a rare disease, the incidence of cryptococcosis has increased in recent years because of its frequent occurrence in AIDS patients. *C neoformans* and *H capsulatum* are only two of the more than 100 microorganisms that have been reported with increased frequency among HIV-infected persons, and cryptococcosis and histoplasmosis are both classified as AIDS-indicator opportunistic infectious diseases.

Raccoon Feces

A roundworm commonly known as Raccoon Roundworm (*Baylisascaris*) lives in the digestive tracts of raccoons, and can potentially cause a serious infection in humans if infected roundworm eggs in soil, water or an object that has been contaminated with raccoon feces are accidentally ingested.

Mouse Droppings

Hantaviruses are found in the droppings, urine and saliva of infected rodents and humans can contract the virus from breathing in airborne particles or from being bitten. In Canada, a hantavirus capable of causing disease in humans – named Sin Nombre virus – has been identified in deer mice. Although the risk in Canada is low, when it happens, the disease can be very severe.

Exposure to hantaviruses can cause a rare, but often fatal, disease called Hantavirus pulmonary syndrome (HPS). The earliest documented case of HPS in Canada was contracted in Alberta in 1989. Since then, there have been over 70 confirmed cases. Most of the cases occurred in western Canada (Manitoba, Saskatchewan, Alberta and British Columbia), except for one case in Quebec.⁵

Hantavirus is typically transmitted by breathing particles in air from the droppings, urine and saliva of infected rodents. However, there have been a small number of reported cases of HPS believed to have been contracted through rodent bites.

⁵ Health Canada – “It’s Your Health – Hantaviruses” – August 2009.

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APPENDIX F

Photographs

Project Photographs
DRDC – Toronto, Ontario



Photo: 1

Date:
February 15, 2023.

Location/Description:
Exterior view of DRDC Building showing approximate location of Room 2219 where the metal siding will be accessed as part of the renovations.



Photo: 2

Date:
February 15, 2023.

Location/Description:
View of typical HVAC unit on roof to be replaced. Sample P-1 (yellow pipe paint) was collected on the roof.



Photo: 3

Date:
February 16, 2023.

Location/Description:
Roof-top condenser units to be replaced.

Project Photographs
DRDC – Toronto, Ontario



Photo: 4

Date:
February 15, 2023.

Location/Description:
Room 1700.

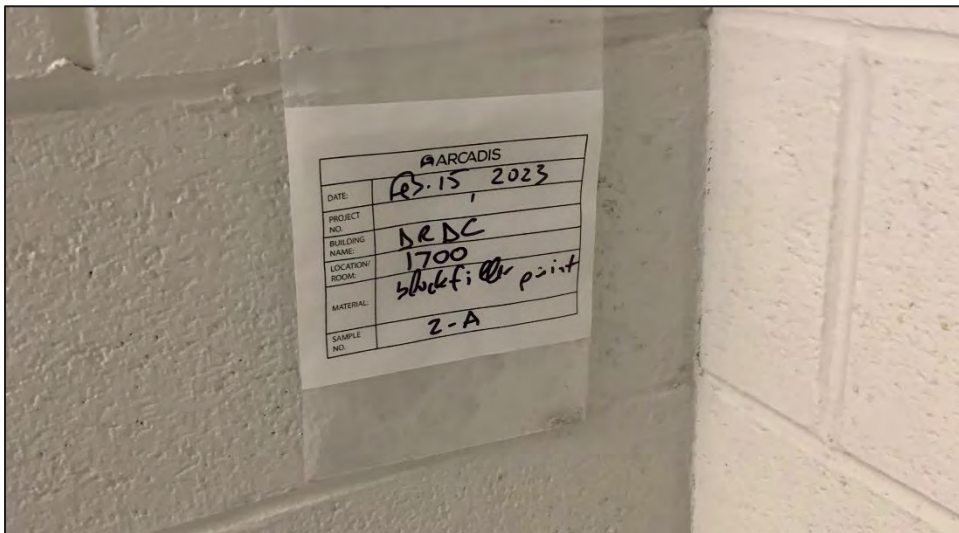


Photo: 5

Date:
February 15, 2023.

Location/Description:
Room 1700/Location of Samples 2-A, B and C (non-asbestos-containing block filler paint) and Samples 3-A, B and C (non-asbestos-containing block mortar).

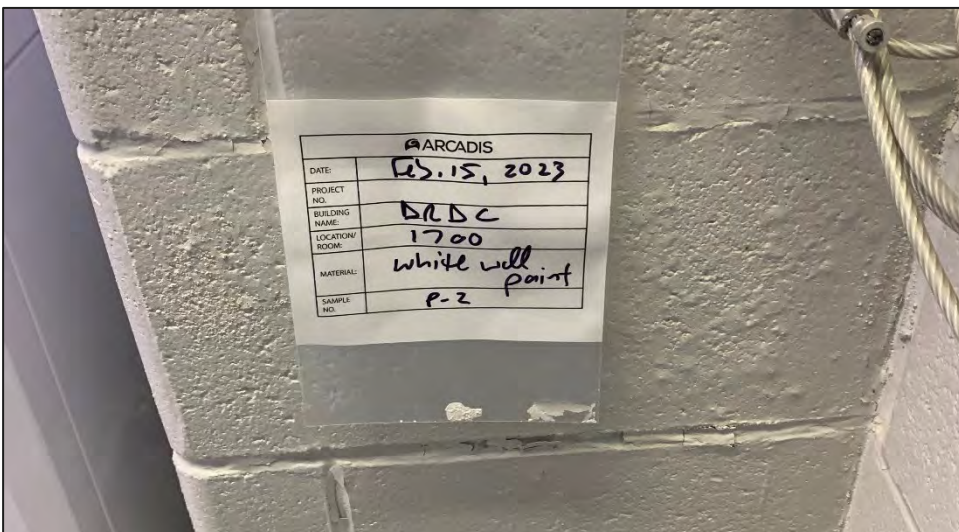


Photo: 6

Date:
February 15, 2023.

Location/Description:
Room 1700/Location of Sample P-2 (white wall paint).

Project Photographs
DRDC – Toronto, Ontario



Photo: 7

Date:
February 15, 2023.

Location/Description:
Room 1516.



Photo: 8

Date:
February 15 and 16, 2023.

Location/Description:
Room 1100.



Photo: 9

Date:
February 15 and 16, 2023.

Location/Description:
Asbestos-containing pipe fitting insulation along north wall and assumed to be present in vertical pipe chase at northeast corner.

Project Photographs
DRDC – Toronto, Ontario

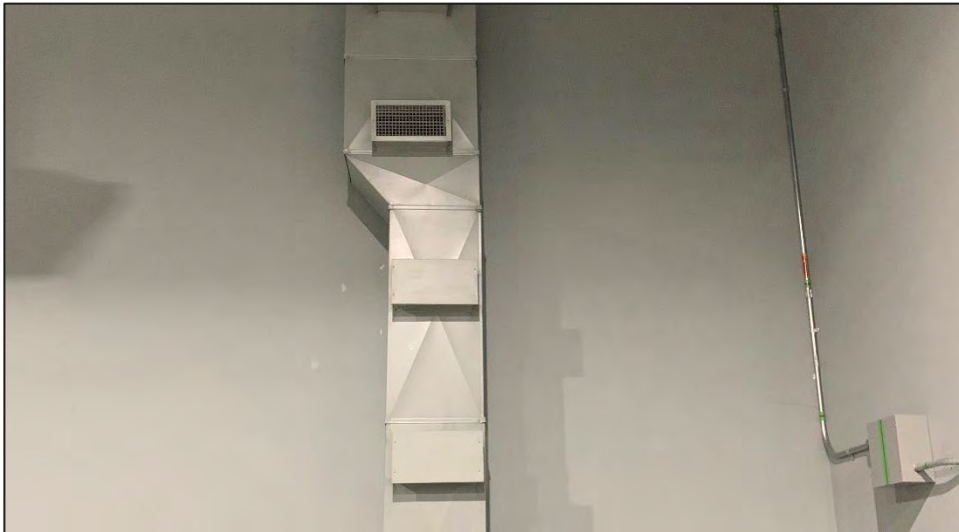


Photo: 10

Date:
February 15, 2023.

Location/Description:
Room 1542 area of work.
Sample P-6 (grey wall paint was collected here).

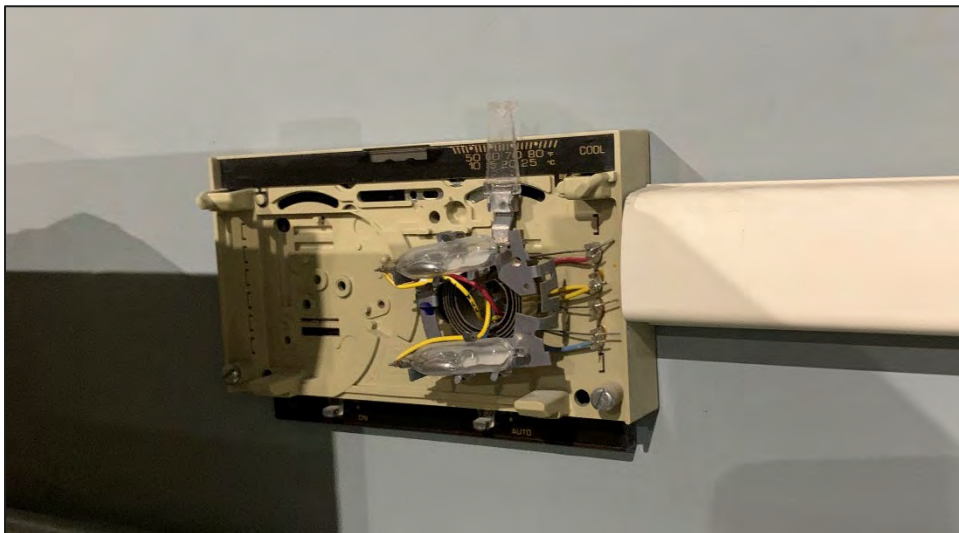


Photo: 11

Date:
February 15 and 16, 2023.

Location/Description:
Room 1542/Mercury-containing thermostat.

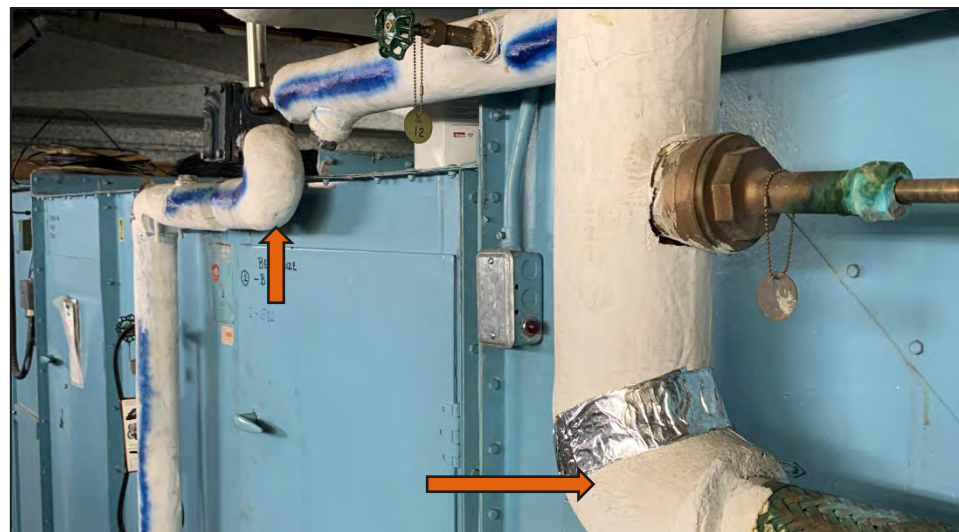


Photo: 12

Date:
February 15, 2023.

Location/Description:
Room 2219/View of asbestos-containing pipe fitting insulation.

Project Photographs
DRDC – Toronto, Ontario



Photo: 13

Date:
February 15, 2023.

Location/Description:
Room 2219/View of asbestos-containing duct paring cement (under canvas cover). Vibration sleeve (assumed asbestos-containing) is also shown.

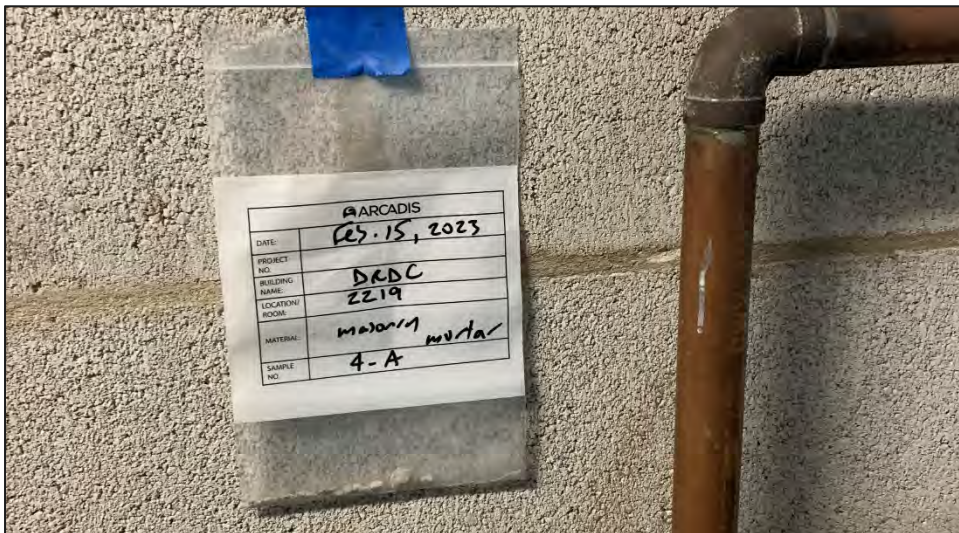


Photo: 14

Date:
February 15, 2023.

Location/Description:
Room 2219/Location of Sample 4-A (non-asbestos-containing masonry mortar). Samples 4-B and 4-C were also collected in Room 2219.

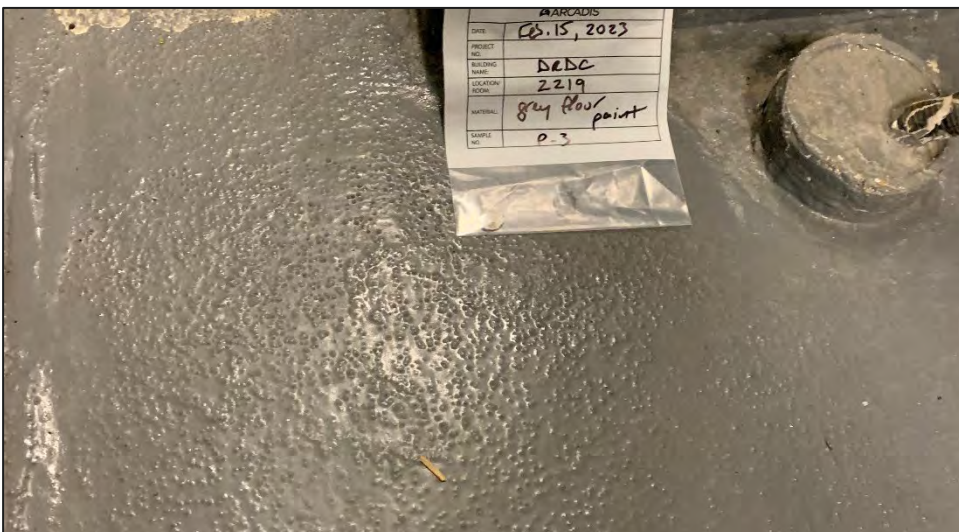


Photo: 15

Date:
February 15, 2023.

Location/Description:
Room 2219/Location of Sample P-3 (grey floor paint).

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Photo: 16

Date:
February 15, 2023.

Location/Description:
Room 1205A.

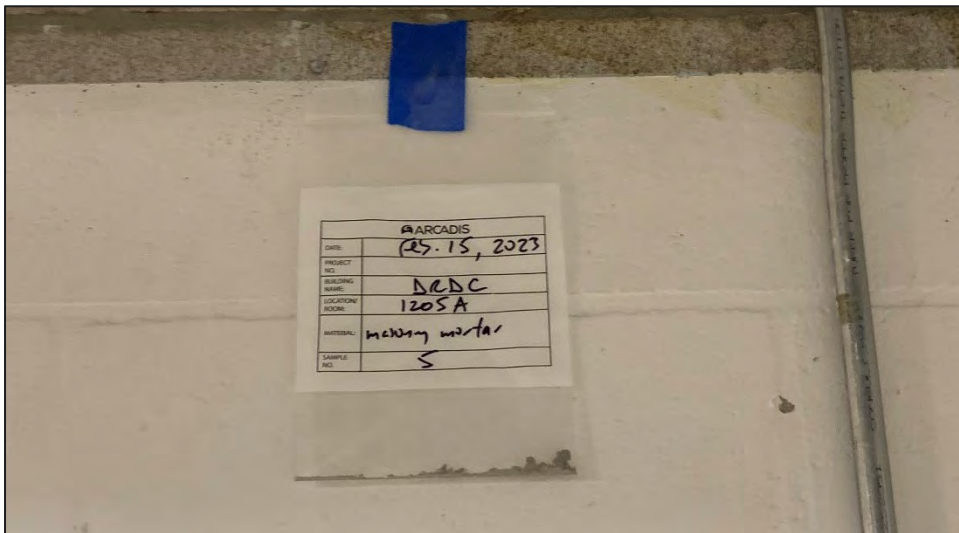


Photo: 17

Date:
February 15, 2023.

Location/Description:
Room 1205A/Location of Sample 5 (non-asbestos-containing masonry mortar).

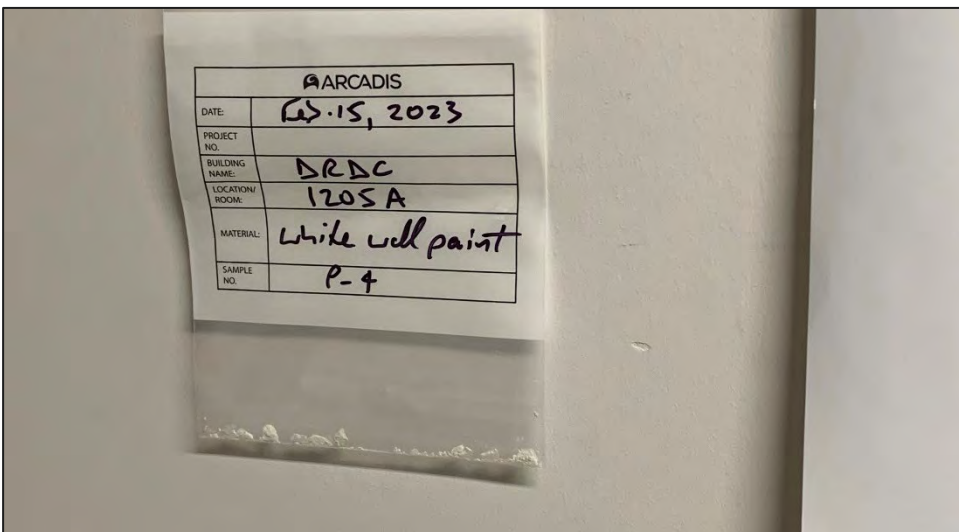


Photo: 18

Date:
February 15, 2023.

Location/Description:
Room 1205A/Location of Sample P-4 (white wall paint).

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DRDC – Toronto, Ontario



Photo: 19

Date:
February 15, 2023.

Location/Description:
Room 2232.

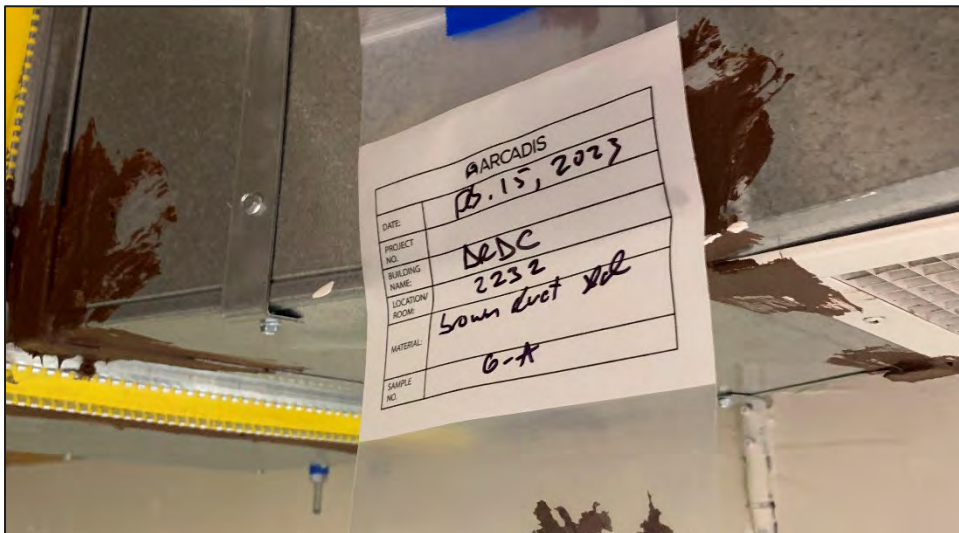


Photo: 20

Date:
February 15, 2023.

Location/Description:
Room 2232/Location of Sample 6-A (non-asbestos-containing brown duct seal). Samples 6-B and 6-C were also collected here.

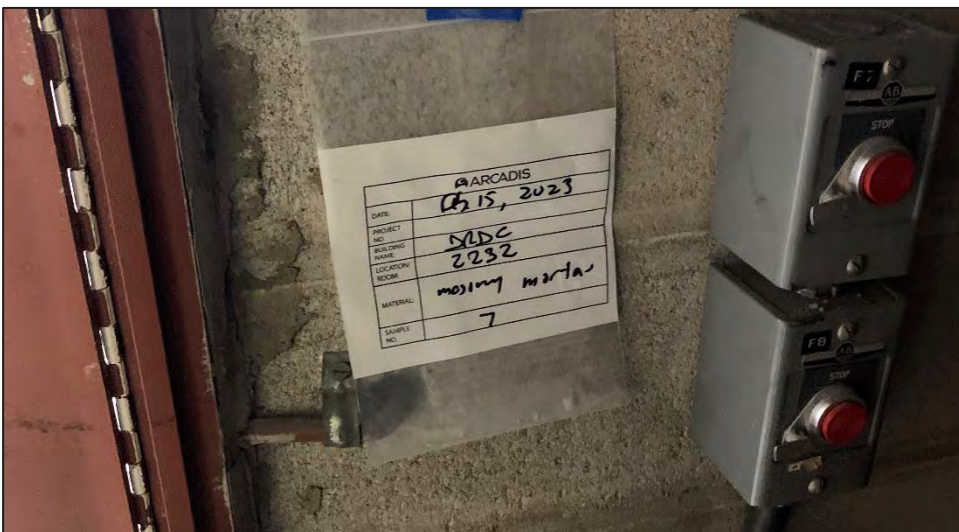


Photo: 21

Date:
February 15, 2023.

Location/Description:
Room 2232/Location of Sample 7 (non-asbestos-containing masonry mortar).

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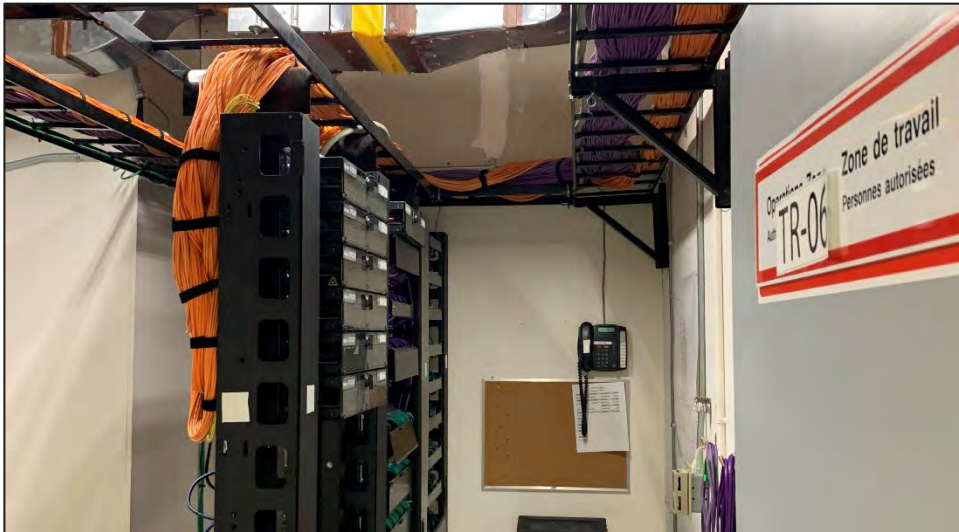


Photo: 22

Date:
February 15, 2023.

Location/Description:
Room 2020c.



Photo: 23

Date:
February 15, 2023.

Location/Description:
Room 2020c/Location of Sample 8-A (non-asbestos-containing brown duct seal). Samples 8-B and 8-C were also collected here.

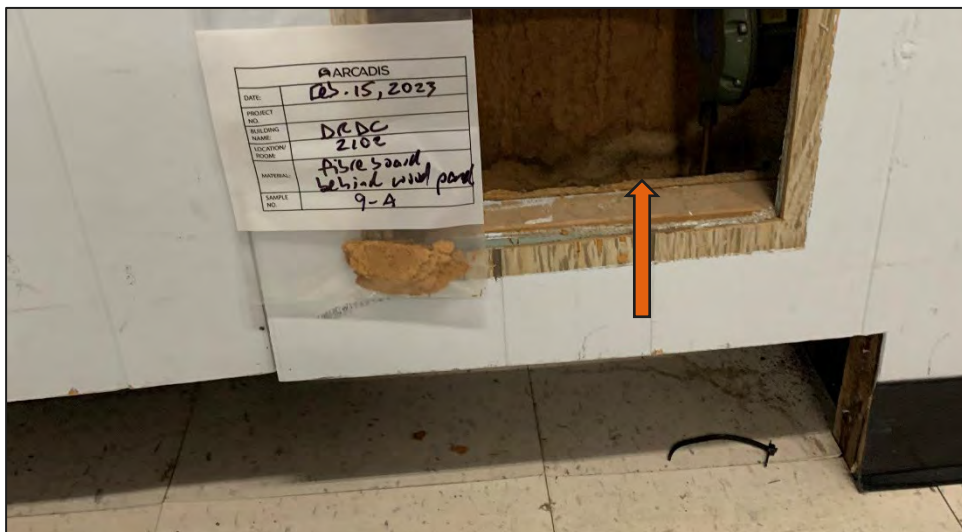


Photo: 24

Date:
February 15, 2023.

Location/Description:
Room 2102/Location of Samples 9-A, 9-B and 9-C (non-asbestos-containing fibreboard behind wall panel).

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Photo: 25

Date:
February 15, 2023.

Location/Description:
Room 2102/View of asbestos-containing cement board and asbestos-containing pipe insulation in pipe chase).

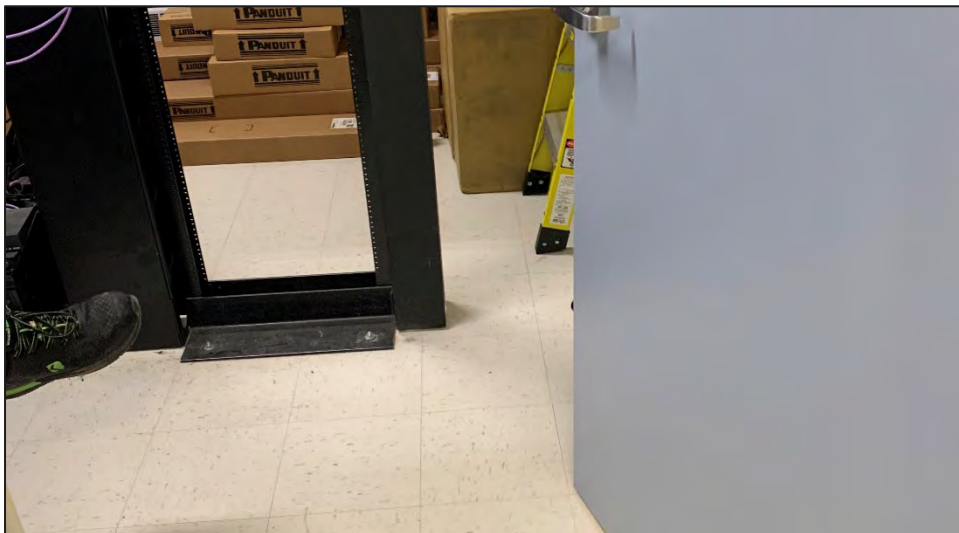


Photo: 26

Date:
February 16, 2023.

Location/Description:
Room 2205.

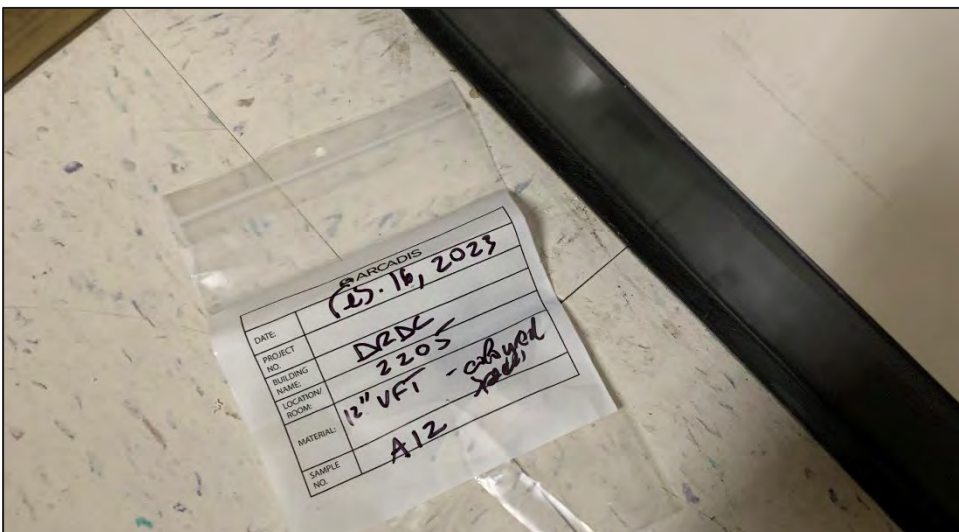


Photo: 27

Date:
February 16, 2023.

Location/Description:
Room 2205/Location of Sample 12 (non-asbestos-containing 12" x 12" vinyl floor tile – beige, coloured specks).

Project Photographs
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Photo: 28

Date:
February 16, 2023.

Location/Description:
Room 2213i.

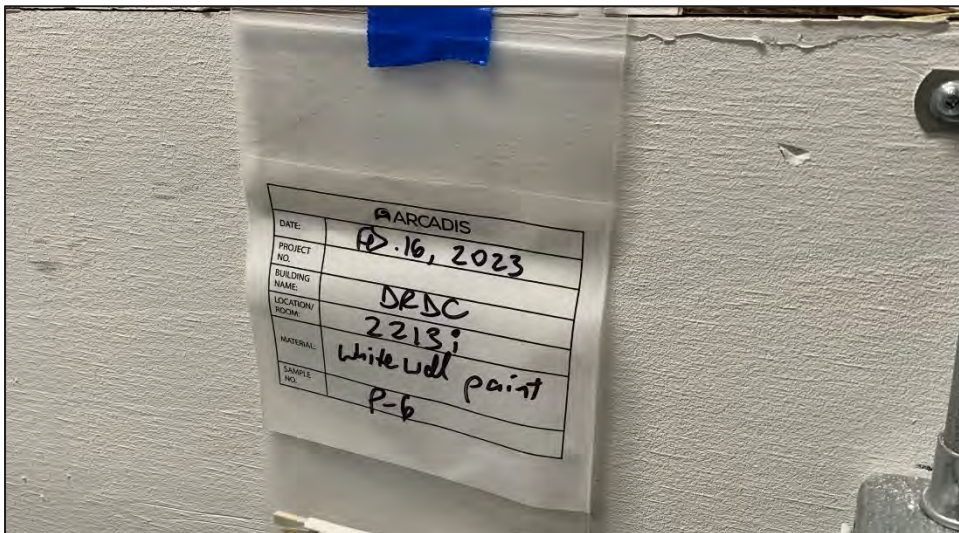


Photo: 29

Date:
February 16, 2023.

Location/Description:
Room 2213i/Location of Sample P-6 (white wall paint).



Photo: 30

Date:
February 15, 2023.

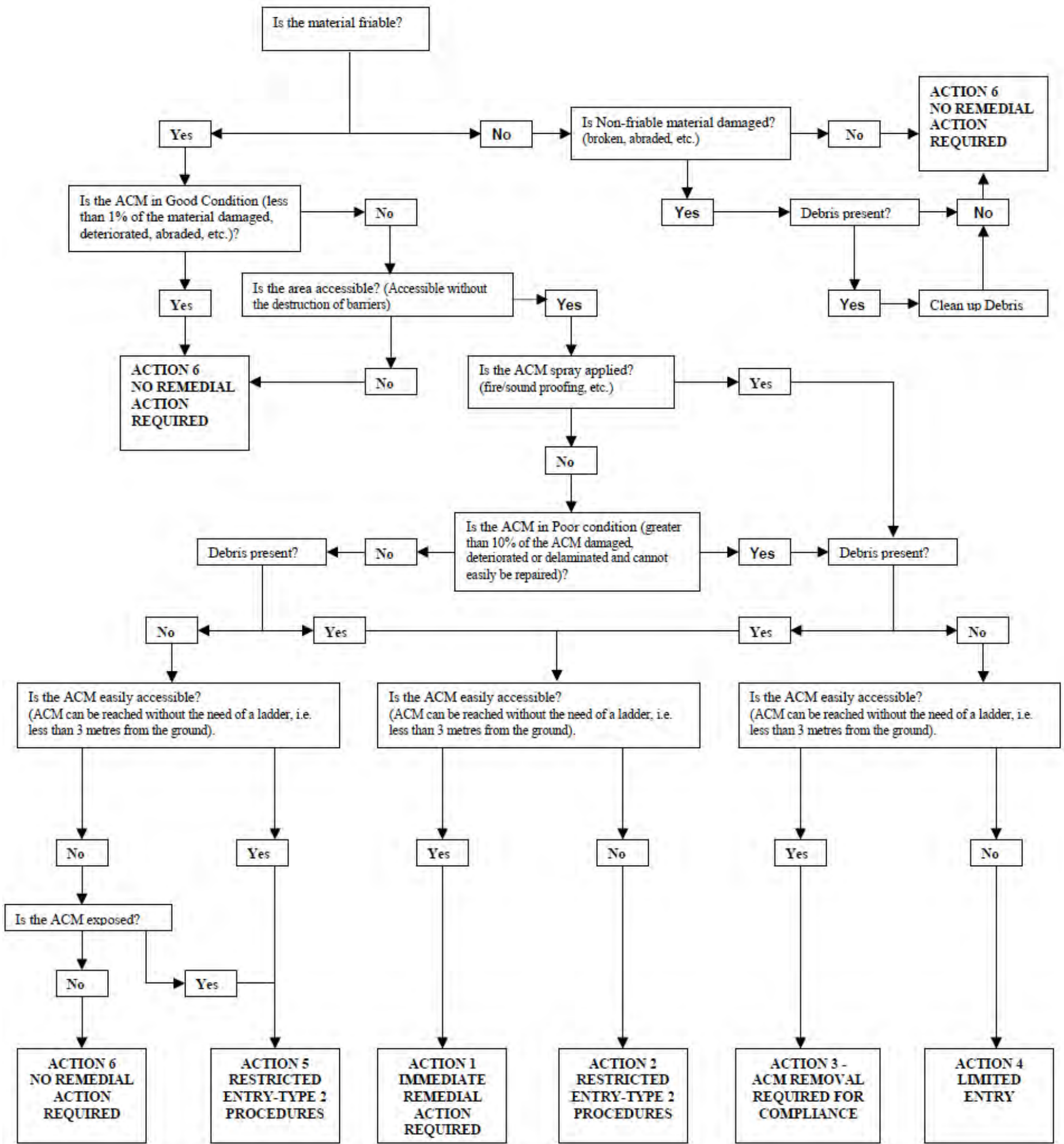
Location/Description:
Room 2213i/Location of Samples 13-A, 13-B and 13-C (non-asbestos-containing 2'x 2' vinyl floor tiles).

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APPENDIX G

Asbestos Condition Assessment and Response Chart

ASBESTOS CONDITION ASSESSMENT AND RESPONSE CHART



- ACTION 1 – Restrict access to the area and clean up the ACM debris using appropriate asbestos procedures.
 - ACTION 2 – Restricted Entry into areas that contain, or may contain ACM Debris. All entry into the area will require at a minimum Type 2 procedures until the ACM debris have been cleaned up, and the source of the debris have been stabilized or removed.
 - ACTION 3 – Asbestos removal required for compliance. Develop scope of work and utilize appropriate removal procedures.
 - ACTION 4 – Limited Entry: personnel who enter into these areas have to be aware of the presence of the type and location of the ACM. If any entry into the area may cause a disturbance of the ACM, Type 2 procedures must be used for entry until the ACM is removed.
 - ACTION 5 – ACM may be repaired if the ACM is considered to be in Fair Condition (less than 10% damaged), and it is unlikely for the material to be damaged, or disturbed again. Once the ACM has been repaired it may be treated as in GOOD condition (less than 1% damaged).
 - ACTION 6 – No remedial action is required. The materials are to be managed in accordance with the Asbestos Management Directive.
- NOTE: *Pro Active Removal may be a part of an Asbestos Management plan or for removal of ACM that are in locations that may not be desirable regardless of the materials condition.*

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APPENDIX H

MOL – Sample List of Suspect Asbestos-Containing Building Materials



Ministry of
Labour

Appendix 2 – Sample List of Suspect Asbestos-Containing Building Materials

Issued: November 2007

Content last reviewed: May 2011

There are an estimated 3000 products that contain asbestos. In Ontario asbestos was widely used in sprayed-on material and in pipe and boiler insulation until 1973^[3]. The use of many other asbestos containing materials continued until the mid 1980's. Asbestos is still used in the manufacture of a limited number of products, including some floor tiles, cement products, friction materials and textiles. The following list was adapted from the United States Environmental Protection Agency's (EPA) Sample List of Suspect Asbestos Containing Materials^[4]. It is not an all inclusive list but is intended as a general guide to show which types of building materials may contain asbestos.

Possible Asbestos-Containing Materials in Buildings

- Acoustical Plaster
- Adhesives
- Asphalt Floor Tile
- Base Flashing
- Blown-in (Loose fill) Insulation
- Boiler Insulation
- Breaching Insulation
- Caulking/Putties
- Ceiling Tiles and Lay-in Panels
- Cement Pipes
- Cement Siding
- Cement Wallboard
- Construction Mastics (floor tile, carpet, ceiling tile, etc.)
- Cooling Towers
- Decorative Plaster
- Ductwork Flexible Fabric Connections
- Electrical Cloth
- Electrical Panel Partitions
- Electrical Wiring Insulation
- Elevator Brake Shoes
- Elevator Equipment Panels
- Fire Doors
- Fireproofing Materials
- Flooring Backing
- Heating and Electrical Ducts
- High Temperature Gaskets
- HVAC Duct Insulation
- Joint Compounds
- Pipe Insulation (corrugated air-cell, block, etc.)
- Roofing Felt
- Roofing Shingles
- Spackling Compounds
- Sprayed-on Insulation

- Taping Compounds (thermal)
- Textured Paints/Coatings
- Thermal Paper Products
- Vinyl Floor Tile
- Vinyl Sheet Flooring
- Vinyl Wall Coverings
- Wallboard

[3] J.S. Dupre, J.F. Mustard & R.J. Uffin, *Report of the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario*, Ontario Ministry of the Attorney General, Toronto, Ontario, 1984, page 12.

[4] US Environmental Protection Agency.

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Disclaimer: This web resource has been prepared to assist the workplace parties in understanding some of their obligations under the Occupational Health and Safety Act (O.H.S.A.) and the regulations. It is not intended to replace the O.H.S.A. or the regulations and reference should always be made to the official version of the legislation.

It is the responsibility of the workplace parties to ensure compliance with the legislation. This web resource does not constitute legal advice. If you require assistance with respect to the interpretation of the legislation and its potential application in specific circumstances, please contact your legal counsel.

While this web resource will also be available to Ministry of Labour inspectors, they will apply and enforce the O.H.S.A. and its regulations based on the facts as they may find them in the workplace. This web resource does not affect their enforcement discretion in any way.



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